

REGULATIONS AND COURSE CATALOGUE

**B.V.Sc. & A.H. DEGREE
ACADEMIC YEAR 2016-17 ONWARDS**

AS AMENDED UP TO 08-09-2020



**FACULTY OF VETERINARY SCIENCE
SRI VENKATESWARA VETERINARY UNIVERSITY
TIRUPATI**

PREFACE

The Veterinary Council of India has framed the Minimum Standards of Veterinary Education- (B.V.Sc & AH- Degree Course)Regulations , 2016 in supersession of the Veterinary Council of India - Minimum Standards of Veterinary Education-Degree course (B.V.Sc & AH) Regulations, 2008 .According to the VCI - MSVE(B.V.Sc&AH- Degree Course) Regulations, 2016 the Veterinary curriculum shall have Core Courses and Internship including Entrepreneurial Training.

The curriculum is meant to provide adequate emphasis on cultivating logical and scientific habits of thought, clarity of expression, independence of judgment, ability to collect information and develop habits of self education. The curriculum lays emphasis on personality development and character expression for an independent professional career of the graduate. Thus, the overall emphasis is on developing a graduate with a thorough knowledge of the subject and practical skills for animal welfare and enhancing livestock productivity.

The University has implemented the Veterinary Council of India Minimum Standards of Veterinary Education- (B.V.Sc&AH-Degree Course) Regulations,2016 from the Academic year 2016-17 onwards and accordingly the Regulations and Course catalogue is brought as amended up to 08-09-2020 to provide the relevant information to the students, teachers and other officials of the University.

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FACULTY OF VETERINARY SCIENCE
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In exercise of the powers conferred by clause (d) of sub section 2 of Section 22 of Sri Venkateswara Veterinary University Act, 2005 (Act No. 18 of 2005) read with Statute No. 19 of section 41 (a) of the First Statutes made by the Government of Andhra Pradesh, the Academic Council of Sri Venkateswara Veterinary University hereby makes the following regulations keeping in view the curriculum and syllabus as prescribed in the Minimum Standards of Veterinary Education Regulations-2016 of the Veterinary Council of India, New Delhi for the degree course, B.V.Sc & A.H.

REGULATIONS

- 1.0 Short title:** These regulations shall be called the “SVVU Under Graduate (B.V.Sc. & A.H) Regulations, 2016”.
- 2.0 Commencement:** These regulations shall apply to the students admitted into B.V.Sc & A.H course from the *Academic Year 2016-17 onwards*.
- 3.0 Definitions**
 - 3.1 Course of study:** A degree course of Bachelor of Veterinary Science & Animal Husbandry shall comprise of a course of study consisting of curriculum and syllabus provided in the course catalogue spread over five and half complete professional years including a compulsory internship of ‘one year’ duration undertaken after successful completion of all credit hours as prescribed in the syllabus. During the course of study there shall be training in veterinary clinical complex or state veterinary hospital or private veterinary hospital, animal farm or livestock farm complex as part of the course.
 - 3.2 Professional year:** ‘Professional year’ means a period consisting of minimum Two hundred and ten (210) instructional days, excluding annual examination days except fourth professional year which consists of 315 instructional days. First professional year of Bachelor of Veterinary Science and Animal Husbandry classes shall commence latest by 1st September of every year. The annual examinations shall be conducted prior to or after summer vacation for the year. The annual examinations shall be followed by annual vacation. The duration of summer and annual vacation will be as decided by the University.
 - 3.3 Credit hours:** Credit hours means the weekly unit of work recognized for any particular subject as per the course catalogue. A lecture class of one hour per week shall be counted as one credit whereas a practical class of two hours duration and a working period of three hours in the Veterinary Clinical Complex (VCC) and Livestock Farm Complex (LFC) per week shall count as one credit.
 - 3.4 Subject:** The subject will be divided into different units for the purpose of teaching and examinations. The annual examinations (Theory and Practical) will be conducted in two papers (Paper - I & Paper - II). The units for Paper – I & Paper - II for each subject are as appended.

- 3.5 Internal Examinations:** Three (03) internal theory examinations will be conducted during a professional year. The examinations will be conducted with 30%, 60% (31 to 60%) and 90% (61 to 90%) course coverage for first, second and third internal examinations respectively. The internal examinations will be conducted for 40 marks which will be reduced to 10. The pattern of internal examinations question papers shall be uniform for all the colleges and subjects.
- 3.6 Annual Examinations:** The annual examinations shall be held on such dates, time and places as the university may determine and shall be completed in time so that the results are announced before the onset of the ensuing academic year.
- 3.7 Grade point of a subject:** Grade point in a subject shall be the total marks obtained by a student out of 100 divided by 10.
- 3.8 Credit point of subject:** Credit point in a subject shall be Grade point multiplied by the credit hours.
- 3.9 Grade point average:** Grade point average shall be the sum of the total credit points earned divided by the sum of credit hours in a professional year.
- 3.10 Overall Grade Point Average (OGPA) :**Overall Grade Point average shall be the sum of the grand total of credit points earned divided by the grand sum of the credit hours.

4.0 Admissions

Admissions including selections to the B.V.Sc. & A.H., ordinarily made in the beginning of the first professional year, shall be in accordance with the regulations laid down from time to time by the University.

Eligibility: A pass in two year Intermediate Examination conducted by the Board of Intermediate Education, Andhra Pradesh or any other Examination recognized as equivalent thereto by the University or Intermediate Board with the following subjects mainly.

- i) Physics
- ii) Chemistry
- iii) Biology
- iv) English

A candidate under general category for admission to the B.V.Sc. & A.H. degree course must have passed in each of the subjects of English, Physics, Chemistry and Biology and obtained 50% marks in aggregate of these subjects, at the qualifying examination. In respect of candidates belonging to the Scheduled Castes / the Scheduled Tribes or other special category students as specified by the Government from time to time shall be 5% less than that prescribed for general category (i.e.,47.5%).

The students who are educated abroad seeking admissions in veterinary colleges should have passed the subjects of Physics, Chemistry, Biology and English up to the 12th standard level with 50% marks in aggregate of these subjects.

Sponsored candidates shall have to qualify the admission procedures as laid down for the students under general category.

Admission of candidates to Bachelor of Veterinary Science and Animal Husbandry degree course under bilateral exchange Programme shall be regulated by Veterinary Council of India or on recommendation of Government of India.

15% of the total number of seats of each recognized Veterinary college which is included in the First Schedule of the Act shall be reserved and filled on an all India basis through Common Entrance Examination and seats for the candidates belonging to Schedule Caste or Schedule Tribes or Physically handicapped or Other backward classes against said

15% quota of Veterinary Council of India shall be reserved to be filled up as per Government of India Policy.

The candidates selected through this examination shall be admitted in various recognized Veterinary colleges as per the eligibility criteria prescribed in these regulations only and the last date for reporting of these candidates to the allotted University or Veterinary Institution shall be 15th September of that year irrespective of the closing date of admission of that University or Veterinary Institution for that year, if earlier, the vacant seats may be filled by the veterinary college or university by 30th September which shall be the final cut-off date for the admission and thereafter no admission shall be made. Unfilled VCI Quota seats shall be filled by university based on marks obtained by the candidates in the EAMCET/as prescribed by state government in their respective local areas from out of the merit lists prepared for this purpose based on merit, presidential order, region and social status.

After the final admissions, each Veterinary college shall submit the details of the students admitted in the first professional of B.V.Sc and AH programme and similarly the list of students who pass out shall also be submitted to the Veterinary Council of India.

Criteria for selection: The selection of candidates for all the seats except those reserved for VCI Quota shall be made on the basis of marks obtained by the candidates in the EAMCET in their respective local areas from out of the merit lists prepared for this purpose. The candidates will be selected based on merit, presidential order, region and social status. Twenty five per cent (25%) seats shall be reserved for candidates of all Social Categories coming from families of Agriculturists (Farmers) owning a minimum of 1 acre of Agricultural land either in the name of the parents or in the name of the candidates who have studied for a minimum of 4 years in the schools located in Non-Municipal areas. Ten percent of seats over and above the total number of seats are allotted to candidates belonging to EWS Category.

Age :He/she should have completed minimum age of 17 years and not crossed the maximum age of 22 years as on the 31st December of that year of his or her admission to the 1st year of Bachelor of Veterinary Science and Animal Husbandry course and maximum age shall be 25 years in respect of Scheduled Caste or Scheduled Tribes and 27 years for Physically Challenged candidates.

- 5.0 Fee:** The fee for application, annual fee, special fee, examination fee and other fee shall be as prescribed by the University from time to time.
- 6.0 Subjects, Credits and Syllabi:** The details of the subjects, credit and syllabi shall be as prescribed by VCI and approved by the Academic Council from time to time. The medium of instruction shall be English.
- 7.0 Advisory System:** The time table shall provide for one hour per week for the meeting of students with Advisors. The student should make all correspondence with authorities through advisor only. The Advisor shall maintain a record containing particulars of previous history of the student, subjects registered, examinations appeared and grades obtained in each course as per the format prescribed by the University.
- 8.0 Registration**
- 8.1** Registration for the first time in the University: Students who have received notification of admission from the University will receive on arrival guidelines for registration from the Associate Dean of the respective colleges.
- 8.2** A registration and orientation programme will be conducted by the Associate Dean of the College for the benefit of the students joining the University for the first time. Registration of

students shall not be allowed after the expiry of 25% working days in the year of admission.

8.3 Attendance in respect of fresh students for the first year shall be reckoned from the date of registration by a particular student.

8.4 The following are the steps in registration of students for different subjects:

a) At the beginning of each academic year there shall be an annual registration for various subjects. The student in each batch shall have to register for the set of subjects offered in “toto” for the batch and fill in the registration cards. The Advisor in turn will countersign and send them to the Associate Deans Office. The Associate Dean’s office should prepare lists of students who have registered for each subject and send them subject wise to the concerned teacher within a week after the last date of registration.

b) Students are permitted to register with late fee as detailed below :

1 st day of registration	:	Only fee
2 nd day	:	Fees + Rs.100 as late fee
3 rd day	:	Fee + Rs.200 as late fee
4 th day	:	Fee + Rs.300 as late fee
5 th day	:	Fee + Rs.400 as late fee
6 th day	:	Fee + Rs.500 as late fee
7 th day	:	Fee + Rs.600 as late fee
8 th day	:	Fee + Rs.700 as late fee
9 th day	:	Fee + Rs.800 as late fee
10 th day	:	Fee + Rs.900 as late fee

Registration shall not be permitted after 10th day

c) Failed student(s) shall register all the subjects in which they failed for fulfillment of the requirements of the professional class

d) Study load :

Syllabus. – (1) The details of syllabus comprising of 81 credits (equivalent to 179 credit hrs of semester system) are the minimum requirement for a programme leading to Bachelor of Veterinary Science and Animal Husbandry degree and the summary of the distribution of courses shall be as follows:-

Professional Year	Theory	Practical	Total
First (One Year)	12	06	18
Second (One Year)	15	07	22
Third (One Year)	15	09	24
Fourth (One and a half year)	08	09	17
	50	31	81

(Equivalent to 179 credit hrs. of semester system)

(2) In addition to the Core Courses above, a student shall have to successfully complete the Internship including Entrepreneurial Training for the award of Bachelor of Veterinary Science and Animal Husbandry degree.

(3) Remount Veterinary Squadron or National Cadet Crop or National Social Service or Sports and games shall be non- credit (0+1) training programmes of which RVS or NCC or Sports and Games during First and Second Professional years and NSS during Third Professional year shall be compulsory for the award of Bachelor of Veterinary Science and Animal Husbandry degree and the performance of the

students in these training programmes shall be assessed and graded as 'Satisfactory' or 'Unsatisfactory' and student has to obtain 'Satisfactory' grading for successful completion of course requirements. The 7 days Special NSS camp shall be held during the fourth professional year and students have to stay in base camp instead of shuttling from college.

- (4) The Syllabus prescribed in these regulations is the minimum instructional syllabus and is illustrative of the subject content for teaching different subjects at the Veterinary colleges in the country for Bachelor of Veterinary Science and Animal Husbandry degree programme:

Provided that there is scope for flexibility of addition of topics or courses in the programme as per need or regional or institutional demand from time to time and such changes shall be non-violative and commensurate to the basic structure, curriculum and infrastructure prescribed in these regulations.

9.0 Internship

- 9.1** Every student of Bachelor of Veterinary Science and Animal Husbandry degree course shall be required after passing the fourth professional examination to undergo compulsory rotating internship to the satisfaction of the University for a minimum period of twelve calendar months so as to be eligible for the award of the degree of Bachelor of Veterinary Science and Animal Husbandry and full registration with the council.
- 9.2** Compulsory rotating internship shall include a full time training in Veterinary and Animal Husbandry services (including emergencies and night duties, Sundays and holidays) and the intern shall devote whole time to the training and shall not be allowed to accept a whole time or part time appointment paid or otherwise.
- 9.3** Internship shall be undertaken only after completion of all credit requirements of Veterinary curriculum including Remount Veterinary Squadron or National Cadet Corp or National Social Service or Sports and games as applicable under these regulations.
- 9.4** The university shall issue a provisional course completion certificate of having passed all the professional examinations and having successfully completed prescribed course work.
- 9.5** The State or Union territory Veterinary Council shall grant provisional registration to the candidate on production of provisional Bachelor of Veterinary Science and Animal Husbandry course completion certificate and the provisional registration shall be valid for a minimum period of twelve months and maximum of sixteen months.
- 9.6** After provisional registration with the State or Union Territory Veterinary Council, the candidate shall register for internship of twelve calendar months.
- 9.7** Interns shall be actively involved in rendering veterinary service under the supervision of an experienced teacher.
- 9.8** The intern shall assist the teacher or in-charge in all activities of the units they are posted in.
- 9.9** During the period of internship the intern shall be provided accommodation or lodging and paid consolidated remuneration in the form of internship allowance as may be decided by the University or Institution from time to time.
- 9.10** The intern shall be entitled for fifteen days casual leave and the leave cannot be claimed as a matter of right until and unless the sanctioning authority sanctions it and an intern willfully absents from the training programme even if for part of a day or during off hours duty (including Sundays and holidays) he or she may be treated absent for that day and the candidate shall be required to undergo training for the additional days in lieu of the absence period and internship allowance shall not be paid for these additional days.
- 9.11** The internship programme shall be monitored by a Committee consisting of Associate Dean, in-charge of Veterinary Clinical Complex, in-charge of Livestock Farm Complex and Associate

Professor (Internship) of Veterinary Clinical Complex and Assistant Professor (Internship & Entrepreneurialship) of Livestock Farm Complex as members and this Committee shall monitor effective implementation of the internship training programme from time to time and shall be required to inspect the internship programme at different intervals of time randomly.

- 9.12** In case of unsatisfactory work or performance or shortage of attendance or both the period of compulsory rotating internship shall be extended by two months and the student shall be reevaluated, if again found unsatisfactory or is unable to secure 50 marks, he shall be given one more chance after another two months and if he still is found unsatisfactory due to any reason, the intern has to re-register afresh for internship programme for entire twelve calendar months including registration with the State Veterinary Council.
- 9.13** Internship allowance shall be paid only for twelve calendar months and no internship allowance shall be paid for the period of absence or unsatisfactory performance or extended period or re-registration period.
- 9.14** The compulsory rotating internship shall be in the following areas, namely:-
- (i) Posting in Veterinary Clinical Complex of other constituent colleges of university/ Veterinary Hospital/Veterinary Polyclinic etc.,for Clinical training covering veterinary medicine, surgery and radiology, gynaecology and obstetrics, clinical emergencies, indoor ward care, lab diagnosis, ambulatory, hospital management, record keeping etc; (6½ Months)
 - (ii) Posting at Veterinary Clinical Complex of Veterinary college of other state in India with provision of rent free accommodation; (15 days)
 - (iii) Posting in any four of Zoo or wild life centre or National Parks, Meat Plant or Abattoirs, Milk Plants, Field Hospital, Animal Welfare Organization, Vaccine Institute, Remount Veterinary Corps, Pharmaceutical, Feed Industry for hands on training in each establishment etc.,; (1 Month)
 - (iv) Entrepreneurial training and management covering farm routines of cattle and buffalo farms, piggery or rabbitry, sheep and goat farms, and equine or camel unit etc. Poultry production and management covering layer and broiler production, hatchery and chick management and learning farm practices like record keeping and other related activities in LFC of other constituent colleges of university/Livestock Research stations of the university(LRS,Garividi,BRS,Venkataramannagudem,LRS,Palamner,LRS,Guntur,LRS,Sid daramapuram etc.); (4 Months) i.e Poultry -35 days,cattle-55 days,sheep-20 days,swine and rabbitry-10 days.

One of the following entrepreneurial trainings shall be implemented to all students in batches at Livestock research stations of the university/LFC of other constituent colleges of University during internship training programme.

- 1) Ram lamb rearing
 - 2) Swine production
 - 3) Broiler production
 - 4) Quail production
 - 5) Milch cattle rearing
 - 6) Meat and egg products processing
 - 7) Milk and milk products processing
 - 8) Feed production
 - 9) Mineral mixture preparation
- (v) Each intern shall submit a Project Report on completion of entrepreneurial training and this training is aimed at developing entrepreneurial skill for self-employment and the university or college shall provide interest free loans, technical support and infrastructure for these activities. Inputs, day-to-day work and financial accounting shall be undertaken by the students;

- (vi) The profits, if any, shall be kept by the students, provided, in case of loss, the Associate Dean of the college through the Entrepreneurial Committee consisting of four faculty members (at least one subject matter specialist) may evaluate the reasons of such loss and provide compensation in case it is found that the loss has been inadvertent;
- (vii) The In-charge or nominee of each posting shall regulate the training of such interns and submit the evaluation report of each intern out of 20 marks which shall be accounted at the time of final evaluation;
- (viii) The remaining days shall be utilized for the final assessment of interns as prescribed in these regulation, with the objective of having achieved following core competency namely:-
- a) Restraint of cow, sheep, horse, dog and pig. Haltering, snaring, muzzling, tail switch, bandaging of horse for exercise and stable bandaging;
 - b) Animal identification, dentition and ageing of animals;
 - c) Housing layout or requirements of livestock and poultry;
 - d) Computation of ration of livestock of different breeds and age groups in health and disease;
 - e) Fodder management and interpretation of feed quality evaluation;
 - f) Physical evaluation of livestock health parameters (auscultation, percussion, recording of temperature, pulse, heart rate, respiration rate etc.);
 - g) Recording and interpretation of cardiovascular response;
 - h) Testing of milk and milk products for quality, clean milk production;
 - i) Carcass quality evaluation (ante-mortem & post-mortem examination);
 - j) Specific diagnostic tests for zoonotic diseases;
 - k) Sample collection, handling and dispatch of biological materials for laboratory examination;
 - l) Staining techniques for routine clinico-pathological examinations;
 - m) Relating post-mortem lesions to major livestock diseases;
 - n) Haematological evaluation (total leukocyte count, differential leukocyte count, haemoglobin, packed cell volume, erythrocyte sedimentation rate etc.) and interpretation;
 - o) Tests and their interpretation for haemoprotozoan diseases;
 - p) Body fluids collection, examination and interpretation as an aid to diagnosis;
 - q) Urine evaluation procedures and interpretation as indicators for diagnosis of diseases;
 - r) Fecal examination- procedures and interpretation;
 - s) Examination of skin scrapings and interpretation;
 - t) Interpretation of blood chemistry profile in diseases;
 - u) Deworming procedures and doses for different species of animals or birds;
 - v) Managing an outbreak of infectious or contagious disease;
 - w) Approach to diagnosis of a given disease condition;
 - x) Pre-anesthetic administration and induction, maintenance of general anaesthesia

- and dealing with anesthetic emergencies;
- y) Local anaesthetic administration;
- z) Nerve blocks- sites, functional application;
- (za) Suture material, suture pattern and tying knots;
- (zb) Common surgical procedures including dehorning, docking, caesarian section, ovariohysterectomy, castration, rumenotomy;
- (zc) Application of plaster castorsplint for fracture immobilization and other bandaging procedure in large and small animals;
- (zd) Soundness in horses;
- (ze) Rectal examination–palpation of pelvic or abdominal organs in cattle or horses or buffaloes,
- (zf) Detection of oestrus, artificial insemination, pregnancy diagnosis;
- (zg) Management of vaginal or uterine prolapse and dystocia;
- (zh) Andrological examination of bull, handling, preservation and evaluation of semen;
- (zi) Vaccination procedures , vaccination schedules and vaccine types for different diseases;
- (zj) Handling of radiograph, interpretation of a given radiograph of large and small animals;
- (zk) Client management;
- (zl) Managing a clinical practice, ambulatory van, transporting a sick animal requirements, etc.;
- (zm) Dosage regimens of important drugs;
- (zn) Drug administration techniques in different species of animals-oral, parenteral, rectal, intra-peritoneal and intra-uterine;
- (zo) Identification of major livestock or poultry breeds;
- (zp) Measuring climatic parameters and their interpretation;
- (zq) Communication technology tools.

9.15 Details of day to day work, posting and duration needs to be worked out by the Veterinary Institution as per its needs and infrastructure facilities and the activities of interns shall be regulated by an Associate Professor (Internship) posted in Veterinary Clinical Complex and Assistant Professor (Internship and Entrepreneurship) posted in Livestock Farm Complex.

9.16 The intern shall have the following functions, responsibilities and duties namely:-

- (i) Participation with clinical faculty in the hospital practice;
- (ii) To Share the emergency and night duties on rotation in the large and small animal hospitals including Sundays and holidays;
- (iii) Participation with staff of the place of posting in Veterinary Practice, Production or Technology;
- (iv) Hands-on diagnostic and treatment procedures for hospitalized cases under the supervision of the attending veterinarian;
- (v) To administer primary care to emergency cases and participate in service such as anesthesia, radiology, ultrasonography, endoscopy, laboratory and diagnostic procedures. Medicine, Gynaecology and Surgery rounds are held periodically allowing the interns to present cases and participate in topic discussion.

9.17 The training shall be supplemented by fortnightly sessions of clinical conference, farm operation and data analysis, preparation of feasibility reports, project report, campaigns or discussions in clinical training, farm training and technology.

9.18 The intern shall maintain a log book of day to day work which shall be verified and certified by the supervisor under whom he or she works and in addition, the interns shall prepare a brief project report on the basis of his or her case study or case analysis, survey reports etc. and shall be based on his or her own study during the internship and such reports be supervised by more than one teacher, if required and the interns shall present such report in seminar organized for the purpose.

9.19 The assessment of each intern shall be based upon the evaluation of log book or project report, his or her performance reports from all the minimum prescribed training postings, entrepreneurial output, clinical case reports and their presentation, viva and comprehensive examination in core competence in veterinary skills through a written test by an Evaluation Committee comprising of the faculty representing the concerned departments appointed by the Associate Dean for this purpose and the distribution of marks for various components of assessment shall be as under, namely:-

Log book or Project Report :	10 Marks
Performance in different postings:	20 Marks
Entrepreneurial output:	20 Marks
Case Reports or Presentation:	10 Marks
Written test:	30 Marks
Viva :	10 Marks
Total:	100 Marks

9.20 The minimum pass marks in internship assessment shall be 50 out of 100.

9.21 After successful completion of Internship, the Associate Dean shall then issue the certificate of satisfactory completion of internship training as prescribed by the Veterinary Council of India.

9.22 A candidate shall become eligible for registration with State or Union Territory Veterinary Council only on the award of the B.V.Sc and A.H. degree or production of a provisional degree certificate by the University.

10.0 Attendance

10.1 The required condition of attendance shall not be deemed to have been satisfied in respect of the subject, unless the student has ordinarily attended all the scheduled theory and practical classes; provided, the minimum requirement of attendance shall not be *less than 75%* of scheduled theory & practical classes separately . However, the attendance requirements for internship shall be followed as per regulation No. 9.10

10.2 On the recommendation of the Associate Dean, permission may be given by the Dean of Student Affairs to depute the students for representing the College/ University at Inter Collegiate/Inter University meet, in NCC, NSS, Games and Sports meet and other extracurricular, co-curricular meets. The absence of students in such cases, shall be allowed up to a maximum of 20 working days (30 working days in case of Fourth Professional year) and for the course of 0+1 credit, the relaxation shall be of only seven days. However, no such relaxation shall be allowed for internship Programme.

However, the entire period of deputation of students for participating in pre RDC and RD camps only shall be considered and no relaxation of any sort will be permissible in respect of Annual examinations. For pre RD and RD camps maximum of two chances will be given in entire study period for any individual. Such students who are given condonation for participating in pre RD and RD camps are not eligible to claim condonation for participating in intercollegiate/inter University meets in respect of NSS, Games and Sports and other

extracurricular and co curricular activities in the same academic year.

- 10.3** A candidate having attendance below 75% in a subject either in Theory or Practical / both shall not be eligible to appear both Annual Board Theory and Practical Examinations of that subject.
- 10.4** The percentage of attendance of a student in a subject shall be computed on the basis of the total number of theory and practical classes scheduled between the date of commencement of instruction and date of closing of instruction irrespective of the date of registration, provided, for the student who are reverted back owing to failure in the compartmental examination, the attendance shall be counted from the date of declaration of result of compartment examination and the date of closing of instructions.
- 10.5** The attendance for First Year shall be counted from the date of registration.
- 10.6** Registration of students shall not be allowed after the expiry of 25% *working days in the year of admission*.
- 10.7**
- a.** If a student admitted to the 1st year does not register the subjects of the year or having registered does not put in at least 75% of attendance in all the subjects of 1st year B.V.Sc. his / her admission shall stand cancelled.
 - b.** A student who wishes to seek relaxation of the above provision may apply to the Associate Dean giving the grounds and proof thereof due to which he / she could not fulfill the minimum attendance requirements. The readmission of such a student shall be considered by a committee consisting of the Associate Dean, a Senior Professor of the College nominated by the Associate Dean, The Advisor of student concerned and the University Medical Officer as a Co-opted member wherever necessary. But a student has to put in a minimum of 60% attendance in the First Year.
- 10.8** When a student has to leave the College after completion of first year of study for reasons beyond his / her control, he / she shall obtain prior permission of the Associate Dean for discontinuation within one month from the date of absence. If a student fails to taken such permission, he / she shall not be eligible for re-admission.

The maximum period of break shall not exceed two academic years under any circumstances including the year during which he / she discontinued.

A student, permitted to discontinue by the Associate Dean, shall apply to the Associate Dean for readmission at least one month before the commencement of the academic year in which readmission is sought. If the discontinuation period exceeds two academic years, the admission shall stand cancelled automatically. However, this facility shall be available to a student only once during his / her degree programme.

In no case, a student shall be allowed to continue his or her Bachelor of Veterinary Science and Animal Husbandry studies beyond Nine academic years (excluding Internship) in a Veterinary College including discontinuation period.

- 10.9** When a student leaves, the College taking his / her Transfer Certificate, he / she shall not be eligible for re-admission.
- 10.10** Mass absence of students from a class or Examination: Absence of students enmass from a class or examination shall not be condoned. The Associate Dean, in addition, may order suspension of the course, if deemed necessary.

11.0 Examination and Evaluation

- 11.1** The detailed lecture outlines in each subject shall be prepared by the teacher(s) concerned in consultation with the Head of the Department and approved by the University Head of the Department which will be made available to the students during the first week of the

professional year. The Head of the Department or Associate Dean shall ensure that the schedule is adhered to and alternate arrangements are made to cover up the loss in case of any eventualities of unavoidable reasons that lead to non-adherence of the above schedule.

- 11.2** Work distribution chart of each teacher shall be available with Associate Dean's office for inspection of the Council and in each subject, professors and senior teachers shall be actively involved in teaching, especially in conducting practical for degree course.
- 11.3** The examination shall be to assess whether the student has been able to achieve a level of competence and for academic assessment, evaluation of practical aspects of the curriculum shall receive much greater emphasis leading to separate examinations and requiring the student to secure a minimum of 50% marks, in theory as well as in practical, in each such subject.
- 11.4** The weightage of theory and practical shall be in the ratio of 60:40 respectively.
- 11.5** The distribution of marks for objective and subjective questions in each subject shall be in the ratio of 40:60 respectively in Internal and Annual examinations.
- 11.6** The schedule of examination during Bachelor of Veterinary Science and Animal Husbandry course shall consist of internal assessment and annual examinations as detailed below, namely:-

Internal Assessment	Course coverage		
First	30%	Max. Marks 40	Weightage 10
Second	60%	Max. Marks 40	Weightage 10
Third	90%	Max. Marks 40	Weightage 10
Annual examination (Theory)	Paper-I Paper-II	Max. Marks 100 Max. Marks 100	Weightage 20 Weightage 20
Annual examination (Practical)	Paper-I Paper-II	Max. Marks 60 Max. Marks 60	Weightage 20 Weightage 20

- 11.7** There shall be four professional examinations- one each after 1st, 2nd, and 3rd year and the fourth after one and half year. These professional examinations shall have only the theory component with external system. The practical component shall be dealt with internally. Annual professional examination shall be held after the completion of 100% course content in each subject and the result of best two internal assessments shall be accounted for.
- 11.8** The examination for Livestock Farm Complex and Veterinary Clinical Complex shall be conducted twice a year i.e. first practical exam after completion of 50% syllabus and the second one, when the course is completed but the second exam shall comprise of entire syllabus .
- 11.9** The evaluation of answer books of internal examinations shall be done by the concerned teacher(s) whereas evaluation of answer books of annual theory examinations shall be done by the external examiner(s).
- 11.10** The annual board practical examinations shall be conducted after the annual board theory examinations by a Board of Examiners consisting of concerned Head of the Department, Teacher and a representative of the Associate Dean and the teachers

while evaluating practical, shall take into account the followings, namely:-

- (i) A record or log book maintained by each student as practical records;
- (ii) Written/ practical test or observation and recording of the skill with which each student executes the practical;
- (iii) Assessment of the comprehensive skill and knowledge of each student through an oral examination (viva-voce).

- 11.11** The answer-books of internal assessment shall be shown to students and the records of internal assessment as well as that of annual practical examination shall be submitted to Controller of Examination. The answer scripts of annual practical examinations shall also be shown to the students within 7 days from the date of examination. The performance of the students in internal theory and all components of annual practical examination shall be displayed in the respective Departmental notice boards within 7 days from the date of last practical examination in the concerned subject.
- 11.12** The practical manuals shall be prepared by the respective departments for each subject.
- 11.13** The duration of internal examinations shall be one hour whereas the duration of annual theory examination for each paper (Paper I and II) conducted on different days shall be three hours each .
- 11.14** The annual theory examination(s) shall be conducted by inviting the question paper from appointed paper setter(s) and a paper setter shall be provided the courses and syllabus prescribed by the Veterinary Council of India including detailed course outline and the paper setter shall be requested to prepare two sets of question papers, each for main examination and compartment examination (if any).
- 11.15** The format of internal Theory examination question paper shall be as indicated in Annexure III .The internal examinations shall be conducted by the concerned Associate Deans during first Theory class hour while other classes will be conducted as per schedule. The dates by which the internal examinations have to be completed will be as indicated in academic Calendar .The evaluation of answer books of internal examinations shall be done by the concerned teacher(s).No reexaminations shall be held on whatsoever grounds .To be eligible for appearing Annual Examination one has to attend minimum of two internal examinations in the concerned subject. The best two internal examinations marks shall be submitted by the course teachers through the Head of the department and Associate Dean to the Controller of Examinations or Registrar one month prior to the commencement of annual examinations.
- 11.16** The schedule of annual examinations shall be adhered to strictly and no re-examination shall be allowed in events of students' strike, boycott, walkouts, medical grounds or what-so-ever may be the reason. The annual practical examination marks shall be submitted by Associate Dean to the Controller Examination / Registrar immediately after completion of Annual Practical Examination. The format of Annual Theory Examination question paper shall be as indicated in Annexure IV. The evaluation of answer books of annual theory examinations of all colleges shall be done by the external examiner(s) at respective colleges. The coding and decoding shall be done at respective colleges.
- 11.17** The compartment examination shall be conducted within twenty calendar days of subsequent year registration:

Provided that a candidate may be allowed to provisionally sit in the next class provided he or she has failed only in two subjects and cannot be promoted to next Bachelor of Veterinary Science and Animal Husbandry class unless he or she has cleared the failed subject(s).

11.18 The records of examination shall be made available to the Council, as and when required and the records of assessment may be retained till six months after the conduct of the annual examination.

11.19 **Evaluation of Annual Practical examination**

Materials to be evaluated for practical Annual Board Practical Examination.

- (a) Performance during Practical examination (Spotting, experiment, problem solving / case study etc.) : 30 marks
- (b) Viva-Voce : 10 Marks
- (C) Practical record : 10 Marks
- (d) Observation : 5 Marks
- (e) Assignment : 5 Marks

11.20 Unfair means during examinations:

The Associate Dean of the college shall be responsible for dealing with all cases of "Use of unfair means" in the various examinations. The phrase, "Use of Unfair means", includes possession of any information or material by the student, taking to other students, copying from other students or from printed or written materials etc. The invigilator concerned, on finding the use of unfair means by any student may take the answer scripts of the student and the material evidence, if any and the explanation from the student. The student may also be sent out of the examination hall immediately. The invigilator concerned shall report each case of unfair means direct to the Associate Dean immediately with full details of the incident, answer scripts, the available evidence and explanation of the concerned student, if any.

The Associate Dean, on receipt of the report, may give an opportunity to the concerned student to represent his case. Considering all the available evidence, the Associate Dean shall take appropriate action immediately. The penalty shall be as indicated below.

- (a) A student found using unfair means during an internal examination shall be deemed to have failed in that paper and so shall not be permitted to appear for any of the examinations in that paper including Annual Examination in that academic year. Such cases shall also not be considered for conditional promotion and compartmental examinations. The annual registration of that particular paper is treated as cancelled.
- (b) A student found using unfair means during the Annual examination shall be deemed to have failed in all the papers he / she has registered in that academic year and / or in such of those course in which he appeared for annual examination in that year. In such cases, the student shall not be permitted to take the remaining examinations, if any, in that academic year and shall also be deemed to have attempted and failed in that examination and provisions of regulation shall apply for deciding his / her promotion or otherwise.
- (c) The Associate Dean shall report each case falling under (a) and (b) above immediately, after passing orders to the Dean of Veterinary Science.

For using unfair means of a serious nature such as ignoring the repeated instructions of invigilator or abusing or threatening or assaulting the invigilator, warranting higher penalties than those indicated in clauses (a) and (b) above, the Associate Dean, besides treating the students as failed in all the courses he registered in that year, may further debar the students for the succeeding year and the fact informed to the Dean of Veterinary Science. If further or more severe punishment is felt necessary, the Associate Dean shall immediately inform the University about the full details of each together with all the material evidence, if any, and his recommendation. The explanation or representation

of the student, if any, may also be sent. The Vice-Chancellor after examining the case, may debar the student for further period or permanently. The decision of the Vice-Chancellor is final.

The parent or the guardian of the concerned student shall be informed of any punishment awarded to the student and the reason therefore.

11.21 Scrutiny of answer papers and rectification of errors

1. Re-evaluation of answer book(s) is not permitted. However, there shall be a provision of scrutiny of answer book(s).
2. A student, however, may be allowed to get his or her theory answer book(s) scrutinized, for which, the student shall have to apply to Controller of Examination or Coordinator of examination within three days after the declaration of result and after paying prescribed fee.
3. The Controller or Coordinator (Examination) shall arrange the scrutiny of answer book(s) by the Screening Committee to be constituted by the Dean.
4. The scrutiny shall be for re-totaling of the marks, and evaluation of unmarked question(s), if any.
5. In case, the total marks are found to be incorrect on scrutiny, the same shall be corrected and the result shall be revised accordingly (even if it is towards lower side) and if, any question is found to be unchecked by the examiner, the answer book(s) shall be sent to the Examiner for doing the needful and the result(s) shall be revised accordingly if there occurs any change in the marks.
6. No representation by the student(s) shall be entertained regarding the outcome of the result after scrutiny.
7. In case a student on the basis of the result of scrutiny becomes eligible for the compartmental examination, he or she may apply to the concerned authority to appear in the compartment examination on the announced scheduled date and the scheduled date of the compartment examination shall under no circumstances be changed on this account.
8. A committee comprising of Controller of Examinations and faculty deans shall moderate the results obtained at the annual examination and the Committee shall review the results as a whole in University level and recommend the moderation in the event of failure of more than 10% of the student actually appearing in that particular subject and any moderation suggested shall be uniformly applied to all students for that paper (s) without altering the merit of the passed candidates.
9. Any moderation effected should not involve enhancing of more than total of 5 marks in a professional year for a particular candidate and in no case more than 3 marks in one subject and the provisions for moderation of results shall not apply to compartmental Examinations and there shall be no provision for grace marks in any case. The moderation can be done for both theory and practical together or separately for theory & Practical in a subject .

12.0 Promotions (Academic Status and Scholastic Deficiencies)

1. Promotion of a student in a professional year shall be decided only on the basis of aggregate marks of internal assessment and annual examinations.
2. A student shall be promoted to next higher professional class only if he or she has passed in all the subjects of his or her class by obtaining at least 50% marks in theory (internal and

external combined) and practical separately.

3. A student should secure OGPA of 5.00 out of 10.00 at the end of degree programme to be eligible to get Bachelor of Veterinary Science and Animal Husbandry degree.
4. A student may also be allowed provisional promotion to next higher class till the declaration of the result of the compartment examination, provided the provisional promotion shall be subject to clearance in the compartment examination of that or those subject(s) and shall be provisional and if the student fails in the compartment examination, he or she shall stand automatically reverted to the class from where he or she was allowed provisional promotion.
5. Failed students shall register again for the failed subjects and such students shall have to fulfill all requirements of the relevant subjects afresh.
6. A student failing in the annual examination for three consecutive years in a professional year of Bachelor of Veterinary Science and Animal Husbandry degree programme shall be finally dropped automatically from the University on account of poor academic performance (except fourth professional year).
7. In no case, a student shall be allowed to continue his or her Bachelor of Veterinary Science and Animal Husbandry studies beyond Nine academic years (excluding Internship) in a Veterinary College.

13.0 COMPARTMENTAL EXAMINATION

1. A student failing in a maximum of two subjects only may be allowed to appear in compartmental examination for those subject(s) and the compartmental examination shall comprise of the annual component of both the theory and practical of the failed subject(s) which shall constitute 40 and 40 per cent weightage, respectively and the marks obtained in internal assessment of theory shall be considered for the evaluation of compartmental examination. If a student is absent for more than one internal theory examination /Annual theory /Annual Practical examination or falls short of attendance in a subject does not entitle him / her to consider for the compartmental Examinations.
2. The compartmental examination shall be conducted within twenty calendar days of subsequent year registration and if the student fails in the compartmental examination, he or she shall be reverted back to the original class and the results of such compartment examination shall be declared within ten days after the examination is conducted.

14.0 Graduation requirements

14.1 The student shall satisfy minimum residential requirement of Four Professional years i.e. Four and half years and internship programme of 'one year' duration under taken after successful completion of all credits as prescribed syllabus. The total duration of course is Five and half years.

14.2 Requirements for Bachelor's Degree

- a. A student undergoing course of study leading to award of B.V.Sc. & A.H. (Bachelor of Veterinary Science & Animal Husbandry) shall pass the subjects and complete the minimum number of credit hours prescribed therefore, by the Academic Council from time to time by obtaining a minimum OGPA of 5.0 in the 10 point scale.
- b. The University shall issue a provisional course completion certificate on passing the Annual Board Examination at the end of fourth professional year (i.e. four and half years), on the basis of which the student has to register for the grant of provisional registration by the State Veterinary Council / Veterinary Council of India.
- c. Internship: Every student is required after passing the fourth professional year annual examination to undergo compulsory rotational internship to the satisfaction of the

University for a minimum period of *one year* so as to be eligible for the award of degree of B.V.Sc. & A.H.

14.3 Classification of successful candidates: The successful candidates after completion of the graduation requirements who secured an OGPA of 5.0 or more in the 10.0 point scale shall be classified as under:

8.000 and above	-	First Division with Distinction.
7.000 – 7.999	-	First Division
6.000 – 6.999	-	Second Division
5.000 – 5.999	-	Pass.

15.0 Student responsibility: All under-graduate students studying in this University are expected to know the requirements for the award of Bachelor's degree and general academic requirements and assume full responsibility for meeting them. They are expected to keep constantly in touch with their advisors so that the latter may watch their progress and guide them along right lines. In no case will a regulation be waived or exemption made simply because a student pleads ignorance of it.

16.0 Migration / Transfer of student from one recognized Veterinary College / Institution to another

1. Student studying in a recognized veterinary college which is included in the First Schedule of the Act may be allowed to migrate or be transferred to another recognized veterinary college under another or same University.
2. The migration or transfer may be allowed by the university concerned after passing 1st year of Bachelor of Veterinary Science and Animal Husbandry degree course within one month of the start of academic session of 2nd year of the receiving College or University.
3. The number of students migrating or transferring from one veterinary college to another veterinary college during the period of one academic year will be kept to the maximum limit of 5% of the intake capacity of each of the veterinary colleges in one year.
4. The cases not covered under sub regulations, (1) to (3) may be referred to the Veterinary Council of India for consideration on merits.
5. An intimation about the admission of migrated or transferred students into any veterinary college shall be sent to the Veterinary Council of India by the respective Institution.

17.0 Record of Courses: To ensure that requirements for the award of degree have been completed by a student, the University shall keep a record of courses completed by the students. A copy of the same shall be maintained by the Associate Dean of the concerned college.

18.0 Authorities to approve results and issue pass certificates, transcripts etc.

The Vice-chancellor shall approve the results on the recommendation of the Dean of Veterinary Science and the Registrar shall issue the provisional pass certificate, transcript etc., to the candidate.

19.0 Award of Diploma: A diploma under the seal of the University and duly signed by the Officers authorized in this behalf shall be presented at a Convocation to each candidate who has successfully completed the graduation requirements for the award of Degree/Diplomas. In case of candidates who have successfully completed the graduation requirements for the award of degree and are admitted 'IN ABSENTIA' to a degree at a Convocation, shall be sent by post. The diploma shall set for the name of the candidate, father's name, degree, month and year of successful completion of the graduation requirement etc.

20.0 Amending or Cancellation of results: If the result of a candidate is discovered to be vitiated by error, malpractice, fraud, improper conduct or any other reasons, the Vice-Chancellor shall have the powers to amend the result in such a manner as to accord with the true position, and to make such declaration as the Vice-Chancellor may deem necessary in that behalf.

If it is found that the result of a candidate has been vitiated by malpractices, fraud or other improper conduct where by he / she has been benefited and that he / she has in the opinion of the Vice-Chancellor, been a party to or conceived at the malpractice, fraud or improper conduct, the Vice-Chancellor shall have the power at any time, notwithstanding the award of a diploma or a certificate or prize or a scholarship, amend the result of such candidate and to make such declaration as the Vice-Chancellor may deem necessary in that behalf, including debarring of the candidate from the University for such a period as may be specified and the cancellation of the result of the candidate in such manner as the Vice-Chancellor may decide.

21.0 Transitory provision

These regulations shall apply to the students who shall be admitted from the academic year 2016-17 and onwards. They shall not be applicable to backlog students.

22.0 No Regulation made by the Academic Council, governing the under-graduate courses of study shall be construed, to limit or abridge the powers of the Academic Council to deal with any case or cases of any student or students of B.V.Sc. & A.H. course in such manner as it may appear to it to be just and equitable.

Course Catalogue

B.V.Sc. & A.H. Degree

	Veterinary Curriculum:
a)	The following shall be the veterinary curriculum, namely:- (i) Core Courses; and (ii) Internship including Entrepreneurial Training;
b)	The curriculum shall provide adequate emphasis on cultivating logical and scientific habits of thought, clarity of expression, independence of judgment, ability to collect information and to correlate them and develop habits of self-education;
c)	Medium of instruction for B.V.Sc. and A.H. degree course shall be in English;
d)	Practical training at Livestock Farm Complex or Clinical practice shall be organized in small groups of 5 to 10 students so that each teacher can give personal attention to each student with a view to improve his or her skill and competence in handling of the patients and each practical batch for a course shall be preferably not more than twenty students;
e)	Efforts shall be made to encourage students to participate in group discussions and seminars to enable them to develop personality, character expression and other abilities which are necessary for a veterinary graduate to function either in solo practice or as a team member when he or she begins his or her independent professional career and an appropriate time slot for this activity be provided in the student study time table.

Subjects to be covered in the Bachelor of Veterinary Science and Animal Husbandry Degree Course - The following shall be the subjects for B.V.Sc. and A.H. degree course, namely:-

- (a) Veterinary Anatomy
- (b) Veterinary Physiology
- (c) Veterinary Biochemistry
- (d) Veterinary Pharmacology and Toxicology
- (e) Veterinary Parasitology
- (f) Veterinary Microbiology
- (g) Veterinary Pathology
- (h) Veterinary Public Health and Epidemiology
- (i) Animal Nutrition
- (j) Animal Genetics and Breeding
- (k) Livestock Production Management
- (l) Livestock Products Technology
- (m) Veterinary Gynaecology and Obstetrics
- (n) Veterinary Surgery and Radiology
- (o) Veterinary Medicine
- (p) Veterinary and Animal Husbandry Extension Education
- (q) Veterinary Clinical Practices
- (r) Livestock Farm Practices

COURSES AND COURSE CONTENTS

PROFESSIONAL YEARWISE DISTRIBUTION OF COURSES

1. <u>FIRST PROFESSIONAL</u>	
Veterinary Anatomy	4+3=7
Veterinary Physiology	4+1=5
Livestock Production Management	4+2=6
	Total 12+6=18
Non-credit course	
RVS or NCC or Sports and Games	0+1
2. <u>SECOND PROFESSIONAL</u>	
Veterinary Biochemistry	2+1=3
Veterinary Microbiology	3+2=5
Veterinary Pathology	4+2=6
Animal Genetics and Breeding	3+1=4
Animal Nutrition	3+1=4
	Total 15+7=22
Non-credit course	
RVS or NCC or Sports and Games	0+1
3. <u>THIRD PROFESSIONAL</u>	
Veterinary Pharmacology and Toxicology	4+1=5
Veterinary Public Health and Epidemiology	3+1=4
Veterinary Parasitology	3+2=5
Livestock Products Technology	2+1=3
Veterinary and Animal Husbandry Extension Education	3+1=4
Veterinary Clinical Practices – I	0+1=1
Livestock Farm Practices	0+2=2
	Total 15+9=24
Non-credit course	
NSS	0+1
4. <u>FOURTH PROFESSIONAL</u>	
Veterinary Surgery and Radiology	2+1=3
Veterinary Medicine	4+1=5
Veterinary Gynaecology and Obstetrics	2+1=3
Veterinary Clinical Practices –II	0+6=6
	Total 8+9=17

ANNUAL EXAMINATIONS

1. VETERINARY ANATOMY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1, 2, 3 and 4	100	20
Paper – II	5,6, 7 and 8	100	20
Practical			
Paper – I	1, 2, 3 and 4	60	20
Paper – II	5,6, 7 and 8	60	20

2. VETERINARY PHYSIOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1 and 2	100	20
Paper – II	3 and 4	100	20
Practical			
Paper – I	1 and 2	60	20
Paper – II	3 and 4	60	20

3. VETERINARY BIOCHEMISTRY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1 and 3	100	20
Paper – II	2	100	20
Practical			
Paper – I	1 and 3	60	20
Paper – II	2	60	20

4. LIVESTOCK PRODUCTION MANAGEMENT

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1,2,3,4 and 5	100	20
Paper – II	6, 7, 8 and 9	100	20
Practical			
Paper – I	1, 2, 3 and 4	60	20
Paper – II	5, 6, 7 and 8	60	20

5. VETERINARY MICROBIOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1,2 and 3	100	20
Paper – II	4 and 5	100	20
Practical			
Paper – I	1,2 and 3	60	20
Paper – II	4 and 5	60	20

6. VETERINARY PATHOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1,2 and 3	100	20
Paper – II	4, 5 and 6	100	20
Practical			
Paper – I	1,2 and 3	60	20
Paper – II	4, 5 and 6	60	20

7. ANIMAL GENETICS AND BREEDING

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1 and 2	100	20
Paper – II	3	100	20
Practical			
Paper – I	1 and 2	60	20
Paper – II	3	60	20

8. ANIMAL NUTRITION

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1 and 2	100	20
Paper – II	3 and 4	100	20
Practical			
Paper – I	1 and 2	60	20
Paper – II	3 and 4	60	20

9. VETERINARY PHARMACOLOGY & TOXICOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1,2, 3 and 4	100	20
Paper – II	5 and 6	100	20
Practical			
Paper – I	1 and 2	60	20
Paper – II	3, 4 and 5	60	20

10. VETERINARY PUBLIC HEALTH & EPIDEMIOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1 and 2	100	20
Paper – II	3 and 4	100	20
Practical			
Paper – I	1 and 2	60	20
Paper – II	3 and 4	60	20

11. VETERINARY PARASITOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1, 2 and 3	100	20
Paper – II	4 and 5	100	20
Practical			
Paper – I	1, 2 and 3	60	20
Paper – II	4 and 5	60	20

12. LIVESTOCK PRODUCTS TECHNOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1 and 2	100	20
Paper – II	3 and 4	100	20
Practical			
Paper – I	1 and 2	60	20
Paper – II	3 and 4	60	20

13. VETERINARY AND ANIMAL HUSBANDRY EXTENSION EDUCATION

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1,2,3,4 and 5	100	20
Paper – II	6,7,8 and 9	100	20
Practical			
Paper – I	1	60	20
Paper – II	2	60	20

14. VETERINARY SURGERY AND RADIOLOGY

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1,2,3 and 4	100	20
Paper – II	5 and 6	100	20
Practical			
Paper – I	1,2,3 and 4	60	20
Paper – II	5 and 6	60	20

15. VETERINARY MEDICINE

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1,2,3 and 4	100	20
Paper – II	5,6 and 7	100	20
Practical			
Paper – I	1,2 and 3	60	20
Paper – II	4 and 5	60	20

16. VETERINARY GYNAECOLOGY AND OBSTETRICS

Papers	Units	Maximum Marks	Weightage
Theory			
Paper – I	1	100	20
Paper – II	2 and 3	100	20
Practical			
Paper – I	1	60	20
Paper – II	2 and 3	60	20

VETERINARY CLINICAL PRACTICE (VCC)

The practical component will be dealt with internally. The examination for VCP shall be conducted twice a year i.e. first practical exam after completion of 50% syllabus and the second one, when the course is completed but the second exam shall comprise of entire syllabus.

The examination should comprise of following components:

- (i) Submission of 10 complete cases each of Surgery, Medicine, Gynaecology
- (ii) Case presentation
- (iii) Review of treatment of 5 cases
- (iv) Written Objective Questions (Surgery, Medicine, Gynaecology and Lab diagnosis)
- (v) Viva

LIVESTOCK FARM PRACTICES (LFP)

The practical component will be dealt with internally. The examination for LFC shall be conducted twice a year i.e. first practical exam after completion of 50% syllabus and the second one, when the course is completed but the second exam shall comprise of entire syllabus.

The examination should comprise of following components:

- (i) Day to day activities
- (ii) Record Book
- (iii) Written Objective Questions
- (iv) Viva/ Any other suitable component as per conditions

COURSE CONTENTS

(1) GENERAL REMARKS

Alternate use of animals as model for demonstration shall be encouraged and the computer simulations, Interactive CD-Rom, films, charts and life like models shall be used for better understanding of the subject and the programme to obtain cadavers ethically be established at all veterinary colleges.

(2) DEPARTMENT-WISE DESCRIPTION

(i) DEPARTMENT OF VETERINARY ANATOMY

VETERINARY ANATOMY

Credit Hours: 4+3

Dissection will be carried out on cadavers procured by way of donation of animals or animals obtained from post-mortem section and the donated animals should be either incurable or in terminal stages and preserved specimens should be used.

Within one year each college must setup a body donation programme or wild body programme.

Computer simulations software's, models, mannequins, plastinated specimens, preserved body organs, models should be used for better understanding of the subject.

THEORY

UNIT: 1

Introduction to anatomy and branches of anatomy and descriptive terms used in anatomy and study of anatomical planes.

General Osteology, Arthrology and Myology: Study of properties and structure of bone. Classification of skeletons, classification of bones with suitable examples and terms used in osteology. Introduction to arthrology, classification of joints, different diarthrodial joints, structure of diarthrodial joints and movements permitted. Introduction to myology, classification of muscles, etymology of muscles. Description of tendon, ligaments, aponeurosis, synovial bursa and synovial sheath.

(Note: Detailed description of muscles of different regions of the body will be studied in the respective practical).

General Angiology, Neurology and Aesthesiology: Introduction to angiology. Structure of heart. General plan of systemic and pulmonary circulations, lymphatic and venous systems. Introduction to neurology and parts of central, peripheral and autonomic nervous system and sense organs. Formation of spinal nerve. Structure of meninges, brain, spinal cord.

Different surface regions, joint regions, Palpable Bony areas or prominences of the body of the animal. Palpable Lymph nodes and Arteries of the body and Surface veins for Venepuncture. Sites for collection of Bone marrow and Cerebrospinal fluid.

General Splanchnology: Introduction to splanchnology, boundaries of thoracic, abdominal and pelvic and pelvic cavities, topography of different organs of digestive, respiratory, urinary, endocrine, male and female reproductive systems of domestic animals and fowl.

Principles and application of Radiography and Ultrasound for bones and soft tissues.

UNIT-2

Fore limb: Study of bones of fore limb of ox and differences in horse, dog, pig and fowl. Study of hoof of ox and horse. Study of joints, ligaments, stay apparatus, major blood vessels, nerves, veins and lymph nodes of fore limb. Sites for Radial, Median, Ulnar and Volar nerve blocks.

UNIT-3

Head and neck: Study of cranial and facial bones, cervical vertebrae of ox and differences in horse, dog, pig and fowl. Boundaries of the oral, orbital, nasal and cranial cavities. Study of paranasal sinuses in ox, horse, dog and pig. Study of articulations and special ligaments of the head and neck. Muscles of face, mastication, eye, ear, tongue, pharynx, soft palate, hyoid and larynx. Study of teeth, hard and soft palate, tongue, pharynx, larynx, thyroid, parathyroid and salivary glands and differences in horse, dog, pig and fowl. Study of cranial nerves, blood vessels and lymph nodes of head and neck regions. Study of boundaries of jugular furrow and structures of carotid sheath along with neck muscles. Study of sense organs, trachea and oesophagus. Age determination by Dentition. Sites for Tracheotomy, Esophagotomy, Ligation of Stenosis duct and Mental, Mandibular, Maxillary, Cornual, Infraorbital, Supraorbital (frontal), Orbital and Auriculopalpebral nerve blocks and surgical approach to guttural

pouches in horse. Importance of Cornual nerve and superficial Temporal artery in Amputation of Horn in cattle.

UNIT-4

Thorax: Study of thoracic vertebrae, ribs and sternum of ox and differences in horse, dog, pig and fowl. Study of joints, special ligaments, blood vessels, nerves, lymph vessels and lymph nodes of thorax. Study of organs of thorax i.e. trachea, thymus, oesophagus, lungs and differences in horse, dog, pig and fowl. Study of pleura, its reflections and mediastinum. Areas of auscultation and percussion of heart and lungs and site for Paracentesis Thoracis.

UNIT-5

Abdomen: Study of bones of abdomen of ox and differences in horse, dog, pig and fowl. Study of joints, special ligaments, blood vessels, nerves of abdomen region. Blood and nerve supply to abdominal viscera. Study of peritoneal reflections, organs of digestive, urinary, male and female reproductive systems present in abdomen and differences in horse, dog, pig and fowl. Study of mammary glands in cow and differences in mare, bitch and sow. Study of spleen of ox and differences in horse, dog, pig and fowl. Study of major veins, lymph vessels, lymph nodes and endocrine glands of abdomen. Boundaries and Clinical importance of the flank and Para Lumbar Fossa. Sites for Liver, Gall Bladder and Caecal Biopsies, Laparotomy, Rumenocentesis, Rumenotomy, abomasotomy, splenectomy, Cystotomy, Caesarean Operation, enterotomy and paravertebral block.

UNIT-6

Hind limb and pelvis: Study of bones of hind limb and pelvis of ox and differences in horse, dog, pig and fowl. Study of joints, ligaments, blood vessels, lymph nodes and nerves of hind limb, pelvis and tail region and pelvic viscera. Study of pelvic peritoneal reflections, organs of digestive, urinary, male and female reproductive systems present in pelvic cavity and differences in horse, dog, pig and fowl. Boundaries of the inguinal canal and structures of the spermatic cord, pre pubic tendon and its importance. Study of external genital organs. Sites for Tibial, Peroneal, Plantar and Pudic nerve blocks, Patellar desmotomy, Urethrotomy, Castration, Vasectomy, cranial and caudal epidural anaesthesia.

UNIT-7

Cytology, cell junctions, study of basic tissues i.e. epithelial, connective, muscular and nervous tissues, blood and bone marrow. Study of microscopic structures of digestive, circulatory, urinary, respiratory, nervous, lymphatic, endocrine, male and female genital systems and mammary glands of domestic animals. Study of microscopic structure of sense organs i.e. eye, ear and integument.

UNIT-8

Introduction to embryology, gametogenesis, fertilization, cleavage, types of eggs, morula, blastulation, gastrulation, types of implantation, twinning. Formation of foetal membranes in mammals and birds, Placenta and its classification. Different germ layers and their derivatives. Study of development of organs of digestive system including accessory structures i.e. tongue, teeth, salivary glands, liver and pancreas. Study of development of organs of respiratory, urinary, circulatory, lymphatic, nervous, musculoskeletal, male and female reproductive systems. Development of endocrine glands, sense organs i.e. eye and ear.

PRACTICAL

UNIT-1

Study of general terms used in anatomy, study of anatomical planes. Study of different parts of skeleton, different surface and joint regions. Study of boundaries of thoracic, abdominal and pelvic cavities. Demonstration of different types of joints, muscles, tendons, ligaments, synovial bursa and synovial sheath. In situ demonstration of heart, meninges, brain and spinal cord. Boundaries of Thoracic, Abdominal and Pelvic Cavities and in situ demonstration of organs of digestive, respiratory, urinary, endocrine, male and female reproductive systems of domestic animals.

Demonstration of Different surface regions, joint regions and Palpable Bony areas or prominences of the body of the animal, Common sites of fractures, Palpable Lymph nodes and Arteries of the body (ventral coccygeal artery in ox, femoral artery in dog and cat, facial artery in horse) and Surface veins for Venepuncture (cephalic vein and recurrent tarsal vein in dog and cat, jugular vein in large

animals.) and Sites for collection of Bone marrow and Cerebrospinal fluid. Visualization of Radiographs and ultrasound pictures of various organs and Fractures of various bones.

UNIT-2

Fore limb: Demonstration of different bones of fore limb of ox and comparison with horse, dog, pig and fowl. Dissection of the fore limb. Study of joints, ligaments, muscles, major blood vessels, lymph nodes and nerves of fore limb. Study of sites for different nerve blocks or neurectomies in fore-limb. Study of suprascapular nerve paralysis-shoulder sweeney, radial nerve paralysis-capped elbow. Structure of the equine hoof and comparison with ox. Demonstration of radiographs of normal bones of fore limb. Clinical importance of cephalic vein for intravenous injections in dog.

UNIT-3

Head and neck: Demonstration of cranial and facial bones, cervical vertebrae of ox and comparison with horse, dog and fowl. Dissection of muscles of face, mastication, tongue, pharynx, soft palate, hyoid, larynx, eye and ear. Dissection of superficial neck muscles. Dissection of brain and its parts. Dissection or demonstration of tunics of eye. Study of teeth, tongue, pharynx, thyroid, parathyroid and salivary glands and differences in horse, dog, pig and fowl. Study of cranial nerves and blood vessels of head and neck regions. Study of trachea and oesophagus. Study of nerve blocks of the head i.e. cornual, auriculo-palpebral, Peterson's orbital nerve block, mandibulo-alveolar and mental nerve blocks. Importance of facial artery for recording pulse in horse. Surgical importance of Stenson's duct in domestic animals. Surgical approach to guttural pouches-Viborg's triangle. Clinical importance of jugular vein for intravenous injections in large animals. Demonstration of radiographs of normal bones of head and neck.

UNIT-4

Thorax: Demonstration of thoracic vertebrae, ribs and sternum of ox and comparison with horse, dog, pig and fowl. Dissection of muscles, blood vessels, nerves and lymph nodes of thorax. Demonstration of organs of thorax i.e. trachea, oesophagus, thymus, lungs and heart and differences in horse, dog, pig and fowl. Study of pleural reflections of thoracic cavity. Demonstration of sites for auscultation and percussion. Recurrent laryngeal nerve paralysis-roaring in horses. Choke or oesophageal obstruction. Demonstration of radiographs and videos of ultrasonography of organs of thorax.

UNIT-5

Abdomen: Demonstration of bones forming boundaries of abdomen of ox and comparison with horse, dog, pig and fowl. Dissection of muscles, blood vessels and nerves of abdomen. Demonstration of peritoneum, omentum, mesentery and organs of digestive, urinary, male and female reproductive systems present in abdomen and differences in horse, dog, pig and fowl. Demonstration of mammary glands of cow, mare, bitch and sow. Demonstration of major veins, lymph vessels and lymph nodes of abdomen. Topographic location of abdominal viscera of ox and comparison with horse, dog, pig and fowl. Demonstration of sites for laparotomy, caesarean section, ovario-hysterectomy, catheterization of urinary bladder and sites for paravertebral and epidural anaesthesia. Demonstration of Boundaries and Clinical importance of the flank and Para Lumbar Fossa, Sites for Liver, Gall Bladder and Caecal Biopsies, Laparotomy, Rumenocentesis, Rumenotomy, abomasotomy, splenectomy, Cystotomy, Caesarean Operation, catheterization of urinary bladder and enterotomy and paravertebral block. Demonstration of radiographs and videos of ultrasonography of organs of abdomen.

UNIT-6

Hind limb and pelvis: Demonstration of bones of hind limb of ox and comparison with horse, dog, pig and fowl. Demonstration of joints and ligaments of hind limb and pelvis. Dissection of muscles, blood vessels, lymph nodes and nerves of hind limb and pelvic cavity. Demonstration of peritoneal reflections of pelvic cavity and organs of digestive, urinary, male and female reproductive systems in pelvic cavity and differences in horse, dog, pig and fowl. Study of external genital organs. Clinical importance of femoral artery to record pulse in dog. Clinical importance of recurrent tarsal vein for intravenous injections in dog. Demonstration of radiographs of normal bones and videos of ultrasonography of organs of pelvis. Demonstration of Sites for Tibial, Peroneal, Plantar and Pudic nerve blocks, Patellar desmotomy, Urethrotomy, Castration, Vasectomy and cranial and caudal epidural anaesthesia.

UNIT-7

Microscopy and micrometry. Comparison of light and electron microscopy. Histological techniques, processing of tissues for paraffin sectioning and haematoxylin and eosin staining. Microscopic examination of epithelium, connective tissue, muscular tissue, nervous tissue and blood. Microscopic examination of organs of digestive, circulatory, urinary, respiratory, nervous, lymphatic, endocrine, male and female genital systems and sensory organs of domestic animals.

UNIT-8

Demonstration of Placenta, umbilical cord and foetal membranes of different domestic animals. Demonstration of congenital anomalies of domestic animals as per availability. Study of slides of developing organs of different systems as per the availability.

A embalmed cadaver of buffalo calf (procured through donated animals or cadavers obtained from post-mortem section) for every 24 students to be used for dissection purposes.

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2, 3 and 4	100	20
Paper-II	5,6,7 and 8	100	20
PRACTICAL			
Paper-I	1, 2, 3 and 4	60	20
Paper-II	5,6,7 and 8	60	20

(ii) DEPARTMENT OF VETERINARY PHYSIOLOGY AND BIOCHEMISTRY

VETERINARY PHYSIOLOGY AND BIOCHEMISTRY

Credit Hours: 6+2

VETERINARY PHYSIOLOGY

Credit Hours: 4+1

VETERINARY BIOCHEMISTRY

Credit Hours: 2+1

VETERINARY PHYSIOLOGY

THEORY

UNIT- 1 (BLOOD, CARDIOVASCULAR, NERVOUS AND MUSCULAR SYSTEMS)

Introduction to Blood; Properties of blood as a body fluid, metabolism and fate of R.B.C; Hemoglobin-chemical structure, synthesis, physiological functions, derivatives of hemoglobin;

Heart- morphological characteristic, systemic excitability conduction and transmission processes. Cardiac Cycle: Regulation of cardiac output; coronary circulation; properties of pulse; metabolism and energetics of working myocardial cell, extrinsic and intrinsic regulation; Electro Cardio Graph and its significance in Veterinary Sciences - Echocardiography. Haemorrhage haemostasis. Haemodynamics of circulation, circulatory mechanics, resistance to flow, vasoconstriction, nervous and circulating fluid volume controls of blood pressure, neurohormonal control of vascular smooth muscle. Circulatory controls- shock stresses, regional and fetal circulation. Capillary exchange, control of blood pressure. Adjustment of circulation during exercise.

Muscle Physiology-basic muscle unit characteristic-electrical phenomenon in muscle cell - muscle action potential, excitation and propagation of impulse characteristics- latent period refractiveness, threshold level-all and none characteristics - contractile mechanism - excitation - contraction coupling- neuro-muscular transmission, types of muscle contraction, phenomenon of fatigue, rigor mortis. Organization of nervous system- Mechanism of information processing, hierarchical control. Major function system- sensory, consciousness, emotion, motor and visceral control and basic functional unit - neuron structure, type- functional characteristics of sub-units of neuron. Membrane potential - ionic basis of resting membrane potential (RMP) nerve action potential, excitation and propagation of impulse characteristics- latent period- refractiveness, threshold level-all and none characteristics.

Degeneration and regeneration of nerve fibre. Synaptic and junctional transmission. Functions of nervous system-reflexes-control of posture and movements, autonomic nervous system and visceral control. Neurotransmitter wakefulness, sleep cycle. Higher function of nervous system - learning, memory, electroencephalography. Sense organs and receptors physiology of special senses - Eye: functional morphology, nourishment and protection neural pathway, receptors- optics, ocular muscles and movements, photochemistry, Vision defects Ear: Physiology of hearing and common hearing impairment. Vestibule apparatus. Physiology of olfaction and taste

UNIT-2 (DIGESTIVE AND RESPIRATORY SYSTEMS)

Morphological characteristic of mono gastric and poly gastric digestive system. Prehension, rumination; defecation; vomition; regulation of secretory function of saliva, stomach, intestine, pancreas; bile secretion; hunger, appetite control, developmental aspects of digestion; luminous, membranous and microbial digestion in rumen and intestine; permeability characteristics of intestine, forces governing absorption, control intestinal transport of electrolyte and water, enzymatic digestion in monogastric and fermentative digestion in rumen, modification of toxic substances in rumen. Digestion in birds. Functional morphology of respiratory apparatus. Mechanics of breathing. Transport of blood gases, foetal and neonatal oxygen transport, dissociation curves, pressures, recoil tendency, elasticity, surfactants, pleural liquid, compliance, exchanges of gases in lungs and tissues, neural and chemical regulation of breathing, diffusion, perfusion, hypoxia. Frictional resistance to air flow, airways smooth muscle contraction, respiratory muscle work, panting, adaptation of respiration during muscle exercise, high altitude hypoxia, Non-respiratory lung functions. Respiration in birds.

UNIT-3 (EXCRETORY AND ENDOCRINE SYSTEMS)

Kidney- Functional morphology of nephrons, factors determining filtration pressure, determination of glomerular filtration rate (GFR) and renal plasma flow – Re-absorption mechanisms for glucose, protein, amino acids, electrolytes; ammonium mechanism, glomerulo-tubular balance, methods of studying renal functions; urine concentration; micturition, uremia. Fluid, water balance, fluid therapy, dehydration, water concentration mechanisms. Acid base balance and H⁺ regulation, correction and evolution of imbalances, total osmotic pressure. Formation and excretion of urine of Birds. Cerebrospinal fluid, synovial fluids - composition, formation and flow; Joints. Regulation of bone metabolism and homeostasis.

Hormone cell interaction, sub-cellular mechanisms-metabolism of hormones-methods of study of endocrine system; Receptors- mechanism of regulation; Chemistry of hypothalamo- hypophyseal hormones, target organ, pineal, thyroid, thymus, pancreas, adrenal, prostaglandins, hormones of calcium metabolism, disorders, rennin-angiotensin system, atrial natriuretic factors, erythropoietin, GI hormones, pheromones.

UNIT-4 (REPRODUCTION, LACTATION, GROWTH AND ENVIRONMENTAL PHYSIOLOGY)

Genetic and endocrine control of gonadal development, modification of gonadotrophin release, ovarian functions, follicular development, dynamics, endocrine and receptor profiles, sexual receptivity, ovarian cycle, post-partum ovarian activity, ovum transport, capacitation, fertilization, reproductive cycles in farm animals- hormones present in the biological fluids during pregnancy and their uses for the diagnosis of pregnancy- maternal foetal placental participation in pregnancy and parturition, immunology of gestation, preparturient endocrine status.

Spermatogenic cycle and wave- function of sertoli cell-Leydig cell-semen - composition- evaluation; Testosterone - function and regulation - cryptorchidism. Puberty - photoperiod - uses of androgens, progestogens, estrogens.

Functional and metabolic organization of mammary glands - structure and development; effect of estrogens and progesterone; hormonal control of mammary growth; lactogenesis and galactogenesis; biosynthesis of milk constituents-secretion of milk and metabolism, prolactin and lactation cycle.

Biochemical and genetic determinants of growth, regulation of growth, metabolic and hormone interactions, factors affecting efficiency of growth and production in ruminants and single stomach animals. Growth in meat producing animals and birds, growth curves. Recombinant gene transfer technologies for growth manipulation- advantages and limitations. Protein deposition in animals and poultry.

Heat balance, heat tolerance, hypothermia, hyperthermia, thermo-regulation in farm animals, role of skin, responses of animals to heat and cold, fever, body temperature and hibernation. Temperature regulation in birds.

Climatology- various parameters and their importance. Effect of different environmental variables like temperature, humidity, light, radiation, altitude on animal performance. Acclimation, acclimatization - general adaptive syndrome. Clinical aspects of endocrine - reproductive functions, circadian rhythm. Neurophysiology of behaviours, types of behaviour, communication, Learning and memory behavioural plasticity.

PRACTICAL

UNIT- 1 (BLOOD, CARDIOVASCULAR, NERVOUS AND MUSCULAR SYSTEMS)

Collection of blood samples - Separation of serum and plasma - Preservation of de-fibrinated blood - enumeration of erythrocytes, leucocytes - differential leucocytic count - platelet count - estimation of hemoglobin - haematocrit - erythrocyte sedimentation rate - packed cell volume - coagulation time-bleeding time -Erythrocyte fragility and viscosity - blood grouping - recording of ECG - measurement of arterial blood pressure (Sphygmomanometry). Simulation experiments on Nerve- Muscle and heart physiology.

UNIT-2 (DIGESTIVE AND RESPIRATORY SYSTEMS)

Counting of rumen motility, estimation of volatile fatty acids and ammonia nitrogen in rumen liquor. Bacterial and protozoal count. *In-vitro* action of proteolytic enzymes- Amylase, pepsin and trypsin. Recording of respiration, spirometry. Recording of volume and capacities in different physiological states including determination of vital capacities.

UNIT-3 (EXCRETORY AND ENDOCRINE SYSTEMS)

Urine analysis-physiological constituents, pathological determinates, determination of Glomerular Filtration Rate. Titerable acidity, determination of inorganic phosphorus, urine ammonia nitrogen and creatinine in urine. Recording of rumenointestinal movements (Demonstration) and Bio assay for tropic hormone. Demonstration of hormone estimation.

UNIT-4 (REPRODUCTION, LACTATION, GROWTH AND ENVIRONMENTAL PHYSIOLOGY)

Oestrus and phases of oestrous cycle in animals (vaginal mucus). Behavioural signs of oestrus. Sperm motility, sperm concentration -live and dead - abnormal sperm count. Measurement of growth in various species. Measuring surface area of animals. Health parameters of animals- body temperature, pulse, respiration and heart rate. Measurement of animal environmental conditions. Behaviour of animals- mating behavior, feeding behaviour (liveorvideo graphicorcomputer simulated demonstration).

PAPERS	ANNUAL EXAMINATION		
	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1and 2	100	20
Paper-II	3 and 4	100	20
PRACTICAL			
Paper-I	1and 2	60	20
Paper-II	3 and 4	60	20

VETERINARY BIOCHEMISTRY

Credit Hours: 2+1

THEORY

UNIT-1 (GENERAL VETERINARY BIOCHEMISTRY)

Scope and Importance of Biochemistry. Structure of Biological Membranes and Transport across Membranes. Donnan Membrane Equilibrium. Dissociation of Acids, pH, Buffer Systems, Henderson-Hasselbalch Equation. Biochemistry of Carbohydrates: Biological Significance of Important Monosaccharides(Ribose, Glucose, Fructose, Galactose, Mannose and Amino Sugars), Disaccharides (Maltose, Isomaltose, Lactose, Sucrose and Cellobiose), Polysaccharides, (Starch, Dextrins, Dextrans, Glycogen, Cellulose, Inulin, Chitin) and Mucopolysaccharides Including Bacterial Cell Wall

Polysaccharides. Biochemistry of lipids: Properties and biological significance of simple, compound and derived lipids and lipoproteins. Fat indices. Structure and functions of prostaglandins. Biochemistry of proteins: Classification, Structure, Properties - Biological significance of proteins. Amino acids: Structure and classification. Physical and chemical properties of amino acids - amphoteric nature, optical activity and peptide bond formation. Biochemistry of nucleic acids: Chemistry of purines, pyrimidines, nucleosides and nucleotides. Biological significance of nucleosides and nucleotides. Structures and functions of deoxyribonucleic acid (DNA) and a typical ribonucleic acid (RNA).

UNIT-2 (INTERMEDIARY METABOLISM)

Enzymes: Definition and classification. Coenzymes, cofactors and iso-enzymes. Properties: Protein nature, enzyme-substrate complex formation, modern concept of the active center of enzyme. Specificity of enzyme action: Substrate specificity, group specificity, stereo or optical specificity. Factors influencing enzyme action: Effects of temperature, pH, concentration of substrate and enzyme. Enzyme units: International Units, katal, turnover number and specific activity. Enzyme inhibition: Competitive, non-competitive, uncompetitive inhibition and suicidal inhibition. Allosteric enzymes. Biological oxidation: Enzymes and coenzymes involved in oxidation and reduction. Respiratory chain or electron transport chain, oxidative phosphorylation, inhibitors, uncouplers and other factors influencing electron transport chain. Carbohydrate metabolism: Glycolysis, Krebs's cycle, HMP shunt, gluconeogenesis, Cori cycle, glycogenesis, glycogenolysis, Bioenergetics of carbohydrate metabolism. Lipid metabolism: Beta oxidation of fatty acids, ketone body formation, biosynthesis of fatty acids. Bioenergetics of lipid metabolism.

Protein metabolism: Biosynthesis and Degradation. Deamination, transamination and decarboxylation of amino acids. Ammonia transport and urea cycle. Nucleic acid metabolism: Metabolism of purines and pyrimidines. DNA and RNA biosynthesis and regulation. Regulation and Integration of metabolism.

UNIT- 3 (VETERINARY ANALYTICAL BIOCHEMISTRY)

Disorders of Carbohydrate Metabolism: Diabetes mellitus, Ketosis, Bovine Ketosis, Pregnancy toxemia, hypoglycaemia in baby pigs, hyperinsulinism in Dogs. Hormonal control of carbohydrate metabolism and regulation of blood sugar.

Biochemical tests for the detection of disturbance in carbohydrate metabolism. Plasma Proteins and clinical significance, Proteins and Dysproteinemias,. Acute Phase proteins. Lipid Profile in disease diagnosis. Clinical Enzymology - Diagnostic importance of non-functional plasma enzymes and Isoenzymes, Liver function tests - Classification - Biochemical tests for differential diagnosis. Biochemical tests of renal function - Urine analysis - Role of BUN, Uric acid and Creatinine in diagnosis. Disturbance in acid base balance and its diagnosis. Biochemistry of digestive disorders. Biochemistry of oxidative stress and shock. Biochemical basis of fluid therapy. Detoxification in the body: Metabolism of xenobiotics, General reactions for biotransformation of different groups of substances, Cytochrome p450 system of enzymes.

PRACTICAL

UNIT-1 (GENERAL VETERINARY BIOCHEMISTRY)

Concentration of solutions and system International (S.I.) Units; Preparation or standardization of acids and alkalies; Preparation of Buffers; Titration curve of acid versus base; Qualitative test for carbohydrates and identification of unknown carbohydrates; Determination of acid number of an oil; Color and precipitation reactions of proteins; Estimation of amino acids (Sorensen's Method).

UNIT-2 (INTERMEDIARY METABOLISM)

Effect of temperature and pH on enzyme activity; Estimation of blood or plasma Glucose, Protein, Inorganic phosphate, Calcium, Magnesium; Estimation of ascorbic acid by Dichlorophenolindophenol (DCPIP) method; Estimation of milk lactose by Benedicts quantitative method; Estimation of sodium and potassium by flame photometer; Paper or thin layer Chromatography of amino acids; Estimation of vitamin A by colorimetry.

UNIT-3 (VETERINARY ANALYTICAL BIOCHEMISTRY)

Detection of Pathological Constituents in Urine; Assays of ALT and AST in Serum; Acute phase proteins (AorG Ratio); Estimation of total serum cholesterol, Blood Urea Nitrogen, creatinine, serum bilirubin (Direct, Indirect and Total).

Principles of various diagnostic tests, normal and abnormal values in different species, differential

diagnosis, correlating with diseases and rationale of arriving at the conclusion need to be rediscussed in detail during Final Professional in the course VETERINARY CLINICAL PRACTICES-II, Diagnostic Laboratory Section.

ANNUAL EXAMINATION			
PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1 and 3	100	20
Paper-II	2	100	20
PRACTICAL			
Paper-I	1 and 3	60	20
Paper - II	2	60	20

(iii) **DEPARTMENT OF LIVESTOCK PRODUCTION MANAGEMENT**

LIVESTOCK PRODUCTION MANAGEMENT

Credit Hours: 4+2

THEORY

UNIT-1 (GENERAL LIVESTOCK MANAGEMENT)

Demographic distribution of livestock and role in Indian economy. Problems and prospects of livestock industry in India. Common animal husbandry terms. (glossary) Body conformation and identification. Transportation of livestock and wild or zoo animals. Common farm management practices including disinfection, isolation, quarantine and disposal of carcass. Introduction to methods of drug administration. Common vices of animals (Cattle, Buffalo, Sheep, Goat,), their prevention and care. Livestock production systems. Animal holding and land holding patterns in different agro-climatic zones. Organic livestock production. Judging and BCS for body parts of livestock. Preparation of animals for show. Culling of animals. Selection and purchase of livestock.

UNIT-2 (FODDER PRODUCTION AND CONSERVATION)

Importance of grasslands and fodder in livestock production. Agronomical Practices for fodder production. Important leguminous and non-leguminous fodders in different seasons. Soil and Water conservation and drainage of water for fodder production. Fodder production for small livestock units. Structures for storage of feeds and fodders. Scarcity fodders and preservation of green fodder. Recycling of animal washings and wastes in fodders production and use of recycle waste.

UNIT-3 (LIVESTOCK PRODUCTION MANAGEMENT-RUMINANTS)

Housing systems, layout and design of different buildings for animals. Selection of site. General principles affecting the design and construction of building for housing for various livestock species. Arrangements of the building with special reference to Indian conditions. Utilization of local materials. Building materials used for construction of wall, roof and floor of animal houses, their characteristics, merits and demerits. Breeds of cattle and buffalo and descriptions of important breeds. Economic traits of cattle and buffaloes. General management and feeding practices of calves, heifers, pregnant, lactating and dry animals, bulls and working animals. Draught ability of cattle and buffaloes. Raising of buffalo males for meat production. Routine animal farm operations and labour management. Animal farm accounts and records. Methods of milking and precautions. Factors affecting quality and quantity of milk production. Clean milk production. Breeds of sheep and goat and their descriptions. Important economic traits for meat, milk and fibre. General management and feeding practices during different stages of growth, development and production (milk, meat and wool). Breeding schedule and management of ram and buck. Weaning and fattening of lambs and kids.

UNIT-4 (ZOO ANIMALS PRODUCTION MANAGEMENT)

Taxonomy of important wild zoo animals. Status and conservation practices of wild life in India. Basic principles of habitat and housing of various classes of wild zoo animals. Size and space requirement (dimension) of cubicles, enclosures of important wild zoo animals. Management of livestock in fringe areas, in and surrounding the breeding areas. Feeding habits, feeds and feeding schedules of captive animals. Restraining, capture, handling, physical examination of captive animals. Classification of zoos, management of sanctuaries, national parks etc. Acts and Rules related to captive animals.

National and international organizations and institutions interlinked to captive animals role and functioning.

UNIT-5 (ANIMAL WELFARE)

Definition of animal welfare and ethics. Human and animal welfare in relation to ecosystem and environmental factors. Role of veterinarians in animal welfare. Animal welfare organizations, Animal Welfare Board of India - their role, functions and current status. Rules, regulations, laws on animal welfare. Prevention of Cruelty to Animals (PCA) Act, 1960 (59 of 1960). Role and function of Committee for the Purpose of Controlling and Supervising Experiments in Animals (CPCSEA). Protection of wild life in nature and captivity. Protection and welfare of performing animals. Welfare of animals during transportation. Animal welfare in commercial livestock farming practices. Protection and welfare of working animals. Pet and companion animal welfare. Animal welfare during natural calamities and disaster management. Legal duties of veterinarians, Common offences against animals and laws related to these offences. Provincial and Central Acts relating to animals. Laws relating to offences affecting Public Health. Livestock Importation Act Evidence, liability and insurance. Code of Conduct and Ethics for veterinarians - the Regulations made under the Act.

UNIT-6 (POULTRY PRODUCTION MANAGEMENT)

Indian poultry industry – Brief outline of the different segments – poultry statistics. Classification of poultry with respect to production characters, age and standards. Production characters of other avian species. Description of indigenous fowls and their value in rural farming. Specific strains developed for rural poultry production; their acceptability and importance in rural eco-system
Brooding management – Types of brooders – preparation of shed – Importance of environmental factors. Housing – Types of poultry houses – space requirements. Recent advances in housing systems and rearing systems. Scavenging system of management – Low input technology – Backyard and semi-intensive units; their management and economic achievements. Deep litter management – control of litter-borne diseases and recycling of litter. Cage management – Different types; Advantages and disadvantages. Management of growers and layers. Management of broilers and breeders. Stress management. Feeding management–Classification of nutrients – Nutrient requirements and feed formulations. Feeding systems–Feed restrictions – phase feeding – Additives and supplements. Water management. Breeding systems and methods of mating. Selection and culling. Breeding for specific characters and for hybrid chicken production. Poultry judging. Egg structure – Physical and chemical composition. Bio-security and principles of disease prevention management. Health care for common poultry diseases – vaccination. General principles of poultry medication.

UNIT-7 (DIVERSIFIED POULTRY PRODUCTION AND HATCHERY MANAGEMENT)

Principles of incubation and hatchery management practices. Factors affecting fertility and hatchability, selection and care of hatching eggs and hatchery hygiene. Candling, sexing, grading, packing and disposal of hatchery waste. Economics of hatchery business – Troubleshooting hatchery failures–Computer applications in hatchery management. Poultry waste management, pollution and environmental issues. Organic and hill farming. Mixed or integrated poultry farming
Vertical & horizontal integration in commercial poultry production – Contract farming. Export or import of poultry produce and marketing. Management of ducks, geese, turkeys, Japanese quails, guinea fowls etc.

UNIT-8 (LABORATORY, RABBIT AND PET ANIMAL PRODUCTION MANAGEMENT)

Importance and selection of laboratory animal, care and housing standards of mice, rats, hamster and guinea pigs. General considerations on feeding and breeding of laboratory animals. Concept of production of specific pathogen free and germ free laboratory animals. Scope of rabbit farming in the country, breeds and their distributions in India. Limitation of rabbit animal production, Selection, care and management of breeding stock for commercial purpose. Identification, care and management of kindling animals. Care of new born, growing stock. Breeding and selection techniques for optimal production of rabbit. Feeds and feeding for rabbit production. Hygienic care and Housing for rabbit production. Disposal, utilization and recycling of waste etc. Preparing projects for micro (Backyard), mini and major rabbit farms. Important breeds of dogs, cats and pet birds. Feeding of dogs, cats and pet birds. Dog show: preparation for show, kennel clubs, important characteristics for judgment. Utility of dogs- guarding, defense, patrolling, riot control, scouting, espionage, mine detection, tracking, guiding, hunting, races, retrieving rescue and other uses.

UNIT-9 (SWINE AND EQUINE PRODUCTION MANAGEMENT)

Introduction and scope of swine farming in the country. Demography of swine population. Selection and breeding techniques in swine. Important breeds (exotic and indigenous) & their characteristics. Housing and feeding of swine. Management of different categories of swine for optimal production: breeding and pregnant sows; sows at farrowing and after farrowing: pig-lets, growing stock, lactating sows, feedlot stock. Equine population of India. Horses, donkeys and mules and their utility. Colors and markings. Identification of breeds of horses. Dentition and ageing of horses. Care and routine management of equines including grooming, saddling and exercise. Stable and its management. Vices of horses. Foot care and shoeing care. Feeding routine for horse, donkeys and mules. Care of stallion. Mating of horses, brood mare and its care. Foaling and care of newborn. Breeding mules. Care of race horses and preparing horses for show. Doping and its detection. Colic and its prevention.

PRACTICAL

UNIT-1 (GENERAL LIVESTOCK MANAGEMENT)

General introduction of the Institute animal farm. Identification of common tools used on animal farm. Familiarization with body points of animals. Methods of identification (marking, tattooing, branding, tagging and electronic chip under pre-emptive analgesia). Use of rope for knot and halter making. Dentition and ageing of animals. Preparation of animals for show and judging. Selection and culling of animals. Preparation of project proposal

UNIT-2 (FODDER PRODUCTION AND CONSERVATION)

Visit to the fodder farm. Familiarization with the various types of fodders in the state and India. Familiarization with various fertilizers and manures. Collection, preservation and storage of feed and fodder; Damages or loss during transfer and storage; methods to prevent them. Cost of calculations of fodder production. Livestock waste utilization and recycling.

UNIT-3 (LIVESTOCK PRODUCTION MANAGEMENT-RUMINANTS)

Layout plans for different livestock houses. Visit to different animal farms and Identification of various breeds of cattle, buffalo, sheep and Goat. Humane handling and restraining of cattle, buffalo, sheep and Goat. Clipping, shearing, dipping, spraying and spotting sick animals. Determination of body weight using different measurements. Familiarization with routine cattle, buffalo, sheep and goat farm operations. Milking of dairy animals. Shearing of sheep. Training of breeding males. Detection of heat. Identification and care of pregnant animals, care of neonatal and young stock. Economics of dairy, sheep or goat farm.

UNIT-4 (ZOO ANIMALS PRODUCTION MANAGEMENT)

Visit to nearby wildlife sanctuary, captive animals centres to study care and management of these animals. To study housing of captive animals. To study feeds and feeding schedule of captive animals. Hygienic preparation, preservation and storage of feeds of captive animals. Familiarization about restraining, handling and physical examination of captive animals.

UNIT-5 (POULTRY PRODUCTION MANAGEMENT)

Common breeds of poultry, different classes, Indian chickens and other avian species breeds. Digestive and respiratory system of chicken. Male and female reproductive system—Quality changes in egg during storage. Economic traits of broilers. Economic traits of egg-type chicken and breeders. All in poultry. Housing and design of a poultry farm. Poultry farm equipment and their classification. Brooding arrangement in broiler farms. Poultry feed ingredients and its quality assessment. Poultry feed preparations. Calculation of different economic indices of broiler farm. Calculation of economic indices of layer farm. Fundamentals in poultry Post-mortem examination for sample collection. Collection and dispatch of samples for PM examination. Management during Summer, Winter and Rainy season. Automation in poultry farms (EC house).

UNIT-6 (INCUBATION AND HATCHERY MANAGEMENT)

Hatchery layout and design. Project report for establishing a broiler farm. Project report for establishing a layer farm. Project report for establishing a breeder farm. Visit to commercial poultry farms or hatchery or feed mill. Visit to farms of other avian species.

UNIT-7 (LABORATORY, RABBIT AND PET ANIMAL PRODUCTION MANAGEMENT)

Identification of body parts and handling, weighing, sexing and weaning of laboratory animals. Marking for identification of laboratory animals for purpose of their individual recording. Computation, feeding

schedule of balanced diet for high breeding efficiency of laboratory animals. Maintenance of breeding records of laboratory animals. Prophylactic measures against common disease of laboratory animals. Hygienic care and control of parasites. Shearing of rabbit. Feeding and Housing requirement and equipments for rabbit. Projects report for establishing of rabbit farm. Handling and restraining of dog, cat and pet bird and equipments for pet animals and birds. Brushing or grooming and bathing of dogs and cats. Nail and tooth care, clipping of hairs for show purpose. Care of pups, kitten and weaning.

UNIT-8 (SWINE AND EQUINE PRODUCTION MANAGEMENT)

Handling, restraining of swine, equines, Identification of pregnant animals, care during pregnancy, isolation and care of farrowing sows and piglets. Preparation of swine, equine for show and judging, Economics of pig. Routine inspection, tooth care and vaccination schedule. Horse riding: walking, trotting, cantering and galloping. Layout plans for sty, stables.

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2, 3, 4 and 5	100	20
Paper-II	6,7,8 and 9	100	20
PRACTICAL			
Paper-I	1, 2, 3 and 4	60	20
Paper - II	5,6,7 and 8	60	20

(iv) DEPARTMENT OF VETERINARY MICROBIOLOGY

VETERINARY MICROBIOLOGY

Credit Hours: 3+2

THEORY

UNIT-1 (GENERAL & SYSTEMATIC VETERINARY BACTERIOLOGY)

Introduction and history of Microbiology; Classification and nomenclature of bacteria; Microscopy and Micrometry; Bacterial stains and techniques; Structure and morphology of bacteria; Growth and nutritional requirement of aerobic and anaerobic bacteria; Normal, opportunistic and saprophytic bacterial flora: Types and sources of infection, method of transmission of infection. Pathogenicity, virulence, determinants of virulence, Epizootic and enzootic diseases, bacteremia, septicaemia and toxemia, endotoxins, exotoxins, antitoxins, toxoids; Bacterial genetics (Mutation, Transformation, Transduction and Conjugation), plasmids and antibiotic resistance.

Study of the following bacteria in relation to isolation, growth, cultural, morphological, biochemical and antigenic characteristics, epidemiology and pathogenesis, pathogenicity, diagnosis, prevention and control of bacterial diseases caused by following bacteria:

Staphylococcus; *Streptococcus*; *Corynebacterium*, *Trueperella*, *Rhodococcus*; *Listeria* and *Erysipelothrix*; *Bacillus*; *Mycobacterium*; *Clostridium*, *Actinomyces*, *Nocardia*, *Streptomyces* and *Dermatophilus*; Family *Enterobacteriaceae* (*E.coli*, *Klebsiella*, *Salmonella*, *Yersinia*, *Proteus*); *Pseudomonas* and *Burkholderia*; *Pasteurella*, *Mannheimia*, *Actinobacillus* and *Haemophilus*, *Brucella*; *Vibrio*; *Campylobacter*; *Bordetella* and *Moraxella*; Gram negative anaerobes: *Bacteriodes*, *Dichlobacteria* and *Fusobacterium*; *Leptospira* and other *Spirochaetes*; *Mycoplasma*, *Coxiella*, *Neorickettsia*, *Ehrlichia*, *Anaplasma*, *Rickettsia*; *Chlamydia* and *Chlamydophila* Emerging, re-emerging and transboundary bacterial pathogens.

UNIT-2 (VETERINARY MYCOLOGY)

Introduction, classification, general properties of fungi; Growth and Reproduction of fungi; Study of following important pathogenic fungi in relation to their isolation, growth, morphological, cultural, biochemical and antigenic characteristics, epidemiology, pathogenesis, diagnosis and control of fungal diseases caused by following genera: *Candida* and

Cryptococcus; *Aspergillus*; *Penicillium*; Dermatophytes and *Malassezia*; Dimorphic fungi, *Rhinosporidium* and *Sporotrichum*; *Mycetoma* and *Zygomycetes*; Mycotic mastitis and mycotic

abortion; Mycotoxicoses

UNIT-3 (MICROBIAL BIOTECHNOLOGY)

Basic concepts and scope of Recombinant DNA technology; Gene cloning, Cloning vectors and expression vectors; Transformation and transfection; Southern, Northern and Western blotting; Bioinformatics, Gene banks; Application of molecular and biotechnological techniques: Polymerase chain reaction, Nucleic acid hybridization, DNA library, DNA sequencing and DNA fingerprinting; IPR. Ethics and regulatory issues in Animal Biotechnology.

UNIT-4 (VETERINARY IMMUNOLOGY AND SEROLOGY)

History of Immunology; Lymphoid organs, tissues and Cells: Types of Immunity; Antigens, hapten, epitope, Specificity, T dependent and T independent Antigens, heterophile Antigens, cross reacting Antigens, blood group Antigens, Mitogens and factors affecting immunogenicity; Adjuvants; Antibody: Structure, physiochemical properties and functions of various classes of immunoglobulins, Theories of antibody production; Hybridoma and monoclonal antibodies, Serological reactions. Major histocompatibility complex (MHC) structure, function and gene organization; Structure of BCR and TCR; Antigen processing and presentation; Complement system: activation pathways and biological consequences; Cytokines: general properties, major types and function; Hypersensitivity: classification and mechanism of induction; Autoimmunity; Immunotolerance; Concept of Immunity to Microbes, Vaccines and other biological.

UNIT-5 (GENERAL AND SYSTEMATIC VETERINARY VIROLOGY)

History of Virology; Introduction to viruses; Structure of Viruses; Classification of Viruses; Viral Replication; Genetic and Non-genetic viral interactions; Virus-Cell Interactions; Viral Pathogenesis, Oncogenesis, latency and immunopathology. Studies on General Properties, Antigens, Cultivation, Pathogenesis, Epidemiology, Clinical Signs, Diagnosis, Prevention and Control of following Viruses and Prions Causing Diseases in Livestock and Poultry: *Birnaviridae*: Infectious bursal disease virus; *Reoviridae*: Rotaviruses, Bluetongue virus, African horse sickness virus; *Paramyxoviridae*: Newcastle disease virus, Canine distemper virus, PPR virus; *Rhabdoviridae*: Rabies virus, Ephemeralfever virus, *Bornaviridae*: Borna virus. *Orthomyxoviridae*: Swine, Equine, Avian Influenza Viruses. *Coronaviridae*: Infectious Bronchitis virus, Transmissible gastroenteritis virus; *Arteriviridae*: Equine viral arteritis virus, *Picornaviridae*: FMD virus, Duck viral hepatitis virus; *Caliciviridae*: Feline calici Virus, *Togaviridae*: Equine encephalomyelitis viruses; *Flaviviridae*: Swine fever virus, BVD virus; *Retroviridae*: Visna or maedi virus, Equine infectious anemia virus, Lymphoid leucosis virus, Bovine leukemia virus. *Poxviridae*: Capripoxvirus, Avipoxvirus, Cowpoxvirus; *Asfarviridae*: African Swine Fever Virus; *Herpesviridae*: Bovine herpes viruses, Equine Herpes viruses, Infectious laryngotracheitis virus, Marek's disease virus, Pseudorabies virus, Malignant Catarrhal Fever virus; Duck Plague virus, *Adenoviridae*: Infectious Canine Hepatitis virus, Egg Drop Syndrome virus, Fowl adenovirus, *Papillomaviridae*: Papillomatosis, *Parvoviridae*: Canine parvoviruses, Feline panleucopenia virus; *Circoviridae*: Chicken Anemia Virus: Prions: Scrapie, Bovine Spongiform Encephalopathy; Emerging, re-emerging and transboundary viruses and Viral Infections.

PRACTICAL

UNIT-1 (GENERAL AND SYSTEMATIC VETERINARY BACTERIOLOGY)

Orientation to bacteriology laboratory; Methods of sterilization and disinfection; Preparation of culture media for cultivation of aerobic and anaerobic bacteria; Methods of inoculation, Cultivation of aerobic and anaerobic bacteria; Isolation of bacteria in pure culture; Simple staining, Negative staining, Differential staining procedures of bacteria: Gram's staining, Acid fast staining; Special staining procedures: Capsule and Spore staining; Bacterial motility; Culture sensitivity test; Outlines of collection, transportation and processing of samples for bacterial disease diagnosis.

Characterization of *Staphylococcus*; *Streptococcus*; *E. coli* *Salmonella*; *Klebsiella* and *Proteus*; *Pseudomonas*; *Pasteurella*; *Clostridium*; Isolation and identification of bacteria from clinical cases of Mastitis, Abortions, Enteric, Respiratory and Pyogenic infections.

UNIT-2 (VETERINARY MYCOLOGY)

Outline of collection, transportation and processing of samples for fungal disease diagnosis, Preparation of culture media, Cultivation and slide culture technique of fungi; Cultural characteristics of fungi; Lactophenol cotton blue staining to study morphology of fungi; Culture sensitivity test of fungi; Diagnosis of Aspergillosis and Candidiasis; Demonstration of other important yeast, moulds and Dermatophytes

UNIT-3 (MICROBIAL BIOTECHNOLOGY)

Extraction and quantitation of nucleic acid; Plasmid isolation and plasmid profiling; Agarose gel electrophoresis for studying or diagnosis of nucleic acid of microbes; SDS PAGE electrophoresis for studying or diagnosis of proteins of microbes; Use of Multimedia and audio-visual aids for molecular biology aspects.

UNIT-4 (VETERINARY IMMUNOLOGY AND SEROLOGY)

Inoculations of lab animals, preparation of antigen, Raising of antisera, separation and preservation of serum, Concentration of Immunoglobulins, Agglutination tests: Plate, Tube, Haemagglutination, Precipitation test: Agar gel precipitation Test, Single radial immunodiffusion test, Immunoelectrophoresis, Cell mediated immune response (DTH), Enzyme linked immunosorbent assay (ELISA), Visit and appraisal of Veterinary biological institute.

UNIT-5 (GENERAL AND SYSTEMATIC VETERINARY VIROLOGY)

Orientation to a virology laboratory; Collection, preservation, transport of samples and their processing in virology laboratory; Isolation of viruses in laboratory animals or poultry or embryonated chicken eggs; Preparation of media and reagents for cell culture; Subculture and maintenance of continuous cell lines; Quantitation of cells by viable cell counts in a haemocytometer; Cryopreservation and recovery of cell cultures; Preparation of Primary cell culture (chicken embryo fibroblast or Lamb kidney); Demonstration of cytopathic effect by viruses in cell culture (Important virus isolates available in the department); Demonstration of Titration of virus by TCID₅₀ and plaque assay in cell cultures*; Demonstration of neutralizing antibodies by serum neutralization test in cell cultures* ; Agar gel precipitation test for detection of virus infection*; Titration of Newcastle disease virus by haemagglutination test; Haemagglutination inhibition test for detection of antibodies to Newcastle disease virus; ELISA for detection of viral antigen and antibodies; Molecular techniques for viral disease diagnosis

*Important virus isolates available in the department.

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1,2 and 3	100	20
Paper-II	4 and 5	100	20
PRACTICAL			
Paper-I	1, 2and 3	60	20
Paper - II	4 and 5	60	20

(v) DEPARTMENT OF VETERINARY PATHOLOGY

VETERINARY PATHOLOGY

Credit Hours: 4+2=6

THEORY

UNIT-1 (GENERAL VETERINARY PATHOLOGY)

Introduction and scope of Veterinary Pathology. Major intrinsic and extrinsic causes of disease. Haemodynamic disorders (hyperaemia, congestion, haemorrhage, oedema, thrombosis, embolism and infarction). Glycogen overload, amyloidosis and fatty changes. Reversible and irreversible cell injury- degenerations, necrosis and its types, apoptosis, differences between post-mortem autolysis and necrosis, gangrene and its types. Major exogenous and endogenous pigments. Metastatic and dystrophic calcification. Photosensitization. Disturbances in growth (Aplasia, hypoplasia, atrophy, hypertrophy, hyperplasia, metaplasia and dysplasia). Inflammation: Definitions, classification, various cell types and their functions, mediators, cardinal signs and systemic effects. Wound healing by primary and secondary intention including growth factors. Immunopathology in brief (immunodeficiency, hypersensitivity and autoimmunity).

UNIT-2 (SYSTEMIC VETERINARY PATHOLOGY)

Pathological changes affecting Digestive, Respiratory, Musculoskeletal, Cardiovascular, Haematopoietic, Lymphoid, Urinary, Reproductive, Nervous, Endocrine systems, Skin and Appendages, Ear and Eye.

UNIT-3 (ANIMAL ONCOLOGY, VETERINARY CLINICAL PATHOLOGY AND NECROPSY)

Animal Oncology: Definitions, general characteristics and classification of neoplasms. Differences between benign and malignant tumours, aetiology, carcinogenesis and spread of neoplasms, tumour immunity, effects and diagnosis of tumours, staging and grading of neoplasms. Pathology of various types of tumours in domestic animals (epithelial, connective tissue, hematopoietic tissue etc.)

Veterinary Clinical Pathology: Introduction, Haematology – Different anticoagulants used in haematology, interpretation of blood tests (haemoglobin, packed cell volume, total erythrocyte count, erythrocytic indices, erythrocytic sedimentation rate, total leukocyte count, absolute count of different leucocytes), blood smear examination and its interpretation.

Urinalysis- Interpretation of physical, chemical and microscopic examination of urine. Study of biopsy and cytology including exfoliative cytology as rapid diagnostic techniques.

Necropsy: Introduction, objectives, pre-necropsy guidelines, procedure for post mortem examination of various species of animals including wild animals, post mortem changes, collection, preservation and dispatch of specimens (morbid materials) for laboratory examination, writing of post mortem report, veterolegal necropsy, veterolegal wounds.

UNIT-4 (PATHOLOGY OF INFECTIOUS AND NON-INFECTIOUS DISEASES OF DOMESTIC ANIMALS)

Pathology of viral infections: Pathogenesis, gross and microscopic pathology of foot and mouth disease, Rinderpest, malignant catarrhal fever, blue tongue, infectious bovine rhinotracheitis, bovine viral diarrhoea, Peste des Petitis (PPR), equine infectious anaemia, equine influenza, equine viral arteritis, equine rhinopneumonitis, classical swine fever, swine influenza, rabies, canine distemper, infectious canine hepatitis, canine parvovirus infection, feline panleukopenia, maedi, jaagziekte, pox virus diseases in different animals. Vesicular stomatitis, vesicular exanthema, equine encephalomyelitis, diseases caused by rota and corona viruses.

Pathology of prion diseases (scrapie, bovine and feline spongiform encephalopathies).

Pathology of bacterial infections: Pathogenesis, gross and microscopic pathology of tuberculosis, Johne's disease, actinomycosis, actinobacillosis, anthrax, clostridial group of diseases (black quarter, black disease, enterotoxaemia, braxy, botulism tetanus), streptococcosis including strangles in horses, staphylococcosis, glanders, pasteurellosis, leptospirosis, listeriosis, swine erysipelas, brucellosis, corynebacterium infections (caseous lymphadenitis, pseudotuberculosis), campylobacteriosis, salmonellosis, and colibacillosis including oedema disease in pigs, and necrobacillosis).

Pathogenesis, gross and microscopic pathology of mycoplasma infection (contagious bovine pleuropneumonia, contagious caprine pleuropneumonia, porcine enzootic pneumonia), diseases of chlamydial group, Q-fever, anaplasmosis and ehrlichiosis.

Pathogenesis, gross and microscopic pathology of superficial and deep mycoses - ringworm (dermatophytosis), aspergillosis, zygomycosis, histoplasmosis, cryptococcosis, rhinosporidiosis and candidiasis. Pathogenesis, gross and microscopic pathology of aflatoxicosis, ochratoxicosis, trichothecosis, Degnala disease and ergototoxicosis.

Pathogenesis, gross and microscopic pathology of fasciolosis, babesiosis, theileriosis and trypanosomiasis. Pathological changes (in brief) of amphistomiasis, ascariasis, strongylosis, haemonchosis, spirocercosis, filariasis, hookworm, tapeworm infections, coccidiosis, toxoplasmosis, cryptosporidiosis,

Pathological changes of nutritional imbalances (in brief) due to carbohydrates, proteins, fats, minerals and vitamins and metabolic diseases (pregnancy toxemia, post-parturient haemoglobinuria, hypomagnesemic tetany, azoturia, and sway back enzootic ataxia, pica and Rheumatism like syndrome).

Gross and microscopic pathology (in brief) of toxicities like arsenic, copper, lead, mercury, cadmium, strychnine, nitrate/nitrite, hydrocyanic acid, fluoride, selenium and oxalates; insecticide/pesticide poisoning, plant poisoning (bracken fern, gossypol, ratti and lantana)

UNIT-5 (AVIAN PATHOLOGY)

Avian Inflammation, Viral Diseases: Pathogenesis, gross and microscopic pathology of Ranikhet disease, infectious bursal disease, infectious bronchitis, infectious laryngotracheitis, fowl pox, avian influenza, Marek's disease, leukosis/sarcoma group of diseases, reticuloendotheliosis, avian encephalomyelitis, inclusion body hepatitis, hydro-pericardium syndrome, chicken infectious anaemia, avian nephritis, egg drop syndrome, reovirus infections.

Bacterial Diseases: Pathogenesis, gross and microscopic pathology of colibacillosis, infectious coryza,

clostridial diseases, salmonella infections, fowl cholera, tuberculosis and spirochaetosis. Pathogenesis, gross and microscopic pathology of *Mycoplasma* infections, chlamydiosis.

Pathogenesis, gross and microscopic pathology of aspergillosis, thrush, favus, aflatoxicosis, ochratoxicosis and trichothecosis.

Gross and microscopic pathology (in brief) of helminthic diseases (flukes, cestodes, nematodes), protozoal diseases (coccidiosis, histomoniasis), ectoparasites.

Gross and microscopic pathology of nutritional imbalances due to carbohydrates, proteins, minerals and vitamins. Miscellaneous diseases (Heat stroke, vent gleet, internal layer, false layer, pendulous crop, breast blister, ascites syndrome, fatty liver and kidney syndrome, fatty liver syndrome, cage layer fatigue, gout, hemorrhagic syndrome, round heart disease, impaction of oviduct, egg bound condition, bumble foot) and common vices.

UNIT-6 (PATHOLOGY OF DISEASES OF LABORATORY AND WILD ANIMALS)

Pathology of important diseases of rats, mice and guinea pigs (Tyzzer's disease, Pseudotuberculosis, Salmonellosis, Infectious ectromelia, Infantile diarrhea, Murine hepatitis virus, Lymphocytic choriomeningitis); Pathology of important diseases of rabbits (Pasteurellosis, Blue breasts, Treponematosis, Enterotoxaemia, Rabbit pox, Infectious myxomatosis, Papillomatosis, Coccidiosis, Mite infestation). Gross and microscopic pathology of important diseases of wild animals (West Nile Fever, Rabies, FMD, Pox, Kyasanaur forest disease, Infectious hepatitis virus, Anthrax, Tuberculosis, Colibacillosis, Clostridial infections Trypanosomosis, Babesiosis, Theileriosis, Nutritional deficiency diseases)

PRACTICAL

UNIT-1 (GENERAL VETERINARY PATHOLOGY)

Study of gross pathological specimens and recognition of pathological lesions. Histopathological techniques– Processing of tissue for paraffin embedding technique, section cutting, staining and identification of microscopic lesions. Examination of histopathological slides showing general pathological alterations.

UNIT-2 (SYSTEMIC VETERINARY PATHOLOGY)

Study of gross specimens and histopathological slides pertaining to systemic pathology.

UNIT-3 (ANIMAL ONCOLOGY, VETERINARY CLINICAL PATHOLOGY AND NECROPSY)

Macroscopic and microscopic examinations of various types of benign and malignant tumours. Examination of blood for routine haematological tests in domestic animals and poultry. Physical, chemical and microscopic examination of urine. Post mortem examination of different species of animals including wild and laboratory animals.

UNIT-4 (PATHOLOGY OF INFECTIOUS AND NON-INFECTIOUS DISEASES OF DOMESTIC ANIMALS)

Post mortem examination and its interpretations, Study of gross specimens and histopathological slides of various organs pertaining to infectious and non- infectious diseases of domestic animals. Demonstration of causative agents in tissue section by special staining methods and use of rapid diagnostic tests.

UNIT-5 (AVIAN PATHOLOGY)

Post mortem examination of poultry and writing of post mortem report. Collection, preservation and dispatch of morbid materials in poultry diseases. Study of gross specimens and histopathological slides of different diseases of poultry.

UNIT-6 (PATHOLOGY OF DISEASES OF LABORATORY AND WILD ANIMALS)

Post mortem examination of laboratory and wild animals. Study of gross specimen and histopathological slides of diseases affecting laboratory and wild animals.

ANNUAL EXAMINATION			
PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2 and 3	100	20
Paper-II	4, 5 and 6	100	20
PRACTICAL			
Paper-I	1, 2 and 3	60	20
Paper - II	4, 5 and 6	60	20

(vi) **DEPARTMENT OF ANIMAL GENETICS AND BREEDING**

ANIMAL GENETICS AND BREEDING

Credit Hours: 3+1

THEORY

UNIT-1 (BIOSTATISTICS AND COMPUTER APPLICATION)

Biostatistics: Introduction and importance of statistics and biostatistics, Classification and tabulation of data. Parameter, Statistic and Observation. Graphical and diagrammatic representation of data. Measures of Central tendency (simple and grouped data). Measures of Dispersion (simple and grouped data). Probability and probability distributions: Binomial, Poisson and Normal. Moments, Skewness and Kurtosis. Correlation and Regression. Introduction of sampling methods. Tests of hypothesis- t and Z- tests. Chi-square test. Design of experiment- Completely randomized design (CRD). Randomized block design (RBD). Analysis of variance and F-test of significance. Introduction to Non-parametric tests.

Computer Application: Introduction to computer languages. Data Base Management. Review of MS-Office and its components (MS-Word, Excel, Power Point and Access). Analysis of data using MS-Excel. Concepts of computer networks, internet & e-mail.

UNIT-2 (PRINCIPLES OF ANIMAL AND POPULATION GENETICS)

Animal Genetics: History of Genetics. Mitosis vs Meiosis. Chromosome numbers and types in livestock and poultry. Overview of Mendelian principles. Modified Mendelian inheritance. Pleiotropy, Penetrance and expressivity. Multiple alleles; lethals; sex-linked, sex limited and sex influenced inheritance. Sex determination. Linkage, crossing over and construction of linkage map. Mutation, Chromosomal aberrations. Cytogenetics, Extra-chromosomal inheritance. Molecular genetics, nucleic acids-structure and function. Gene concept, DNA and its replication. Introduction to molecular techniques.

Population Genetics: Introduction to population genetics; individual vs population. Genetic structure of population: Gene and genotypic frequency. Hardy - Weinberg law and its application. Forces changing gene and genotypic frequencies (eg Mutation, migration, selection and drift). Quantitative vs qualitative genetics; concept of average effect and breeding value. Components of Variance. Concept of correlation and interaction between Genotype and Environment. Heritability and Repeatability. Genetic and Phenotypic Correlations.

UNIT-3 (PRINCIPLES OF ANIMAL BREEDING)

Livestock and Poultry Breeding: History of Animal Breeding. Classification of breeds. Economic characters of livestock and poultry and their importance. Selection, types of selection, response to selection and factors affecting it. Bases of selection: individual, pedigree, family, sib, progeny and combined, indirect selection. Method of selection, Single and Multi trait. Classification of mating systems. Inbreeding coefficient and coefficient of relationship. Genetic and phenotypic consequences of inbreeding, inbreeding depression, application of inbreeding. Out breeding and its different forms. Genetic and phenotypic consequences of outbreeding, application of outbreeding, heterosis. Systems of utilization of heterosis; Selection for combining ability (RS and RRS). Breeding strategies for the improvement of dairy cattle and buffalo. Breeding strategies for the improvement of sheep, goat, swine and poultry. Sire evaluation. Open nucleus breeding system (ONBS). Development of new breeds or strains. Current livestock and poultry breeding policies and programmes in the state and country. Methods of conservation- livestock and poultry conservation programmes in the state and country.

Application of reproductive and biotechnological tools for genetic improvement of livestock and poultry. Breeding for disease resistance.

Breeding of pet, zoo and wild animals: Classification of dog and cat breeds. Pedigree sheet, selection of breeds and major breed traits. Breeding management of dogs and cats. Common pet birds seen in India and their breeding management. Population dynamics and effective population size of wild animals in captivity or zoo or natural habitats. Planned breeding of wild animals. Controlled breeding and assisted reproduction. Breeding for conservation of wild animals.

PRACTICAL

UNIT-1 (BIOSTATISTICS AND COMPUTER APPLICATION)

Collection, compilation and tabulation of data. Estimation of measures of central tendency (mean, median, mode) for simple and grouped data. Estimation of measures of dispersion (Range, standard deviation, standard error, variance, and coefficient of variation) for simple and grouped data. Graphical and diagrammatic representation of data. Estimation of correlation and regression. Simple probability problems, Normal distribution. Tests of significance: t-test, Z – test, Chi-square, F- tests. Completely randomized design (CRD). Randomized block design (RBD). Computer basics and components of computer. Simple operations: internet and e-mail, Entering and saving biological data through MS-Office (MS-Excel)

UNIT-2 (PRINCIPLES OF ANIMAL AND POPULATION GENETICS)

Monohybrid, Dihybrid cross and Multiple alleles. Modified Mendelian inheritance and sex linked inheritance. Linkage and crossing over. Demonstration of Karyotyping in farm animals. Calculation of gene and genotypic frequencies, Testing a population for Hardy-Weinberg equilibrium. Calculation of effects of various forces that change gene frequencies. Computation of population mean, average effect of gene and gene substitution and breeding value. Estimation of repeatability, heritability, genetic and phenotypic correlations.

UNIT-3: (PRINCIPLES OF ANIMAL BREEDING)

Computation of selection differential and intensity of selection, Generation interval, expected genetic gain, correlated response, EPA and Most probable producing ability (MPPA). Estimation of inbreeding and relationship coefficient. Estimation of heterosis. Computation of sire indices. Computation of selection index.

PAPERS	ANNUAL EXAMINATION		
	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1 and 2	100	20
Paper-II	3	100	20
PRACTICAL			
Paper-I	1 and 2	60	20
Paper - II	3	60	20

(vii) DEPARTMENT OF ANIMAL NUTRITION

ANIMAL NUTRITION

Credit Hours: 3+1

THEORY

UNIT-1 (PRINCIPLES OF ANIMAL NUTRITION AND FEED TECHNOLOGY)

History of animal nutrition. Importance of nutrients in animal production and health. Composition of animal body and plants. Nutritional terms and their definitions. Nutritional aspect of carbohydrates, protein and fats. Role and requirement of water, metabolic water. Importance of minerals (major and trace elements) and vitamins in health and production, their requirements and supplementation in feed. Common feeds and fodders, their classification, availability and importance for livestock and poultry production. Measures of food energy and their applications - gross energy, digestible energy, metabolizable energy, net energy, total digestible nutrients, starch equivalent, food units, physiological fuel value. Direct and indirect calorimetry, carbon and nitrogen balance studies. Protein evaluation of

feeds - Measures of protein quality in ruminants and non-ruminants, biological value of protein, protein efficiency ratio, protein equivalent, digestible crude protein. Calorie protein ratio. Nutritive ratio. Introduction to feed technology- Feed industry; Processing of concentrates and roughages. Various physical, chemical and biological methods for improving the nutritive value of inferior quality roughages. Preparation, storage and conservation of livestock feed through silage and hay and their uses in livestock feeding. Harmful natural constituents and common adulterants of feeds and fodders. Feed additives in the rations of livestock and poultry and their uses.

UNIT-2 (APPLIED RUMINANT NUTRITION-I)

Importance of scientific feeding. Feeding experiments. Digestion and metabolism trial. Norms adopted in conducting digestion trial. Measurement of digestibility. Factors affecting digestibility of a feed. Feeding standards, their uses and significance, merit and demerits of various feeding standards with reference to ruminants. Balanced ration and its characteristics.

UNIT-3 (APPLIED RUMINANT NUTRITION-II)

Nutrient requirements and methods for assessing the energy and protein requirements for maintenance and production in terms of growth, reproduction, milk, meat, wool and draft purpose. General principles of computation of rations. Formulation of rations and feeding of dairy cattle and buffaloes during different phases of growth and production (neonate, young, adult, pregnant, lactating and dry animals; breeding bull) and working animals. Formulation of ration and feeding of sheep and goat during different phases of growth and production (milk, meat and wool). Feeding of high yielding animals and role of bypass nutrients. Metabolic disorders and nutritional interventions. Use of NPN compound for ruminants.

UNIT-4 (APPLIED NON-RUMINANT NUTRITION)

Nutrient requirements in poultry, swine and equine - Energy and protein requirement for maintenance and production. Methods adopted for arriving at energy and protein requirements for maintenance and production in terms of growth, reproduction and production (egg, meat and work). Feeding standards for non-ruminants and poultry Formulation of rations as per Bureau of Indian Standards and Indian Council of Agricultural Research specifications. Feeding of swine (Piglets, Growers, Lactating and pregnant sows, Breeding boar, Fattening animals), equine (foal, yearling, broodmare, stallion and race horses) and poultry (Starter, Growers, Broilers, Layers) with conventional and unconventional feed ingredients. Feeding of ducks, quails, turkeys and laboratory animals. Nutrient requirements of mice, rat, rabbit and guinea pig. Diet formulation, preparation and feeding of rabbits and laboratory animals. Nutrient requirement and feeding of different categories of dogs and cats; peculiarities of feeding cats. Feeding of wild animals and birds in captivity. Metabolic disorders and nutritional intervention.

PRACTICAL

UNIT-1 (PRINCIPLES OF ANIMAL NUTRITION AND FEED TECHNOLOGY)

General precautions while working in nutrition laboratory. Familiarisation of various feeds and fodders. Preparation and processing of samples for chemical analysis - herbage, faeces, urine and silages. Preparation of solutions. Weende System of analysis - Estimation of dry matter, total ash, acid insoluble ash, crude protein, ether extract, crude fibre, nitrogen free extract in feed samples. Estimation of calcium and phosphorus. Demonstration of detergent methods of forage analysis. Qualitative detection of undesirable constituents and common adulterants of feed.

UNIT-2 (APPLIED RUMINANT NUTRITION-I)

Calculation of nutritive value of different feed stuffs in terms of digestible crude protein (DCP), total digestible nutrient (TDN), Nutritive ratio (NR) and balance of nutrients.

UNIT-3 (APPLIED RUMINANT NUTRITION-II)

Calculation of requirements of nutrients in terms of DCP, TDN and metabolisable energy (ME) for maintenance, growth, and other types of production like meat, milk, wool, reproduction and draft purpose. Formulation of rations for different categories of livestock under different conditions. Formulation of rations for feeding of livestock during scarcity periods. Visit to Animal Farm and Feed Mill.

UNIT-4 (APPLIED NON-RUMINANT NUTRITION)

Calculation of requirements of nutrients for growth, reproduction and other types of production like egg

and meat. Formulation of rations for poultry and swine with conventional and unconventional feed ingredients. Principles of compounding and mixing of feeds. Visit to farms. Formulation of balance diets for horses, dogs and cats. Feeds and feeding schedule of zoo animals and birds-diet charts.

ANNUAL EXAMINATION			
PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1 and 2	100	20
Paper-II	3 and 4	100	20
PRACTICAL			
Paper-I	1 and 2	60	20
Paper - II	3 and 4	60	20

(viii) **DEPARTMENT OF VETERINARY PHARMACOLOGY AND TOXICOLOGY**

VETERINARY PHARMACOLOGY

Credit Hours: 4+1

THEORY

UNIT-1 (GENERAL PHARMACOLOGY)

Introduction, historical development, branches and scope of Pharmacology. Sources and nature of drugs. Pharmacological terms and definitions, nomenclature of drugs. Principles of drug activity: Pharmacokinetics - Routes of drug administration, absorption, distribution, biotransformation and excretion of drugs. Pharmacodynamics - Concept of drug and receptor, dose-response relationship, terms related to drug activity and factors modifying the drug effect and dosage. Adverse drug reactions, drug interactions.

UNIT-2 (DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM)

Neurohumoral transmission, Pharmacology of neurotransmitters. Adrenoceptors agonists and antagonists, adrenergic neuron blockers, cholinergic agonists and antagonists.

Autacoids: Histamine, histamine analogues and antihistaminic agents, 5-Hydroxytryptamine and its agonists and antagonists, eicosanoids, platelet activating factors, angiotensin, bradykinin and kallidin.

UNIT-3 (DRUGS ACTING ON CENTRAL NERVOUS SYSTEM)

Classification of drugs acting on CNS. History, mechanism and stages of general anaesthesia.

Inhalant, intravenous and dissociative anaesthetics. Hypnotics and sedatives; psychotropic drugs, anticonvulsants, opioid analgesics, non-steroidal anti-inflammatory drugs, analeptics and other CNS stimulants. Drugs acting on somatic nervous system: Local anaesthetics, muscle relaxants. Euthanizing agents.

UNIT-4 (DRUGS ACTING ON DIFFERENT BODY SYSTEMS)

Drugs acting on digestive system: Stomachics, antacids and antiulcers, prokinetics, carminatives, antizymotics, emetics, antiemetics, purgatives, antidiarrhoeals, cholagogues and chologogues. Rumen pharmacology.

Drugs acting on cardiovascular system: Cardiotonics and cardiac stimulants, antiarrhythmic drugs, vasodilators and antihypertensive agents, haematopoietic drugs, coagulants and anticoagulants.

Drugs acting on respiratory system: Expectorants and antitussives, respiratory stimulants, bronchodilators and mucolytics.

Drugs acting on urogenital system: Diuretics, drugs affecting urinary pH and tubular transport of drugs, ecobolics and tocolytics.

Pharmacological basis of fluid therapy. Pharmacotherapeutics of hormones. Drugs acting on skin and mucous membranes: Emollients, demulcents and counter irritants.

UNIT-5 (VETERINARY CHEMOTHERAPY)

Introduction and historical developments of chemotherapy. Antimicrobial agents: Classification, general principles in antimicrobial chemotherapy, antimicrobial resistance, combined antimicrobial therapy. Sulphonamides and their combination with diaminopyrimidines. Penicillins, cephalosporins, cephamycins and other beta lactams, beta lactamase inhibitors. Aminoglycosides and aminocyclitols, tetracyclines, amphenicols (chloramphenicol, thiamphenicol, florfenicol), macrolides, quinolones and fluoroquinolones, polypeptides (polymyxins, bacitracin) and glycopeptide antibiotics, Miscellaneous agents: Lincosamides, novobiocin, virginiamycin, tiamulin, nitrofurans and methenamine, Antitubercular drugs. Antifungal agents: Topical and systemic agents including anti-fungal antibiotics. Antiviral and anticancer agents. Anthelmintics: Drugs used against nematodes, cestodes, trematodes. Antiprotozoal agents: Drugs used in trypanosomiasis, theileriosis, babesiosis, coccidiosis, amoebiasis, giardiasis and trichomoniasis. Ectoparasiticides. Antiseptics and disinfectants. Pharmacology of drugs of abuse in animals.

Pharmacology of indigenous medicinal plants: Scientific name, common name, active principles, pharmacological actions and therapeutic uses of Ginger, ocimum, neem, piper longum, withania, leptadenia, tinospora, embilica, eucalyptus, glycyrrhiza, trichospermum, curcuma, adiantum, butea, aloes, sena, rhubarb, catechu etc.

UNIT-6 (VETERINARY TOXICOLOGY)

General Toxicology: Definitions, history of toxicology, fundamentals and scope of toxicology. Sources and classification of toxicants, factors modifying toxicity, general approaches to diagnosis and treatment of poisoning.

Toxicity caused by metals and non-metals: Arsenic, lead, mercury, copper, molybdenum, selenium, phosphorus, fluoride, nitrates or nitrites, chlorate, common salt and urea.

Poisonous plants: Cyanogenetic plants, abrus, ipomoea, datura, nux vomica, castor, oxalate producing plants, plants causing thiamine deficiency, plants causing photosensitization and lathyrism, oleander, and cotton.

Toxicity caused by Agrochemicals: Insecticides - Chlorinated hydrocarbons, organophosphates, carbamates, pyrethroids, newer insecticides. Herbicides, fungicides and rodenticides.

Fungal and bacterial toxins: Aflatoxins, rubratoxin, ochratoxin, sporidesmin, citrinin, F-2 toxin, trichothecenes, ergot, fescue, botulinum toxin and tetanus toxin.

Venomous bites and stings: Snake, scorpion, spider, bees and wasp, toad and fishes (puffer fish, shellfish). Toxicity caused by food additives and preservatives. Drug and pesticide residue toxicology.

Environmental pollutants: Air and water pollutants. Concept of radiation hazards.

PRACTICAL

UNIT-1 (GENERAL PHARMACOLOGY)

Handling and washing of laboratory wares. Handling and operation of commonly used laboratory instruments. Concept of good laboratory practices (GLP). Pharmacy appliances. Principles of compounding and dispensing. Metrology, systems of weights and measures, pharmacy calculations. Pharmaceutical processes. Pharmaceutical dosage forms. Prescription writing, incompatibilities. Drug standards and regulations, custody of poisons. Compounding and dispensing of powders, ointments, mixtures, liniments, lotions, liquors, tinctures, emulsions and electuaries.

UNIT-2 (ANS PHARMACOLOGY)

Demonstration of the action of autonomic agonists and antagonists on intact or isolated preparations of the laboratory animals. Simulated animal experiments should be preferred over use of live animals. The lab for simulated experiments should be established within a span of one year.

UNIT-3 (CNS PHARMACOLOGY)

Handling of lab animals. Regulatory guidelines for use of lab animals. Demonstration of the effect of CNS active drugs and local anaesthetics in laboratory animals. The lab for simulated experiments should be established within a span of one year.

UNIT-4 (VETERINARY CHEMOTHERAPY)

Demonstration of various chemotherapeutic agents and their dosage forms. Demonstration of antibiotic sensitivity test and its interpretation.

UNIT-5 (VETERINARY TOXICOLOGY)

Collection, preservation and dispatch of material for toxicological analysis. General principles for

toxicological analysis. Detection of heavy metals or non-metals or plant poisons. Demonstration of agrochemical toxicity and its antidotal therapy via simulation methods. Demonstration of toxic weeds and plants of local area. Methods of calculation of median lethal dose (LD₅₀) or maximum tolerated dose (MTD).

ANNUAL EXAMINATION			
PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2, 3 and 4	100	20
Paper-II	5 and 6	100	20
PRACTICAL			
Paper-I	1 and 2	60	20
Paper - II	3, 4 and 5	60	20

(ix) **DEPARTMENT OF VETERINARY PUBLIC HEALTH AND EPIDEMIOLOGY**
DEPARTMENT OF VETERINARY PUBLIC HEALTH AND EPIDEMIOLOGY

Credit Hours: 3+1=4

THEORY

UNIT-1 (VETERINARY PUBLIC HEALTH AND FOOD SAFETY)

Aims and scope of Veterinary Public Health. Role of veterinarians in public health. One Health concept and initiatives. Veterinary Public Health administration. Sources of contamination. Principles and concepts of food hygiene and safety. Milk hygiene in relation to public health. Hygienic and safe milk production practices including steps for prevention and control of milk contamination, adulterants, antimicrobial residues, agrochemicals, subclinical mastitis or udder infections etc.. Microbial flora of milk and milk products. Milk plant and dairy equipment hygiene. Quality control of milk and milk products. Milk hygiene practices in India and other countries.

Elements of meat inspection and meat hygiene practices. Pathological conditions associated with the transport of food animals. Hygiene in abattoirs and meat plants. Detection of conditions or diseases and judgements during ante mortem and post mortem inspection. Examination of lymph nodes. Meat as a source of disease transmission. Sources of contamination of meat and methods of carcass decontamination. Speciation of meat. Animal welfare and public health issues. Classification of low risk and high risk material generated in an abattoir and its hygienic disposal. Inspection of poultry for human consumption. Occupational health hazards in abattoir and meat plants.

Foodborne infections and intoxications associated with foods of animal origin. Toxic residues (pesticides, antibiotics, metals and hormones) in foods and associated health hazards. Types of biohazards. Hazard analysis and critical control points (HACCP) system. Importance of ISO 9000 and 14000 series in meat industry. Risk analysis, assessment and management. International food safety standards: World Organisation for Animal Health (OIE), World Trade Organization (WTO) agreements and Codex Alimentarius Commission. Sanitary and phytosanitary measures in relation to foods of animal origin. Food Safety and Standards Act and Regulations. Role of Food Safety and Standards Authority of India (FSSAI), Bureau of Indian Standards (BIS) and other national agencies.

UNIT-2 (VETERINARY EPIDEMIOLOGY)

Definitions, components and aims of epidemiology. Factors influencing occurrence of livestock diseases and animal production. Determinants of disease. Transmission and maintenance of infections. Ecology of disease. Measures and patterns of disease occurrence. Survey and surveillance of animal diseases and related parameters. Epidemiological methods- Descriptive, analytical, experimental, theoretical, serological and molecular. Animal disease forecasting. Strategies of disease management: prevention, control and biosecurity. Economics of animal diseases. National and international regulations on livestock diseases. Role of OIE and laws on international trade of animals and animal products.

UNIT-3 (ZOO NOTIC DISEASES)

Definition, history and socio-economic impact of zoonotic diseases. Classification of zoonoses and approaches to their management. Multisectoral approach for zoonoses prevention and control. Emerging, re-emerging and occupational zoonoses. Role of domestic, wild, pet and laboratory animals and birds in transmission of zoonoses. Zoonotic pathogens as agents of bioterrorism. Epidemiology, clinical manifestations and management of the following zoonoses: Rabies, Japanese encephalitis, influenza, Kyasanur forest disease, Crimean Congo haemorrhagic fever, Nipah encephalitis, Ebola virus infection, anthrax, brucellosis, tuberculosis, leptospirosis, listeriosis, plague, glanders, Q fever, rickettsiosis, chlamydiosis, taeniasis, cysticercosis, hydatidosis, larva migrans, diphyllbothriasis, trichinellosis, toxoplasmosis, fasciolosis, paragonimiasis, sarcocystosis, cryptosporidiosis, amoebiasis, giardiasis, leishmaniasis, superficial and systemic mycosis and prion diseases. Foodborne bacterial zoonoses: salmonellosis, *E. coli* infection, staphylococcal gastroenteritis, clostridial food poisoning, campylobacteriosis etc.

UNIT-4 (ENVIRONMENTAL HYGIENE)

Scope and importance. Ecosystem: Components structure and functions. Biodiversity: uses, threats and conservation. Natural resources: types, uses and abuses. Environmental contaminants in food chain-bioaccumulation, biomagnification and persistent organic pollutants. Environmental pollution: Sources, nature of pollutants, effects on animal and human health. Rural and urban pollution. Air pollution, sources and hazard. Air pollution in animal houses, effect on health and productivity. Airborne diseases – Classification, health hazard, prevention and control. Water-Sources, contamination & their prevention. Water qualities- Physical, chemical, bacteriological and radiological. Water purification methods for community water supplies. Waterborne diseases – Classification, health hazard, prevention and control. Soil, marine and thermal pollution- Classification, sources, hazard, prevention and control. Noise pollution – Sources, hazards, prevention and control. Nuclear hazards or radiological hazard-Types, hazards and radiation protection. National rules and legislations related to environmental pollution and role of pollution control board in India. Biosafety: Importance, classification and biosafety measures for prevention of risk hazards. Disaster management and mitigation. Solid and liquid waste management at farms and biomedical waste management. Sanitation and disinfection of farm and hospital environment in veterinary public practice for infection control. Global warming and greenhouse effect- Definition, greenhouse gases, impact of climate change and international treaties or protocols. Management of waste from animal industries. Stray and fallen animal management and carcass disposal. Vector and reservoir control.

PRACTICAL

UNIT-1 (VETERINARY PUBLIC HEALTH AND FOOD SAFETY)

Collection of samples for chemical and bacteriological examination. Grading of milk by dye reduction test, direct microscopic examination and standard plate count. Quality assurance tests for processed milk and milk products. Tests for plant sanitation-Air, water and equipment. Microbiological examination of raw milk, pasteurized milk, milk products, meat, meat products and eggs-standard plate count, coliform count, enterococcal count, psychrophilic and psychrotrophic organisms, thermophilic bacteria and yeast and mold count. Detection of organisms of public health significance from food products by techniques. Tests for detection of mastitic milk. Ante-mortem and post-mortem inspection of food animals. Demonstration or detection of toxic chemicals and contaminants of public significance from milk and meat. Detection of antimicrobial residues in milk and meat by microbiological and analytical techniques. Demonstration of speciation of meat.

UNIT-2 (VETERINARY EPIDEMIOLOGY)

Sampling methods for epidemiological studies. Measurement of disease frequencies. Sources, storage, retrieval and representation of disease information or data. Demonstration of selected software programmes or models. Evaluation of sensitivity and specificity of diagnostic tests by epidemiological methods. Determination of associations of disease and hypothesized causal factors. Survey of an animal disease on a farm. Epidemiological investigation of disease outbreaks.

UNIT-3 (ZOOONOTIC DISEASES)

Detection, isolation and identification of important pathogens of zoonotic importance from animal, human and environmental sources including foods of animal origin. Detection of zoonotic diseases by serological, molecular and hypersensitivity tests. Study of probable association of human disease conditions with animal diseases present in an area. Study of rural environment and health status of rural community.

UNIT-4 (ENVIRONMENTAL HYGIENE)

Sampling methods for testing quality of air, water, soil and other environmental sources. Physical, chemical and microbiological examination of water. Estimation of residual chlorine and chlorine demand. Isolation & identification of pathogens from air, water and other environmental sources. Disinfection of animal houses. Determination of efficacy of disinfectants – Phenol coefficient, MIC and MBC. Demonstration or visit to water purification system. Demonstration of various ventilation systems in animal houses and specialized laboratories. Demonstration of toxic residues in water and other environmental sources. Visit to local polluted site and documentation of local environmental problems – like dumping grounds, local slum areas, crowded localities etc.

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1 and 2	100	20
Paper-II	3 and 4	100	20
PRACTICAL			
Paper-I	1 and 2	60	20
Paper - II	3 and 4	60	20

(x) DEPARTMENT OF VETERINARY PARASITOLOGY

VETERINARY PARASITOLOGY

Credit Hours: 3+2

THEORY

UNIT- 1 (GENERAL VETERINARY PARASITOLOGY)

Parasitology: Introduction, Important historical landmarks, importance of parasitology in veterinary curriculum. Types of parasites (ecto, endo, hyper, obligatory, facultative, stenoxenous, euryxenous, monoxenous, heteroxenous, histozoic, coelozoic, temporary, permanent, pseudo, aberrant, incidental, opportunistic, zoonotic, protelean etc.). Types of hosts (definitive, intermediate, reservoir, paratenic, natural, unnatural, etc.) and vectors. Types of animal associations (symbiosis, phoresy, commensalism, parasitism, mutualism and predatorism). Modes of transmission of parasites and methods of dissemination of the infective stages of the parasites. International Code of Zoological Nomenclature: Rules and regulations, Standard Nomenclature of Animal Parasitic Diseases (SNOAPAD). Immunity against parasitic infections or infestations, natural and acquired immunity, premunity, sterile immunity, autoimmunity, passive immunity, concomitant immunity and immune evasion by parasites. General harmful effects of parasites including various tissue reactions caused by parasites. General control measures against parasites. Characters of various phyla of parasites.

UNIT-2 (TREMATODES AND CESTODES OF VETERINARY IMPORTANCE)

Trematodes: Introduction, general account and classification, general life cycle of trematodes with morphological features of their developmental stages. Important morphological features, life cycles, modes of transmission, pathogenesis, epidemiology, diagnosis and general control measures (including chemo- and immuno-prophylaxis) of the following trematode parasites: Liver flukes (*Fasciola*, *Dicrocoelium* and *Opisthorchis*), intestinal flukes (*Fasciolopsis*). Blood flukes causing nasal schistosomiasis (*Schistosoma nasalis*), visceral schistosomiasis (*S. spindale*, *S. indicum*, *S. incognitum*) and cercarial dermatitis. Paramphistomes (*Paramphistomum*, *Cotylophoron*, *Calicophoron*, *Gigantocotyle*, *Gastrothylax*, *Fischoederius*, *Carmyerius*, *Gastrodiscus*, *Gastrodiscoides* and *Pseudodiscus*). *Paragonimus*, *Prosthogonimus* and Echinostomes.

Cestodes: Introduction, general account and classification, general life cycle of cestodes with morphological features of their developmental stages (Metacestodes). Important morphological features, life cycles, modes of transmission, pathogenesis, epidemiology, diagnosis and management of the following cestode parasites: Equine tape worms (*Anoplocephala*, *Paranoplocephala*) and ruminant tape worms (*Moniezia*, *Avitellina*, *Stilesia*, *Thysaniezia*). Dog tape worms (*Dipylidium*, *Taenia*, *Echinococcus*). Poultry tape worms (*Davainea*, *Cotugnia*, *Raillietina*, *Amoebotaenia*, *Choanotaenia* and *Hymenolepis*). Broad fish tapeworm (*Diphyllobothrium*) and *Spirometra*.

UNIT-3 (NEMATODES OF VETERINARY IMPORTANCE)

Nematodes: Introduction, general account and classification, general life cycle of nematodes with morphological features of their developmental stages. Important morphological features, life cycles, modes of transmission, pathogenesis, epidemiology, diagnosis and management of the following nematode parasites: *Ascaris*, *Parascaris*, *Toxocara*, *Toxascaris*, *Ascaridia*, *Heterakis* and *Oxyuris*. *Strongyloides*, *Strongylus*, *Chabertia*, *Syngamus* and *Oesophagostomum*. Kidney worms (*Stephanurus* and *Dioctophyma*), hook worms (*Ancylostoma* and *Bunostomum*). *Trichostrongylus*, *Ostertagia*, *Cooperia*, *Nematodirus*, *Haemonchus* and *Mecistocirrus*. *Habronema*, *Draschia*, *Thelazia*, *Spirocerca*, *Gongylonema*, *Physaloptera* and *Gnathostoma*. *Dirofilaria*, *Parafilaria*, *Onchocerca*, *Setaria* and *Stephanofilaria*. Lungworms (*Dictyocaulus*, *Muellerius*, *Protostrongylus* and *Metastrongylus*). Guinea worm (*Dracunculus*), *Trichinella*, *Trichuris*, *Capillaria*. Acanthocephala (*Macracanthorhynchus*). Study of anthelmintic resistance and its types.

UNIT-4 (ARTHROPODS OF VETERINARY IMPORTANCE)

Arthropods: Introduction, general account and classification, general life cycle of arthropods with morphological features of their developmental stages. Important morphological features, general bionomics, life cycle, vector potentiality, pathogenesis and control of following arthropods affecting animals and birds: Bugs (*Cimex*). Biting midges (*Culicoides*), black flies (*Simulium*), sandflies (*Phlebotomus*), mosquitoes (*Culex*, *Anopheles* and *Aedes*). Horse flies (*Tabanus*), *Haematopota* and *Chrysops*. *Musca*, *Stomoxys*, *Haematobia* and *Sarcophaga*. Warbles (*Hypoderma*), stomach bots (*Gasterophilus*, *Cobboldia*), nasal bots (*Oestrus ovis*, *Cephalopina*), Bottle flies (*Calliphora*, *Lucilia*, *Chrysomya*), myiasis. *Hippobosca*, *Melophagus*, *Pseudolynchia*. Lice (*Haematopinus*, *Linognathus*, *Trichodectes*, *Damalinia*, *Menopon*, *Lipeurus*, *Menacanthus* and *Heterodoxus*). Fleas (*Ctenocephalides*, *Echidnophaga*, *Xenopsylla*, *Pulex*). Arachnids : General account, soft ticks (*Argas*, *Ornithodoros* and *Otobius*). Hard ticks (*Hyalomma*, *Haemaphysalis*, *Rhipicephalus*(*Boophilus*), *Dermacentor*, *Ixodes* and *Amblyomma*). Mites (*Dermanyssus*, *Ornithonyssus*, *Demodex*, *Notoedres*, *Sarcoptes*, *Psoroptes*, *Chorioptes*, *Cnemidocoptes* and *Otodectes*). Pentasomida (*Linguatula*). Study of insecticide or acaricide resistance.

UNIT-5 (PROTOZOA OF VETERINARY IMPORTANCE)

Introduction, general account and classification, general life cycle of protozoa with morphological features of their developmental stages. Differentiation from bacteria and rickettsia. Important morphological features, life cycles, modes of transmission, pathogenesis, epidemiology, diagnosis and general control measures (including chemo- and immuno-prophylaxis) of the following protozoan parasites of veterinary and zoonotic importance : *Leishmania* (Visceral and cutaneous leishmaniasis), *Trypanosoma* (*T. evansi*, *T. theileri*, *T. equiperdum*). *Trichomonas* (Bovine and avian trichomoniasis). *Histomonas* (Black head in turkeys). *Entamoeba*, *Giardia* and *Balantidium* spp, Coccidia and coccidiosis of poultry and domestic animals. Cyst forming coccidia (*Toxoplasma*, *Sarcocystis* and *Neospora caninum*) and *Cryptosporidium*. Malarial parasites of animals and poultry (*Plasmodium*, *Haemoproteus* and *Leucocytozoon*). Piroplasms (*Babesia*, *Theileria*) and *Hepatozoon*. *Anaplasma* and *Ehrlichia* Resistance to antiprotozoals.

PRACTICAL

UNIT- 1 (GENERAL VETERINARY PARASITOLOGY)

Demonstration of the types of final and intermediate hosts. Demonstration of different organs or tissues of the hosts affected with endo- and ectoparasites. Visit to Post Mortem Hall to acquaint with different organs of animals affected with parasites. Demonstration of specific parasitic lesions caused by endo- and ectoparasites. Faecal examination techniques, egg counts, examination of faecal samples for the trematode, cestode, nematode eggs and protozoan cysts or oocysts or trophozoites. Demonstration of faecal culturing techniques. Methods of collection, fixation, preservation, staining and mounting of various types of parasites. Blood smear preparation: Wet, thin and thick smears. Staining of blood smears for demonstration of microfilariae and haemoprotozoan parasites. Collection and examination of skin scrapings for mites. Examination of urine samples and nasal washings for parasitic findings.

UNIT-2 (TREMATODES AND CESTODES OF VETERINARY IMPORTANCE)

Study of morphological characters of adults and developmental stages of the following trematodes and cestodes: *Fasciola*, *Fasciolopsis*, *Dicrocoelium*, *Opisthorchis*, *Schistosoma*,

Paragonimus, Prosthogonimus, Echinostomes, Paramphistomes (Paramphistomum, Cotylophoron, Gigantocotyle, Gastrothylax, Fischoederius, Gastrodiscus, Gastrodiscoides and Pseudodiscus), Anoplocephala, Paranoplocephala, Moniezia, Avitellina, Stilesia, Davainea, Cotugnia, Raillietina, Amoebotaenia, Choanotaenia, Hymenolepis, Dipylidium, Taenia, Echinococcus, Diphyllbothrium and Spirometra. Demonstration of gross and microscopic lesions of parasites.

UNIT-3 (NEMATODES OF VETERINARY IMPORTANCE)

Study of morphological characters of adults and developmental stages of the following nematodes: *Ascaris, Parascaris, Toxocara, Toxascaris, Ascaridia, Heterakis, Oxyuris, Strongyloides, Strongylus, Chabertia, Syngamus* and *Oesophagostomum. Stephanurus, Dioctophyma, Ancylostoma, Bunostomum, Ostertagia, Trichostrongylus, Cooperia, Nematodirus, Haemonchus* and *Mecistocirrus. Habronema, Draschia, Thelazia, Spirocercia, Gongylonema, Physaloptera, Gnathostoma, Dirofilaria, Parafilaria, Onchocerca, Setaria, Stephanofilaria, Dictyocaulus, Muellerius, Protostrongylus, Metastrongylus, Dracunculus, Trichinella, Trichuris, Capillaria* and *Macracanthorhynchus.* Demonstration of gross and microscopic lesions of parasites.

UNIT-4 (ARTHROPODS OF VETERINARY IMPORTANCE)

Study of morphological characters of adults and life cycle stages of the following arthropods: *Culicoides, Simulium, Phlebotomus, Cimex, Culex, Anopheles, Aedes, Tabanus, Haematopota* and *Chrysops Musca, Stomoxys, Haematobia, Gasterophilus, Hypoderma, Oestrus ovis,* bottle flies, *Sarchophaga, Hippobosca, Melophagus* and *Pseudolynchia. Trichodectes, Menopon, Menacanthus, Lipeurus, Haematopinus, Linognathus* and *Damalinia Xenopsylla, Ctenocephalides* and *Echidnophaga. Argas, Ornithodoros, Otobius, Ixodes, Hyalomma, Rhipicephalus (Boophilus), Haemaphysalis, Dermacentor* and *Amblyomma. Dermanyssus, Ornithonyssus, Demodex, Notoedres, Sarcoptes, Psoroptes, Chorioptes, Cnemidocoptes, Otodectes* and *Pentastomida.* Demonstration of gross and microscopic lesions of parasites.

UNIT-5 (PROTOZOA OF VETERINARY IMPORTANCE)

Study of morphological characters of different stages of following protozoan parasites: *Leishmania, Trypanosoma, Trichomonas, Histomonas, Entamoeba, Balantidium, Giardia, Eimeria, Isospora, Sarcocystis, Toxoplasma* and *Cryptosporidium. Plasmodium, Haemoproteus* and *Leucocytozoon. Babesia, Theileria* and *Hepatozoon,* Rickettsial organism *Anaplasma* and *Ehrlichia.* Demonstration of formol ether and Ziehl-Neelson's staining techniques and other faecal examination techniques. Diagnosis of intestinal protozoan infections by iodine and eosin stain methods. Demonstration of gross and microscopic lesions due to protozoan parasites. Demonstration of *Haemoproteus columbae* in the blood. Demonstration of sporulation for diagnosis of coccidian parasites.

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2 and 3	100	20
Paper-II	4 and 5	100	20
PRACTICAL			
Paper-I	1, 2 and 3	60	20
Paper - II	4 and 5	60	20

(xi) **DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY**

LIVESTOCK PRODUCTS TECHNOLOGY

Credit Hours: 2+1=3

THEORY

UNIT-1 (MILK AND MILK PRODUCTS TECHNOLOGY)

Retrospect and prospects of milk industry in India. Layout of milk processing plant and its management. Composition and nutritive value of milk and factors affecting composition of milk. Physico-chemical properties of milk. Microbiological deterioration of milk and milk products. Collection, chilling, standardization, pasteurization, UHT treatment, homogenization, bactofugation. Dried, dehydrated and fermented milk. Introduction to functional milk products. Preparation of cream, butter, paneer or channa, ghee, khoa, lassi, dahi, ice-cream, mozzarella cheese and dairy byproducts. Common defects of milk products and their remedial measures. Packaging, transportation, storage

and distribution of milk and milk products. Good manufacturing practices and implementation of HACCP in milk plant. Organic milk products. Food safety standards for milk and milk products. Cleaning and sanitation in milk plant. Dairy effluent management

UNIT-2 (WOOL SCIENCE)

Introduction to wool, fur, pelt and specialty fibers with respect to processing industry. Glossary of terms of wool processing. Basic structure and development of wool follicle. Post shearing operations of wool, classification and grading of wool, physical and chemical properties of wool. Impurity of wool, factors influencing the quality of wool. Brief outline of processing of wool.

UNIT-3 (ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS TECHNOLOGY)

Layout and management of rural, urban and modern abattoirs. HACCP concepts in abattoir management. FSSAI standards on organization and layout of abattoirs. Animal welfare and pre-slaughter care, handling and transport of meat animals including poultry. Procedures of Ante-mortem and post mortem examination of meat animals. Slaughtering and dressing of meat animals and birds. Emergency and casualty slaughter. Evaluation, grading and fabrication of dressed carcasses including poultry. Abattoir byproducts; rendering, meat, bone, glue, gelatin, fat and byproducts of pharmaceutical value. Skin and hides; methods of flaying, defects, preservation and tanning. Treatment of condemned meat and carcasses. Management of effluent emanating from abattoir.

UNIT-4 (MEAT SCIENCE)

Prospect of meat industry in India. Structure and composition of muscle (including poultry muscle). Conversion of muscle to meat. Nutritive value of meat. Fraudulent substitution of meat. Preservation of meat and poultry; drying, salting, curing, smoking, chilling, freezing, canning, irradiation and chemicals. Ageing of meat. Modern processing technologies of meat and meat products. Packaging of meat and meat products. Formulation and development of meat; kabab, sausages, meat balls or patties, tandoori chicken, soup, pickles. Fermentation of meat products. Physico-chemical and microbiological quality of meat and their products. Basics of sensory evaluation of meat products. Nutritive value, preservation, packaging of egg and egg products. Laws governing national or international trade in meat and meat products. Organic and genetically modified meat and poultry products.

PRACTICAL

UNIT-1 (MILK AND MILK PRODUCTS TECHNOLOGY)

Sampling of milk. estimation of fat, solid not fat (SNF) and total solids. Platform tests. Cream separation. Detection of adulteration of milk. Determination of efficiency of pasteurization. Preparation of milk products like ghee, paneer or channa, khoa, ice-cream or kulfi, milk beverages. Visit to modern milk processing and milk products manufacturing plants.

UNIT-2 (WOOL SCIENCE)

Wool sampling techniques. Tests for identification of wool; determination of fleece density, fiber diameter, staple length, crimp and medullation percentage. Scouring or clean fleece yield.

UNIT-3 (ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS TECHNOLOGY)

Methods of ritual and humane slaughter, flaying and dressing of food animals including poultry. Carcass evaluation. Determination of meat yield, dressing percentage, meat bone ratio and cut up parts. Preparation of different abattoir byproducts. Visit to slaughterhouses or meat plants.

UNIT-4 (MEAT SCIENCE)

Packaging of meat, poultry and shell eggs and their products. Estimation of deteriorative changes in meat and meat products. Preparation of comminuted and non comminuted meat and poultry products. Evaluation of external and internal egg quality and preservation technique of eggs

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1 and 2	100	20

Paper-II	3 and 4	100	20
PRACTICAL			
Paper-I	1 and 2	60	20
Paper - II	3 and 4	60	20

(xii) **DEPARTMENT OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION EDUCATION**
VETERINARY AND ANIMAL HUSBANDRY EXTENSION EDUCATION Credit Hours: 3+1
THEORY

UNIT-1 (LIVESTOCK BASED LIVELIHOODS AND THEIR EVOLUTION)

History of domestication and their social dimensions. Evolution and relationship between agriculture and animal husbandry. Farming and characteristics of farming in India. Classification of farming, types and systems. Peasant farming, cooperative farming, collective farming, contract farming, estate farming, organic farming, capitalistic farming, small-scale farming, large-scale farming, intensive, extensive farming, specialized, diversified, mixed, integrated and dry land farming. Role of animals in the contemporary society.

UNIT-2 (EXTENSION EDUCATION AND DEVELOPMENT)

Early extension efforts in India. Types of education: Formal, non-formal and informal education. Extension education: Concept, levels, objectives and dimensions. Principles, philosophy and functions of extension education. Teaching-learning process and steps in extension teaching. Concept of need and its types. Rural development - Concept, significance and importance of rural development programmes for poverty alleviation. Problems and Issues in development. Panchayati Raj System.

UNIT-3 (RURAL SOCIOLOGY IN VETERINARY EXTENSION)

Concept of sociology and rural sociology in animal husbandry extension. Culture: definition, elements, change, impact on production systems. Basic sociological concepts - society, community and association. Rural society: characteristics and differences among society, community and culture. Characteristics and differences among tribal, rural and urban communities. Social control: concept and means of social control (techniques, folkways, taboos, mores and laws). Social stratification: definition, forms and characteristics (caste system and class system). Social institutions in rural society: Social, economic, political, religious and educational (definition, composition and function). Social change: concept, importance and factors. Social groups: different groups, classification of social groups and their characteristics. Leadership: definition, functions of leader, types of rural leaders, Key communicators and their role in the animal husbandry extension.

UNIT-4 (TRANSFER OF TECHNOLOGY FOR LIVESTOCK DEVELOPMENT)

Technology- Concept, generation process, application, merits and de-merits. Adoption and diffusion of innovations, stages of adoption, adopter categories, innovation decision process, attributes of innovations, diffusion process, factors affecting adoption and diffusion processes. Programme planning- principles, objectives and steps. Evaluation of extension programme, constraints in the adoption of scientific animal husbandry practices. Role of extension agents in diffusion of livestock innovations. Cattle and buffalo improvement programmes: Key Village Scheme, Intensive Cattle Development Project, Gosadan and Gaushala. Dairy development programmes: concept of cooperation, Rochdale principles of cooperation, objectives of cooperative, Amul pattern of dairy cooperative system and Operation Flood. Transfer of technology projects of Indian Council of Agricultural Research (ICAR): Krishi Vigyan Kendra (KVK), Agricultural Technology Information Centre (ATIC), Agricultural Technology Management Agency (ATMA), National Agricultural Innovation Project (NAIP), Rashtriya Krishi Vikas Yojana (RKVY) etc. Different ongoing central and state government animal husbandry development programmes being run related to sheep, goat, poultry, piggery, fodder production etc.

UNIT-5 (COMMUNICATION AND EXTENSION TEACHING METHODS)

Communication and its functions. Basic concepts: communication fidelity, communication gap, time lag in communication, empathy, homophily and heterophily, propaganda, publicity, persuasion and development communication. Types of communication: Intrapersonal, interpersonal, verbal, non-verbal, vertical, horizontal, organizational communication etc. Elements of communication: Communicator, message, channel, treatment of message, audience, and audience response

(feedback). Barriers of communication. Individual contact methods: Farm and home visit, farmer's call, personal letter, adaptive or minikit trial, farm clinic etc. Group contact methods: Result demonstration, method demonstration, group meeting, training, field day or farmers' day, study tour etc. Mass contact methods: Farm publications (leaflet, folder, pamphlet, booklet, bulletin, farm magazine, newsletter etc.), mass meeting, campaign, exhibition, newspaper, radio, television, mobile short message service. Selection and use of extension teaching methods.

UNIT-6 (LIVESTOCK ECONOMICS AND MARKETING)

Introduction to Economics and Livestock Economics: definition and scope (production, consumption, exchange and distribution). Basic concepts- wants, goods, wealth, utility, price, value, assets, capital, money, income etc. Important features of land, labour, capital and organization. Theories of demand, supply and cost. Theories of production (law of diminishing return, increasing return, constant return and return to scale). Concept of market: market, market structure and classification of markets. Market price and normal price, price determination under perfect competition in short and long run. Marketing functions: meaning and their classification (packaging, transportation, grading, standardization, storage and warehousing, processing and value addition, buying and selling, market information, financing, risk bearing, minimization of risks (speculation and hedging). Marketing agencies, institutions and channels for livestock and livestock products. Government interventions and role in marketing of livestock and livestock products. External trade in livestock products, recent policies on trade and international trade agreements and their implications in livestock sector.

UNIT-7 (LIVESTOCK ENTREPRENEURSHIP)

Definition of entrepreneur, entrepreneurship, enterprise and manager. Difference between entrepreneur and entrepreneurship, entrepreneur and enterprise, entrepreneur and manager. Theories of entrepreneurship: Sociological theory, economic theory, cultural theory, psychological theory. Types, characteristics and functions of an entrepreneur. Forms of entrepreneurship: (Sole proprietorship, partnership, corporation, cooperative, joint stock company, Private and Public Limited Company). Introduction to financial management: concept, function, analysis of financial statement, sources of capital (banks, venture capitals, etc.). Project appraisal- Introduction, importance, techno-economic feasibility, criteria of project evaluation (discounted and non-discounted), capital budgeting, etc. Business plan for enterprise. Institutions promoting entrepreneurship in India. Entrepreneurship development programmes. Accounting: objectives, common terms. Personnel management- identification of work, job analysis, division of labour etc. Resource management- organization aspect of livestock farms, resources and procurement of inputs and financial resources, break-even- analysis etc.

UNIT-8 (INFORMATION AND COMMUNICATION TECHNOLOGY)

Strengths and limitations of ICTs application in livestock sector and farmers capacity building. Information kiosk, E-learning, CAD, virtual class room, virtual reality, multi-media etc. Cyber extension- problems and prospects in livestock extension. Computer networking: (LAN, MAN, WAN, Internet, tele-conferencing, tele-text, radio-text, video-text, interactive cable distribution system, satellite communication, internet, www, etc.).

UNIT-9 (CONTEMPORARY ISSUES IN LIVESTOCK ENTERPRISES)

Gender and animal husbandry- definition, difference between gender and sex, role of women in animal husbandry, gender sensitization, importance of gender sensitization in animal husbandry, need for gender analysis, gender budgeting and mainstreaming. Salient features of recent livestock census, livestock insurance scheme, national livestock mission. Sustainability- concept of sustainability of livestock production system (social, environmental and economic challenges faced). Introduction to environmental consequences of livestock rearing. Animal welfare: Introduction to animal welfare, ethics and rights. Importance of animal welfare in the contemporary society. Expectations from veterinary professionals.

PRACTICAL

UNIT-1 Tools of data collection: Preparation of instrument for conducting social survey; Visit to nearby village: Conducting social survey for assessment of farming system and constraints; Data analysis and reporting; Organizing demonstration for farmers; identification of key communicators by Socio-metric method; Familiarization with audio-visual aids; Principle and use of projectors; Preparation of Radio Script Preparation of Television script; Preparation and use of poster; Preparation and use of chart;

Preparation and use of flash cards; Preparation and use of farm publications for extension work; Planning and organizing an awareness campaign (Health and Production); Planning and organization of animal health camps; Exercise on rapid rural appraisal (RRA).; Exercise on participatory rural appraisal (PRA) technique; Planning and organization of group discussion.

UNIT-2 Rules of debit and credit in livestock business transactions. Journal Entry and Ledger Posting. Writing of CashBook. Balancing and preparation of final accounts. Exercise on calculation of depreciation. Visit to commercial enterprises of livestock production. Preparation of dairy entrepreneurial project report. Preparation of sheep and goat entrepreneurial project report. Preparation of poultry entrepreneurial project report. Preparation of piggery or rabbit entrepreneurial project report. Techno-economic feasibility report. Exercise on Break-even analysis. Exercise on BCR, IRR and NPW. Case study of successful entrepreneurial project. Visit to livestock market. Visit to livestock fair. Exercise on economics of diseases

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2, 3, 4 and 5	100	20
Paper-II	6, 7, 8, and 9	100	20
PRACTICAL			
Paper-I	1	60	20
Paper - II	2	60	20

(xiii) **VETERINARY CLINICAL COMPLEX (VCC)**

VETERINARY CLINICAL PRACTICES-I (Third year)

Credit Hours: 0+1

Orientation and understanding the working of Veterinary Clinics including hospital set up, administration and work force management. Doctor client interaction, Orientation to local language or dialector local terminology of the diseases. Registration, filling up registration cards, history taking, handling and restraining of animals. Preliminary clinical examination such as recording of temperature, respiration, pulse, motility of digestive system etc. Familiarization and practice of first aid procedures. Practice of collection, labeling, packaging and storage of laboratory samples. Preparation and sterilization of surgical packs, instruments, drapes and operation theaters. Familiarization with antiseptic dressing techniques and bandaging.

VETERINARY CLINICAL PRACTICES-II

(Fourth year)

Credit Hours: 0+6

The students shall be Imparted the trainings on rotation basis in the following sections of Veterinary Clinical Complex (VCC):

Ambulatory Section:

Each Veterinary college should adopt five villages where in the health, production and treatment part should be taken care of in a holistic manner.

Handling, examination, diagnosis and treatment of sick animals in the field conditions under the supervision of faculty. Ambulatory Clinics shall be operated by small groups of students and faculty of clinical departments through an equipped ambulatory mobile unit.

Diagnostic Laboratory Section:

Veterinary Clinical Diagnostic Laboratory will be an important component of Teaching Veterinary Clinical Complex that will impart training to students for laboratory evaluation and interpretation of clinical samples leading to definitive diagnosis of diseases. This activity will improve competence of students in examining clinical samples (biochemical, toxicological, pathological, parasitological and bacteriological) at the clinical complex, analyzing and correlating with clinical findings and interpreting the results. Collection labeling, transportation, and preservation of body fluid samples, writing results and report. Interpretation of data in relation to specific diseases. Clinical significance and interpretation of serum glucose, lipids, proteins, blood urea nitrogen, creatinine, uric acid, ketone bodies, bilirubin and electrolytes from samples. Clinical significance and interpretation of examination of urine samples.

Clinical evaluation of blood (Haemoglobin, packed cell volume, total erythrocytic count, erythrocytic sedimentation rate, total leukocytic count and differential leukocytic count) from clinical samples. Evaluation of acid-base balance and interpretation. Biochemical aspects of digestive disorders, endocrine functions. Liver, kidney and pancreatic function tests. Role of enzymes for detection of tissue or organ affection. Preparation of microscopic slides from tissue collected for diagnosis and its histopathological interpretation. Examination of biopsy and morbid material for laboratory diagnosis. Laboratory evaluation and diagnosis of samples for parasitic diseases (routine faecal examinations-direct smear method, simple sedimentation and floatation methods, quantitative faecal examination, pastural larval counts). Examination of skin scrapings, examination of blood. Orientation to a clinical Microbiology laboratory, collection, transport and processing of specimens from clinical cases for diagnosis of important bacterial, fungal and viral diseases. Isolation of bacteria from clinical samples, identification of bacteria by Grams staining and cultural or biochemical characteristics. Drug sensitivity and rationale for therapy. Diagnosis of diseases by employing tests like Agar Gel precipitation Test, ELISA etc.

Note: The Laboratory shall run in collaboration with the Department of Pathology and Physiology and Biochemistry. Biochemist appointed in this section will be involved in teaching of students regarding principles of various diagnostic tests, normal and abnormal values in different species, differential diagnosis, correlating with diseases and rationale of arriving at the conclusion.

Medicine Section:

Orientation and understanding the working of Veterinary Clinics including hospital set up, administration and work force management. Understanding the different methods of record keeping, retrieval, processing, analysis and interpretation of data. Involvement in outpatient department (OPD), Indoor patient, Critical care or intensive care unit, sanitation, practice management etc. Doctor client interaction: Orientation to local language or dialect or local terminology of the diseases.

Registration, filling up registration cards, clinical practice comprising of clinical examination of the patient, with emphasis on history taking, examination techniques- palpation, percussion and auscultation. Familiarization and practice of first aid procedures and emergency medicine. Practice of collection, labeling, packaging and evaluation of laboratory samples. Relating generic and trade names of drugs along with their doses, indications and contraindications to prescribed treatment regimens.

Systematic examination of various systems, recording of clinical observations viz. temperature, respiration, pulse, cardiac sounds, cardiac function, pulmonary function, functional motility of digestive system, routes and techniques of administration of medicaments. Tentative and confirmatory diagnosis and treatment of common clinical cases like pharyngitis, laryngitis, stomatitis, indigestion, gastritis, ruminal impaction, tympany, enteritis, traumatic reticulo-peritonitis, traumatic pericarditis, pneumonia, haemoglobinuria, haematuria. milk fever, ketosis, rickets, osteomalacia, common poisoning, and others clinical cases as reported in the section.

Collection of materials like urine, faeces, skin scraping, blood, milk and other body fluids for laboratory tests. Preparation of case records; follow-up records etc. Readiness to treat and handle casualties and other emergencies in the clinics. Learning and practicing passing of stomach and naso-gastric tube. Screening of livestock or poultry through tests, mass diagnostic campaigns. Vaccination and other disease prevention and control programmes in the field.

Learning the use of various advance non invasive diagnostic aids like Ultrasonography, Ophthalmoscope etc.

Practice of feeding of sick animals. Acts and regulations pertaining to generation and disposal of biomedical wastes in veterinary institutions. Biomedical waste generation, handling, storage, sorting, coding, transportation and disposal. Hazards of biomedical waste, and impact of biomedical waste on the environment.

Gynecology and Obstetrics Section

Practice of artificial insemination, pregnancy diagnosis, clinical examination and management of cases of anoestrus, silent oestrus, infertility and conception failure. Treatment of cases of metritis, cervicitis, vaginitis etc. Handling and management of cases of retention of placenta or fetal membranes, ante and post partum prolapse of vagina. Examination and handling of cases of dystocia, fetotomy, caesarian etc. Castration of male calves, breeding soundness, evaluation of bulls, ovariohysterectomy and collection of cervical and vaginal mucus for cytology. Rectal examination and vaginal examination of genitalia. Familiarization with common drugs and hormones used in reproductive disorders including infertility, epidural and local anaesthesia for gynaecological cases. Filling of clinical case records and their maintenance.

Surgery and Radiology Section

Familiarization and understanding the use of equipments used in surgical sections of the VCC. Restraining and positioning of different species of animals for examinations, diagnosis and surgical treatment. Prescription of common drugs, their doses and uses in clinical surgical practice. Filling of clinical case records and their maintenance. Preparation and sterilization of surgical packs, instruments, drapes and operation theaters. Passing of stomach tube and gastric tube. Catheterization and urine collection.

Techniques of examination of neuromuscular and skeletal functions, Familiarisation with antiseptic dressing techniques, bandaging, abdomino-centesis, thoracocentesis. Topography anatomy of animals. Radiographic positioning, terminology and interpretation.

Treatment and Management of various surgical conditions including inflammation, wounds, abscess, cysts, tumors, hernia, haematoma, hemorrhage, sinus, fistula, necrosis, gangrene, bum, sprain, tendinitis etc. Management and treatment of fractures, dislocations and other affections of joints, facial paralysis, Eye worm and other affections of Eye. Irregular teeth and their rasping, tail amputation, knuckling, upward fixation of patella (medical patellar desmotomy) etc.

Familiarisation with the landmarks for the approach to various visceral organs, thoraco-centesis, abdominocentesis. Rumenotomy, laparotomy, palpation and visualisation of viscera, urethrotomy, castration, vasectomy, caudectomy, thoracotomy, cystotomy, cystorraphy and splenectomy. Examination of horse for soundness, lameness and preparation of certificate for soundness. Tenotomies, suturing of tendon, shortening of tendon.

Pet Animal Section

Registration, filling up registration cards, history taking. Relating generic and trade names of drugs alongwith their doses, indications and contraindications to prescribed treatment regimens. Familiarization and practice of first aid procedures and emergency medicine. Practice of collection, labeling, packaging and evaluation of laboratory samples. Clinical examination techniques- palpation, percussion and auscultation, systematic examination of various systems, recording of clinical observations viz. temperature, respiration, pulse, cardiac sounds, cardiac function, pulmonary function, functional motility of digestive systems. Routes and techniques of administration of medicaments. Diagnosis and treatment of diseases. Collection of materials like urine, faeces, skin scraping, blood, milk and other body fluids for laboratory tests. Preparation of case records; follow-up records etc. Vaccination and other disease prevention and control programmes. Practice of pregnancy diagnosis, examination of cases of anoestrus, silent oestrus and conception failure. Rectal examination of genitalia, vaginal examination. Epidural and local anaesthesia for gynaecological cases. Restraining and positioning techniques for examination, diagnosis and surgical treatment. Preparation of surgical packs, sterilization procedures for surgical instruments. Passing of stomach tube and gastric tube. Catheterization and urine collection. Familiarization with antiseptic dressing techniques. Topography anatomy of pet animals. Radiographic positioning and terminology.

The practical component will be dealt with internally. The examination for VCP shall be conducted twice a year i.e. first practical exam after completion of 50% syllabus and the second one, when the course is completed but the second exam shall comprise of entire syllabus.

The examinations should comprise of following components:

- (i) Submission of 10 complete cases each of Surgery, Medicine, Gynaecology -10 Marks
- (ii) Case presentation -5 Marks
- (iii) Review of treatment of 5 cases -5 Marks
- (iv) Written Objective Questions (Surgery, Medicine, Gynaecology and Lab diagnosis) –20 Marks
The pattern of question paper shall be as indicated in Annexure -V
- (v) Viva -10 Marks

The First Examination shall be conducted during scheduled practical class and second examination shall be conducted after the annual board theory examinations

(xiv) LIVESTOCK FARM COMPLEX

LIVESTOCK FARM PRACTICES

(Third year)

Cr. Hr. 0+2

Aim of Livestock farm practices is actual involvement of students in all aspects of animal rearing so that they can rear animals on their own. Hands on training of the students on the overall farm practices

of livestock management including cleaning, feeding, watering, grooming, milking, routine health care, record keeping, sanitation, housing, fodder production, preparation of mineral mixture, cost economic of fodder production. Care of pregnant animals, management of parturition, care of neonatal and young stock. Management of broiler, layer farm and hatchery.

One full day per week comprising of six contact hours will be kept entirely for LFP where the students should be divided into small batches on rotational basis wherein they should be actually involved in different activities such as milking, feeding etc.

The practical component will be dealt with internally. The examination for LFC shall be conducted twice a year i.e. first practical exam after completion of 50% syllabus and the second one, when the course is completed but the second exam shall comprise of entire syllabus.

The examinations should comprise of following components:

- (i) Day to day activities : 10 Marks
- (ii) Record book : 10 Marks
- (iii) Written objective questions : 10 Marks
(The pattern of question paper shall be as indicated in Annexure –VI)
- (iv) Viva : 10 Marks
- (v) Examination (spotting/problem solving) : 10 Marks

The First Examination shall be conducted during scheduled practical class and second examination shall be conducted after the annual board theory examinations

(xv) DEPARTMENT OF VETERINARY SURGERY AND RADIOLOGY

VETERINARY SURGERY AND RADIOLOGY

Credit Hours:2+1

THEORY

UNIT-1(VETERINARY GENERAL SURGERY)

Introduction: Historical perspective, Definitions, classification of surgery, tenets of Halsted. Pre-operative, intra-operative and post-operative considerations: History taking, physical examination, clinico-pathological testing, intra-operative and postoperative care.

Sterilization and disinfection: Definitions, surgical sterilization, various methods of sterilization (Heat, chemical and radiations etc.), disinfections.

Sutures: Definitions, suturing, factors influencing suturing, characteristics of an ideal suture material, types of suture material-absorbable and non-absorbable, surgical knots, various suture patterns-apposition, eversion, inversion and special.

Treatment of acute and chronic inflammation: Use of anti-inflammatory drugs and proteolytic enzymes.

Haemostasis (physical and chemical methods, systemic haemostats, surgical diathermy)

Basic surgical affections: Definitions, classification, diagnosis and treatment of abscess, tumour, cyst, hernia, haematoma, necrosis, gangrene, burn and scald, frost bite and surgical affections of muscles, artery and vein, sinus and fistula.

Wounds: Definition, classification, examination and diagnosis, general principles for treatment of aseptic, contaminated and septic wounds, healing and factors affecting wound healing, complications of wounds and their remedies. Surgical infection; their prevention and management: Classification of infection, Introduction to biomaterials and stem cell therapy in wound management

Management of surgical shock. Principles of fluid therapy in surgical patients.

UNIT-2 (VETERINARY ANAESTHESIOLOGY)

Introduction: Development of anaesthesiology, Terminology, classification and indications. General considerations of anaesthesia: Factors affecting anaesthesia and selection of anaesthetic technique, factors modifying uptake, distribution and elimination, patient evaluation, categories of patients according to physical status, selection of anaesthetic agent and patient preparation. Pain and its

management in animals
Local and regional anaesthesia: Definitions, local anaesthetics, mechanism of action
Premedication, properties and use of different preanaesthetics: Uses of premedication, ,
Anticholinergic, sedatives and tranquilizers (Phenothiazine derivatives, Benzodiazepines, Butyrophenones, Narcotic analgesics, Alpha-2 agonists, dosage chart of all the drugs.
General anaesthesia: Definitions, methods of induction of anaesthesia, Intravenous anaesthetics (Total intravenous anaesthesia), monitoring of anaesthesia.
Inhalation anaesthesia: Advantages of inhalant anaesthetics, types of inhalant anaesthetics their properties and effect on various systems, methods of administration of inhalant anaesthesia.
Dissociative anaesthesia: Definition, drugs, clinical application, properties and effect on various body systems.
Avian, wild, zoo, exotics and lab animal anaesthesia and capture myopathy
Anaesthetic emergencies and management, Toxicity, antidote and reversal agents.

UNIT-3 (VETERINARY DIAGNOSTIC IMAGING TECHNIQUES)

Introduction to Radiology-General terminology of radiology, Physical properties of X-Rays, Scope and uses of Radiology, Directional terms for veterinary radiology. Production of X-rays and factors influencing production of X-rays. Radiation hazards and safety measures- Scattered radiation, Biological effects of radiation, Direct and indirect effects, Early and late effects, Radiation sensitivity of different body cells, Radiation protection, General principles of radiation safety, Radiation monitoring devices, Requirement of an ideal radiographic section. The statutory requirements of radiology set-up as per Atomic Energy Regulatory Board of India (AERB). Production of quality diagnostic radiograph. Recording of image- Manual and digital processing of X-ray films, storage and retrieval system. Radiographic Quality and faults- Radiographic detail, density and contrast and factors affecting them, Radiographic faults, their possible causes and prevention. Contrast radiography- Definition, indications, contraindications and types of contrast radiography, Different contrast materials and their use, Techniques of some selected contrast radiography in animals (Barium swallow, Retrograde urography etc) Diagnostic ultrasonography- Principles, indications, techniques and artifacts of ultrasonography. Advanced diagnostic imaging tools- The brief introduction to the use and limits of some advanced imaging techniques, Interventional radiology - CAT scanning, MRI, etc

UNIT-4: (REGIONAL SURGERY-I)

Head and Neck: Affections of lips, cleft palate, tongue, cheek, and their treatment: General anatomical considerations, avulsion of lip, cleft lip ranula, neoplasm and traumatic injuries. Affections of teeth and jaws and their treatment: General anatomical considerations, Developmental abnormalities, dental tartar, periodontal disease, overgrown molars, fractures and luxations of jaw. Affections of nose, face, ear, head and horn and their treatment: General anatomical considerations.
Brachycephalic syndrome, Stenotic nostrils, nasal polyps, empyema of sinuses, fracture and avulsion of horn, horn cancer, aural haematoma, otitis. Affections of eye and their treatment: General anatomical considerations and examination of eye. Affections of eyelids and nictitating membrane and their treatment: entropion, ectropion, chalazion, sty, Cherry eye and traumatic injuries. Affections of lachrymal apparatus, eyeball and orbit and their treatment: occlusion of nasolacrimal duct, traumatic proptosis, panophthalmia, orbital neoplasms, glaucoma, eye worms. Affections of cornea, iris and lens and their treatment: corneal ulcers, corneal opacity, Kerato Conjunctivitis Sicca (KCS), prolapse of iris, corneal dermoid, corneal lacerations and perforations, cataract. Affections of guttural pouch, oesophagus and their treatment: General anatomical considerations. Empyema, tympanitis and Mycosis of guttural pouch, oesophageal diverticulum, megaesophagus, achalasia and choke. Affections of glands of head and neck and their treatment: General anatomical considerations. Salivary mucocele, sialoliths, salivary fistula Affections of neck and their treatment: General anatomical considerations. Yoke gall, yoke abscess, fistulous withers, poll evil, torticollis. Affections of larynx and Trachea: Tracheal collapse, stenosis, roaring in horses, dorsal entrapment of soft palate in horses and camels, emergency tracheotomy. Management of ocular emergencies. Tracheotomy

UNIT-5: (REGIONAL SURGERY-II)

Thorax and Abdomen: Thoracic affections: Surgical approaches, perforated wounds, pyothorax, pneumothorax, pneumocele, Diaphragmatic hernia and traumatic pericarditis in cattle. Abdominal affections: Surgical approach to the abdomen in different animal species. Common surgical affections of the stomach in dogs and their management: dilation and torsion of stomach, gastric ulcerations, foreign bodies in the stomach, pyloric stenosis. etc Surgical affections of the stomach in large animal and their management: Ruminal impaction, traumatic reticulitis, omasal and abomasal impaction and abomasal displacement. Surgical affections of small intestines and their management: Intestinal

obstruction, intussusception and strangulation (volvulus). Techniques of intestinal anastomosis. Surgical affections of large intestine and their management: Caecal dilatation and torsion, rectal prolapse, rectal and perineal tear, recto-vaginal fistula. Surgical affections of anus and perineal region and their management: Atresia-ani, anal stenosis, anal sac impaction. Other surgical affections of abdomen and their management: Perforating wounds and fistulae of abdomen, umbilical hernia, ventral abdominal hernia, inguinal and scrotal hernia, perineal hernia. Urinary system: Urolithiasis and its management. Urolithiasis in small and large animals. Patent urachus, ectopic ureter. Surgical management of equine colic. Genital system: Surgical affections of male genital system and their management, prostatic enlargement or hyperplasia or neoplasm, Phimosis, paraphimosis, preputial prolapse, penile amputation. Castration, vasectomy, scrotal ablation in large and small animals. Surgical affections of female genital system and their management: Canine transmissible venereal tumour. Ovariohysterectomy and caesarean section. Applications of rigid and flexible endoscopes in the management of surgical disorders. Integumentary system: Surgical affections of udder, teat and canine mammary neoplasms. Surgical affections of tail and tail docking Wildor zoo animal surgery (only awareness)

UNIT-6 (ORTHOPEDICS AND LAMENESS)

Body conformation of the horse in relation to lameness (trunk, fore limb and hind limb).

Lameness: Its definition classification and diagnosis. General methods of therapy for lameness. Body and limb conformation in relation to lameness in equine.

Equine lameness: Shoulder slip (sweeny), bicipital bursitis, omarthritis, capped elbow, radial paralysis, carpalitis. bent knee, and knock- knee. Hygroma of knee, open knee, blemished knee. Fracture of carpal bone, fracture of accessory carpal, contraction of digital flexors. Splints, sore shin, wind puffs, sesamoiditis, Osstots, ringbone, quittor, side bone, Navicular disease, pyramidal disease. Laminitis, sand crack, seedy toe, fractures of third phalanx, pedal osteitis, and sole penetration. Canker, thrush and corn, Monday morning disease, cording up, myositis of psoas, Mac thrombosis, Crural paralysis, subluxation of sacroiliac joint rupture of round ligament trochanteric bursitis. Upward fixation of patella, stringhalt, gonitis, chondromalacia of patella, rupture of tendoachilles, rupture of peroneus tertius, fibrotic myopathy and ossifying myopathy. Thoroughpin, bog spavin, spavin, curb, capped hock.

Canine lameness: Intervertebral disc diseases, elbow and hip dysplasia, rupture of cruciate ligament, elbow hygroma etc.; their management, Onychectomy.

Bovine lameness: Contusion of sole, ulceration of sole, septic laminitis, avulsion of hoof and subluxation of patella, interdigital fibroma, cyst, sand crack, and hoof deformities.

Fracture: Definitions, classification, fracture healing and complications.

Fracture: The preliminary assessment and management of fractures. Techniques of external immobilization of fractures. Techniques of internal immobilization of fractures. Management of fracture complications. Luxations: Definition, signs, diagnosis. Management of common joint luxations in animals. Spinal trauma, diagnosis and its management. Rehabilitation and physiotherapy of orthopaedic patients

PRACTICAL

UNIT-1(VETERINARY GENERAL SURGERY)

Introduction to layout of operation theatre and surgical unit. Introduction of common surgical equipment and instruments. Suture materials, surgical knots and suture patterns. General examination of surgical patients. Preparation of surgical patients. Other operation theatre routines like sterilization, preparation of theatre, Surgeon and surgical pack. Bandaging and basic wound management Demonstration (or Audio visual aids) of surgery, control of haemorrhage and suturing

UNIT-2 (VETERINARY ANAESTHESIOLOGY)

Familiarization with anaesthetic apparatus, monitoring equipment and accessories. Methods of local infiltration analgesia (Linear ring block, inverted L block etc.) Regional nerve block demonstration and practice (Auriculopalpebral block, Peterson block or 4 point retrobulbar nerve block, Paravertebral, epidural etc.) Intravenous regional anaesthesia in cattle. Administration of general anaesthesia in small and large animals. (Demonstration and practice). Administration of inhalant anaesthesia (Demonstration). Monitoring of general anaesthesia. Management of anaesthetic emergencies, use of artificial respirator and analeptics. Visit to a wild animal facility or audio-visual aids or both.

UNIT-3 (VETERINARY DIAGNOSTIC IMAGING TECHNIQUES)

Familiarization with the operation of the x-ray unit. Formulation of X-ray exposure technique charts, Adoption of safety measures and film processing. Positioning and radiography of different parts of the body in small and large animals Handling, viewing and interpretation of radiograph. Familiarization with the film contrast, density and details, common radiographic artifacts. Radiographic pathology of the head, neck and thorax of large and small animals. Radiographic pathology of abdomen of large and small animals. Radiographic pathology of the bones and joints of large and small animals. Demonstration of contrast radiographic techniques in animals. Demonstration of ultrasonography in animals. Fluoroscopy or Image intensifier (familiarization).

UNIT-4: (REGIONAL SURGERY-I)

Demonstration or Audio visual aids: Amputation of horn and disbudding. Tooth rasping, dental scaling. Examination of ear (otoscopy). Examination of eye (General examination, Ophthalmoscopy, tonometry, fluorescein dye test, Scherimer tear test, test for blindness). Operation for aural haematoma. Protection and bandage of eyes, tarsorrhaphy, third eyelid flap, flushing of nasolacrimal duct

UNIT-5: (REGIONAL SURGERY-II)

Demonstration or Audio visual aids-Castration in different species in clinical cases and under animal birth control programme in canine. Ovariohysterectomy in dogs and cats. Rumenotomy, Gastrotomy in dogs, Urethrotomy and urethrostomy. Cystotomy and cystorrhaphy. Enterotomy or Enterectomy. Management of teat and udder affections. Amputation of tail in different animals in clinical cases. Circumcision operation for prepuce and rectal prolapse. Thoracocentesis and abdominocentesis.

UNIT-6 (ORTHOPEDICS AND LAMENESS)

Demonstration or Audio visual aids-Familiarization with various orthopaedic instruments and implants. Basic orthopaedic and neurological examination in small and large animals. Nerve blocks in equine. Application of basic physiotherapy techniques in animals. Basic limb stabilization techniques and splinting techniques. Application of cast in small and large animals. Internal fixation techniques in animals. Medial patellar desmotomy in bovines. Examination of animals for soundness and preparation of soundness certificate.

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2, 3 and 4	100	20
Paper-II	5 and 6	100	20
PRACTICAL			
Paper-I	1, 2, 3 and 4	60	20
Paper - II	5 and 6	60	20

(xvi) DEPARTMENT OF VETERINARY MEDICINE

VETERINARY MEDICINE THEORY

Credit Hours: 4+1

UNIT-1 (GENERAL)

History and scope of Veterinary Medicine, concept of animal diseases. Concepts of diagnosis, differential diagnosis, treatment and prognosis. General systemic states, hyperthermia, hypothermia, fever, septicemia, toxemia, shock, allergy, anaphylaxis, oedema, coma, anaemia, common clinical poisonings and dehydration.

Estimates of diseases, patterns of disease, disease monitoring and surveillance, herd health and quarantine.

UNIT-2 (SYSTEMIC DISEASES)

Etiology, clinical manifestations, diagnosis, differential diagnosis, treatment, prevention and control of the following diseases of cattle, buffalo, sheep, goat, horse, pig, dog, cat and poultry: Diseases of digestive, respiratory, cardiovascular, urinary, nervous, musculoskeletal, haemopoietic, and lymphatic

systems, skin, sense organs including affections of peritoneum, liver and pancreas. Emergency medicine and critical care.

UNIT-3 (METABOLIC AND DEFICIENCY DISORDERS)

Diagnosis and management of diseases caused by deficiency of iron, copper, cobalt, zinc, manganese, selenium, calcium, phosphorus, magnesium, iodine, vitamin A, D, E, B complex, K and C. Diseases of neonates, Alternative or integrated or ethno veterinary medicine in animal disease management. Aetiology, clinical manifestations, diagnosis, differential diagnosis, treatment prevention and control of metabolic or production and endocrine diseases of cattle, buffalo, sheep, goat, horse, pig, dog, cat and poultry i.e. Milk fever, eclampsia, osteodystrophy fibrosa, lactation tetany, downer cow syndrome, ketosis, fat cow syndrome, hypomagnesaemia, Nutritional haemoglobinuria, azoturia, diabetes, hypothyroidism, Cushing syndrome, Addison's disease and Gout.

UNIT-4 (ZOO AND WILD ANIMAL MEDICINE)

Principles of zoo hygiene, public health problems arising from zoos. Prevention, control and treatment of infectious, parasitic, nutritional and metabolic diseases in zoo and wild animals including exotic birds. Acts and Rules related to Zoo and wild animals. National and international organizations and institutions interlinked to wild and zoo animals – role and functioning.

UNIT-5 (BACTERIAL, FUNGAL AND RICKETTSIAL DISEASES)

Aetiology, epidemiology, clinical manifestations, diagnosis, treatment, prevention and control of bacterial, fungal and rickettsial diseases of livestock: mastitis, hemorrhagic septicaemia, brucellosis, tuberculosis, Johne's disease, listeriosis, leptospirosis, campylobacteriosis, actinomycosis, actinobacillosis, bordetellosis, glanders, strangles, ulcerative lymphangitis, colibacillosis, fowl typhoid, pullorum disease, fowl cholera, avian mycoplasmosis, spirochaetosis, salmonellosis, swine erysipelas, contagious caprine pleuropneumonia, contagious bovine pleuropneumonia, anthrax, clostridial infections, ehrlichiosis, chlamydiosis, Q fever, anaplasmosis, dermatophilosis, aspergillosis, candidiasis, histoplasmosis, sporotrichosis, coccidioidomycosis, mycotoxicosis and rhinosporidiosis.

UNIT-6 (VIRAL AND PARASITIC DISEASES)

Aetiology, epidemiology, clinical manifestations, diagnosis, treatment, prevention and control of viral and parasitic diseases of diseases of cattle, buffalo, sheep, goat, horse, pig, dog, cat and poultry: Foot and mouth disease, rinderpest, bovine viral diarrhoea, malignant catarrhal fever, infectious bovine rhinotracheitis, ephemeral fever, blue tongue, sheep pox, goat pox, PPR, classical swine fever, rabies, equine influenza, equine infectious anemia, equine rhinopneumonitis, canine distemper, infectious canine hepatitis, canine parvoviral disease, corona viral infection, adeno virus infection, feline rhinotracheitis, feline pan leucopenia, feline infectious peritonitis, avian influenza, New Castle disease, Marek's disease, avian leucosis, infectious bronchitis, infectious laryngotracheitis, avian enccephalomyelitis, chicken reo virus, fowl pox, infectious bursal disease, chicken infectious anemia, inclusion body hepatitis-hydropericardium syndrome, emerging and exotic viral diseases of global importance.

Parasitic diseases: Trematodes, cestodes, nematodes, protozoan infections and external parasites of clinical importance.

UNIT-7 (JURISPRUDENCE, ETHICS, AND ANIMAL WELFARE)

Legal duties of veterinarians, laws related to medicine, evidence, common offences against animals and laws related to these offences. Examination of living and dead animals in criminal cases. Cruelty to animals and bestiality. Legal aspects of: Examination of animals for soundness, examination of injuries and post-mortem examination. Causes of sudden death in animals. Collection and despatch of materials for chemical examination, detection of frauds-doping, alternation of description, bishoping etc. Cattle slaughter and evidence procedure in courts. Provincial and Central Acts relating to animals. Glanders and Farcy Act 1899 (13 of 1899). Dourine Act 1910 (5 of 1910), Laws relating to offences affecting Public Health. Laws relating to poisons and adulteration of drugs. Livestock importation act, liability and insurance. Code of conduct and ethics for veterinarians - the regulations made under the Act.

Animal welfare organizations and its role in animal welfare, welfare assessment, behaviour and animal welfare, principles and philosophy of animal welfare, animal welfare ethics, improving animal welfare through legislation and incentives, assessment of physiological, behavioural, disease and production measures of animal welfare, assessing welfare in practice, environment enrichment, euthanasia,

welfare of animals used in education and research and transportation, religion and animal welfare, human and animal welfare conflict, veterinary disaster management, human–animal interactions, economics and animal welfare and veterinarians as animal welfare educators

PRACTICAL

UNIT-1 (GENERAL)

Collection of history and general clinical examination. Collection, preservation, packing and dispatch of samples from clinical cases. Nasogastric and orogastric intubation in animals. Oxygen therapy in veterinary practice. Gastric and peritoneal lavage. Collection and examination of cerebrospinal fluid. Blood transfusion .

UNIT-2 (SYSTEMIC DISEASES)

Special examination of cardiovascular system. Examination of urinary system. Special examination of respiratory system. Special examination of gastrointestinal system. ECG, Echocardiography, Ultrasonography, Endoscopy. Special examination of sense organs. . Examination of eye and ear. Collection and examination of peritoneal fluid. Peritoneal dialysis. Neurological examination in animals. Lymph node biopsy and bone marrow aspirate. Methods of medication. Disease Estimation

UNIT-3 (ZOO AND WILD ANIMAL MEDICINE)

Management and restraint of zoo and exotic animals. Drug delivery in zoo and wild animals. Visit to Zoor Sanctuary. Examination of veterolegal cases.

UNIT-4 (BACTERIAL, FUNGAL AND RICKETTSIAL DISEASES)

PRACTICALS

TB, JD and Mallein testing in animal. Brucellosis testing in animals. Physical and chemical tests for detection of mastitis. Application of molecular and serology techniques on clinical samples for disease diagnosis. Pen-side diagnostic tests for infectious diseases. Practical approaches to disease outbreak investigation and its control.

UNIT-5 (VIRAL AND PARASITIC DISEASES)

Collection and examination of skin scrapings- Parasitic, fungal, bacterial. Examination of blood for parasites. Dark field microscopy. Application of Molecular and serological techniques or clinical samples for diagnosis of viral and parasitic diseases.

ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1, 2, 3 and 4	100	20
Paper-II	5, 6 and 7	100	20
PRACTICAL			
Paper-I	1, 2 and 3	60	20
Paper - II	4 and 5	60	20

(xvii) DEPARTMENT OF VETERINARY GYNAECOLOGY AND OBSTETRICS

VETERINARY GYNAECOLOGY AND OBSTETRICS

Credit Hours 2+1

THEORY

UNIT- 1 (VETERINARY GYNAECOLOGY)

Bovine : Applied clinical anatomy and embryology of female reproductive tract - Hereditary and congenital anomalies of female reproductive tract –Puberty and sexual maturity and their endocrine control- Delayed puberty- Its causes, clinical approach, treatment and prevention of delayed puberty- Applied reproductive physiology and endocrinology of oestrous cycle- Oestrous cycle and factors affecting the length of the oestrous cycle- Aberrations of oestrus and their clinical management and problems in oestrus detection and oestrus detection aids –Transportation and survivability of gametes in female reproductive tract-Follicular Dynamics and its clinical impact on fertility improvement- ovulation and aberrations of ovulation-

Incidence causes, diagnosis treatment and prevention of ovulatory failures- Fertilization and aberrations of fertilization- Fertilization failures - embryonic mortality-incidence, causes, diagnosis, treatment and prevention – Pathological affections of ovary, uterine tubes, uterus, cervix , vagina and external genitalia – Clinical management of specific and non-specific forms of infectious infertility- Role of nutrition, climate and stress on reproductive efficiency - Managerial causes of infertility- Anoestrus and repeat breeding syndrome - Diagnostic procedures in infertility investigation – Clinical uses of hormones and drugs in the management of infertility- Surgical procedures for correction of abnormalities of the female reproductive tract. Herd reproductive health management and fertility parameters in individual animals and in herds.

Assisted reproductive techniques: Synchronization of estrus and ovulation and its principle, methodology and implications- Multiple ovulation and Embryo transfer technology-In vitro fertilization.

Equines: oestrous cycle- Seasonality- breeding management- Aberrations of oestrous cycle and ovulations- Techniques of Pregnancy diagnosis- Clinical management of specific and non-specific forms of infectious infertility- Diagnostic procedures in infertility investigation
Ovines and caprines: oestrous cycle- Seasonality- Control of oestrous cycle and infertility

Swines : oestrous cycle- breeding management- Techniques of Pregnancy diagnosis and infertility

Canines and Felines : oestrous cycle- breeding management- Phantom pregnancy- Medical termination of pregnancy – Aberrations of oestrous cycle- Medical and surgical management of affections of ovary, uterine tubes, uterus, cervix, vagina and external genitalia – Methods of Population control by medical and surgical techniques. Comparative reproductive events in camel
Principle, procedure and application of ultrasonography in farm and pet animal reproduction

UNIT-2 (VETERINARY OBSTETRICS)

Farm and pet animals - Maternal recognition of pregnancy – Applied Endocrinology of pregnancy – Pregnancy diagnosis- Duration of pregnancy -Factors affecting gestation length- Care and management of pregnant animals-Implantation, Placentation- Classification, functions –Wandering of ovum- Telegony- Superfetation and Superfecundation – Clinical management of specific and non specific causes of abortion, extra uterine pregnancy, dropsy of fetal membranes and fetus, mummification, maceration, cervicovaginal prolapse, uterine torsion and hysterocele. Parturition- Signs of approaching parturition - Stages of parturition - Initiation and induction of parturition - lactational disorders - Puerparium and factors affecting puerparium - Postpartum care of the dam and neonate in different species of farm and pet animals - Dystocia – Classification - Clinical signs and diagnosis - Handling of Fetal and maternal dystocia – Obstetrical interventions - Mutation – Forced extraction – Fetotomy – Cesarean section in small and large animals – Maternal obstetrical paralysis - Retention of fetal membranes, Total uterine prolapse and common metabolic diseases of puerperal period – Post partum hemorrhage – Sub involution of placental sites - Injuries incidental to parturition - Post partum uterine infections – Post partum resumption of ovarian activity .

UNIT-3(VETERINARY ANDROLOGY AND A.I.)

Farm and pet animals - Comparative clinical reproductive anatomy and endocrinology of the male reproduction - Common congenital and genetic defects of the male reproductive tract – Puberty and sexual maturity and factors affecting them - Sexual behaviour and libido - Sperm transport, erection and ejaculation - Coital injuries and vices in male animals - Semen and ejaculate – Semen collection techniques- Structure of Spermatozoa - Semen evaluation - Semen extenders, dilution, preservation and post thaw evaluation - Artificial insemination techniques in farm and pet animals - Forms of male infertility - Impotentia coeundi and impotentia generandi – Affections of the scrotum, testis, accessory sex glands, penis and prepuce - Breeding soundness evaluation of bull – *In vitro* tests for evaluation of male fertility - Medical and surgical techniques for population control of the male reproduction – Surgical procedure on the male reproductive tract in farm and pet animals.

PRACTICAL

UNIT- 1 (VETERINARY GYNAECOLOGY)

Study of female genital organs using slaughter house specimens- Oestrus detection aids - Techniques of rectal palpation of female reproductive tract - Gynaecological equipment and instruments -Vaginal exfoliative cytology and vaginoscopy-Ultrasonography of female reproductive tract - Surgical procedures on the vulva, vagina and uterus-Study of pathological specimens of female genital tract-Demonstration and practice of ovario-hysterectomy and panhysterectomy- Diagnostic procedures in

investigation of infertility in female animals

UNIT-2 (VETERINARY OBSTETRICS)

Study of pelvis and pelvimetry- Pregnancy diagnosis-Study of foetal membranes of domestic and pet animals -and identification of normal and abnormal foetal membranes-Approaching signs of parturition-Stages of parturition-Approach to an obstetrical case- Obstetrical anaesthesia - obstetrical instrument and equipment - Manipulation of foetal malpresentation in phantom boxes - Maternal causes of dystocia and its management-Fetotomy in cadavers, Demonstration of forceps delivery and Caesarean section in small and large animal clinical cases. Handling of prolapse of genitalia.

UNIT-3 (VETERINARY ANDROLOGY, AI AND ASSISTED REPRODUCTIVE TECHNIQUES)

Study of male genital organs using slaughter house specimens- Techniques of rectal palpation of the male reproductive tract- Andrological and AI equipment -Vasectomy and castration -Surgical procedures on penis, prepuce and scrotum-Planning and organization of AI centre-Preparation of teaser animals -Selection, care, training and maintenance of male animal used for breeding purpose- Techniques of semen collection-Semen evaluation techniques -Sterilization, storage of equipment used for semen collection and Artificial insemination-Preparation of extenders and extension of semen-Preservation of semen-Thawing of semen and technique of AI-Handling and maintenance of LN₂ containers. Diagnostic procedures in investigation of infertility in male animals-Breeding soundness evaluation of bulls- Oestrus synchronization procedures- Multiple Ovulation and Embryo Transfer- *In Vitro* Fertilization

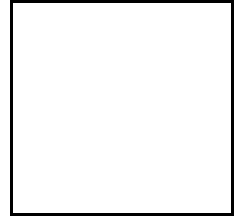
ANNUAL EXAMINATION

PAPERS	UNITS	MAXIMUM MARKS	WEIGHTAGE
THEORY			
Paper-I	1	100	20
Paper-II	2 and 3	100	20
PRACTICAL			
Paper-I	1	60	20
Paper - II	2 and 3	60	20

Serial No. -----

Admn. No. -----

(NAME OF THE DEGREE AWARDING UNIVERSITY)

SEAL
TRANSCRIPT

Name: -----		Father's Name: -----							
Mother's Name: -----									
Name of College: College of Veterinary Sciences _____									
Degree Programme: Bachelor of Veterinary Science and Animal Husbandry (B.V.Sc. & A.H.)									
Admitted in:					Completed in: Last Institution Attended:				
S. No.	Subject	Credit Hrs.	Marks obtained				Total (100)	Grade Point (10 Point Basis)	Credit Points
			Internal Assessment		Annual				
			First (10)	Second (10)	Theory (40)	Practical (40)			
FIRST PROFESSIONAL									
1	Veterinary Anatomy	4+3	7.0	6.0	25.0	28.0	66.0	6.60	46.20
2	Veterinary Physiology	4+1	6.5	7.5	28.0	32.0	74.0	7.40	37.00
3	Livestock Production Management	4+2	7.5	7.0	30.0	33.0	77.5	7.75	46.50
4	RVS or NCC or Sports and Games	0+1 (NC)	-	-	-	-	-	-	S
SECOND PROFESSIONAL									
1	Veterinary Pathology	4+2	7.5	7.5	25.0	32.0	72.0	7.20	43.20
2	Veterinary Biochemistry	2+1	7.5	6.5	29.0	29.0	72.0	7.20	21.60
3	Veterinary Microbiology	3+2	7.0	8.0	25.0	33.0	73.0	7.30	36.50
4	Animal Genetics & Breeding	3+1	8.0	7.5	29.0	32.0	76.5	7.65	30.60
5	Animal Nutrition	3+1	7.5	8.0	31.5	35.0	82.0	8.20	32.80
6	RVS or NCC or Sports and Games	0+1 (NC)	-	-	-	-	-	-	S
THIRD PROFESSIONAL									
1	Veterinary Pharmacology & Toxicology	4+1	7.0	6.5	26.0	34.0	73.5	7.35	36.75
2	Veterinary Parasitology	3+2	6.5	7.0	30.0	35.0	78.5	7.85	39.25
3	Veterinary Public Health	3+1	8.0	7.0	25.0	32.0	72.0	7.20	28.80
4	Livestock Products Technology	2+1	7.5	7.5	28.0	35.0	78.0	7.8	23.40
5	Veterinary Extension Education	3+1	8.0	7.0	30.0	35.0	80.0	8.0	32.00
6	Veterinary Clinical Practice	0+1	40 out of 50		40 out of 50		80.0	8.00	8.00
7	Livestock Farm Practices	0+2	42 out of 50		43 out of 50		85.0	8.5	17.00

	NSS	0+1 (NC)							S
FOURTH PROFESSIONAL									
1	Veterinary Surgery & Radiology	2+1	6.5	8.0	26.5	34.0	75.0	7.50	22.50
2	Veterinary Medicine	4+1	7.5	7.5	28.0	35.0	78.0	7.80	39.00
3	Veterinary Gynaecology & Obstetrics	2+1	8.0	7.0	25.0	35.0	75.0	7.50	22.50
4	Veterinary Clinical Practice	0+6	40 out of 50		40 out of 50		80.0	8.00	48.00
FIFTH PROFESSIONAL									
1	Internship Programme								S

Grand Total of Credit Hours: 81

Grand Total of Credit Points: 604.60

(NC) Non Credit Hours: 2

Over All Grade Point Average (OGPA): 7.460 out of 10

Percentage of Marks: 74.60%

RESULT: PASSED WITH FIRST DIVISION

CONDUCT: SATISFACTORY

*Cleared with Compartment

**Failed in First or Second or Third or Fourth year

***Internship extended or repeated

DATE:

Assistant Registrar (Academic)

Signature with Seal

Calculation of Grade Point (GP), Credit Point (CP), Grade Point Average (GPA) & Overall Grade Point Average (OGPA)

- **GP** in a subject will be the total marks obtained by a student out of 100 divided by 10.
- **CP** in a subject will be GP multiplied by the credit hrs.
- **GPA** = Sum of the total credit points earned divided by the sum of credit hrs.
- **OGPA** = Sum of the grand total credit points earned divided by the grand sum of credit hrs.
- **Percentage of Marks** = OGPA multiplied by 10

NOTE:

1. Evaluation

Overall performance of the student in various examinations including the internal and annual examination by securing 50% in theory and practical separately shall be the criterion of passing or failing in a subject. A student is required to secure an aggregate of 50% marks in theory and an aggregate of 50% marks in practical to be declared to have passed in a subject. If a student fails in two subjects only, he or she is eligible to appear in the compartment examination of those subjects which shall include the components of annual theory and practical examination only.

2. Division

Pass OGPA 5.000-5.999

Second Division OGPA 6.000-6.999

First Division OGPA 7.000-7.999

First Division with Distinction* OGPA 8.000 and above

3. In case a student has passed a subject through compartment examination, the same be mentioned against the particular subject in the transcript.
4. In case a student fails in a particular year, the same be mentioned in transcript.
5. If the internship is extended or repeated, the same be mentioned in transcript

Serial No. -----

Admn. No. -----

(NAME OF THE DEGREE AWARDING UNIVERSITY)

SEAL

**DETAILED MARKS CERTIFICATE
FIRST PROFESSIONAL (B. V. Sc. & A. H.)**

Father's Name: -----

Name: -----

Academic Year: -----

Mother's Name: -----

Subject	Credit Hrs.	Marks obtained				Total (100)	Grade Point (10 Point Basis)	Credit Points
		Internal Assessment		Annual				
		First (10)	Second (10)	Theory (40)	Practical (40)			
Veterinary Anatomy	4+3	7.0	6.0	25.0	28.0	66.0	6.60	46.20
Veterinary Physiology	4+1	6.5	7.5	28.0	32.0	74	7.4	37.00
Livestock Production Management	4+2	7.5	7.0	30.0	33.0	77.5	7.75	46.50
NCC or RVS OR Sports and Games	0+1 (NC)							S or US

Total Credit

CURRENT: Hrs: 18

Total Credit Points Earned: 151.30

GPA: 7.204

CUMMULATIVE: Total Credit Hrs:

Total Credit Points Earned:

OGPA: 7.204or10.00

RESULT:

1. Pass with Grade Point Average (GPA)

2. * Cleared with compartment.

3. Fail

Assistant Registrar (Academic)

for Registrar

Calculation of Grade Point (GP), Credit Point (CP), Grade Point Average (GPA) & Overall Grade Point Average (OGPA)

- **GP** in a subject will be the total marks obtained by a student out of 100 divided by 10.
- **CP** in a subject will be GP multiplied by the credit hrs. The credit points earned will be zero if the GP in a subject is less than 5.00)
- **GPA** = Sum of the total credit points earned divided by the sum of credit hrs.
- **OGPA** = Sum of the grand total credit points earned divided by the grand sum of credit hrs.

ANNEXURE - III

(Question Paper Format)

SRI VENKATESWARA VETERINARY UNIVERSITY

INTERNAL EXAMINATION

B.V.Sc. & A.H. COURSE

Time : 1 hour

Max. Marks : 40

PART - A

Time : 20 Minutes

Total Marks : 16

	Type of questions	Questions	Marks
A	Fill in the blanks	6	6 X 1 = 06
B	Multiple Choice	10	10 X 0.5 = 05
C	Match the following	10	10 X 0.5 = 05

PART - B

Time : 40 Minutes

Total Marks : 24

Answer any Four questions

(All questions carry equal marks (6 each))

4 X 6 = 24 M

- 1.
- 2.
- 3.
- 4.
5. **Write short notes on any Three of the following (3 X 2 = 6 M)**
 - a.
 - b.
 - c.
 - d.

ANNEXURE - IV

(Question Paper Format)

SRI VENKATESWARA VETERINARY UNIVERSITY
ANNUAL THEORY EXAMINATION
B.V.Sc. & A.H. COURSE

Time : 3 hours

Max. Marks : 100

PART – A

Time : 30 Minutes

Total Marks : 40

	Type of questions	Questions	Marks
A	Fill in the blanks	20	20 X 1 = 20
B	Multiple Choice	30	30 X 0.5 = 15
C	Match the following	10	10 X 0.5 = 05

PART - B

Time : 2 ½ Hours

Total Marks : 60

Answer any Ten questions. All questions carry equal (6) Marks

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
9. a
b
- 10 .a
b

11. Write short notes on any Three of the following (3 X 2 = 6 M)

- a.
- b.
- c.
- d.

12. Write short notes on any Three of the following (3 X 2 = 6 M)

- a.
- b.
- c.
- d.

ANNEXURE - V

(Question Paper Format)

SRI VENKATESWARA VETERINARY UNIVERSITY

VETERINARY CLINICAL PRACTICES – I / II

WRITTEN OBJECTIVE PRACTICAL EXAMINATION

THIRD / FOURTH YEAR - B.V.Sc. & A.H. COURSE

Time : 30 Minutes

Max. Marks : 40

	Type of questions	Questions	Marks
A	Fill in the blanks	20	20 X 1 = 20
B	Multiple Choice	30	30 X 0.5 = 15
C	Match the following	10	10 X 0.5 = 05

ANNEXURE - VI

(Question Paper Format)

SRI VENKATESWARA VETERINARY UNIVERSITY

LIVESTOCK FARM PRACTICES

WRITTEN OBJECTIVE PRACTICAL EXAMINATION

THIRD YEAR B.V.Sc. & A.H. COURSE

Time : 30 Minutes

Max. Marks : 20

	Type of questions	Questions	Marks
A	Fill in the blanks	10	10 X 1 = 10
B	Multiple Choice	10	10 X 0.5 = 05
C	Match the following	10	10 X 0.5 = 05

COURSE CATALOGUE

**SRI VENKATESWARA VETERINARY UNIVERSITY
FACULTY OF DAIRY SCIENCE**

Academic Year 2016-17 Onwards



**FACULTY OF DAIRY SCIENCE
SRI VENKATESWARA VETERINARY UNIVERSITY
TIRUPATI**

II. CURRICULUM

A. NORMS:

1. Degree Nomenclature

B. Tech (Dairy Technology): Bachelor of Technology (Dairy Technology)

2. System of Education

Formal Education with Semester System

3. Program Duration

8 Semesters (4 Academic Years)

4. Maximum Permissible Course Work Load

24 Evaluated Credits per Semester

5. Course Curriculum and Credits Requirement

5.1 The course work should be completed in the 8 semesters with 170 Instructional Credits.

5.2 The total credit requirement for the under-graduate degree programme shall be **182 credits** – 170 Instructional Credits + 12 Non evaluated credits consisting of Student READY Rural Dairy Work Experience Programme (0+10), and Physical Education (0+1) and NSS (0+1)

6. Departments

1. Dairy Business Management
2. Dairy Chemistry
3. Dairy Engineering
4. Dairy Microbiology
5. Dairy Technology

7. Evaluated and Non-Evaluated Credits

Sl. No	Departments	Credits	
		T+P	Total
A. Evaluated Credits			
1	Dairy Business Management	17+09	26
2.	Dairy Chemistry	12+07	19
2	Dairy Engineering	23+15	38
3	Dairy Microbiology	11+6	17
4	Dairy Technology	26+14	40
	Student READY In- Plant Training	0+20	20
	Student READY Experiential Learning Module	0+10	10
Total Instructional and evaluated Credits		80+90	170

B. Non-Evaluated Credits			
1.	Student READY Rural Dairy Work Experience Programme (Summer Break)	0+10	10
2.	Physical Education	0+1	1
3	NSS/NCC	0+1	1
Total Non-evaluated Credits		0+12	12

B. DEPARTMENT-WISE COURSES**Dairy Technology**

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DT 211	Market Milk	4 (3+1)
2	DT 212	Fat Rich Dairy Products	3 (2+1)
3	DT 213	Traditional Indian Dairy Products	3 (2+1)
4	DT 214	Condensed & Dried Milks	4 (3+1)
5	DT 221	Cheese Technology	4 (2+2)
6	DT 222	Ice-cream & Frozen Deserts	3 (2+1)
7	DT 311	Packaging of Dairy Products	3 (2+1)
8	DT 312	By Products Technology	3 (2+1)
9	DT 321	Sensory Evaluation of Dairy Products	3 (2+1)
10	DT 322	Food Technology - I	3(2+1)
11	DT 421	Dairy Plant Management	2 (1+1)
12	DT 422	Waste Disposal & Pollution Abatement	2 (1+1)
13	DT 423	Food Technology -II	3 (2+1)
		Total	40 (26+14)

Dairy Engineering

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DE 111	Engineering Drawing	1 (0+1)
2	DE 112	Workshop Practice	2 (1+1)
3	DE 113	Fluid Mechanics	3 (2+1)
4	DE 121	Heat & Mass Transfer	3 (2+1)
5	DE 122	Thermodynamics	2 (1+1)
6	DE 123	Basic Electrical Engineering	3 (2+1)
7	DE 124	Boilers and Steam Generation	2 (1+1)
8	DE 211	Refrigeration & Air-conditioning	3 (2+1)
9	DE 212	Dairy Engineering	3 (2+1)
10	DE 221	Dairy Process Engineering	3 (2+1)
11	DE 311	Instrumentation and Process Control	3 (2+1)
12	DE 312	Material Strength & Dairy Machine Design	3 (2+1)
13	DE 321	Food Engineering	3 (2+1)
14	DE 322	Energy Conservation and Management	2(1+1)
15	DE 323	Dairy Plant Design and Layout	2(1+1)
		Total	38 (23+15)

Dairy Chemistry

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DC 111	Physical Chemistry of Milk	3 (2+1)
2	DC 112	Biochemistry	2 (1+1)
3	DC 121	Chemistry of Milk	3 (2+1)
4	DC 221	Chemistry of Dairy Products	3 (2+1)
5	DC 222	Human Nutrition	2 (1+1)
6	DC 311	Chemical Quality Assurance	3 (2+1)
7	DC 321	Food Chemistry	3 (2+1)
		Total	19 (12+7)

Dairy Microbiology

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DM 111	Fundamentals of Microbiology	3 (2+1)
2	DM 121	Microbiology of fluid milk	3 (2+1)
3	DM211	Microbiology of Dairy Products	2 (1+1)
4	DM221	Starter Cultures and Fermented Milk Products	3 (2+1)
5	DM 311	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
6	DM 321	Food and Industrial Microbiology	3 (2+1)
		Total	17 (11+6)

Dairy Business Management

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DB 111	Milk Production Management and Dairy Development	3 (2+1)
2	DB 112	Communication Skills	2 (1+1)
3	DB 113	Environmental Studies	2 (1+1)
4	DB 121	Economic Analysis	2 (2+0)
5	DB 122	Computer and Application Software Packages	2 (1+1)
6	DB 221	Fundamentals of Dairy Extension	3 (2+1)
7	DB 311	ICT in Dairy Industry and Operation Research	3 (1+2)
8	DB 321	Marketing Management & International Trade	2 (2+0)
9	DB 421	Financial Management and Cost Accounting	3 (2+1)
10	DB 422	Entrepreneurship Development and Industrial Consultancy	2 (2+0)
11	DB 423	Industrial Statistics	2 (1+1)
		Total	26 (17+9)

C. SEMESTER WISE DISTRIBUTION OF COURSES**Semester – I**

S.N	Course No	Title of the Course	Credit Hours
1	DB 111	Milk Production Management and Dairy Development	3 (2+1)
2	DB 112	Communication Skills	2 (1+1)
3	DB 113	Environmental Studies	2 (1+1)
4	DC 111	Physical Chemistry of Milk	3 (2+1)
5	DC 112	Biochemistry	2 (1+1)
6	DE 111	Engineering Drawing	1 (0+1)
7	DE 112	Workshop Practice	2 (1+1)
8	DE 113	Fluid Mechanics	3 (2+1)
9	DM 111	Fundamentals of Microbiology	3 (2+1)
10	SC 111	Physical Education	1 (0+1)
		Total	22 (12+10)

Semester – II

S.N	Course No	Title of the Course	Credit Hours
1	DB 121	Economic Analysis	2 (2+0)
2	DB 122	Computer and Application Software Packages	2 (1+1)
3	DC 121	Chemistry of Milk	3 (2+1)
4	DE 121	Heat & Mass Transfer	3 (2+1)
5	DE 122	Thermodynamics	2 (1+1)
6	DE 123	Basic Electrical Engineering	3 (2+1)
7	DE 124	Boilers and Steam Generation	2 (1+1)
8	DM 121	Microbiology of fluid milk	3 (2+1)
		Total	20 (13+7)
Student READY Rural Dairy Work Experience Programme-I (Summer Break)			5 (0+5)

Semester – III

S.N	Course No	Title of the Course	Credit Hours
1	DE 211	Refrigeration & Air-conditioning	3 (2+1)
2	DE 212	Dairy Engineering	3 (2+1)
3	DM 211	Microbiology of Dairy Products	2 (1+1)
4	DT 211	Market Milk	4 (3+1)
5	DT 212	Fat Rich Dairy Products	3 (2+1)
6	DT 213	Traditional Indian Dairy Products	3 (2+1)
7	DT 214	Condensed & Dried Milks	4 (3+1)

		Total	22 (15+7)
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Semester – IV

S.N	Course No	Title of the Course	Credit Hours
1	DB 221	Fundamentals of Dairy Extension	3 (2+1)
2	DC 221	Chemistry of Dairy Products	3 (2+1)
3	DC 222	Human Nutrition	2 (1+1)
4	DE 221	Dairy Process Engineering	3 (2+1)
5	DM 221	Starter Cultures and Fermented Milk Products	3 (2+1)
6	DT 221	Cheese Technology	4 (2+2)
7	DT 222	Ice-cream & Frozen Deserts	3 (2+1)
		Total	21 (13+8)
		Student READY Rural Dairy Work Experience Programme-II (Summer Break)	5 (0+5)

Semester – V

S.N	Course No	Title of the Course	Credit Hours
1	DB 311	ICT in Dairy Industry and Operation Research	3(1+2)
2	DC 311	Chemical Quality Assurance	3 (2+1)
3	DE 311	Instrumentation and Process Control	3 (2+1)
4	DE 312	Material Strength & Dairy Machine Design	3 (2+1)
5	DM 311	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
6	DT 311	Packaging of Dairy Products	3 (2+1)
7	DT 312	By Products Technology	3 (2+1)
8	SC 311	NSS	1 (0+1)
		Total	22 (13+9)

Semester – VI

S.N	Course No	Title of the Course	Credit Hours
1	DB 321	Marketing Management and International Trade	2 (2+0)
2	DC 321	Food Chemistry	3 (2+1)
3	DE 321	Food Engineering	3 (2+1)
4	DE 322	Energy Conservation and Management	2(1+1)
5	DE 323	Dairy Plant Design and Layout	2 (1+1)
6	DM 321	Food and Industrial Microbiology	3 (2+1)
7	DT 321	Sensory Evaluation of Dairy Products	3 (2+1)
8	DT 322	Food Technology - I	3 (2+1)
		Total	21 (14+7)

Semester – VII

S.N	Course No	Title of the Course	Credit Hours
1	DT 411	Student READY In- Plant Training	20 (0+20)
		Total	20 (0+20)

Semester – VIII

S.N	Course No	Title of the Course	Credit Hours
1	DB 421	Financial Management & Cost Accounting	3 (2+1)
2	DB 422	Entrepreneurship Development and Industrial Consultancy	2 (2+0)
3	DB 423	Industrial Statistics	2 (1+1)
4	DT 421	Dairy Plant Management	2(1+1)
5	DT 422	Waste Disposal and Pollution Abatement	2 (1+1)
6	DT 423	Food Technology -II	3 (2+1)
7	DT 424	Student READY Experiential Learning Module	10 (0+10)
Total			24 (9+15)

D. DISTRIBUTION OF COURSE CREDITS

A. Year-Wise Course Credit Distribution

Year	Evaluated Credits	Non-Evaluated Credits
I Year	41	6
II Year	43	5
III Year	42	1
IV Year	44	0
Total	170	12

B. Semester-Wise Course Credit Distribution

Semester	Evaluated Credits	Non-Evaluated Credits
I	21	1
II	20	5
III	22	0
IV	21	5
V	21	1
VI	21	0
VII	20	0
VIII	24	0

	170	12
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III. SYLLABUS

I. DAIRY BUSINESS MANAGEMENT

DB 111 Milk Production Management and Dairy Development 3(2+1)

Theory

Introduction to Animal Husbandry. Distinguishing characteristics of India and exotic breeds of dairy animals and their performance. Systems of breeding and methods of selection of dairy animals. General dairy farm practices - Identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates. Management of lactating and dry cows and buffaloes. Methods of milking, milking procedure and practices for quality milk production. Dairy farm records and their maintenance. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises. Common disease problems in dairy animals, their prevention and control. Feed nutrients required by animal body. Feed resources for milk production and their nutritive values. Digestive system of ruminants and measures of feed energy. Nutrients requirements for growth and milk production. Feeding standards, Structure and function of mammary system. Milk secretion and milk let-down. Male and female reproductive system. Estrus and reproductive cycle, Ovulation, fertilization, gestation, parturition, pregnancy diagnosis. Artificial insemination and embryo transfer and their role in animal improvement introduction to biotechniques in dairy animal production.

Practical

- 1-2. Handling and restraining of dairy animals
- 3-4. External body parts and judging of cattle and buffaloes
- 5-6. Feeding and management practices of calves
- 7-8. Identification of common feeds and fodders
- 9-11. Preparation of rations for adult animals
- 12-13. Milking of dairy animals and cleaning and sanitation of milking equipments
- 14-15. Identification of reproductive and digestive organs
16. Demonstration of semen collection, processing and artificial insemination

DB 112 Communications skills 2(1+1)

Theory

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/miscommunication. *Basic Communication Skills:* Listening, Speaking, Reading and Writing Skills; Précis writing /Abstracting/Summarizing; Style of technical communication Curriculum vitae/resumé writing; Innovative methods to enhance vocabulary, analogy questions. *Structural and Functional Grammar:* Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective

case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

Practical

1. Listening
2. Note making
3. Writing skills
4. Writing skills
5. Précis writing
6. Summarizing and abstracting;
7. Reading and comprehension (written and oral) of general and technical articles 1
8. Reading and comprehension (written and oral) of general and technical articles 2
9. Micro-presentations and Impromptu Presentations:
10. Feedback on presentations;
11. Stage manners:grooming, body language, voice modulation, speed;
12. Group discussions;
13. Public speaking exercises;
14. Vocabulary building exercises;
15. Interview Techniques;
16. Organization of events.

DB 113 Environmental Studies

2(1+1)

Theory

Environmental Science: An introduction, Ecosystem: kinds, structure, characteristics, functioning, Biochemical cycles, Natural resources and their managements, Environmental pollution, Air pollution, Water pollution, Solid waste pollution, Noise pollution, Soil pollution, Radio active pollution, Food processing industry waste and its management, Management of urban waste water, Recycling of organic waste, Recycling of factory effluent, Control of environmental pollution through low, Composting of biological waste and Sewage, uses of water disposal effluent treatment, microbial examination.

Practical

1. Environment and its analysis.
2. Water quality parameters.
3. Collection of sample for pollution study.
4. Determination of pH from the sample.
5. Determination of acidity from the sample.
6. Determination of alkanity from sample.
7. Estimation of dissolved oxygen.
8. Estimation of BOD.
9. Estimation of COD.
10. Estimation of nitrates.
11. Estimation of phosphates.
12. Estimation of pollutant elements.

13. Estimation of heavy/toxic elements.
14. Estimation of lead/mercury.
15. Visit to industrial sewage disposal unit.
16. Visit to Dairy plant

Theory

Basic concepts-wants, goods, wealth, utility, consumption, demand and supply, Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach for consumer's behaviors. Theory of demand-law of demand, demand schedule, demand function, determinates of demand, individual consumer demand and market demand, demand forecasting, elasticity of demand, price elasticity, income elasticity and cross elasticity, Consumer's surplus. Theory of production- concepts of firm and industry, basic factors of production and their role, production function for a single product, nature of production function, laws of returns. Concepts of costs-fixed and variable costs, short run and long run costs, average and marginal costs, economics and diseconomies of scale. Concept of market- types of market, pricing and output under different market situations, market price and normal price, price determination under perfect Competition, monopoly, oligopoly and monopolistic competition. National income – GDP, GNP, NNP, disposable personal Income, per capita income, inflation.

DB 122 Computer and Application Software Packages

2(1+1)

Theory

History, features, classification and organization and I/O peripheral devices for computers; Features of modern operating systems; number systems and coding schemes; Basics of networking and communications; Internet, email concepts and application, Word-processing and desktop publishing, Electronic spreadsheet basics and operations, Database management system basics and operations; Fundamental of presentation-graphic packages. Recent strides in computing.

Practical

1. Create a document and format it with different styles
2. Create a bio-data form
3. Create an interview/call letter as the main document and create 4 records for 4 persons. Use mail merge to create a common letter to all these four
4. Prepare a Visiting Card for a Managing Director for the Company
5. To create an electronic spread-sheet in which you enter the following Decimal numbers and convert them into Octal, Hexa decimal and Binary numbers vice versa.
6. Create a database and use different mathematical / string functions
7. Create a suitable database to sort/filter the data in the worksheet
8. Create a suitable examination database and find the sum of the marks of each student and the respective class secured by the student
9. The KAL InfoTech company shows the sales of Different products for 5 years. Create Bar-graph, 3D and Pie Charts for the following
10. Prepare a Presentation about your Department using MS- PowerPoint.
11. Create a database called Student using MS ACCESS with at least 10 records
12. Create a query to extract the records based on certain criteria

13. Create an update query to modify the details in the database
14. Create a delete / append query to modify the database
15. Create a report called Student using MS ACCESS with at least 10 records
16. Create an e-mail id

DB 221 Fundamentals of Dairy Extension

3(2+1)

Theory

History, need, definition, philosophy, principles, approaches and objectives of extension education. Present status of dairy and animal husbandry development programme launched in pre and post-independence era. Teaching and learning process, Extension Teaching Methods, classification and selection of teaching methods. Importance of Audio-Visual-Aids. Identification of rural leaders, their characteristics, role and function in rural development, training of rural leaders. Principle of working with group and their mobilisation. Need, principle and step of programme planning. Evaluation of extension programmes. Diffusion of innovations and categories of farmers. Problems of different stake holders, Conceptual orientation about different terms, like- RRA, PRA, IVLP/TAR, ATMA, ATIC, PTD, etc.

Practical

- 1-2. Hands-on training on use of LCD projector,
- 3-4. Hands-on training on use of PA system,
- 5-6. Hands-on training on use of camera.
- 7-8. Script writing,
- 9-10. Preparation and use of audio-visual aids
- 11-12 Animation for dairy stakeholders.
- 13-14. Group discussion technique.,
- 15-16. Hands on learning of field problems in dairy and animal husbandry.

DB 311 ICT in Dairy Industry and Introduction to Operations Research 3 (1+2)

Theory

Introduction–Elementary concepts, objectives of operations research, Applications of OR in decision-making. Modeling in Operation Research. Linear Programming: Introduction, mathematical formulation of the problem, Graphical solution, Simplex technique for solving simple LP problems. Inventory Control – Introduction and general notations, Economic lot size models with known demand. Replacement – Introduction, Replacement of items whose efficiency deteriorates with time. Queuing – Introduction and general notions, Classification of queues and their problems, Probability distribution of queues. Various models in the queuing system. Sequencing – Statement of the problem, notations and assumptions, Problems with ‘n’ jobs and two machines. Generalization to ‘m’ machines. Transportation model – Definition and application of transportation model, Formulation of transportation problems and their solutions. Assignment problems and their solutions. Framework of PERT and CPM, Activities, events and network, PERT and activity time estimates, probability of project completion Critical path analysis.

Practical

1. LP problem – Mathematical formulation problem 1
2. LP problem – Mathematical formulation problem 2
3. LP problem – Graphical method – on Minimisation
4. LP problem – Graphical method – on Maximisation
5. LP Problem – Simplex method with \leq problem 1
6. LP Problem – Simplex method with \leq problem 2
7. LP Problem – Simplex method with \geq problem 1
8. LP Problem – Simplex method with \geq problem 1
9. Inventory control problems – Economic lot size 1
10. Inventory control problems – Economic lot size 2
11. Inventory control problems – EOQ - 1
12. Inventory control problems – EOQ - 2
13. Replacement problem1
14. Replacement problem2
15. Replacement problem3
16. Replacement problem4
17. Queuing Theory Problem 1
18. Queuing Theory Problem 2
19. Queuing Theory Problem 3
20. Queuing Theory Problem 4
21. Problem on sequencing – “n” jobs with two machines
22. Problem on sequencing – “n” jobs with two machines
23. Problem on sequencing – ‘m’ model 1
24. Problem on sequencing – ‘m’ model 2
25. Problem on formulation of Transportation model
26. Problem on transportation 1
27. Problem on transportation 1
28. Problem on transportation 1
29. Problem on Assignment 1
30. Problem on Assignment 2
31. PERT
32. CPM

DB 321 Marketing Management and International Trade

2(2+0)

Theory

Concept of marketing; Functions of marketing; concepts of marketing management; scope of marketing management; marketing management.Process; concepts of marketing- mix, elements of marketing- mix. Market Structure and Consumer Buying Behaviour: Concept of market structure, marketing environment, micro and macro environments. Consumers buying behaviour, consumerism. Marketing Opportunities Analysis: Marketing research and marketing information systems; Market measurement- present and future demand; Market forecasting; market segmentation, targeting and positioning. Allocation and marketing resources.Marketing Planning Process. Product policy and planning: Product-mix; product line; product life cycle. New product development process. Product brand, packaging, services decisions. Marketing channel decisions.Retailing, wholesaling and distribution.PricingDecisions.Price determination and pricing policy of milk products in

organized and unorganized sectors of dairy industry. Promotion-mix decisions. Advertising; How advertising works; Deciding advertising objectives, advertising budget and advertising message; Media Planning; Personal Selling, Publicity; Sales Promotion. Food and Dairy Products Marketing. International Marketing and International Trade. Salient features of International Marketing. Composition & direction of Indian exports; Trends in International Dairy Trade, International marketing environment; Deciding which & how to enter international market; Exports- Direct exports, indirect exports, Licensing, Joint Ventures, Direct investment & internationalization process, Deciding marketing Programme; Product, Promotion, Price, Distribution Channels. Deciding the Market Organization; World Trade Organization (WTO)

DB 421 Financial Management and Cost Accounting

3 (2+1)

Theory

Introduction: Definition, scope and objectives of financial management. Different Systems of Accounting: Financial Accounting, Cost accounting, Management Accounting. Double entry system of Book-Keeping. Preparation of Accounting Records: Journal, Purchases and Sales Book and Posting in Ledger, Cash Book. Preparation of Final Accounts and adjustments at the end of trading period. Preparation of Trial Balance Banking Transactions and Bank reconciliation statements. Statements of Financial Information: Accounting system: A source of financial statements, Classification of capital and revenue expenditure, Balance Sheet, Profit and Loss Account, Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making. *Financial Analysis:* Nature and uses of financial analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Utility of Ratio analysis. Cost Volume – Profit analysis and operating leverage, Break-even analysis, Profit analysis and operating analysis, Utility of CVP analysis. Capital Structure: C.S Planning, risk return trade off, financial leverage. Cost of capital: Management of cost of capital, cost of debt, debentures, preference share capital, equity share capital & retained earning, overall cost of capital. *Investment decision:* Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Pay back period method, Accounting rate of return method. Capital budgeting: Complex Investment Decisions: Investment timing & duration Investment decisions under inflation, Investment decisions under capital rationing. *Project Report;* Feasibility Report Valuation. Working capital management- Concept & determinants of working capital, Estimating working capital needs. Depreciation – Concept and method. Introduction, Definition, Objectives, Common terms. *Costing:* Essentials of sound costing system. Different methods of costing, elements of cost: Labour- recording of time, idle time, methods of remunerating labour, Premium & Bonus Plans, Materials, Overheads. *Cost classification:* Direct and Indirect expenses, fixed and variable costs. Various methods of apportioning indirect expenses. Inventory Management: Planning, control and costing. Stores & storekeeping, scope & importance, purchase procedure, types of purchase, location of stores & materials, procedure for the movement of stores, different methods of pricing materials, store records. Cost Sheets- Different methods, Statement of cost and statement of profit estimates, Tenders or Quotations. Contract or Terminal costing. Process Costing: Process losses and inter-process profits, joint products and by products costing. Ascertainment of cost of milk production. Preparation of Cost Account Information for managerial decisions.

Practical

1. Preparation of Profit and Loss account - 1
2. Preparation of profit and loss account - 2
3. Preparation of Balance Sheet.
4. Problem on Cash flow statement - 1
5. Problem on Cash flow statement - 2
6. Problem on Funds flow statement - 1
7. Problem on Funds flow statement – 2
8. Problem on Ratio analysis.
9. Problem on Break-Even Analysis.
10. Problem on Profit analysis.
11. Problem on Operating Analysis.
12. Problem on Financial leverage.
13. Problem on Cost of Capital.
14. Problem on Investment decisions.
15. Problem on Capital budgeting - 1
16. Problem on Capital budgeting – 2

DB 422 Entrepreneurship Development and Industrial Consultancy 2(2+0)

Theory

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business/entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs)/SSIs. Export and Import. Policies relevant to dairy sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of dairy inputs industry. Characteristics of Indian dairy processing and export industry. Social Responsibility of Business. *Industrial Consultancy:* Dairy plant management system- milk procurement from the rural milk producer, milk processing and products manufacturing. Pricing and marketing of milk and milk products. Survey on milk production potential and marketed surplus of milk for setting up of milk plants. Recruitment and training of manpower, Estimation of costs of product manufacture and energy utilization in food processing plants. Sources of finance for setting up of dairy farms and processing plants/ units. Guidelines for obtaining ISO/HACCP certification for dairy plants. Assessment of entrepreneurial skills and characteristics for successful entrepreneur. Consumer opinion surveys. Pricing of milk and milk products. Preparation of feasibility reports for setting of dairy farms, composite milk plants, collection centers, chilling units and processing units.

DB 423 Industrial Statistics

2 (1+1)

Theory

Definition and scope; sources of animal husbandry and dairy statistics. Measures of central tendency, Measures of dispersion, Moments, skewness and kurtosis. Elementary notions of probability, Laws of addition and multiplication probability. Theoretical frequency distributions: Binomial, Poisson and Normal distribution and their application. Concepts of sampling methods, Introduction to testing of hypotheses, Tests of significance-Z, t, F tests, and their application in the field of dairying. Analysis of variance- One-Way and two-way classification. Simple correlation coefficient and its test of significance, Linear regression, rank correlation. Basic concepts of statistical quality control, Control charts for variables and attributes, Fundamental concepts of acceptance sampling plan.

Practical

1. Measures of central tendency – Mean
2. Measures of central tendency –Median
3. Measures of central tendency – Mode
4. Measures of dispersion – Mean deviation
5. Measures of dispersion – Quartile deviation
6. Measures of dispersion – Standard deviation
7. Problem on Skewness 1
8. Problem on Skewness 2
9. Fitting of binomial and Poisson distribution.
10. Application of ‘Z’ test for one and two sample problems.
11. Application of ‘t’ test for one and two sample problems.
12. Application of Chi-square test and F-test.
13. Correlation
14. Regression.
15. Rank correlation coefficient.
16. Control chart for variables & attributes

II. DAIRY CHEMISTRY

DC 111 Physical Chemistry of Milk

3(2+1)

Theory

Constituents and gross composition of milk of different species and breeds of milch animals, *Colloidal State*: Distinction between true and colloidal solution, lyophilic & lyophobic solution, properties of colloidal system. Properties of colloidal systems, Gels-their formation and properties. Milk as a colloidal system and its stability. Elementary idea about emulsion. Density : Density and specific gravity, pycnometer method, hydrometer lactometer. Density and specific gravity of milk, effect of various processing variables on the density and specific gravity of milk. *Liquid State*: Surface tension, surface energy interfacial tension. Surface tension of mixtures. Surface tension of milk and the factors affecting it. Viscosity- Definition of viscosity, Newtonian and Non-Newtonian liquids, Stokes Law, influence of temperature and concentration of solute on viscosity. Viscosity of milk, evaporated milk and condensed milk. Refractive index. Colligative Properties of Dilute Solution: Vapour pressure, Raoult's Law, Depression of freezing point, Elevation of boiling point. Freezing point and boiling point of milk. Osmosis and Osmotic pressure. Inter-relation of colligative properties. Aqueous solution of Electrolytes: Electrolytes; non-electrolytes, ionic mobility, electrical

conductance, Ostwald Dilution Law, Kohlrawsch Law, Electrical conductance of milk. Ionic Equilibria: Dissociation of water, ionic product of water, concept of pH and pOH and their scale. Acids and bases: Bronsted Lewis concepts of acids and bases, dissociation constants of acids and bases. Salt-their hydrolysis. Buffer solutions. Derivation of Henderson – Hasselbachequation and it application, buffer capacity and buffer index, milk as a buffer system. Equilibrium of electrolytes. pH indicators. Oxidation- Reduction: Redox potential, Nernst equation, electrochemical cells. Hydrogen, glass and calomel electrodes. Redox system of milk. Nuclear Chemistry: The nature of isotopes, radio isotopes. Half-life period of radio isotopes. Some of the important radio isotopes. Occurrence of radio nuclide in milk & milk products. Molecular Spectroscopy: The spectrum of electromagnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet Spectroscope. Mention of mass, NMR spectroscopy.

Practical

1. Sampling of milk – principle – sampling methods from different sources – composite sample.
2. Determination of density and specific gravity of milk by using Pycknometer, hydrometer and lactometer
3. Determination of viscosity of milk using Ostwald's viscometer
4. Determination of surface tension of milk using Stalagmometer
5. Determination of interfacial tension between oil and water phase
6. Determination of freezing point of milk
7. Preparation of buffer solutions
8. Electrometric method for determination of pH of buffers and milk
9. Determination of acidity of milk by colorimetric and electrometric methods
10. Determination of electrical conductance of milk
11. Determination of redox potential of milk
12. Coagulation of milk by using electrolytes
13. Determination of refractive index of skm milk and whey
14. Determination of pK_{a1} , pK_{a2} and pI
15. Titration of amino acids in the presence and absence of formaline
16. Verification of Labert Beer's law

DC 112 Biochemistry

2(1+1)

Theory

Bio-Molecules: General structures, classification and functions of bio molecules-Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA. *Enzymes:* Activation energy /Transition state & Enzyme Classification, Coenzymes/Co-factors & Enzyme kinetics, Mechanism of enzyme action, Factors effecting enzyme activity, Enzyme inhibition, isozymes& Regulatory Enzymes, Immobilization of enzyme, Ribozymes & Zymogens. *Metabolism :*Glycolysis, Gluconeogenesis, TCA cycle, Glycogen synthesis and degradation, Pentose phosphate pathway, Fatty acid oxidation, Urea cycle and transaminase reactions, ATP and Electron transport chain.

Practical

1. Estimation of alkaline phosphatase by converting non – chromogenic substrate to chromogenic substrate
2. Study the effect of temperature on enzyme activity
3. Study the effect of pH on the enzyme activity
4. Study the influence of enzyme inhibitors on the enzyme activity
5. Estimation of catalase activity by spectrophotometric method
6. Determination of MichaeliMenten activity of an enzyme
7. Estimation of RNA by colorimetric method
- 8-9. Measurement of proteolysis in different proteins
- 10-11. Measurement of lipolysis in different fats and oils
- 12-13. Estimation of vitamin a in ghee
- 14-15. Estimation of vitamin C is blood plasma
16. Estimation of amylase activity

DC 121 Chemistry of Milk

3(2+1)

Theory

Definition and structure of milk, factors affecting composition of milk, Nomenclature and classification of milk proteins, Casein: Isolation, fractionation and chemical composition, physico-chemical properties of casein, Whey proteins: Preparation of total whey proteins: α -Lactalbumin and β -Lactoglobuline. Properties of α -Lactalbumin and β -lactoglobulin, Immunoglobulin and other minor milk proteins and non proteins nitrogen constituents of milk, Hydrolysis and denaturation of milk proteins under different physical and chemical environments, Estimation of milk proteins using different physical and chemical methods, Importance of genetic polymorphism of milk proteins ,Milk enzymes with special reference to lipases, Xanthine Oxidase, phosphates, proteases and lactoperoxidase ,Milk carbohydrates their status and importance. Physical and chemical properties of lactose, Sugar amine condensation, amadori re arrangement, production of hydroxyl methyl furfural (HMF), Processing related degradation of lactose, Definition, general composition and classification of milk lipids.Nomenclature and general structure of glycerides, factors affecting the fatty acid composition. Milk phospholipids and their role in milk products, Unsaponifiable matter and fat soluble vitamins, Milk Salts: Mineral in milk (a) major mineral (b) Trace elements, physical equilibria among the milk salts and Milk contact surfaces and metallic contamination.

Practical

1. Milk Sampling techniques from different sources for chemical analysis
2. Determination of titratable acidity of milk
3. Determination of pH of milk
4. Determination of fat percent in milk by volumetric method
5. Determination of fat percent in milk by gravimetric method
6. Determination of fat percent in milk by electronic methods
7. Determination of Total solids and solids non fat in milk by gravimetric and calculation method
8. Determination of total milk proteins by kjeldahl and volumetric methods
9. Determination of casein, whey proteins and NPN in milk
10. Determination of lipase and phosphatase activity in milk
11. Determination of lactose content in milk by Lane And Eynon method
12. Determination of lactose content in milk by polarimetric method
13. Determination of Ash content in milk
14. Determination of calcium and phosphorus in milk
15. Determination of temporary and permanent hardness of water
16. Estimation of available chlorine from bleaching powder

DC 221 Chemistry of Dairy Products

3(2+1)

Theory

Chemical composition and legal standards of milk products. Chemistry of creaming and factors affecting the same. Ripening and neutralization of cream. Theories of churning and factors affecting the same. Butter colour. Ghee: Physico-chemical changes during manufacture. Hydrolytic and oxidative deterioration, their causes, prevention and role of antioxidants. Physico-chemical changes in milk constituents during manufacture and storage of traditional dairy products: Khoa, Paneer, Dahi, Channa, Lassi, Chakka, Shrikhand. Chemistry of cheese: milk clotting enzymes, enzymatic coagulation of milk, biochemical changes during ripening. Physico-chemical changes during preparation and storage of concentrated and dried milk products. Physico-chemical changes during processing and storage of ice cream and frozen desserts. Role and mechanism of stabilizers and emulsifiers in ice cream.

Practical

1. Determination of fat percent in cream by volumetric method
2. Determination of fat percent in cream by gravimetric method
3. Analysis of butter: Estimation of moisture, fat and salt content in butter
4. Analysis of ghee – estimation of moisture
5. Analysis of ghee – determination of Reichert Meissel value/ polenske value
6. Analysis of ghee – determination of Butyro Refractometer reading
7. Analysis of ghee – determination of acid value
8. Determination of sucrose and lactose in sweetened condensed milk
9. Analysis of milk powder – estimation of moisture and acidity, and ash content
10. Analysis of milk powder – estimation of fat percentage, solubility and bulk density
11. Analysis of Ice cream : estimation of fat and total solids
12. Analysis of cheese – estimation of moisture and fat percent

13. Analysis of cheese – estimation of salt content
14. Analysis of khoa and paneer – estimation of moisture and fat percent
15. Estimation of protein content in milk powder by kjeldhal method
16. Estimation of protein content in cheese powder by kjeldhal method

DC 222 Human Nutrition

2(1+1)

Theory

Fundamentals of human nutrition, concept of balanced diet, nutrient requirements of different age groups. Methods of evaluation of nutritive value of food and nutritional value of cow, buffalo and human milk, biochemical composition and energy value of foods with special reference to milk and dairy products. Nutrition, digestion and absorption, Vitamins (structure and function), Hormones (structure and function), Milk intolerance and hypersensitivity, Safety aspects of food additives, toxic elements, antibiotics, radionuclides in milk and milk products. Nutraceutical, antioxidants, food toxins, anti-nutritional factors, probiotics and cultured dairy products. Biochemical aspect of post-harvest storage specifically food spoilage.

Practical

1. Estimation of serum proteins by Biuret method / Lowry method
2. Estimation of blood glucose by Folin Wu method
3. Estimation of serum phosphorus content by Fiske and Subba Row method
4. Estimation of blood Creatinine, triglyceride and cholesterol levels
5. Estimation of calorific value of foods
6. Diet and nutritional survey a) identification of vulnerable and risk groups
7. Diet and nutritional survey b) breast feeding and weaning practices
8. Use of anthropometric measurement in children
9. Preparation of visual aids for nutritional disorders
10. Field visit for observing the working of nutrition and health oriented programs based on survey visits
11. Field visit to hospitals for observing the nutritional deficiencies
12. Identification of mono, di and poly saccharides
13. Identification of proteins (Albumin, gelatine and peptone)
14. Detection of antibiotics/ in food products
15. Planning of high protein, low fat, and specialized diets
16. Detection of toxin in food products

DC 311 Chemical Quality Assurance

3(2+1)

Theory

Importance of chemical quality control, quality assurance and total quality management in dairy industry. Role of national and international food regulatory systems and standards with respect to quality and safety of milk and milk products: FSSAI, PFA, AGMARK, BIS ISO, IDF, Codex, etc., Application of food safety management system (ISO: 22000). Hazard analysis and critical control points (HACCP) system and its application in dairy industry with respect to chemical quality. Setting up of testing facilities and analytical laboratories; concept of mobile testing laboratories. Accreditation of analytical laboratories. Preparation and standardization of reagents required in the analysis of milk and milk products. Sampling procedures; labeling of samples for analysis; choice of analytical tests for milk and milk products for chemical analysis and instrumental methods of analysis. Calibration of dairy glassware; including butyrometer, pipettes, burettes, hydrometers, lactometers and thermometer. Testing methods for the detection of adulterants, preservatives and neutralizers in milk and milk products. Environmental contaminants such as pesticides, antibiotics, heavy metals in milk and milk products and their chemical testing methods. Importance of milk contact surfaces, metallic contamination in dairy industry. Chemical quality of water in dairy industry. Prediction of shelf life behavior of milk and milk products.

Practical

1. Calibration of dairy glass ware - hydrometers – butyrometers
2. Calibration of dairy glass ware – volumetric flasks, burettes and pipettes
3. Preparation and standardization of dairy reagents – alkalies and acids
4. Preparation and standardization of dairy reagents – sodium thiosulphate and silver nitrate
5. Preparation and standardization of dairy reagents – Fehlings and EDTA solution
6. Preparation and standardization of dairy reagents – Gerber's acid
7. Testing of amyl alcohol for fat estimation
8. Chemical analysis of permissible additive in milk
9. Chemical analysis of permissible additive in milk products
10. Chemical analysis of detergents and sanitizers
11. Detection of adultrants, preservatives and neutralizers in milk and milk products
12. Detection of adulteration of ghee with vegetable oil
13. Detection of adulteration of ghee with animal body fat
14. Analysis of market samples milk and milk products
15. Determination of temporary and permanent hardness of water
16. Estimation of available chlorine in bleaching powder

DC 321 Food Chemistry

3(2+1)

Theory

Water: Water binding and chemical reaction mediated by water. *Food proteins:* Classification and physico-chemical and structural properties. *Lipids:* Definition, classification of lipids, Unsaponifiable matter contents in various fats and oils, classification and chemical composition. *Carbohydrates:* Classification of carbohydrates, polysaccharides, viz. linear, branched and modified. Properties and utilization of common polysaccharides, viz. cellulose, glycogen, hemicelluloses, pectin. *Food Enzymes:* Hydrolases and lipases, utilization in food chemistry. *Minerals in foods:* Main elements, trace elements in eggs, cereals and cereal products, vegetables and fruits. *Aroma compounds in foods:* Threshold value, off-flavours. *Food additives:* Vitamins and Amino acids, Minerals, Aroma Substances/flavour enhancers- Monosodium glutamate, 5-nucleotides sugar substitutes, sorbitol sweeteners- saccharin, and cyclamate, Food colours and food preservatives. *Antinutritional factors and Food contaminants:* Toxic trace elements, radio nucleotides. Cereal and cereal products: Individual constituents like proteins, lipids, carbohydrates and vitamins in cereals flour and their relationship in dough making, influence of additives /minor ingredients on baking properties: physico-chemical changes during baking. *Legumes:* Classification, general composition and physico-chemical properties. *Vegetables and Fruits:* Classification, general composition, chemical changes during ripening and storage. *Jams, Jellies and Pickles:* Classification, composition and preservation. Preservation of foods, general principles of food preservation.

Practical

1. Determination of gluten content in wheat flour
2. Determination of total ash and acid insoluble ash in wheat flour
3. Determination of starch in wheat flour
4. Determination of nitrogen in cereal products
5. Determination of acidity in citrus fruits
6. Determination of vitamin C in citrus fruits
7. Determination of total solids in tomato ketchup
8. Determination of acidity in tomato ketchup
9. Determination of total sugar, in tomato ketchup
10. Determination of ash and salt content in tomato ketchup
11. Estimation of alkalinity of soluble ash in tea
12. Determination of water extractive in tea leaves
13. Detection of chicory in coffee powder
14. Determination of reducing sugars in jam
15. Determination of iron content in infant foods

III. DAIRY ENGINEERING

DE 111 Engineering Drawing

1(0+1)

Practical

1. Drawing of lines, lettering and types of lettering.
2. Dimensioning types of lines, types of dimensioning.
3. Drawing of scales: Plain Scale

4. Drawing of scales: diagonal scale, comparative scale and Vernier scale.
5. Drawing of Projection: methods of projections, Orthographic projection.
6. Drawing of screw threads: Types of threads and terminologies used in lit.
7. Screw fastening: Types of nuts, types of bolts, stud, locking arrangements for nuts and foundation bolt.
8. Drawing rivets and riveted joints, forms of rivet heads, Types of riveted joints, failure of riveted joints.
9. Drawing of welded joints: Forms of welds, location and dimensions of welds.
10. Drawing of Keys, types of keys
11. Drawing of cotter joint, types of cotter joints
12. Drawing of pin joints, types of pin joints
13. Drawing of shaft couplings, rigid couplings, loose couplings, flexible couplings and universal couplings
14. Drawing of shaft bearings, journal bearings
15. Drawing of pivot bearings, collar bearings.

DE 112 Workshop Practice

2(1+1)

Theory

Introduction: workshop practice, safety, care and precautions in workshop. *Wood working* tools and their use, Carpentry. *Heat treatment process:* Hardening, tempering, annealing and normalizing etc. *Metal work:* Metal cutting. Soldering, Brazing. *Welding:* Electric arc and Gas welding. *Smithy and forging operations:* tools and equipments. *Bench work:* The bench, flat surface filing, chipping, scrapping, marking out, drilling and screwing. *Introduction to following tool machines:* (a) Lathe Machine (b) Milling Machine (C) Shaper and Planner (d) Drilling and Boring machines (e) Grinder (f) CNC Machines etc.

Practical

1. To Study different types of measuring tools used in metrology and determine least counts of Vernier callipers, micrometers and Vernier height gauges.
2. Job work on filing and chipping.
3. To Study different types of fitting tools
4. To marking tools used in fitting practice.
- 5-6. To Study various types of carpentry tools and prepare simple types of at least two wooden joints.
7. Job work on hand hack and power hack saw.
8. Job work on metal sheet working.
9. Job work on butt and lap welding.
- 10-12. To study different types of metal tools (lathe machine, drilling, milling machines.).
13. To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making, threading.
14. Simple exercises in Arc, gas, & Argon welding.
15. Simple exercises in soldering, Brazing.

DE 113 Fluid Mechanics

3(2+1)

Theory

Units and dimensions, Properties of fluids. *Static pressure of liquids*: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid. Pressure on vertical rectangular surfaces. Compressible and non compressible fluids. Surface tension, capillarity. Pressure measuring devices, simple, differential, micro, inclined manometer, mechanical gauges, Piezometer. *Fluidflow*: Classification, steady uniform and non uniform flow, Laminar and turbulent, continuity equation, Bernolli's theorem and its applications. *Flow through pipes*: Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity. Flow through orifices, mouthpieces, notches and weirs, Vena contracta, hydraulic coefficients, discharge losses, Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe. External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube, Rota meter. Water level point gauge, hook gauge. *Dimensional analysis*: Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude. *Pumps*: Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Pump selection and sizing.

Practical

1. Study of various types of pipes and pipe fittings.
2. Study of different types of valves.
3. Study of reciprocating pump.
4. Study of rotary gear pump.
5. Study of piezometer.
6. Study of 'U' Tube manometer.
7. Study of Inclined tube manometer.
8. Study of Venturimeter.
9. Determination of frictional coefficient of given pipe.
10. Determination of minor head loss.
11. Study of Pitot tube.
12. Study the construction and working principle of centrifugal pump.
13. Study of reciprocating pump.
14. Study and measurement of flow of liquid by V- notch.
15. Visit to dairy plant.

DE 121 Heat & Mass Transfer

3(2+1)

Theory

Basic heat transfer process: thermal conductivity, convective film co-efficient, Stefan Boltzman's constant and equivalent radiation co-efficient, Overall heat transfer co-efficient, physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature. *One-dimensional steady state conduction*: Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian coordinates, Linear heat flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal conductivity. Concept of electrical analogy and its application for thermal circuits, Heat transfer through composite walls and insulated pipelines. *Steady-state heat conduction with heat dissipation to environment*: Introduction to extended surfaces (FINS) of uniform area of cross-section. Equation of temperature distribution with different boundary conditions. Effectiveness and efficiency of the

FINS. Introduction to unsteady state heat conduction. *Convection*: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, Some important empirical relations used for determination of heat transfer coefficient. *Heat Exchangers*: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Shell and tube and plate heat exchangers, Heat exchanger design. Application of different types of heat exchangers in dairy and food industry. *Mass transfer*: Fick's Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolal diffusion. Mass transfer co-efficient and problems on mass transfer.

Practical

1. Determination of thermal conductivity: milk, solid dairy and food products.
2. Determination of overall heat transfer coefficient of: shell and tube.
3. Determination of overall heat transfer coefficient of plate heat exchangers.
4. Determination of overall heat transfer coefficient of jacketed kettle used in dairy and food industry.
5. Studies on heat transfer through extended surfaces.
6. Studies on temperature distribution and heat transfer in HTST pasteuriser.
7. Design problems on heat exchangers.
8. Study of various types of heat exchangers.
9. Design problems on mass transfer.
10. Heat transfer in tubular heat exchanger: co-current/counter flow.
11. Heat transfer through composite wall.
12. Heat transfer through lagged pipes.
13. Heat transfer through natural convection.
14. Heat transfer through forced convection.
15. Visit to dairy plant.

DE 122 Thermodynamics

2(1+1)

Theory

Importance and applications of thermodynamics in Dairy/Food processing. **Basic concepts**: Thermodynamic systems, properties, state, processes, cycles, energy, The Zeroth Law of Thermodynamics. *Ideal gases*: Equation of state, Compression and expansion of gases. The first Law of Thermodynamics: Internal energy, enthalpy. Analysis of non-flow and flow processes. *The second Law of Thermodynamics*: Thermodynamic temperature scale, Carnot cycle, heat engine, entropy, reversibility, availability. *Air Cycles*: Otto, Diesel, dual cycles and their efficiencies, Plotting the air cycles on p-V, T-S, p-h diagram etc. *I.C. Engines*: Concepts, Classification, Working of two stroke and four stroke cycle S.I. engines and C.I. engines. Parts of I.C. engine, Performance of IC engines.

Practical

1. Application of thermodynamics in engineering problems.
2. Study of 2-stroke IC engine.
3. Study of 4-stroke IC engine.
4. Study of working of SI engine.
5. Study of working of CI engine.
6. Study of modern fuel injection system of IC engine.

7. Study of diesel fuel supply system-pump type.
8. Study of diesel fuel supply system-fuel injector type.
9. Study of fuel supply system of a petrol engine.
10. Study of air cooling system of an IC engine.
11. Study of water cooling system of an IC engine.
12. Study of lubrication system of IC engine.
13. Study of solar water heater.
14. Study of bio gas plant and appliances.
15. Visit to dairy plant.

DE 123 Basic Electrical Engineering

3(2+1)

Theory

Alternating current fundamentals: Generation of alternating current or voltage, magnitude of induced E.M.F. Alternating current, R.M.S value and average value of an alternating current. Phase relation and vector representation. Cycle, Time period, Frequency, Amplitude, Phase and Phase Difference, Root – Mean Square Value, Average value, Form Factor, Crest or Amplitude Factor. *Poly-phase Circuit:* - Generation of Poly-phase Voltage, Phase Sequence, Interconnection of Three Phases such as Star Connection and Delta Connection and their respective value of current and voltages, Energy Measurement by using Single and Two Watt-meters. *Transformers:* - Working Principle of Transformer, Construction features of Core and Shell type transformer, Elementary theory of an Ideal Transformer, E.M.F. Equation of a Transformer, Vector diagram of transformer with and without load, Transformer losses, voltage regulation and efficiency of transformer, Construction and working on an Single Auto-transformer, Different parts of a 11/0.4 KV, Distribution Transformer. *Three Phase Induction Motor:* - Fundamental working principles, Production of rotating magnetic fields, construction, Different types of Rotor such as Squirrel Cage and Phase wound rotors, Starting of induction motors using Direct on Line (DOL) and Star-Delta Starter. Soft starter and variable frequency drives. *Single Phase Induction Motors:* - Introduction, Different types of single phase induction motors such as Split Phase, Capacitor type, Shaded Pole type, Universal or AC series motors, Repulsion start induction run motor, Repulsion – induction motor. *DC Machine:* - Construction and operation of DC generator, types of generators and their various characteristics. DC motors: Torque speed characteristics of DC motors, Starting and speed control of DC motors by using 3-point DC Starter. *Alternators:-* Elementary working principles, Different parts of an Alternators, Relation between Speed and Frequency, E.M.F. equation in an Alternators. Different types of Circuit Breaker and its use. Introduction to DG set system. *Electric Power Economics:* - Economics of Generation of electrical energy and related important terms such as, load curve, connected load, Maximum Demand, Demand Factor, Average load or demand, Load Factor, Diversity factor and its significance, Capacity Factor or Plant factor, Utilization Factor, Plant Operating Factor and Selection of Units and related numerical, Various types of Tariff used for calculation of electricity bill. *Lighting system:* Introduction to industrial lighting system. *Energy Management and Power Factor Corrections:* - Types of energy, Energy Management, Concept of Energy Audit. Concept of Power Factor, Disadvantages of low power factor, Causes of low power factor, Various methods of improving low power factor, Location of power factor correction equipment, Advantages of power factor improvement.

Practical

1. Introduction to various basic circuits of parallel wiring, stair case wiring, fluorescent light fitting.
2. Study of voltage and current relationship in case of Star connected load.
3. Study of voltage and current relationship in case of Delta connected load.
4. Measurement of power in 3- phase circuit: for a balanced load, using watt meters
5. Measurement of power in 3- phase circuit: for a unbalanced load, using watt meters
6. Measurement of Iron losses of Single Phase transformer by conducting open circuit test
7. Measurement of Copper losses of Single Phase transformer by conducting short circuit test
8. Starting and reversing the speed of a single phase induction motor
9. Starting and reversing the speed of a 3- phase induction motor using Direct on Line (DOL) starter
10. Starting and reversing the speed of a 3- phase induction motor using manual Star Delta starter.
11. Starting and reversing the speed of a DC shunt motor using 3-point DC Starter.
12. Starting of slip-ring induction motor by manual Slip-ring Induction Motor Starter.
13. Starting of slip-ring induction motor by automatic Slip-ring Induction Motor Starter
14. To determine the relation between induced armature voltage and speed of separately DC Shunt Generator.
15. To determine the relation between induced armature voltage and speed of self excited DC Shunt Generator

DE 124 Boilers and Steam Generation

2(1+1)

Theory

Fuels: Chemical properties, Calorific value and its determination, Fuel Burners, Fuel combustion analysis. *Renewable energy sources:* Concepts, classification, Types and description of renewable energy sources. *Properties of steam:* Properties of wet, dry saturated, superheated steam, Use of steam tables and Mollier charts, Analysis of energy input in steam generation and heat gain in steam consumption. *Steam generators:* Definition, classification, fire tube boilers, water tube boilers, Boiler performance parameters, Boiler mountings and Boiler accessories. Layout of steam pipe-line and expansion joints. Introduction to Indian Boiler Regulation Act. *Boiler Draught:* Definition, importance and classification of draught, Natural and artificial draught, Calculation of Height of chimney, Draught analysis. *Air Compressors:* Definition, classification, Reciprocating, Single and multi-stage reciprocating compressors and their theoretical analysis.

Practical

1. To Determine dryness fraction of steam
2. To study different types of boilers with the help of Lab models.
3. To study Boiler mountings
4. To Study of different Boiler accessories.
5. To study boiler de-scaling operations
6. To study steam-line layout
7. To study steam traps.

8. Hydraulic testing of boiler pipes and fittings
9. To study boiler maintenance operations
10. Industrial exposure visit to plant with steam utilization.
11. Study of Package boiler installed in a dairy processing plant.
12. To Study of water softening plant installed with boiler in a dairy processing plant.
13. To Study the construction and working of vertical fire tube boiler.
14. Study of Horizontal water tube boiler.
15. Visit to dairy plant

DE 211 Refrigeration and Air-Conditioning

3(2+1)

Theory

Basic refrigeration cycles and concepts: Standard rating refrigerating machines; Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressors; Theoretical vapour compression cycle; Departure from theoretical vapour compression cycle, representation on *T-S* and *p-h* diagrams; Mathematical analysis of vapour compression refrigeration system. *Refrigerants:* Primary and secondary refrigerants; common refrigerants (Ammonia, Freon, *HFC*, *HCFC* etc); Brine, their properties and comparison. *Multi-Pressure Refrigeration Systems:* Applications; Multi-evaporators with single stage and multi-stage compression and expansion systems; Working, Control and mathematical analysis of above systems. *Refrigeration Equipments and Controls:* Introduction to the types, construction, operation and maintenance of Refrigeration Components, Controls and Safety Devices as used in different refrigeration applications. Capacity control methods, Refrigeration Piping: Purpose, Types, Materials, Fittings and Insulation. *Design and Balancing of Refrigeration System:* Basic elements of design of individual components and a complete refrigeration system. Input and Output design parameters, Balancing of components of refrigeration system for optimum performance. *Absorption Refrigeration Systems:* Simple vapour absorption refrigeration systems, Actual Vapour absorption refrigeration system, Refrigerant absorbent pairs, Absorption cycle analysis. *Cryogenic Freezing:* Cryogenics, cryogenes, properties, applications, cryogenic freezers. *Psychrometry:* Definition, properties of moist air, psychrometric charts, psychrometric processes; Cooling/ Heating coils, humidifiers and dehumidifiers, Temperature and humidity measurements and controls. *Air-conditioning Systems:* Types of cooling loads and their calculation, Design conditions for Human and Industrial air conditioning systems, Analysis of different air-conditioning systems with the help of psychrometric chart. *Cold Storage:* Types of cold storages, Types of cooling loads in cold storages used for food/ dairy products; Construction and operation of cold storage. Insulating materials and vapour barriers.

Practical

1. Study of different types of Refrigeration tools generally used in installation and maintenance of a refrigeration plant/ equipment including charging and leakage-detection tools.
2. Study of specification, components, operation, control, maintenance and precautions taken during working of a Domestic refrigerator.
3. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Bulk Milk cooler.

4. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Walk-in-cooler.
5. Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant.
6. Estimation of installed cooling capacity with the help of observed working pressures.
7. Study of specifications, components, operation, control and maintenance of Ice Bank Tank (IBT).
8. Study of specifications, components, operation, control and maintenance of a Cold Storage.
9. Study of the Evaporative Cooling Devices like Cooling Tower, Spray Pond, Air-Washer or Room air-cooler etc.
10. Study of the parts and components of different types of refrigerant compressors used in various refrigeration applications.
11. Study of different types of capacity control devices used with compressors in a refrigeration plant.
12. Experimental study of a simple refrigeration system on refrigeration tutor or an experimental set-up. (comparison of actual and theoretical performance).
13. Experimental study of an year-round air-conditioning system on an air-conditioning tutor or an experimental set-up.
14. Study and plotting of psychrometric processes using refrigeration/air-conditioning tutor.
15. Measurement of psychrometric properties using psychrometric meters/gadgets
16. Industrial exposure visit to refrigeration/air-conditioning plant.

DE 212 Dairy Engineering

3(2+1)

Theory

Sanitization: Materials and sanitary features of the dairy equipment. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes & fittings. Description, working and maintenance of can washers, bottle washers. Factors affecting washing operations, power requirements of can the bottle washers, CIP cleaning and designing of system. *Mechanical Separation:* Fundamentals involved in separation. Sedimentation, Principles involved in filtration, Types, rates of filtration, pressure drop calculations. Gravity setting, principles of centrifugal separation, different types of centrifuges. Application in Dairy Industry, clarifiers, tri processors, cream separator, self-desludging centrifuge, cold and hot separators, Bactofuge, in-line standardization system, care and maintenance of separators and clarifiers. *Homogenization:* Classification, single stage and two stage homogenizer pumps, power requirement, care and maintenance of homogenizers, aseptic homogenizers. *Pasteurization:* Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Pasteurizer control, Care and maintenance of pasteurizers.

Sterilization: Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers. *Packaging machines:* Pouch filling machine pre-pack and aseptic filling bulk handling system Principles and working of different types of bottle filters and capping machine, Blow molding machines, Aseptic PET bottle filling machine. Cup filling system. Care and maintenance. *Mixing and agitation:* Theory and purpose of mixing. Equipments used for mixing solids, liquids and gases. Different types of stirrers, paddles and

agitators. Power consumption of mixer-impeller, selection of mixing equipment in dairy industry, mixing pumps.

Practical

1. Study of S. S. pipes, fitting and gaskets.
2. Study and selection of pump.
3. Study of different types of milk filter.
4. Study of equipment at raw milk reception dock. Constructional details, operation and maintenance of straight through can washer.
5. Constructional details, operation and maintenance of C.I.P. system.
6. Constructional details, operation and maintenance of homogenizers.
7. Constructional details, operation and maintenance of batch pasteurizer.
8. Constructional details, operation and maintenance of HTST pasteurizer.
9. Comparison of conventional and modern pasteurizer.
10. Constructional details, operation and maintenance of Open type cream separators.
11. Constructional details, operation and maintenance of Hermetic type cream separators.
12. Constructional details, operation and maintenance of sterilization systems. Constructional details, operation and maintenance of pouch filling machine.
13. Constructional details, operation and maintenance of different types of agitators.
14. Constructional details, operation and maintenance of bottle filling and capping machine.
15. Visit to a dairy processing plant.

DE 221 Dairy Process Engineering

3(2+1)

Theory

Evaporation: Basic principles of evaporators, construction and operation, Different types of evaporators used in dairy industry, Calculation of heat transfer area and water requirement of condensers, Basic concepts of multiple effect evaporators, Operations and various feeding systems, Economy of operation, Thermo processor and MVR system, Care and maintenance of evaporators. *Drying:* Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Rate of drying- constant and falling rate, Effect of Shrinkage, Classification of dryers-spray and drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems. Factors affecting bulk density of powder, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers. *Fluidization:* Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers. *Processing equipments:* Mechanization and equipment used in manufacture of indigenous dairy products, Ice-cream and Cheese making equipments. *Packaging equipments:* Packaging machines for milk & milk products. *Membrane Processing:* Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.

Practical

1. Study of construction and operation of: Vacuum pan.
2. Study of construction and operation of Double effect evaporator.
3. Study of construction and operation of different types of condensers.

4. Study of construction and operation of single stage spray dryer using nozzle type atomizer.
5. Study of construction and operation of spray drier with centrifugal atomizer and two stage drier.
6. Study of construction and operation of vacuum and atmospheric drum dryers
7. Study and operation of Butter.
8. Study and operation of Ghee
9. Study and operation of Batch Ice cream freezer.
10. Study and operation of continuous ice cream freezer.
11. Study and operation of cheese making equipments.
12. Study of Reverse osmosis.
13. Study of Ultra filtration system.
14. Design problems on Double effect evaporator.
15. Design problems on vacuum pan.
16. Visit to a milk product plant.

DE 311 Instrumentation and Process Control

3(2+1)

Theory

Instrumentation scheme & characteristics: Measurands. Some basic discussion about electric field, potential, capacitance, resistance etc. Definition, Application and types of measurements, instrument classification, Functional elements of an instrument, standards, calibration, introduction to static characteristics and dynamics characteristics, selection of instruments, loading effects. Dynamic characteristics of measurement systems. *Introduction to various types of sensors:* Definition, principle of sensing & transduction, classification, selection and applications of Sensors., Measurement of parameter : Measurement of length ,angle, area , temperature , pressure flow , speed, force , torque, vibration , level , concentration (conductivity and ph) measurement . Flow measurement using magnetic flow measurement. Piezoelectric transducer. *Micro-sensors and smart sensors:* Construction, characteristics and applications. *Electronic Instruments:* Role and importance of general purpose test instruments, Electronic Millimeter, Cathode Ray Oscilloscope, Measurement of amplitude, frequency and phase using CRO Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator. Display devices and recorders like X-Y & X-T recorders. *Automation:* Introduction to plant automation, automation hierarchy, PLC, SCADA

Practical

1. Strain gauge characteristics and weight measurement.
2. Measurement of pressure using bellows and diaphragm.
3. Preparations and calibration of thermocouple.
4. Study the construction and working Bourdon pressure gauge.
5. Test and calibration of pressure gauges using dead weight tester.
6. Study the mechanism of pH meter and its electrodes.
7. Study of proximity sensor
8. Study the different parts and working of pressure switch.
9. Study the different parts of an indicating instrument.
10. Study of RTD and Thermister.
11. Study of different speed measurement sensor/ instruments.

12. Study of LVDT.
13. Study of level/ flow controller.
14. Study of PLC.
15. Visit to an automatic controlled dairy plant.

DE 312 Material Strength & Dairy Machine Design

3(2+1)

Theory

Strength of Materials: Basic concepts in Statics and Dynamics. Force Systems. Equilibrium condition, friction, Law of friction, Second moments of inertia, Parallel axis theorem. Dynamics: Equation of motion. Translation and rotation of a Rigid body, work and mechanics of materials: Stress-Axial Load classification Strain-Hooke's law, stress-strain diagram, Poisson's Ratio: Shearing Stresses. Torsion, Torsion formula, Angle to Twist of circular members. Power transmission shear force and bending moments, Shear in Beams, Bending Moment in beams. Pure bending of beams, Flexural stress shearing stresses in beams relations between centre, Torsional and flexural loads. *Dairy Machine Design:* Procedures, Specification, strength, design factor, factor of safety selection of factor of safety. Materials and properties. Static strength, ductility, hardness, fatigue, designing for fatigue conditions. Theories of failure, Stresses in elementary machine parts, Design of a drive system. Design of length and thickness of belt. *Bearing:* Journal and Anti-friction bearings. Selection of ball, tapered roller and thrust bearing. Springs, helical and leaf springs. Energy stored in springs. Design and selection of springs.

Practical

1. Study of Resultant forces.
2. Stress-strain diagram evaluation of elastic constants.
3. Study of pulley, gears and V-belts in power transmission.
4. Shear force and bending moment diagrams – I (Ferrous Metals).
5. Shear force and bending moment diagrams – II (Non-Ferrous Metals).
6. Shear force and bending moment diagrams – III (Non- Metals).
7. Study of flexural stresses.
8. Study of shearing stresses in beams.
9. Study of fits and tolerances.
10. Design stresses in elementary machine parts.
11. Design of shafts.
12. Design of axles.
13. Design of keys.
14. Design of springs.
15. Design of couplings.
16. Design of bearings.

DE 321 Food Engineering

3(2+1)

Theory

Rheology: Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rheological parameters, properties of granular food and powders, Properties of solids foods, Viscoelastic models. Measurement of food texture. *Food Freezing*: Thermal properties of frozen foods. Prediction of freezing rates. Plank's equation, Design of food freezing equipment, Air blast freezers, Plate freezers, spiral freezers, and immersion freezers, IQF, storage of frozen foods. Freeze concentration. *Food dehydration*: Estimation of drying time for food products, constant rate period and falling rate period dehydration. Diffusion controlled falling rate period. Use of heat and mass balanced in analysis of continuous dryers, Classification of driers, tray, vacuum, vacuum band, tunnel, bin, solar, drying, freeze drying, spin flash. *Freeze dehydration*: Heat and mass transfer, Calculation of drying time, Industrial freeze drying. *Other food processing operations and equipments*: Equipment for pulping, fruit juice extraction, blanching, dehulling, size reduction, milling, extrusion and distillation.

Practical

1. To determine physical properties of food product
2. To determine viscosity of food product.
3. To study size reduction equipment
4. To study food freezers.
5. To study freeze drier.
6. To determine drying characteristics of food product.
7. To study Tray driers.
8. To study solar driers.
9. To study juice extraction equipment
10. To compare hot water and steam blanching.
11. To study construction and working of distillation system.
12. To study various size reduction equipment.
13. Design problems of Cold Store.
14. Visit to cold storage.
15. Visit to food processing plant.

DE 322 Energy Conservation and Management 2(1+1)

Theory

Introduction: Potential and opportunities of industrial energy conservation in dairy and food processing. Energy conservation Act 2001 and its important features, Schemes of Bureau of Energy Efficiency (BEE). Electricity Act 2003, Integrated energy policy. Energy management & audit: Definition, energy audit, need, types of energy audit. Energy audit approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution. Energy balances and computation of efficiencies of equipment. Role of Energy inspectors and Auditors in energy management. Electrical load management: Demand management, energy management information systems, Energy saving controllers and cost saving techniques. Quality of power, Power factor and its improvement. Transformers, losses in transformers. Energy savings in transformers. Electric motor-selection and application, Energy efficient motors. Variable Speed Drives and Variable

Frequency Drives (VFD) and their role in saving electric energy. Bureau of Energy Efficiency (BEE): Power saving guide with “Star Ratings” of electrical appliances: Induction Motors, Air conditioners, Refrigerators and Water Heaters. Industrial Lighting: Quality of light, types of light sources, energy efficiency, Light controls.

Energy efficiency and conservation in utilities:

High efficiency boilers, improved combustion techniques for energy conservation, Fluidized Bed Combustion and multi fuel capabilities. Energy conservation in steam distribution systems, efficient piping layouts, protective & insulation coverings in utility pipes. Steam conservation opportunities. Upkeep and maintenance of steam auxiliaries and fittings. Energy conservation in Refrigeration and AC systems (HVAC), Cooling towers, Pumps and pumping systems, Fans, Blowers, Air compressors. Maintenance and upkeep of Vacuum lines and Compressed air pipe lines. Conservation and reuse of water, water auditing. Energy conservation opportunities in Wastewater treatment.

Processing equipments: Improving efficiency and energy conservation opportunities in few important food processing operations like Thermal processes, Evaporation, Drying & Freezing. Role of steam traps in energy saving. Energy Savings methods in hot air generator, Thermic fluid heater, Steam radiator.

Energy conservation in buildings: Concepts of “Green Buildings”. Waste-heat recovery and thermal energy storage in food processing facilities. Condensate recovery and reuse. Application of recuperator to recover energy from flue gases from boiler, DG exhaust, hot air from spray dryer, FBD etc. Diesel generating sets (stand by AC Gen sets): Energy saving opportunities in DG sets, Fuel and Oil conservation; important regular maintenance aspects. Carbon credits and carbon trade: Concepts of CDM, economic and societal benefits. Cleaner energy sources: Introduction to Solar, and Bio-mass Energy; Solar thermal and photo-voltaic energy options for food processing industries. Role of automation in conservation of energy in dairy and food processing: Incorporation of enhanced PLC based computer controls and SCADA.

Practicals

1. Study of energy conservation Act 2001.
2. Study of schemes of BEE.
3. Study of concepts of energy balance in Unit Operations and System boundaries.
4. Solving examples on energy balance.
5. Solving problems on electrical energy use and management: Connected load, Maximum demand, Demand factor and Load curve.
6. Solving problems on electrical energy use and management: Maximum demand.
7. Solving problems on electrical energy use and management: Demand factor.
8. Solving problems on electrical energy use and management: Load curve.
9. Determination of load factor of an installation.
10. Study of use of power factor meter.
11. Determination of true power and wattles power using pf meters, Watt meter, Ammeter and Volt meter.
12. Study of performances of a general type of induction motor and energy and an energy efficient induction motor.
13. Study of use of VSD.
14. Study of various types of electrical appliances classified under different BEE star ratings.

15. Drawing energy Balance on a boiler. Collection of data, Analysis of results and determination of efficiency.
16. Exercise on energy audit of Students Experimental Dairy Plant.

DE 323 Dairy Plant Design And Layout

2(1+1)

Theory

Introduction of Dairy Plant design and layout: Type of dairies, perishable nature of milk, reception flexibility. Classification of dairy plants, Location of plant, location problems, selection of site. Hygienic design considerations for dairy processing plants. *Planning:* Dairy building planning, Process schedule, basis of dairy layout, importance of planning, principles of dairy layout. Space requirements for dairy plants, estimation of service requirements including peak load consideration. *Dairy plant design aspects:* General points of considerations for designing dairy plant, floor plant types of layouts, service accommodation, single or multilevel design. Arrangement of different sections in dairy, sitting the process sections, utility/service sections, offices and workshop. Arrangement of equipment, milk piping, material handling in dairies, Common problems, office layouts-flexibility. Development and presentation of layout, model planning, use of planning table in developing plot plant and detailed layout. *Building construction materials:* Floors, general requirement of dairy floor finishes, floors for different section of dairy. Foundations, walls doors and windows. *Other design aspects:* Drains and drain layout for small and large dairies. Ventilation, fly control, mold prevention, illumination in dairy plants. *Computer aided Design:* Introduction to CAD software.

Practical

1. Building symbols and convention.
2. Symbols for equipments.
3. Symbols for P & I diagrams
4. Study of process schedule.
5. To draw layout of collection/chilling centre.
6. Visit to dairy processing plant for understanding of layout of different sections.
7. To draw layout of small dairy plant.
8. To draw layout of small dairy plant using CAD.
9. To draw layout of medium dairy plant.
10. To draw layout of large dairy plant.
11. To draw layout of cheese plant.
12. To draw layout of ice-cream plant.
13. To draw layout of butter manufacturing unit.
14. To draw layout of ghee plant.
15. To draw layout of composite dairy plant

IV. DAIRY MICROBIOLOGY

DM 111 Fundamentals of Microbiology

3(2+1)

Theory

Overview of history and scope of microbiology: Discovery of Microorganisms and Microscopy (types, working principles and applications); Theories of Biogenesis and abiogenesis; Contributions of Leeuwenhoek, Pasteur, Tyndal, Joseph Lister, Robert Koch, Edward Jenner and Alexander Fleming; Scope and application of microbiology in fields like Dairy, Food, Pharmaceutical, Industrial, Medical and agriculture. *Classification of Microbes:* Microbial classification systems, numerical taxonomy, General properties and principles of microbial classification, Whittaker's five kingdom and Carl Woese's three domain classification system; Systematics of bacteria and Bergey's manual of systematic bacteriology, Phylogenetic tree. *Prokaryotic and Eucaryotic microorganisms:* Structure and functions of prokaryotic cells; Differences between prokaryotes and eukaryotes; Differences between cell wall of Gram positive and Gram negative bacteria; Structure of Archeal cell wall. *Microbial growth and nutrition:* Bacterial growth curve; factors affecting growth of bacteria, direct and indirect methods of measurement of bacterial growth; Bacteriostatic and bactericidal agents; Common nutrient requirements and nutritional types of microorganisms. *Diversity of Microorganisms:* Viruses: Structure and Classification; Bacteriophages; Differences between viruses and bacteria; Fungi: Classification of Fungi; Reproduction in Fungi; Protozoa and algae. *Microbial Ecology and Environmental Microbiology:* Microflora of air, soil and water and Microbes of Extreme environment like Archea. *Basics of Microbial Genetics and Host-Microbe interactions:* DNA as the genetic material, Structure of DNA/ RNA, DNA replication, transcription and translation; Basic concepts of immunology; Role of immune system in governing host-microbe interactions, Microbial Commensalism, Colonization, Infection, Disease and Vaccines

Practical

1. General instruction for microbiological laboratory
2. Microscope- simple and compound
3. Microbiological equipments; autoclave, hot air oven, incubator, centrifuge, colorimeter, laminar airflow, membrane filter.
4. Simple staining- methylene blue; crystal violet;
5. Negative staining.
6. Differential staining (Gram).
7. Differential staining (Spore, acid fast).
8. Motility of microorganisms - hanging drop technique.
9. Measurement of size of microorganisms by micrometry (ocular and stage).
10. Preparation of commonly used growth media liquid and solid
11. Preparation of simple and differential media
12. Isolation techniques for microorganisms – Streak, spread and pour plate.
13. Enumeration of microorganisms in air and soil.
14. Enumeration of microorganisms in soil
15. Enumeration of microorganisms in water: total viable count, coliform (MPN).
16. Visit to Microbiology Laboratory of Dairy/Food Industry.

DM 121 Microbiology of Fluid Milk

3(2+1)

Theory

Microbes associated with raw milk: Microbial contaminants of raw milk supplies, their sources during various stages of production i.e. milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms and preventive measures. Types of microbial spoilage - souring, curdling, bitty cream, proteolysis, lipolysis, abnormal flavors and discolouration. Mastitis milk - types of mastitis, causative micro-flora of mastitis, compositional and microbiological changes during mastitis infection, their processing and public health. *Concept of clean milk production:* Hygienic milk production system; Cleaning and sanitation of udder, animal, utensils, equipments and dairy farm environment; Microbiological quality of milk produced in organized and un-organized sector in India and comparative information in developed world; Microflora of aseptically drawn milk and its natural antimicrobial systems - immunoglobulins, lactoferrin, lysozyme and lactoperoxidase (LP) system. *Microbiological aspects of fluid milk:* Pasteurization, boiling, sterilization, ultra high temperature (UHT), non thermal (pulsed field) micro-filtration, bactofugation, standardization and homogenization. Significance of heat resistant and post processing contaminants in fluid milk with special reference to proteases and lipase enzymes and their role in spoilage of processed milk. Bio-film formation during processing and their control measures. *Public health aspects of fluid milk:* Microbial zoonotic diseases transmitted through fluid milk; Milk borne diseases - food infection, intoxication and toxin-infection caused *E. coli*, *Salmonella typhi*, *Staphylococcus aureus*, *Bacillus cereus*, *Listeria monocytogenes*, *Shigella species*, *Campylobacter* etc. Microbiological grading and legal standards of raw and processed milk.

Practical

1. Morphological examination of common dairy microorganisms (size and shape, arrangement and sporulation).
2. Estimation of microbial load and grading of raw milk by standard plate count (SPC)
3. Estimation of microbial load and grading of raw milk by direct microscopic count (DMC)
4. Grading of raw milk by dye reduction tests (MBRT)
5. Grading of raw milk by dye reduction tests (RRT)
6. Grading of processed/ market milk by total viable count, coliform and methylene blue reduction time.
7. Enumeration of psychrotrophic and thermophilic bacteria in raw and market milk
8. Enumeration of thermophilic and spore forming bacteria in raw and market milk
9. Detection of sources of contamination: Air, water, and utensils
10. Detection of sources of contamination: Equipment and personnel, line testing.
11. Spoilage of milk caused by microorganisms: Souring, sweet curdling and gassiness
12. Spoilage of milk caused by microorganisms: Lipolysis, ropiness, proteolysis and discolouration.
13. Detection of mastitis milks: pH, chloride content, Hotis test and CAMP test.
14. Detection of mastitis milks: SLST and somatic cell count
15. Detection and estimation of coliforms: presumptive, rapid coliform
16. IMViC Tests.

DM 211 Microbiology of Dairy Products

2(1+1)

Theory

Microbiology of Cream and Butter - Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in cream and butter; Microbiological aspects including defects in pasteurized (ripened/unripened cream), sterilized and UHT cream; Factors influencing the microbial growth during batch/continuous butter making process; Microbial Defects in butter - Bacterial/mold discoloration, enzymatic deterioration and their control measures; Regulatory microbiological standards. *Microbiology of Condensed, Evaporated and Dried products*: Type of microorganisms associated with condensed, evaporated and dried products, their growth/ survival during manufacture and storage; Microbial defects - Bacterial thickening / Mold button formation in SCM; Gassiness/bloating, Bacterial coagulation (Sour and sweet), Bitterness, Fishy flavor in evaporated milk; pre-heating/DSI temperature and their impact on microflora of dried products; Effect of reconstitution on microbial quality of milk powder including baby foods and survivability of pathogens; Regulatory microbiological standards

Microbiology of Ice Cream and Frozen desserts: Microenvironment in ice cream, microbiological quality of ingredients, critical process factors and their impact on entry of pathogens in ice cream and frozen desserts, their survival during storage, food poisoning outbreaks and legal standards. *Microbiology of Indigenous Milk Products*: Predominance of spoilage and pathogenic organisms in khoa and khoa based sweets – burfi, peda, gulabjamun, etc., paneer, Chhanna and Chhanna based sweets – rasogulla; kheer, shrikhand, dahi, kulfi etc.; Factors affecting the microbiological quality in reference to production, processing, storage and distribution; Microbial safety in relation to potential pathogens and their public health significance; Microbial defects, control measures and legal standards; Active packaging concepts and role in bio-preservation.

Practical

1. Microbiological examination of raw cream for Standard plate count (SPC), lipolytic and coliform counts, direct microscopic count (DMC) and dye reduction tests
2. Microbiological examination of pasteurized cream for Standard plate count (SPC) and coliform counts
3. Microbiological examination of sterilized and UHT cream for Standard plate count (SPC) and sterility test.
4. Microbiological examination of unsalted butter for SPC, psychrotrophic, lipolytic, coliforms and yeast and mold count; K.Q test.
5. Microbiological examination of salted butter for SPC, psychrotrophic, lipolytic, coliforms and yeast and mold count; K.Q test
6. Microbiological examination of concentrated milk for SPC, coliforms and yeast and mold
7. Microbiological examination of concentrated milk for spores, thermophilic and thermophilic counts.
8. Microbiological examination of dried milks for SPC, coliforms, *Staph. Aureus* and *B. cereus*,
9. Microbiological examination of dried milks for *E. coli*, *Salmonella*, Sulphite reducing clostridia and Staphylococcal enterotoxins.
10. Microbiological examination of ice-cream and other frozen desserts for SPC, coliforms and Staphylococcal counts;

11. Microbiological examination of ice-cream and other frozen desserts - Detection of *Salmonella* spp./*E. coli*.
12. Microbiological examination of khoa for SPC, coliforms and yeast and mold counts.
13. Microbiological examination of paneer for SPC, coliforms and yeast and molds counts.
14. Microbiological examination of shrikhand for SPC, Spores, coliforms, yeast and molds and Staphylococcal counts.
15. Microbiological examination of paneer and shrikhand for Spores, and Staphylococcal counts.
16. Microbiological examination of packaging materials for SPC, Spores and Yeast and mold counts.

DM 221 Starter Cultures and Fermented Milk Products

3(2+1)

Theory

Types, metabolism and propagation of starter cultures: History, classification and importance of starter Cultures in dairy industry; Single, multiple, defined and mixed strain starters; Probiotics and Special cultures like exopolysaccharide production; Propagation of starter cultures-concentrates - direct bulk and direct vat starter cultures, factors affecting propagation; Metabolism of starter cultures (carbohydrate, protein, citrate) and production of metabolites and antibacterial substances; methods of starter distillates their merits/demerits.

Activity, Purity, Preservation of Starters and Starter Failure: Quality and activity tests for dairy starters and their preservation- methods (liquid, spray drying, vacuum drying, freeze-drying, frozen concentrate, concentrated dried cultures), merits and demerits; factors affecting the survival of cultures during preservation; Defects in starters and their control; Starter failures- effect of antibiotic residues, sanitizers and bacteriophages. Phages-life cycle, sources, prevention, chemical and mechanically protected systems. *Role of Starters in fermented milks:* Role of starters in the preparation of various fermented milks; Types of fermented milks - dahi, yoghurt, acidophilus milk; different types of dahi and yoghurt; preparation; defects and their control. Kefir and koumiss : origin and characteristics; microbiology of kefir grains; Other fermented milks such as Bulgarian milk, cultured buttermilk, Leben, Villi and Yakult; Microbiology of fermented milk products; their nutritional and therapeutic significance. *Chesse Starters:* Classification, desirable properties, Artisanal and adjunct cheese cultures, primary and secondary flora of cheese; biochemical changes during ripening, bacterial and mold ripened cheeses: soft, semi-soft, semi-hard, hard, Brick and Brie cheese, Camembert and Roquefort cheese; Rennet: rennet substitutes, microbial rennet and recombinant chymosin

Practical

1. Testing purity of starter cultures by gram's staining, catalase test; creatine test.
2. Testing starter activity by dye reduction tests, Horrall-Elliker, White Head & Cox test.
3. Preparation of single and mixed starter cultures.
4. Evaluation of homo-fermentation and hetero-fermentation separately and in combination.
5. Preservation of starter cultures by freeze-drying techniques.
6. Preparation of concentrated starter (DVS).
7. Effect of physical factors (temperature, pH, Salt and Sugar) on dairy starters.
8. Testing milk for presence of inhibitory substances using *B. stearothermophilus* and *S. thermophilus* as indicator organisms.

9. Effect of presence of antibiotic residues in milk on starter activity.
10. Evaluation of associative growth of Starter cultures in milk.
11. Detection of Bacteriophages in cheese whey by plaque assay method.
12. Preparation and microbial examination of dahi
13. Preparation and microbial examination of yoghurt
14. Preparation and microbial examination of cultured butter milk, acidophilus milk and kefir
15. Analysis of cheese for total spore and anaerobic spore count.
16. Microbiological analysis of cheddar cheese at different stages of manufacture of (storage and ripening).

DM 311 Quality and Safety Monitoring in Dairy Industry

3(2+1)

Theory

Consumer Awareness about Microbiological Quality and Safety of Dairy Foods: Changing scenario; Concepts of quality control, quality assurance and food safety; Global quality and food safety standards, Integrated food law, its main features and functions. *Introduction to Food Safety Management System:* Concepts of Quality Management System (QMS)–ISO: 9000:2000; Principles of QMS; Standard requirements for QMS; HACCP concept and principle with special reference to biological hazards in dairy foods, TQM tools and techniques. *Microbiological Risk Analysis Concepts:* Risk assessment, risk management and risk communication; risk profiling of dairy products; Microbiological criteria and two and three class sampling plan / guidelines; Bio-safety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant. *Rapid Enumeration Techniques:* Enumeration principles and procedure for rapid detection of predominant hygiene indicator organisms and pathogens like *E. coli* (*E. coli* O157:H7), *Salmonella*, *Shigella*, *Staphylococcus aureus*, *Bacillus cereus* and *Listeria monocytogenes*. *Role of Biosensors for monitoring hygiene and safety of dairy foods:* Detection of antibiotic residues in milk –Delvo SP, MDR test, penzyme test, charm assay, lateral flow assay (ROSA test) etc. Detection of aflatoxins, pesticides other inhibitors etc. and their public health importance in dairy foods. *Plant and equipment hygiene:* Concepts of hygiene and sanitation, microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply, quality of air, personnel hygiene, treatment and disposal of waste water and effluents.

Practical

1. Rapid detection of total plate count, yeast and mold counts, Coliform, count using D-count
2. Rapid detection of total plate count, yeast and mold counts, Coliform, count using 3M Petrifilm kits.
3. Rapid detection of *E. coli*, Enterococci, Enterobacteriaceae count using D- count
4. Rapid detection of *E. coli*, Enterococci, Enterobacteriaceae count using 3M Petrifilm kits.
5. Rapid detection of *Staphylococcal enterotoxins* based on antigen antibody principle using VIDAS system
6. Rapid detection of *E. coli* O157:H7 based on antigen antibody principle using VIDAS system
7. Rapid detection of *Listeria monocytogenes* based on antigen antibody principle using VIDAS system

8. Rapid detection of *Salmonella* based on antigen antibody principle using VIDAS system.
9. Rapid detection of antibiotic residues in milk using Delvo SP, MDR test, Charm assay, Lateral flow assay (ROSA test).
10. Rapid detection of aflatoxin M1/ pesticides residues in milk using Charm Assay, Lateral Flow Assay (ROSA test) / Enzyme Inhibition Assay using Luminometer.
11. Evaluation of common sanitizing agents used in dairy plants by suspension test.
12. Evaluation of common sanitizing agents used in dairy plants by capacity test.
13. Microbiological tests for assessing equipment and personnel hygiene by swab methods

14. Microbiological tests for assessing equipment and personnel hygiene by rinse methods
15. Determination of BOD in dairy waste water
16. Quality evaluation by HACCP in the preparation of dairy products

DM 321 Food and Industrial Microbiology

3(2+1)

Theory

Scope of food microbiology: Basic aspects, history and scope of food microbiology. Intrinsic and extrinsic factors that affect microbial growth in different foods.

Microbial Spoilage of foods: Microbial spoilage of fruits, fruit juices, vegetables, cereals, meat, poultry, sea foods, carbonated soft drinks, canned foods; Sources of contamination; Control of spoilage. *Food preservation:* Principles of food preservation : physical methods viz. low temperature and high temperature preservation (D, Z and F Values); Drying Methods; Chemical preservatives, Natural antimicrobial compounds and bio- preservation; Mode of action of various preservation methods on microbes. *Fermentation processes:* Fermentation processes : Historical development, the range, components and types (i.e. submerged, surface and solid state fermentation); criteria for selection of industrially important microorganisms; preservation and improvement of industrially important microorganisms using metabolic engineering/genetic engineering; media for industrial process; upstream and downstream processing. *Types of fermenters:* Fermenters: types (batch, fed batch and continuous), functions, design and control; sterilization; growth rate analysis, estimation of biomass; difference in chemostat and turbidostat. *Microbial production of industrial products:* Immobilization of enzymes/cells; Microorganisms and processes involved in the production of single cell protein and industrial alcohol, beer and wine; organic acids (citric and lactic), enzymes (protease, lipase and rennet), vitamin (B₁₂), antibiotics and bacteriocins; and fermented whey beverages.

Practical

1. Microbiological examination of fresh and canned fruits
2. Microbiological examination of fresh and canned vegetables
3. Microbiological examination of fresh and canned juices
4. Microbiological examination of flour and bread
5. Microbiological examination of eggs
6. Microbiological examination of meats
7. Isolation of psychrophilic, salt and sugar tolerant microorganisms from foods.
8. Isolation of industrially important microorganisms from environment.
9. Determination of Z, D and F values.
10. Production and assaying of microbial enzymes (protease/ lipase).

11. Production of lactic acid from whey
12. Production of nisin and assaying the antimicrobial activity of the culture
13. Design and control of a table-top and 10 liter lab fermenter (Demonstration)
14. Production of ethyl alcohol from molasses and whey by yeasts
15. Production of fermented whey beverages
16. Educational tour to food processing/ fermentation industries

V. DAIRY TECHNOLOGY

DT 211 Market Milk

4(3+1)

Theory

Market milk industry in India and abroad: Distinctive features of tropical dairying as compared to those of the tropical climate of developed countries. Collection and transportation of milk; a) Organization of milk collection routes b) Practices for collection of milk, preservation at farm, refrigeration, natural microbial inhibitors, lactoperoxidase system. Reception and treatment (pre-processing steps) of milk in the dairy plant: a) Reception, chilling, clarification and storage: General practices. b) Homogenisation: Definition, pretreatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST) c) Effect of homogenization on physical properties of milk. d) Bactofugation: Theory and microbiology. Thermal processing of milk: a) Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q_{10} value. b) Factors affecting thermal destruction of microorganisms. c) Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing. d) Product control in market milk plant. e) Defects in market milk. f) Manufacture of special milks: toned, doubled toned, reconstituted, recombined, flavoured, homogenized, vitaminised and sweet acidophilus milk. g) Manufacture of sterilized milk. h) Distribution systems for market milk. UHT processing of milk: a) Relevance of UHT processing in the tropical climate b) UHT plants: Description. Direct, Indirect, with upstream and downstream homogenization, third generation UHT plants. c) Aseptic packaging, types and systems of packaging, sterilizing packages, filling systems. d) Technical control in the UHT plant. e) Shelf life of UHT milk and tests for UHT milk. Nutritive value of milk. Effect of heat processing on nutritive value. Cleaning and sanitization of dairy equipment.

Practical

1. Familiarization with equipments for reception of milk in plant.
2. Pretreatments: Chilling, clarification, filtration of milk.
3. Standardization and numericals relating to it.
4. Cream separation: parts of separator and the process.
5. Operation of LTLT, HTST pasteurizer, laboratory steriliser.
6. Preparation of toned and double toned milks.
7. Preparation of standardised milk.
8. Preparation of flavoured milks.
9. Preparation of sterilised milk.
10. Cleaning of storage tanks, cream separators, HTST plants
11. Manual cleaning and CIP.
12. Detection of adulterants and preservatives in milk.

13. Assessment of homogenisation efficiency in milk.
14. Strength of common detergents used in market milk plant.
15. Strength of common sanitizers used in market milk plant.
16. Visit to the Market Milk Plant

DT 212 Fat-Rich Dairy Products

3 (2+1)

Theory

Status of fat-rich dairy products in India and abroad. *Cream*: a) Definition & Legal standards, efficiency of cream separation and factors affecting it; control of fat concentration in cream. b) Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream. c) Preparation and properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and chip-dips (cultured cream), UHT processing of cream. d) factors affecting quality of cream; ripening of cream e) Packaging, storage and distribution, defects (non-microbial) in cream and their prevention. *Butter*: a) Introduction to the butter making process; theory of churning, Legal standards. b) Technology of Butter manufacture, Batch and continuous methods. Over-run in butter; control of fat losses in butter-milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter. Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butter churn and continuous butter making machine. Special butters and related products: a) Manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter, renovated butter/fractionated and polyunsaturated milk fat products, vegetable oil-blended products and low-fat spreads. b) Manufacture, packaging, storage and characteristics of margarine of different types. *Ghee and butter oil*: a) Methods of ghee making-batch and industrial processes, innovations in ghee production, procedure, packaging and preservation of ghee; utilization of substandard milk. b) Ghee: Composition and changes during manufacture fat constants. C) Butteroil: Manufacture of butteroil, packaging and storage.

Practical

1. Study of Cream Separators
2. Calculation of skimming efficiency and yield of cream.
3. Standardization of cream for consumer products.
4. Neutralization of cream.
5. Pasteurization and cooling of cream.
6. Preparation of sterilized cream.
7. Study of construction and cooperation of the power operated butter churn and butter packaging machine.
8. Preparation of cooking butter by the hand operated churn.
9. Preparation of desi butter.
10. Manufacture of table butter using the power-driven churn.
11. Moisture Control in Butter
12. Preparation of ghee from cream and butter
13. Preparation of Butter oil.
14. Preparation of Low Fat Butter Spread
15. Study and operation of continuous ghee plant.
16. Visit to the Fat Rich Dairy Product Plant

DT 213 Traditional Indian Dairy Products

3(2+1)

Theory

Status and significance of traditional Indian milk products in India. *Khoa*: Classification of types, standards methods of manufacture and preservation, factors affecting yield of khoa. Mechanization in manufacture of khoa. *Khoa based sweets*: Burfi, Peda, Milkcake, Kalakhand, Gulabjaman and their compositional profile and manufacture practices. *Rabri and Basundi*: Product identification, process description, factors affecting yield, physico-chemical changes during manufacture. *Channa*: Product description, standards method of manufacture, packaging and preservation. *Chhana-based sweets*: Rasogolla, Sandesh, Rasomalai. Mechanization of manufacturing process, advances in preservation and packaging. *Paneer*: Product description, standards, method of manufacture, packaging and preservation. Mechanization of Paneer manufacturing/packaging process. *Chakka/Maska and Shrikhand*: Product description, standards, method of manufacture, small scale and industrial process of production, packaging and preservation aspects. *MistiDahi*: Product description method of manufacture and packaging process. *Kheer and Payasam*: Product description methods of manufacture, innovations in manufacturing and packaging processes. Bio preservative principles in enhancing the self-life of indigenous milk products including active packaging.

Practical

1. Preparation of Khoa from cow, buffalo and concentrated milk.
2. Analysis of Khoa for total solids, moisture, fat and acidity
3. Preparation of Basundi
4. Preparation of Burfi and Peda
5. Preparation of Kalakand and Milkcake
6. Preparation of Gulabjamun.
7. Preparation of Paneer from cow, buffalo and mixed milk.
8. Analysis of Paneer for total solids, moisture, fat and acidity
9. Preparation of Chhana from cow and buffalo milk and mixed milk.
10. Analysis of Chhana for total solids, moisture, fat and acidity
11. Preparation of Sandesh and Rasogolla.
12. Preparation of kheer and Rabri.
13. Preparation of Lassi and Butter Milk
14. Preparation of, MistiDahi,
15. Preparation of Chhaka and Shrikhand.
16. Visit to the Market Milk Dairy Plant

DT 214 Condensed and Dried Milks

4(3+1)

Theory

Condensed Milks: History, status and scope in India and abroad, Definition and legal standards: Condensed milk, sweetened condensed milk and evaporated milk, manufacturing techniques; a) Manufacture of evaporated milk including pilot sterilization test, b) Manufacture of sweetened condensed milk, c) Recombined sweetened condensed milk. Grading and quality of raw milk for condensed and evaporated milk, Physico-chemical changes taking place during manufacture of condensed milk, Heat stability of milk and condensed milk and role of stabilizers in the stability of condensed milk, Chemical defects in

condensed milk, their causes and prevention. Recent advances with reference to freeze concentration and membrane concentration. *Dried Milks*: History and status in India and abroad, Grading and quality of raw milk for dried milks, Manufacture of skim milk powder (SMP), whole milk powders and heat classified powders, Physico-chemical changes taking place during manufacture of dried milks, Physical properties of dried milks, Defects in dried milk during manufacture and storage, their causes and prevention, PFA, BIS and International Standards for dried milk, Manufacture of infant foods, malted milk foods and other formulated dried products, Cheese spread powder, ice cream powder, cream powder, butter powder, whey powder, Management of condensed and dried milk industry.

Practical

1. Testing the suitability of milk for concentration
2. Standardization of milk for preparation of Concentrated Milks.
3. Manufacture of plain skim concentrated milk.
4. Manufacture of Sweetened Condensed Milk.
5. Analysis of Sweetened Condensed Milk
6. Manufacture of Evaporated Milk.
7. Pilot Sterilization test for Evaporated milk
8. Analysis of Evaporated Milk
9. Concentration of milk by membrane processing.
10. Manufacturing of Skim Milk Powder by spray drying
11. Manufacturing of Skim Milk Powder by roller drying
12. Analysis of Dried Milk
13. Manufacture of instant milk powder.
14. Manufacture of Infant Food
15. Manufacture of Dairy Whiteners
16. Visit to the Condensed and Dried Milk Plant

DT 221 Cheese Technology

4 (2+2)

Theory

Origin and history of development of cheese manufacture, status and scope in India and abroad. Definition, standards and classification of cheese. Milk quality in relation to cheese making. Pre-treatment of milk; Physical and chemical. Additives and preservatives for cheese making. Rennet preparation and properties, rennet substitutes. Action of rennet on milk in relation to cheese making. Manufacture of different varieties of cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage. Enzyme modified cheese (EMC), flavourings, Application of membrane processing in cheese manufacture. Factors affecting yield of cheese. Packaging, storage and distribution of cheese. Accelerated ripening of cheese. Manufacture of processed cheese, cheese spread and processed cheese foods. Mechanization and automation in cheese processing.

Practical

1. Familiarization with equipments and accessories
2. Familiarization with Cheese varieties

3. Standardization numerical.
4. Standardization of casein/fat ratio
5. Testing the milk for cheese making
6. Study of factors affecting rennet action.
- 7-9 Manufacture of Cheddar cheese.
- 10-12. Manufacture of Gouda cheese.
- 13-15 Manufacture of Mozzarella cheese by Traditional Method
- 16-17. Manufacture of Mozzarella cheese by Direct Acidification Method
- 18-20. Manufacture of Swiss cheese.
- 21-23. Manufacture of un-creamed Cottage cheese.
- 24-26. Manufacture of creamed Cottage cheese.
- 27-28. Manufacture of Feta cheese.
29. Manufacture of processed cheese
30. Manufacture of processed cheese spread
31. Manufacture of processed cheese food
32. Visit to the Cheese Industry

DT 222 Ice-Cream and Frozen Desserts

3(2+1)

Theory

History, development and status of ice cream industry, History, development and status of ice cream industry, Definition, classification and composition and standards of ice cream and other frozen desserts, Stabilizers and emulsifiers-their classification, properties and role in quality of ice cream, Technological aspects of ice cream manufacture, Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control / instrumentation, Types of freezers, refrigeration control / instrumentation, Hygiene, cleaning and sanitation of ice cream plant, Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix and control of overrun, Packaging, hardening, storage and shipping of ice-cream, Defects in ice cream, their causes and prevention, Recent advances in ice-cream industry (flavourings, colourings, fat replacers, bulking agents) and plant management, Nutritive value of ice-cream.

Practical

1. Calculation of standardization of ice-cream mixes.
2. Manufacture of plain ice-cream.
3. Manufacture of fruit flavoured ice-cream
4. Manufacture of chocolate ice cream.
5. Manufacture of fruit ice cream.
6. Manufacture of nut ice cream.
7. Preparation of sherbet.
8. Preparation of ices.
9. Preparation of soft served ice-cream.
10. Preparation of filled ice-cream.
11. Manufacture of kulfi.
12. Study of batch type freezers.
13. Study of continuous type freezers.
14. Manufacture of ice-cream by continuous process.
15. Determination of overrun in ice cream.

16. Visit to the Ice cream Industry.

DT 311 Packaging of Dairy Products

3(2+1)

Theory

Introduction, Importance of Packaging, History of Package Development, Packaging materials, a) Characteristics of basic packaging materials: Paper (paper board, corrugated paper, fibre board), Glass, Metal, Plastics, Foils and laminates, retort pouches, Package forms, Legal requirements of packaging materials and product informatio. Packaging of milk and dairy products such as pasteurized milk, UHT-sterilized milk, aseptic packaging, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeades, concentrated and dried milks including baby foods.Packaging of functional dairy/food products. Modern Packaging Techniques; Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Principles and methods of package sterilization, Coding and Labelling of Food packages, Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipments (including aseptic tank) and machines- Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP, Microbiological aspects of packaging materials. Disposal of waste package materials, Packaging Systems. Hazards from packaging materials in food

Practical

1. Identification of packaging materials
2. Flame Hot wire test
3. Testing of papers/paperboards for Percentage moisture
4. Testing of papers/paperboards for Grease resistance
5. Testing of papers/paperboards for Water absorptiveness
6. Testing of papers/paperboards for Grammage
7. Testing of papers/paperboards for Tearing resistance
8. Testing of papers/paperboards for Bursting strength.
9. Testing of papers/paperboards for Puncture resistance
10. Testing of glass bottle for resistance to thermal shock.
11. Identification of various plastic packing materials
12. Testing of plastics and laminates for Thickness and Water vapour transmission rate (WVTR)
13. Testing of plastics and laminates for Grease resistance.
14. Packaging of different dairy products by using prepak
15. Packaging of different dairy products by vacuum packaging machines.
16. Visit to the Dairy Plant

DT 312 By Product Technology

3(2+1)

Theory

Status, availability and utilization of dairy by-products in India and Abroad. Associated economic and pollution problems, Physico-chemical characteristics of whey, butter milk and ghee residue, *By-products from skim milk: Casein*: types of commercial casein, their specifications, manufacturing processes with basic principles involved. b) Industrial and food uses of caseins c) Manufacture of sodium and calcium caseinates their physico-chemical and functional properties and food applications d) Manufacture of casein hydrolysates and its

industrial application e) *Cooprecipitates*: types, their specifications, manufacturing processes with basic principles involved, functional properties and food applications. *Whey processing*: a) Fermented products from whey, b) Beverages from whey c) Deproteinized and demineralized whey d) Condensed whey e) Dried whey, types and their specification, manufacturing techniques. F) Utilization of whey products. Application of membrane processing for whey processing. *Whey protein concentrates*: a) Methods of isolation with basic principles involved, physico-chemical properties of whey proteins concentrates b) Functional properties and food applications of WPC. *Lactose*: methods for the industrial production of lactose, refining of lactose, uses of lactose and hydrolysis of lactose. Butter milk processing: a) Condensed butter milk b) Dried butter milk c) Utilization of butter milk products. *Ghee residue*: Composition, processing and utilization. Nutritional characteristics of by products.

Practical

1. Manufacture of acid casein from cow and buffalo milk.
2. Manufacture of edible casein from cow and buffalo milk.
3. Manufacture of rennet casein.
4. Manufacture of sodium caseinate.
5. Manufacture of calcium caseinate.
6. Manufacture of co-precipitate.
7. Isolation of whey proteins by cold precipitation technique.
8. Manufacture of whey protein concentrate by ultra filtration process.
9. Manufacture of whey drinks.
10. Manufacture of dried whey.
11. Manufacture of lactose.
12. Incorporation of whey protein concentrates in processed cheese foods.
13. Manufacture of coffee whitener.
14. Preparation of coconut candy from ghee residue
15. Preparation of chocolate from ghee residue
16. Visit to the Dairy Plant

DT 321 Sensory Evaluation of Dairy Products 3(2+1)

Theory

Introduction, definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects. Terminology related to sensory evaluation. Design and requirements of a sensory evaluation laboratory. Basic principles: senses and sensory perception. Physiology of sensory organs. Classification of tastes and odours, threshold value. Factors affecting senses, visual, auditory, tactile and other responses. Fundamental rules for scoring and grading of milk and milk products. Procedure and types of tests – difference tests (Paired comparison, due-trio, triangle) ranking, scoring, hedonic scale and descriptive tests. Panel selection, screening and training of judges. Requirements of sensory evaluation, sampling procedures. Factors influencing sensory measurements. Milk: score card and its use. Judging and grading of milk, defects associated with milk. Cream: desirable attributes and defects in cream, Score card for cream, sensory evaluation of different types of cream. Butter: Specific requirements of high grade butter, undesirable attributes of butter, butter score-card, sensory evaluation of butter. Ghee: grades of ghee, special requirements of quality ghee, defects in ghee, sensory evaluation of ghee. Fermented milks: desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt, chakka, srikhand,

lassi and other fermented drinks. Frozen dairy products: desirable and undesirable characteristics of frozen dairy products. Sensory evaluation of ice cream, kulfi and milk sherbets. Cheese: sensory ~~Quality~~ attributes of some common cheese varieties and their defects, score card for cheese. Sensory evaluation and grading for cheddar, cottage and other varieties of cheeses. Dried dairy products: desirable and undesirable characteristic of dried milks. Sensory evaluation and grading of dry milk products. Concentrated milks: desirable attributes and defects. Sensory evaluation and grading of evaporated and condensed milk. Heat desiccated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of khoa and khoa based sweets. Acid coagulated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of paneer, chhana and chhana based sweets. Consumer acceptance studies: Objectives, methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and consumers studies, limitations. Interrelationship between sensory properties of dairy products and various instrumental and physico-chemical tests.

Practical

1. Determination of threshold value for basic tastes.
2. Determination of threshold value for various odours.
3. Selection of sensory evaluation panel.
4. Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests.
5. Sensory evaluation of milk
6. Sensory evaluation of milk cream.
7. Sensory evaluation of butter and ghee.
8. Sensory evaluation of condensed and evaporated milk.
9. Sensory evaluation of milk powders.
10. Sensory evaluation of cheese and related products.
11. Sensory evaluation of frozen products.
12. Sensory evaluation of khoa and khoa-based sweets.
13. Sensory evaluation of chhana and chhana based sweets.
14. Sensory evaluation of dahi and fermented dairy products.
15. Preparation of milk and milk products with defects, techniques for simulation.
16. Novel techniques of sensory evaluation.

DT 322 Food Technology-I

3(2+1)

Theory

Status of food processing industries in India and abroad, magnitude and inter-dependence of dairy and food industry, prospects for future growth in India. Harvesting, transportation and storage of fruits and vegetables. *Post harvest processing of fruits and vegetables*: Peeling, sizing, blanching, Canning of fruits and vegetables, Drying and freezing of fruits and vegetables. *Juice processing*: General steps in juice processing, role of enzymes in fruit. Juice extraction, equipments and methods of fruit juice extraction, preservation of fruit juices, fruit juice clarification, concentration of fruit juices, fruit juice powders. Fruit juice processing; Orange and tangerine, Lemon and lime juice, Apple juice, Grape juice, Nectars, pulpy juices, tropical blends, Vegetable juices. *Manufacture of Jam, Jelly and Marmalade*: Role played by pectin, sugar and acid in jellied fruit products. Fruits and vegetable preserves, Glazed, Crystallized fruits. Tomato based products: Juice, puree, paste, sauce, ketchup.

Pickles: Principle of pickling, technology of pickles. *Beverages*: Classification, scope, carbonated non-alcoholic beverages and their manufacture. Fruit beverages and drinks, additives for fruit based beverages. *Coffee*: Production practices, structure of coffee/cherry, Coffee processing including roasting, grinding, brewing extraction, dehydration, aromatization, instant coffee. *Tea*: Tea leaf processing, green, red, yellow, instant tea. *Technology of confectionery foods*: Candies, Chewing gums and bubble gums, Toffees, Caramels, Standards of confectionery products. *Chocolate products*: Cocoa bean processing, chocolate liquor, Standards of confectionery products. *Functional foods*: Introduction, Phytochemicals, Milk ingredients as nutraceuticals, fiber-rich food products etc.

Practical

1. Manufacture of toffees.
2. Manufacture of caramels.
3. Testing the efficacy of blanching process
4. Drying of fruits and vegetables
5. Preparation of fruit based drinks and beverages
6. Ready-to-serve drink, Nectar, Squash,
7. Whey-fruit based beverages.
8. Manufacture of fruit jam.
9. Manufacture of fruit jelly.
10. Manufacture of chocolate confections.
11. Manufacture of tomato ketchup/tomato sauce.
12. Manufacture of soups.
13. Manufacture of fruit preserve.
14. Manufacture of candied fruits.
15. Manufacture of fruit bar
16. Manufacture of pickles

DT 411 Student READY In-Plant Training

20 (0+20)

Practical:

In-plant training in commercial dairy and or dairy food processing plants to acquire state of art of technology through exposure to actual field conditions. This will be conducive in enhancing linkages between academic institutions and industry and for more job opportunities to outgoing students. The in-plant training and evaluation will be as per the manual to be used

DT 421 Dairy Plant Management

2(1+1)

Theory

Production Management: Definition, Function and structure of Production Management, Production planning & Control, Work study and measurement motion and time study. *Efficiency of plant operation*: product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency. *Plant Operations*: Energy conservation and Auditing, Product and process control, Control charts, Process Sigma, Efficiency factors losses, Financial and Managerial efficiency. Provision for Industrial Legislation in India, particularly in dairy industry, Factory Act & Regulations. *Human Resource Management*: Personnel Management, Manpower planning, recruitment, training, transfer, promotions policies, Job specifications, Job evaluation, Job enhancement, Job

enrichment, MBO, working conditions. *Safety hazards*: hazards prevention, security for plant machinery and the employees, Plant Maintenance. *Prevention & Break-down maintenance*: Spare parts inventory, tools & lubricants, etc. *Food hygiene*: personnel hygiene, plant hygiene, water quality, etc.

Practical

1. Flow process charts of Heat Desiccated milk products
2. Flow process charts of Fat Rich Dairy products
3. Flow process charts of fermented products
4. Flow process charts of Heat and acid coagulated products
5. Flow process charts of milk puddings
6. Identification of steps of material losses on dairy plants.
7. Identification of hazardous processes and equipments, safety and precautions.
8. Identification and uses of common lubricants.
9. Analysis of cleaning agents
10. Analysis of sanitizers
11. Reports and Records maintenance of dairy plant
12. Operational Precautions
13. CIP Cleaning of Homogenizer
14. CIP cleaning of HTST pasteurizer
15. CIP cleaning of Ice Cream Plant
16. Visit to the Dairy Plant

DT 422 Waste Disposal and Pollution Abatement 2(1+1)

Theory

Wastes discharged from dairy plants: An overview. Wastewater discharged from a) Milk reception dock b) Liquid milk processing section, c) Butter and ghee manufacturing, d) Ice-cream and condensed milk manufacturing, e) Milk powder manufacturing, f) Cheese and paneer manufacturing. Packaging wastes. *Environmental issues in effluent discharge*: a) Effects on waterways, b) Effects on land c) Effects on the atmosphere d) Solid waste. *Waste treatment process in a dairy processing plant*: Wastewater treatment options for A Dairy Processing Plant. Calculation of wastes discharged and the economics thereof.

Practical

1. Waste Utilization processes.
2. Different types of wastes generated in dairy industry
3. Different types of pollutions in dairy industry
4. Various treatments in waste disposal.
5. Waste Generated in Liquid milk processing section
6. Waste Generated in Butter and ghee manufacturing
7. Waste Generated in Ice-cream manufacturing
8. Waste Generated in condensed milk manufacturing
9. Waste Generated in Milk powder manufacturing
10. Waste Generated in CIP section
11. Waste Generated in Cheese and paneer manufacturing
12. Packaging wastes
13. Calculation of wastes discharged and the economics thereof.

14. Analysis of effluent BOD and COD
15. Waste minimization methods
16. Visit to the dairy Effluent treatment plant

DT 423 Food Technology-II

3(2+1)

Theory

Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds, Milling of paddy, quality factors of rice grains, processing of rice bran oil, Instant rice, quick cooking rice, canned rice, Milling technology of wheat, Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour, Milling technology of maize, wet milling of corn, Milling technology of barley, malting of barley and its utilization in manufacture of value added food products including malted milk foods, Dehulling and processing technology of important pulses, Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut, Vegetable protein concentrates/isolates, Utilization of oil cake in food formulation. *Bakery and Snack technology:* Technology of bread, biscuits, crackers and cakes, Technology of manufacturing process of Pasta foods- Macaroni, Noodles and Spaghetti, Technology of breakfast cereals: corn flakes, puffed, extruded snacks, Potato chips. *Meat, fish and egg technology:* Development of meat, poultry, egg and fish industry in India, Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques, Postmortem inspection, rigor mortis and conversion of muscle to meat Slaughterhouse sanitation, meat hygiene and zoonotic diseases, Processing of poultry meat, Egg and egg products – quality assessment of egg, Types, handling, transportation and marketing of fish, Preservation of fish., Manufacturing process of dehydrated fish and fish pickles. Cleaning and sanitation, Waste management of food processing plants.

Practical

1. Manufacture of barley malt.
2. Determination of cooking quality of rice.
3. Manufacture of bread and bun.
4. Manufacture of biscuits.
5. Preparation of noodles.
6. Preparation of cake.
7. Manufacture of potato chips.
8. Preparation of malt based food products.
9. Manufacture of malted milk foods.
10. Manufacture of soy beverage
11. Manufacture of tofu
12. Preparation of salami.
13. Preparation of chicken soup.
14. Manufacture of chicken pickle.
15. Cleaning and sanitation food processing plant
16. Waste management of food processing plant

DT 424 - Student READY Experiential Learning Module

12. Organizing Pulse Polio Camp.
13. Organizing AIDS Awareness Rally
14. Celebrating NSS Day.
15. Observing National Days.
16. Observing United Nations Notified Days.

Student READY Rural Dairy Work Experience Program : 10 (0+10)

Student READY Rural Dairy Work Experience Program will be implemented in two parts as per ICAR V Deans Committee recommendations with 10 (0+10) non-evaluated credits equally distributed during I and II Years. The student will undergo various dairy production and processing activities during the summer breaks.

**Student READY Rural Dairy Work Experience Program-I 5 (0+5)
(Summer Break after II semester)**

The Student READY Rural Dairy Work Experience Program-I is aimed at provide exposure to the students to the areas on Milk Production & Procurement to be taken up in State Dairy Federations/ Dairy Development Departments/ Private Dairies/ Animal Husbandry Department/ Cattle farm/ Progressive dairy farmersthrough visits/tours//survey/training programmes.

**Student READY Rural Dairy Work Experience Program-II 5 (0+5)
(Summer Break after IV semester)**

The Student READY Rural Dairy Work Experience Program-II is aimed at exposure of students on Preliminary Dairy Operations to be taken up in Experimental Dairy/ Referral lab/ Dairy Plants / Exposure to Product manufacturing operations in Dairy & Food Industry through field visits/tours//survey/training programmes

REGULATIONS AND COURSE CATALOGUE

**B.V.Sc., & A.H. Degree
Academic Year 2009-2010 Onwards**

(As amended up to 27-10-2015)



**Faculty of Veterinary Science
SRI VENKATESWARA VETERINARY UNIVERSITY
Tirupati – 517502**

REGULATIONS AND COURSE CATALOGUE

**B.V.Sc., & A.H. Degree
Academic Year 2009-2010 Onwards**

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**Faculty of Veterinary Science
SRI VENKATESWARA VETERINARY UNIVERSITY
Tirupati – 517502**

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PREFACE

The Veterinary Council of India has framed the Minimum Standards of B.V.Sc & A.H Degree Course Regulations, 2008 in supersession of its notification vide GSR 69 (E) dated 7th February,1994. According to the VCI - MSVE Regulations, 2008 the Veterinary curriculum is comprised of six components of study i.e., Core Courses, Tracking Programmes, Study Circles, Entrepreneurial Training, Internship and Competence in Skills.

The curriculum is meant to provide adequate emphasis on cultivating logical and scientific habits of thought, clarity of expression, independence of judgment, ability to collect information and develop habits of self education. The curriculum lays emphasis on personality development and character expression for an independent professional career of the graduate. Thus, the overall emphasis is on developing a graduate with a thorough knowledge of the subject and practical skills for animal welfare and enhancing livestock productivity.

The University has implemented the VCI Regulations, 2008 from the Academic year 2009-10 onwards and accordingly the Regulations and Course catalogue is brought out as amended up to 27-10-2015 to provide the relevant information to the students, teachers and other officials of the University.

K. VENUGOPAL NAIDU
CONTROLLER OF EXAMINATIONS

T.S.CHANDRASEKHARA RAO
DEAN, FACULTY OF VETERINARY SCIENCE

In exercise of the powers conferred by clause (d) of sub section 2 of Section 22 of Sri Venkateswara Veterinary University Act, 2005 (Act No. 18 of 2005) read with Statute No. 19 of section 41 (a) of the First Statutes made by the Government of Andhra Pradesh, the Academic Council of Sri Venkateswara Veterinary University hereby makes the following regulations keeping in view the curriculum and syllabus as prescribed in the Minimum Standards of Veterinary Education Regulations-2008 of the Veterinary Council of India, New Delhi for the degree course, B.V.Sc & A.H.

REGULATIONS

- 1.0 **Short title:** These regulations shall be called the “SVVU Under Graduate (B.V.Sc. & A.H) Regulations, 2009”.
- 2.0 **Commencement:** These regulations shall apply to the students admitted into B.V.Sc & A.H course from the *Academic Year 2009-10 onwards*.

3.0 Definitions

- 3.1 **Course of study:** A degree course of Bachelor of Veterinary Science & Animal Husbandry shall comprise of a course of study consisting of curriculum and syllabi provided in the course catalogue spread over five complete academic years including a compulsory internship of six months duration undertaken after successful completion of all credit hours provided in the syllabi.
- 3.2 **Academic year:** The ‘Academic year’ of the University shall ordinarily be from June to April (except in the case of year of admission) and shall consist of two semesters covering at *least 200 days of instruction excluding the days of examinations*.
- 3.3 **Semester:** Semester is a period consisting of minimum *one hundred instructional* days excluding examination days.
- 3.4 **Credit hours:** A lecture class of one hour per week shall be counted as one credit whereas a practical class of two hours duration or a working period of three hours in the Teaching Veterinary Clinical Complex or Institution or Farm per week shall count as one credit.
- 3.5 **Course:** A course is an unit of instruction or a segment of subject matter (as specified in the course catalogue) to be covered in a semester. It has a specific number, title and credits.
- 3.6 **Subject / Paper:** For the purpose of composite external (board) examination and calculation of grade point a paper / subject is defined as the one which consists of courses / course (if only a single course is involved) in a subject listed under a Department, in an academic year.
- 3.7 **Internal examination:** Examination(s) conducted for each course (theory and practical separately) at the end of each *semester in 50% of total marks* on completion of the course and shall be held without any preparatory leave and without loss of instructional days of a semester.
- 3.7(a) All the internal examinations including re-examinations if any will be conducted as per the timetable communicated by the *Associate Dean of the respective colleges* in sequential order before commencement of next semester/Annual Board examinations.

The Associate Deans shall fix the Time table for Internal theory examination by allowing one day gap between each course wherever feasible.

- (b) A student shall appear in all internal theory as well as internal practical examinations in the course(s) in a subject to become eligible to appear for Annual Board Examination in a particular paper.

3.8 Annual Board Examination: A composite annual examination for a group of courses / a course (if only a single course is involved in the paper) shall be conducted for the rest of 50% marks in theory and practical separately as per schedule of examination fixed by the University at the end of each academic year comprising of all the courses of a particular subject taught during that year.

3.9 Grade point of a paper / subject: It is a value obtained by dividing the total marks (X) obtained in a paper by the maximum marks (Y) allotted to that paper and multiplied by 10. (The grade point shall be calculated for theory and practical separately).

3.10 Credit point of paper / subject: The product of credit hours and grade point obtained by the student in a paper / subject.

3.11 Grade point average : It is the quotient of the total credit points obtained by a student both in theory and practicals of various papers / subjects at the end of each academic year divided by the total credit hours taken by him / her in that year. The grading is done on a 10 point scale. The GPA is to be corrected to first decimal place.

3.12 Overall Grade Point Average (OGPA) : It is the quotient of cumulative credit points obtained by a student in all the papers / subjects both in theory and practicals taken by him / her from the beginning of the first academic year of the degree course divided by the total credit hours of all the papers/ subjects which he / she had completed up to the end of a specific academic year from the first year. It determines the overall performance of a student in all the papers / subjects taken during a period covering more than an academic year. The OGPA is to be corrected to second decimal place.

4.0 Admissions

Admissions including selections to the Under-graduate courses, ordinarily made in the beginning of the first semester of the academic year, shall be in accordance with the regulations laid down from time to time by the University

Eligibility: A pass in two year Intermediate Examination conducted by the Board of Intermediate Education, Andhra Pradesh or any other Examination recognized as equivalent thereto by the University or Intermediate Board with the following subjects mainly.

- i) Physical Sciences
- ii) Biological or Natural Sciences
- iii) English

A candidate under general category for admission to the B.V.Sc. & A.H. degree course must have passed in each of the subjects of English, Physics, Chemistry and Biology and obtained 50% marks in aggregate of these subjects, at the qualifying examination. In respect of candidates belonging to the Scheduled Castes / the

Scheduled Tribes shall be 10% less than that prescribed for general category (i.e.,40%).

Criteria for selection :The selection of candidates for all the seats except those reserved for VCI / NRI Quota shall be made on the basis of marks obtained by the candidates in the EAMCET in their respective local areas from out of the merit lists prepared for this purpose. The candidates will be selected based on merit, presidential order, region and social status.

5.0 Fee: The fee for application, semester fee, special fee, examination fee and other fee shall be as prescribed by the University from time to time.

6.0 Courses, Credits and Syllabi: The details of the courses, credit and syllabi shall be as prescribed by the Academic Council from time to time. The medium of instruction shall be English.

7.0 Advisory System: The time table shall provide for one hour per week for the meeting of students with Advisors. The student should make all correspondence with authorities through advisor only. The Advisor shall maintain a record containing particulars of previous history of the student, courses registered, examinations appeared and grades obtained in each course as per the format prescribed by the University (*Format-I*).

8.0 Registration

8.1 Registration for the first time in the University: Students who have received notification of admission from the University will receive on arrival guidelines for registration from the Associate Dean of the respective colleges.

8.2 A registration and orientation programme will be conducted by the Associate Dean of the College for the benefit of the students joining the University for the first time. Registration of students shall not be allowed after the expiry of 25% of the working days in the semester of admission.

8.3 Attendance in respect of fresh students for the first semester shall be reckoned from the date of registration by a particular student.

8.4 The following are the steps in registration of students for different courses:

- a. At the beginning of each academic year there shall be an annual registration for various courses listed under a subject. The student in each batch shall have to register for the set of courses offered in “toto” for the batch and fill in the registration cards. The Advisor inturn will countersign and send them to the Associate Deans Office. The Associate Dean’s office should prepare lists of students who have registered for each course and send them course wise to the concerned teacher within a week after the last date of registration.
- b. Students are permitted to register with late fee as detailed below :

1 st day of registration	:	Only fee
2 nd day	:	Fees + Rs.100 as late fee
3 rd day	:	Fee + Rs.200 as late fee
4 th day	:	Fee + Rs.300 as late fee
5 th day	:	Fee + Rs.400 as late fee
6 th day	:	Fee + Rs.500 as late fee
7 th day	:	Fee + Rs.600 as late fee

8 th day	:	Fee + Rs.700 as late fee
9 th day	:	Fee + Rs.800 as late fee
10 th day	:	Fee + Rs.900 as late fee

Registration shall not be permitted after 10th day

c. Failed student(s) shall register all the courses of the papers/subjects in which they failed for fulfillment of the requirements of the professional class.

d. **Study load per Semester:** The semester-wise distribution of theory and practical courses comprising of 177 credits (core courses) for B.V.Sc & A.H degree course are summarized below :

Professional Year	Semester	Theory	Practical	Total
First	I	11	7	18
	II	12	8	20
Second	III	12	9	21*
	IV	12	9	21*
Third	V	12	7	19
	VI	13	8	21
Fourth	VII	10	10	20
	VIII	10	8	18**
Fifth	IX	9	10	19
Total		101	76	177

* Inclusive of 1 Credit (0+1) each for two courses on Livestock Farm Practice (non credit).

** Inclusive of 1 Credit (1+0) for Veterinarian in Society (non credit).

e. In addition to the Core Courses above, a student has to successfully complete the Tracking Programmes (Annexure I), Study Circles (Annexure II), Entrepreneurial Training (Annexure III), Internship (Annexure IV) and Core Competence in Veterinary skills (Annexure V) as has been detailed under Course Catalogue of these regulations for the award of B.V.Sc & A.H degree.

f. Students have to register compulsory for any one of the non credit training programmes i.e. Remount Veterinary Corps (RVC) Squadron / National Cadet Corps (NCC)/Equestrian / National Service Scheme (NSS) / Sports and Games for a duration of minimum of two Professional Years for the award of B.V.Sc & A.H degree. The Performance of the students in these training programmes shall be assessed and graded as 'Satisfactory' or 'Unsatisfactory'. A student has to obtain 'Satisfactory' grading for successful completion of course requirements. A Student obtaining unsatisfactory grade in CCA Courses shall have to complete satisfactorily in subsequent academic year. The grades of CCA Courses shall not be linked to promotion.

9.0 Attendance

9.1 The required condition of attendance shall not be deemed to have been satisfied in respect of the course, unless the student has ordinarily attended all the scheduled theory and practical classes; however, the minimum requirement of attendance shall not be **less than 75%** (including attendance benefit, if any) of scheduled theory & practical classes separately on the basis of cumulative attendance of all the courses grouped for a paper for annual examination except for Internship training programme. The minimum attendance prescribed for internship training programme is 90%.

- 9.2 On the recommendation of the Associate Dean, permission may be given by the Dean of Student Affairs to depute the students for representing the College/ University at Inter Collegiate/Inter University meet, in NCC, NSS, Games and Sports meet and other extracurricular and co-curricular meets. The absence of students in such cases, shall be allowed up to a maximum of 20% of the working days (over and above the 25% of absence to be allowed in attendance) provided the list is communicated by the Dean of Student Affairs to the Associate Dean at least two weeks before the last working day. However, this exemption shall not apply to the students who register internship programme. The days of absence of students for participation in intercollegiate/inter University meets, NCC, NSS, Games and Sports and other extracurricular and co-curricular activities shall be treated as if present. The number of conducted classes shall be uniform for entire class except in case of year of admission into course. However, the entire period of deputation of students for participating in pre RDC and RD camps only shall be considered and no relaxation of any sort will be permissible in respect of Annual Board/Semester final examinations. For pre RD and RD camps maximum of two chances will be given in entire study period for any individual. Such students who are given condonation for participating in pre RD and RD camps are not eligible to claim condonation for participating in intercollegiate/inter University meets in respect of NSS, Games and Sports and other extracurricular and co curricular activities in the same academic year.
- 9.3. A candidate having attendance ***below 75% in a paper will not be eligible*** to appear for the Annual Board examination of that paper.
- 9.4. The percentage of attendance of a student in a course/ paper shall be computed on the basis of the total number of theory and practical classes scheduled between the date of commencement of instruction and date of closing of instruction irrespective of the date of registration.
- 9.5. Attendance in respect of fresh students for the first semester during year of admission shall be reckoned from the *date of registration* by a particular student.
- 9.6. Registration of students shall not be allowed after the expiry of *25% of the working days in the semester of admission*.
- 9.7. However, for the students who are reverted back owing to failure in the compartmental examination, the attendance shall be counted from the date of declaration of result of compartmental examination to the date of closing of instructions.
- 9.8.
- a. If a student admitted to the 1st year does not register the courses of the year or having registered does not put in at least 75% of attendance in all the courses of 1st year B.V.Sc. his / her admission shall stand cancelled.
 - b. A student who wishes to seek relaxation of the above provision may apply to the Associate Dean giving the grounds and proof thereof due to which he / she could not fulfill the minimum attendance requirements. The readmission of such a student shall be considered by a committee consisting of the Associate Dean, a Senior Professor of the College nominated by the Associate Dean, The Advisor of student concerned and the University Medical Officer as a Co-opted member wherever necessary. But a student has to put in a minimum of 60% attendance in the first semester .

- 9.9. When a student has to leave the College after completion of first year of study for reasons beyond his / her control, he / she shall obtain prior permission of the Associate Dean for discontinuation within one month from the date of absence. If a student fails to taken such permission, he / she shall not be eligible for readmission.

The maximum period of break shall not exceed two academic years under any circumstances including the year during which he / she discontinued.

A student, permitted to discontinue by the Associate Dean, shall apply to the Associate Dean for readmission at least one month before the commencement of the academic year in which readmission is sought.

If the discontinuation period exceeds two academic years, the admission shall stand cancelled automatically.

However, this facility shall be available to a student only once during his / her degree programme.

- 9.10. When a student leaves, the College taking his / her TC, he / she shall not be eligible for readmission.
- 9.11. Mass absence of students from a class or Examination: Absence of students enmass from a class or examination shall not be condoned. The Associate Dean, in addition, may order suspension of the course, if deemed necessary.

10.0 Evaluation / Examination :

- 10.1 The detailed lecture outlines in each course shall be prepared by the teacher(s) concerned in consultation with the Head of the Department and approved by the University Head of the Department which will be made available to the students during the first week of the semester.
- 10.2 The detailed guidelines to conduct examinations, internal and annual, evaluation / grading, recording, preparation of mark lists, transcripts etc. will be circulated from time to time by the University to the colleges in the light of the guidelines that may be received from Veterinary Council of India, New Delhi from time to time.
- 10.3 The schedule of examination during B.V.Sc & A.H course shall consist of internal (semester) and external (annual) examinations. Internal examination (theory and practical separately) for each course is conducted at the end of each semester and external examinations (theory and practical separately) are conducted at the end of each academic year comprising of all the courses of a particular subject taught during that year.
- 10.4 The internal assessment (semester) shall be conducted in 50% of total marks in theory and practical separately and shall invariably be conducted ***on completion of the course*** as per lecture/ practical schedule explained under sub-regulation 10.1 and shall be held without any preparatory leave. It shall be the responsibility of the University/ College authorities to conduct these examinations without loss of instructional days of a Semester. Internal Practical examination shall be conducted by a board of examiners consisting of teacher/Instructor(s) of the course and a representative of the head of the department. Evaluation of answer books shall be done by the concerned teacher/instructor(s). Marks obtained in theory and practical in the internal examinations would be recorded separately and submitted to the Associate Dean at the end of the particular semester.

- 10.5 The weightage of *Theory and Practical* shall be in the *ratio of 60:40* respectively in both internal and annual examinations irrespective of credit hours.
- 10.6 The distribution of marks for objective and subjective questions in each course / paper shall be in the ratio of 60:40 respectively both in internal and annual examinations.
- 10.7 The students should secure a *minimum of 50% marks*, in theory as well as in practical examinations.
- 10.8 A composite Annual examination for a group of courses/ a course (if only a single course is involved in the paper) shall be conducted for the rest 50% marks in theory and practical separately as per schedule of examinations. The annual theory examination(s) shall be conducted by inviting the question papers from appointed paper setter(s). A paper setter shall be provided the courses and syllabus prescribed by the VCI including detailed course outline. A paper setter shall be requested to prepare two sets of question papers, each for main examination and compartmental examination (if any). Where necessary, more than one paper setter/ examiner can be appointed. The practical examinations shall be conducted by the Board of Examiners appointed by the University and shall consist of two or more internal (representing the subjects being examined) and one external examiner. The evaluation of answer books of annual examinations shall be done by the external examiner(s).
- 10.9 Annual examinations shall be held on such dates, time and places as the University may determine and must be completed so that the results are announced before the onset of the ensuing semester.
- 10.10 The schedule of examinations (internal/external) shall be adhered strictly. Any student claiming to be sick and indisposed or the loss of his close relatives (Father, mother, grand parents, siblings) may be permitted to write the internal examination after the production of a medical certificate from a Civil Surgeon working in Government hospital in case of disease or Mandal Revenue Officer in case of death. A committee consisting of senior most Professor, officer-in –charge of Academic Matters and concerned course teacher of the college may go through and approve the authenticity of the certificate produced by the student. The re-examination shall be held after the end of regular internal examinations and before the commencement of the next semester/Annual Board Examinations. The students have to pay re-examination fee of Rs.500/- per course subject to a maximum of Rs.2000/- in a semester. Absence either in Internal theory or practical examination or both in a course shall be treated as one course for the purpose of re-examination fee. The re-examination fee in case of SC&ST students shall be Rs.400/- per course. There shall be no re-examination for Annual Board Examination what-so-ever may be the reason including medical grounds or for participation of students in NCC camps etc.
- 10.11 There shall be *no supplementary (make up) examinations* during the academic session. However, a candidate may be allowed to provisionally sit in the next class provided he/she has *failed only in two papers*. He/she cannot be promoted to next B.V.Sc & AH class unless he/she has cleared the failed paper(s).
- 10.12 The records of examination shall be made available to the VCI, as and when required and the records of assessment may be retained for six months after the conduct of the Annual examination.

EXPLANATION 1: For the first B.V.Sc & AH examination, the subject of Veterinary Anatomy, has one course in the first semester (VAN-111, 1+2=3) and one course in the second semester (VAN-121, 2+2=4). Internal evaluations for VAN-111 shall be conducted at the end of the 1st semester and for VAN-121 the internal evaluation shall be conducted at the end of the 2nd semester. The marks obtained in the examination shall be recorded separately for theory and practical and sent to the Controller of Examinations. After the completion of courses in the second semester, a composite annual examination (for Veterinary Anatomy Paper-I) shall be conducted for the theory and practical of VAN-111 and VAN-121 giving due weightage to each course. The marks obtained in the theory and practical of internal and annual examination shall be added and the grade point calculated and recorded against Veterinary Anatomy Paper-I. Similar pattern shall be followed for all other subjects of B.V.Sc & A.H Degree course (*Annexure I*).

10.13 Evaluation of Internal Practicals

The evaluation of the practical component of a course will be based on

- (i) Practical record - 10%
- (ii.) a) Performance during practicals (observations of the skills with which each student executes the practical) - 10%
- b) 10% marks shall be awarded for day to day observation book including record of case sheets etc.
- (iii) Practical examination (50%) (spotting, experiment, problems etc.)
- (iv) Project / assignments (10%)
- (v) Viva-Voce (10%).

10.14 Evaluation of Annual Board Practical examination

- (a) Materials to be evaluated for practical Annual Board Practical Examination.
 - i. Performance during practical examination (spotting, experiment, problem solving / case study etc.) – 50%
 - ii. Viva-Voce – 30%
 - iii. Practical record / Projects / Assignment / Log books – 20%
- (b) Conduct of Annual Board Practical examination: The question paper will be set by the external examiner with the help of internal examiners. The evaluation of practical tests and viva will be done by external examiner. Evaluation of practical records, assignment, observations book etc. will be done by the internal examiners.

10.15 Unfair means during examinations:

The Associate Dean of the college shall be responsible for dealing with all cases of “Use of unfair means” in the various examinations. The phrase, “Use of Unfair means”, includes possession of any information or material by the student, taking to other students, copying from other students or from printed or written materials etc. The invigilator concerned, on finding the use of unfair means by any student may take the answer scripts of the student and the material evidence, if any and the explanation from the student. The student may also be sent out of the examination hall immediately. The invigilator concerned shall report each case of unfair means direct to the Associate Dean immediately with full details of the incident, answer scripts, the available evidence and explanation of the concerned student, if any.

The Associate Dean, on receipt of the report, may give an opportunity to the

concerned student to represent his case. Considering all the available evidence, the Associate Dean shall take appropriate action immediately. The penalty shall be as indicated below.

- (a) A student found using unfair means during an internal examination shall be deemed to have failed in that paper and so shall not be permitted to appear for any of the examinations in that paper including Annual Board Examination in that academic year. Such cases shall also not be considered for conditional promotion and compartmental examinations. The annual registration of that particular paper is treated as cancelled.
- (b) A student found using unfair means during the Annual Board examination shall be deemed to have failed in all the papers he / she has registered in that academic year and / or in such of those course in which he appeared for annual examination in that year. In such cases, the student shall not be permitted to take the remaining examinations, if any, in that academic year and shall also be deemed to have attempted and failed in that examination and provisions of regulation 9.11 shall apply for deciding his / her promotion or otherwise.
- (c) The Associate Dean shall report each case falling under (a) and (b) above immediately, after passing orders to the Dean of Veterinary Science.
- (d) For using unfair means of a serious nature such as ignoring the repeated instructions of invigilator or abusing or threatening or assaulting the invigilator, warranting higher penalties than those indicated in clauses (a) and (b) above, the Associate Dean, besides treating the students as failed in all the courses he registered in that year, may further debar the students for the succeeding year and the fact informed to the Dean of Veterinary Science. If further or more severe punishment is felt necessary, the Associate Dean shall immediately inform the University about the full details of each together with all the material evidence, if any, and his recommendation. The explanation or representation of the student, if any, may also be sent. The Vice-Chancellor after examining the case, may debar the student for further period or permanently. The decision of the Vice-Chancellor is final.

The parent or the guardian of the concerned student shall be informed of any punishment awarded to the student and the reason therefore.

10.16 Scrutiny of answer books and rectification of errors

- (1) Re-evaluation of answer book(s) is not permitted.
- (2) A student, however is allowed to get his/her answer book(s) scrutinized, for which, the student shall have to apply to the Associate Dean within three days after the declaration of result and after paying prescribed fee of Rs.80/- for each paper.
- (3) The Associate Dean shall arrange for the scrutiny of answer book(s) by the Moderation Committee.
- (4) Scrutiny means re-totalling of the marks and examination of unmarked question(s), if any.
- (5) The answer book(s) of annual examination shall not be shown to the student under any circumstances.

- (6) In case, the total marks are found to be incorrect on scrutiny, the same will be corrected and the result shall be revised accordingly (even if it is towards lower side). If, however, any question is found to be unchecked by the External Examiner, the answer book(s) shall be sent to the External Examiner for doing the needful and the result(s) shall be revised accordingly, if there occurs any change in the marks.
- (7) No representation by the student(s) shall be entertained regarding the outcome of the result after scrutiny.
- (8) In case a student on the basis of the result of scrutiny becomes eligible for the compartmental examination, he/she may apply to the concerned Associate Dean to appear in the compartmental examination on the announced scheduled date. The scheduled date of the compartmental examination shall under no circumstances be changed on this account.

11.0 Promotions and Failure (Academic Status and Scholastic Deficiencies)

- (1) Promotion or failure of a student in a professional year shall be decided only on the basis of aggregate marks of internal and annual board examinations.
- (2) A student shall be promoted to next higher professional class only if he/ she has passed in all the papers of his/ her class by obtaining atleast 50% marks in theory and practical separately (internal and external combined).
- (3) A student should secure an over all grade point average (OGPA) of 5.00 out of 10.00 at the end of degree programme to be eligible to get B.V.Sc & A.H degree.
- (4) A student may also be allowed provisional promotion to next higher class till the declaration of the result of the compartmental examination(s). However, this promotion shall be subject to clearance in the compartmental examination(s) of that/ those paper(s) and shall be provisional. If the student fails in the compartmental examination(s), he/ she shall stand automatically reverted to the class from where he/ she was allowed provisional promotion.
- (5) Failed student(s) shall register all the courses of the papers/subjects in which they failed for fulfillment of the requirements of the professional class.
- (6) A student failing in the annual examination for *three consecutive years* in a professional year of B.V.Sc & A.H degree programme shall be finally dropped automatically from the University on account of poor academic performance.
- (7) In no case, a student shall be allowed to continue his/ her B.V.Sc & A.H studies beyond *8 academic years* (16 semesters) in a Veterinary College.

12.0 COMPARTMENTAL EXAMINATION

- (1) A student failing in a maximum of two papers only may be allowed once to appear in compartmental examinations for those paper(s). Absence in Annual Board examination (theory and /or practical) shall be treated as failure for the purpose of conditional promotion and compartmental examination. Compartmental examination shall comprise of the external component of both the theory and practical of the failed paper(s), which shall constitute the 100% weightage for that paper(s) and the marks of internal examination shall not be considered for the evaluation of Compartmental examination.

- (2) The compartmental examinations shall be conducted within 20 calendar days after the date on which the concerned professional year examination results are declared. The results of such compartmental examination shall be declared within 5 days after the examination is conducted.
- (3) In case of failure in any of the compartmental paper(s), the student will be reverted back to the previous professional year. Such student(s) shall register all the courses of the papers/subjects in which they failed for fulfillment of the requirements of the professional class.

13.0 Graduation requirements

13.1 The student shall satisfy minimum residential requirement of 9 semesters of study and internship programme of six months.

13.2 Requirements for Bachelor's Degree

- a. A student undergoing course of study leading to award of B.V.Sc. & A.H. (Bachelor of Veterinary Science & Animal Husbandry) shall pass the course and complete the minimum number of credit hours prescribed therefore, by the Academic Council from time to time by obtaining a minimum OGPA of 5.0 in the 10 point scale.
- b. The University shall issue a provisional course completion certificate on passing the Annual Board Examination at the end of 9th Semester, on the basis of which the student has to register for the grant of provisional registration by the State Veterinary Council / Veterinary Council of India.
- c. **Internship:** Every student is required after passing the fifth annual examination to undergo compulsory rotational internship to the satisfaction of the University for a minimum period of *six calendar months* so as to be eligible for the award of degree of B.V.Sc. & A.H.

13.3 Classification of successful candidates : The successful candidates after completion of the graduation requirements who secured an OGPA of 5.0 or more in the 10.0 point scale shall be classified as under :

8.000 and above	-	First Division with Distinction.
7.000 – 7.999	-	First Division
6.000 – 6.999	-	Second Division
5.000 – 5.999	-	Pass.

14.0 **Student responsibility:** All under-graduate students studying in this University are expected to know the requirements for the award of Bachelor's degree and general academic requirements and assume full responsibility for meeting them. They are expected to keep constantly in touch with their advisors so that the latter may watch their progress and guide them along right lines. In no case will a regulation be waived or exemption made simply because a student pleads ignorance of it.

15.0 Migration / Transfer of student from one recognized Veterinary College / Institution to another

- (1) A student studying in a recognized veterinary college may be allowed to migrate/be transferred to another recognized veterinary college under another/same University.
- (2) The migration/transfer may be allowed by the University concerned after passing 1st year of B.V.Sc & A.H degree course within one month of the start of academic session of 2nd year of the receiving college/University. The facility shall also be extended to the backlog students whenever they clear first year examinations. However the request of students after the 2nd, 3rd and 4th year for transfer shall not be considered
- (3) Migration/transfer of a student shall not be allowed during the middle of an academic year.
- (4) The number of students migrating/transferring from one veterinary college to another veterinary college during the period of one academic year will be kept to the maximum limit of 5% of the intake capacity of each of the veterinary colleges in one year.
- (5) Cases not covered under regulations 15.1 to 15.4 may be referred to the Veterinary Council of India for consideration on merits.
- (6) An intimation about the admission of migrated/transferred students into any veterinary college should be sent to the Veterinary Council of India by the respective college/ University.

16.0 Record of Courses: To ensure that requirements for the award of degree have been completed by a student, the University shall keep a record of courses completed by the students. A copy of the same shall be maintained by the Associate Dean of the concerned college.

17.0 Authorities to approve results and issue pass certificates, transcripts etc.

The Vice-chancellor shall approve the results on the recommendation of the Dean of Veterinary Science and the Registrar shall issue the provisional pass certificate, transcript etc., to the candidate.

18.0 Award of Diploma: A diploma under the seal of the University and duly signed by the Officers authorized in this behalf shall be presented at a Convocation to each candidate who has successfully completed the graduation requirements for the award of Degree/Diplomas. In case of candidates who have successfully completed the graduation requirements for the award of degree and are admitted 'IN ABSENTIA' to a degree at a Convocation, shall be sent by post. The diploma shall set for the name of the candidate, father's name, degree, month and year of successful completion of the graduation requirement etc.

19.0 Amending or Cancellation of results: If the result of a candidate is discovered to be vitiated by error, malpractice, fraud, improper conduct or any other reasons, the Vice-Chancellor shall have the powers to amend the result in which a manner as to accord with the true position, and to make such declaration as the Vice-Chancellor may deem necessary in that behalf.

If it is found that the result of a candidate has been vitiated by malpractices, fraud or other improper conduct where by he / she has been benefited and that he / she has in the opinion of the Vice-Chancellor, been a party to or conceived at the

malpractice, fraud or improper conduct, the Vice-Chancellor shall have the power at any time, notwithstanding the award of a diploma or a certificate or prize or a scholarship, amend the result of such candidate and to make such declaration as the Vice-Chancellor may deem necessary in that behalf, including debarring of the candidate from the University for such a period as may be specified and the cancellation of the result of the candidate in such manner as the Vice-Chancellor may decide.

20.0 Transitory provision

These regulations shall apply to the students who shall be admitted from the academic year 2009-10 and onwards. They shall not be applicable to backlog students.

21.0 No Regulation made by the Academic Council, governing the under-graduate courses of study shall be construed, to limit or abridge the powers of the Academic Council to deal with any case or cases of any student or students of B.V.Sc. & A.H. course in such manner as it may appear to it to be just and equitable.

Course Catalogue

B.V.Sc. & A.H. Degree

The veterinary curriculum is comprised of six components of study

- i. Core Courses
- ii. Tracking Programmes
- iii. Study Circles
- iv. Entrepreneurial Training
- v. Internship and
- vi. Competence in skills.

SUBJECTS TO BE COVERED IN THE B.V.Sc & A.H DEGREE COURSE

1. Veterinary Anatomy
2. Veterinary Physiology and Biochemistry
3. Veterinary Pharmacology and Toxicology
4. Veterinary Parasitology
5. Veterinary Microbiology
6. Veterinary Pathology
7. Veterinary Public Health and Epidemiology
8. Animal Nutrition
9. Animal Genetics and Breeding
10. Livestock Production Management
11. Livestock Products Technology
12. Veterinary Gynecology and Obstetrics
13. Veterinary Surgery and Radiology
14. Veterinary Medicine.
15. Veterinary and Animal Husbandry Extension Education.

Semester Wise Distribution of Courses

FIRST PROFESSIONAL YEAR

SEMESTER - I

VAN-111	Veterinary Gross Anatomy-1 (Osteology, Arthrology & Biomechanics)	1+2=3
VPB-111	Veterinary Physiology-1 (Blood, Cardiovascular & Excretory Systems, Body Fluids)	2+1=3
VPB-112	General Veterinary Biochemistry	1+1=2
LPM- 111	Livestock Production Management-1 (General Principles and Ruminants)	3+1=4
AGB -111	Biostatistics and Computer Application	2+1=3
ANN-111	Principles of Animal Nutrition & Feed Technology	2+1=3
CCA	CCA – 111–NCC [€] or CCA – 112 –Sports and Games [¥]	0 + 1*
Total		11+7=18

* Non Credit Courses

[€] NCC is compulsory where there is RVC facility

[¥] Sports and Games shall be registered where there is no RVC Facility

SEMESTER – II

VAN -121	Veterinary Gross Anatomy-II(Myology, Neurology, Angiology & Aesthesiology)	2+2=4
VPB - 121	Veterinary Physiology-II (Neuromuscular, Digestive & Respiratory Systems)	2+1=3
VPB - 122	Veterinary Intermediary Metabolism	2+1=3
LPM - 121	Fodder Production & Grassland Management	1+1=2
LPM - 122	Livestock Production Management-II (Monogastric and Laboratory Animals)	1+1=2
AGB - 121	Principles of Animal Genetics and Population Genetics	2+1=3
ANN – 121	Applied Animal Nutrition-I (Ruminants)	2+1=3
CCA	CCA – 121 – NSS	0 + 1*
Total		12+8=20

* Non Credit Courses

SECOND PROFESSIONAL YEAR

SEMESTER - III

VAN - 211	Veterinary Histology & Embryology	2+2=4
VPA - 211	General Veterinary Parasitology & Helminthology	3+1=4
VPP - 211	General Veterinary Pathology	1+1=2
VMC - 211	General Veterinary Microbiology	1+1=2
LPM - 211	Avian Production Management	1+1=2
ANN - 211	Applied Animal Nutrition-II (Non-ruminants, Poultry & Laboratory Animals)	2+1=3
AGB - 211	Livestock and Poultry Breeding	2+1=3
LFP - 211	Livestock Farm Practice (Non-Credit)	0+1=1
CCA	CCA 211-NCC € or CCA 212 -Sports & Games‡	0+1*
Total		12+9=21

* Non Credit Courses

€ NCC is compulsory where there is RVC facility

‡ Sports and Games shall be registered where there is no RVC Facility

SEMESTER – IV

VAN -221	Veterinary Splanchnology & Applied Anatomy	1+1=2
VPB - 221	Veterinary Physiology-III (Endocrinology, Reproduction, Growth & Environmental Physiology)	3+1=4
VPA - 221	Veterinary Entomology & Acarology	1+1=2
VPA - 222	Veterinary Protozoology	2+1=3
VMC - 221	Veterinary Immunology and Serology	1+1=2
VPP - 221	Systemic Veterinary Pathology	2+1=3
LPM - 221	Commercial Poultry Production and Hatchery Management	1+1=2
LPM - 222	Livestock Production Management-III (Regional interest)	1+1=2
LFP - 221	Livestock Farm Practice (Non-Credit)	0+1=1
CCA	CCA 221-NSS	0+1= 1*
Total		12+9=21

* Non Credit Courses

THIRD PROFESSIONAL YEAR

SEMESTER - V

VPT - 311	General and Systemic Veterinary Pharmacology	2+1=3
VMC - 311	Systemic Veterinary Bacteriology & Mycology	2+1=3
VPP - 311	Special Veterinary Pathology	2+1=3
VPE - 311	Milk and Meat Hygiene, food safety and Public Health	2+1=3
LPT - 311	Milk and Milk Products Technology	1+1=2
LPT - 312	Abattoir Practice and Animal Product Technology	1+1=2
VAE - 311	Principles and Techniques of Veterinary and A.H Extension	2+1=3
Total		<u>12+7=19</u>

SEMESTER - VI

VPT - 321	Veterinary Neuropharmacology	2+1=3
VMC - 321	Systemic Veterinary Virology	2+1=3
VPP - 321	Avian Pathology	1+1=2
VPP - 322	Aquatic Animal Diseases, Health Care and Management	1+1=2
VPE - 321	Veterinary Epidemiology and Zoonosis	2+1=3
LPT - 321	Meat Science	1+1=2
VPB - 321	Animal Biotechnology	2+1=3
VAE - 321	Livestock Economics, Marketing and Business Management	2+1=3
Total		<u>13+8=21</u>

FOURTH PROFESSIONAL YEAR

SEMESTER - VII

VPT - 411	Veterinary Chemotherapy	2+0=2
VSR - 411	General Veterinary Surgery, Anesthesiology and Diagnostic Imaging	2+2=4
VGO - 411	Veterinary Gynecology	2+1=3
VMD - 411	Veterinary Clinical Medicine-I (General & Systemic)	2+1=3
VMD - 412	Veterinary Preventive Medicine-I (Bacterial Fungal & Rickettsial Diseases)	2+0=2
VLD - 411	Veterinary Clinical Biochemistry and Laboratory Diagnosis-I	0+1=1
VCP - 411	Veterinary Clinical Practice	0+5=5
Total		<u>10+10=20</u>

SEMESTER – VIII

VPT - 421	Veterinary Toxicology	2+0=2
VSR - 421	Regional Veterinary Surgery	2+1=3
VGO - 421	Veterinary Obstetrics	1+1=2
VMD- 421	Veterinary Clinical Medicine-II (Metabolic & Deficiency Diseases)	2+0=2
VMD- 422	Veterinary Preventive Medicine-II (Viral & Parasitic Diseases)	2+0=2
VLD- 421	Veterinary Clinical Biochemistry and Laboratory Diagnosis-II	0+1=1
VCP - 421	Veterinary Clinical Practice	0+5=5
TVC - 421	Veterinarian in Society (Non Credit)	1+0=1
Total		10+8=18

FIFTH PROFESSIONAL YEAR

SEMESTER - IX

VSR - 511	Veterinary Orthopedics and Lameness	1+1=2
VMD - 511	Animal Welfare, Ethics & Jurisprudence	2+0=2
VMD - 512	Zoo/Wild Animal Breeding, Management, Nutrition and Health Care	1+1=2
VMD - 513	Pet Animal Breeding Management, Nutrition and Health Care	1+1=2
VGO - 511	Veterinary Andrology and Reproductive Techniques	1+1=2
VPE - 511	Environment and Environmental Hygiene	2+1=3
VAE - 511	Livestock Entrepreneurship	1+0=1
VCP - 511	Veterinary Clinical Practice	0+5=5
Total		9+10=19

Semester Wise Distribution of Theory and Practical

Professional Year	Semester	Theory	Practical	Total
First	I Semester	11	7	18
	II Semester	12	8	20
Second	III Semester	12	9	21*
	IV Semester	12	9	21*
Third	V Semester	12	7	19
	VI Semester	13	8	21
Fourth	VII Semester	10	10	20
	VIII Semester	10	08	18**
Fifth	IX Semester	09	10	19
		101	76	177

*1 Credit (0+1) each for two courses on Livestock Farm Practice (non credit) included.

**1 Credit (1+0) for Veterinarian in Society (non credit) included.

Other Non – Credit Courses

- (1) **Tracking Programme** – Two Programmes of 2 Credits each = 4 Credits during the 3rd to 5th year of B.V.Sc. & A.H. degree course (Refer Annexure I for details)
- (2) **Study circles** – Each student has to enroll himself / herself for atleast two study circles activities during the 3rd to 5th year of B.V.Sc. & A.H. degree course (Refer Annexure II for details)
- (3) **Entrepreneurial Training** - Each student of B.V.Sc. & A.H course shall be required to compulsorily undertake one of the activities of entrepreneurial training during the 3rd to 5th year of B.V.Sc. & A.H. degree course (Refer Annexure III for details)

SUBJECT-WISE DISTRIBUTION OF COURSES

1. VETERINARY ANATOMY

Course No	Course Title	Credit Hours	Semester
VAN- 111	Veterinary Gross Anatomy-1 (Osteology, Arthrology & Biomechanics)	1+2=3	I
VAN- 121	Veterinary Gross Anatomy-II (Myology, Neurology, Angiology & Aesthesiology)	2+2=4	II
VAN- 211	Veterinary Histology & Embryology	2+2=4	III
VAN- 221	Veterinary Splanchnology & Applied Anatomy	1+1=2	IV
	Total	6+7=13	

2. VETERINARY PHYSIOLOGY & BIOCHEMISTRY

Course No	Course Title	Credit Hours	Semester
VPB- 111	Veterinary Physiology-I (Blood, Cardiovascular & Excretory Systems and Body Fluids)	2+1=3	I
VPB- 112	General Veterinary Biochemistry	1+1=2	I
VPB- 121	Veterinary Physiology-II (Neuromuscular Digestive & Respiratory Systems)	2+1=3	II
VPB- 122	Veterinary Intermediary Metabolism	2+1=3	II
VPB- 221	Veterinary Physiology-III (Endocrinology, Reproduction Growth & Environmental Physiology)	3+1=4	IV
VPB- 321	Animal Biotechnology (To be taught jointly with VMC & VGO)	2+1=3	VI
	Total	12+6=18	

3. VETERINARY PHARMACOLOGY & TOXICOLOGY

Course No	Course Title	Credit Hours	Semester
VPT- 311	General and Systemic Veterinary Pharmacology	2+1=3	V
VPT- 321	Veterinary Neuropharmacology	2+1=3	VI
VPT- 411	Veterinary Chemotherapy	2+0=2	VII
VPT- 421	Veterinary Toxicology	2+0=2	VIII
	Total	8+2=10	

4. VETERINARY PARASITOLOGY

Course No	Course Title	Credit Hours	Semester
VPA- 211	General Veterinary Parasitology & Helminthology	3+1=4	III
VPA- 221	Veterinary Entomology and Acarology	1+1=2	IV
VPA- 222	Veterinary Protozoology	2+1=3	IV
	Total	6+3=9	

5. VETERINARY MICROBIOLOGY

Course No	Course Title	Credit Hours	Semester
VMC- 211	General Veterinary Microbiology	1+1=2	III
VMC- 221	Veterinary Immunology and Serology	1+1=2	IV
VMC- 311	Systemic Veterinary Bacteriology and Mycology	2+1=3	V
VMC- 321	Systemic Veterinary Virology	2+1=3	VI
	Total	6+4=10	

6. VETERINARY PATHOLOGY

Course No	Course Title	Credit Hours	Semester
VPP- 211	General Veterinary Pathology	1+1=2	III
VPP- 221	Systemic Veterinary Pathology	2+1=3	IV
VPP- 311	Special Veterinary Pathology	2+1=3	V
VPP- 321	Avian Pathology	1+1=2	VI
VPP- 322	Aquatic Animal Diseases, Health Care and Management (To be taught jointly with VMD and LPM)	1+1=2	VI
	Total	7+5=12	

Associated with the teaching of VLD-411, VLD-421, VMD-512 & VMD-513

7. VETERINARY PUBLIC HEALTH & EPIDEMIOLOGY

Course No	Course Title	Credit Hours	Semester
VPE- 311	Milk & Meat Hygiene, food safety and Public health	2+1=3	V
VPE- 321	Veterinary Epidemiology and Zoonosis	2+1=3	VI
VPE- 511	Environment and Environmental Hygiene	2+1=3	IX
	Total	6+3=9	

8. ANIMAL NUTRITION

Course No	Course Title	Credit Hours	Semester
ANN- 111	Principles of Animal Nutrition & Feed Technology	2+1=3	I
ANN- 121	Applied Animal Nutrition-I (Ruminants)	2+1=3	II
ANN- 211	Applied Animal Nutrition-II (Non-ruminants, Poultry & Laboratory Animals)	2+1=3	III
	Total	6+3=9	

Associated with the teaching of VMD-512 & VMD-513

9. ANIMAL GENETICS & BREEDING

Course No	Course Title	Credit Hours	Semester
AGB- 111	Biostatistics and Computer Application	2+1=3	I
AGB- 121	Principles of Animal Genetics and Population Genetics	2+1=3	II
AGB- 211	Livestock and Poultry Breeding	2+1=3	III
	Total	6+3=9	

Associated with the teaching of VMD-512 & VMD-513

10. LIVESTOCK PRODUCTION MANAGEMENT

Course No	Course Title	Credit Hours	Semester
LPM- 111	Livestock Production Management-I (General Principles and Ruminants)	3+1=4	I
LPM- 121	Fodder Production & Grassland Management	1+1=2	II
LPM- 122	Livestock Production Management-II (Monogastric and Laboratory Animals)	1+1=2	II
LPM- 211	Avian Production Management	1+1=2	III
LPM- 221	Commercial Poultry Production and Hatchery Management	1+1=2	IV
LPM- 222	Livestock Production Management (Regional interest) (Optional: to be developed on the basis of regional interest)	1+1=2	IV
	Total	8+6=14	

Associated with the teaching of VPP-322, VMD-512 & VMD-513

11. LIVESTOCK PRODUCTS TECHNOLOGY

Course No	Course Title	Credit Hours	Semester
LPT- 311	Milk and Milk Products Technology	1+1=2	V
LPT- 312	Abattoir Practice and Animal Product Technology	1+1=2	V
LPT- 321	Meat Science	1+1=2	VI
	Total	3+3=6	

12. VETERINARY GYNAECOLOGY & OBSTETRICS

Course No	Course Title	Credit Hours	Semester
VGO- 411	Veterinary Gynecology	2+1=3	VII
VGO- 421	Veterinary Obstetrics	1+1=2	VIII
VGO- 511	Veterinary Andrology & Reproductive Techniques	1+1=2	IX
	Total	4+3=7	

13. VETERINARY SURGERY & RADIOLOGY

Course No	Course Title	Credit Hours	Semester
VSR- 411	General Veterinary Surgery, Anesthesiology and Diagnostic Imaging	2+2=4	VII
VSR- 421	Regional Veterinary Surgery	2+1=3	VIII
VSR- 511	Veterinary Orthopedics and Lameness	1+1=2	IX
	Total	5+4=9	

Associated with the teaching of VMD-512 & VMD-513

14.VETERINARY MEDICINE

Course No	Course Title	Credit Hours	Semester
VMD- 411	Veterinary Clinical Medicine-I (General & Systemic)	2+1=3	VII
VMD- 412	Veterinary Preventive Medicine-I (Bacterial, Fungal & Rickettsial Diseases)	2+0=2	VII
VMD- 421	Veterinary Clinical Medicine-II (Metabolic & Deficiency Diseases)	2+0=2	VIII
VMD- 422	Veterinary Preventive Medicine-II (Viral & Parasitic Diseases)	2+0=2	VIII
VMD- 511	Animal Welfare, Ethics & Jurisprudence	2+0=2	IX
VMD- 512	Zoo/ Wild Animal Breeding, Management, Nutrition and Health Care (To be taught jointly with Animal Genetics and Breeding, Livestock Production & Management, ANN, VPP and VSR)	1+1=2	IX
VMD- 513	Pet Animal Breeding, Management, Nutrition and Health Care (To be taught jointly with AGB, LPM, ANN, VPP and VSR)	1+1=2	IX
	Total	12+3=15	

Associated with the teaching of VPP-312

14. VETERINARY & ANIMAL HUSBANDRY EXTENSION EDUCATION

Course No	Course Title	Credit Hours	Semester
VAE- 311	Principles & Techniques of Veterinary and A.H Extension	2+1=3	V
VAE- 321	Livestock Economics, Marketing and Business Management	2+1=3	VI
VAE- 511	Livestock Entrepreneurship	1+0=1	IX
	Total	5+2=7	

16. TEACHING VETERINARY CLINICAL COMPLEX

Course No	Course Title	Credit Hours	Semester
VCP- 411	Veterinary Clinical Practice	0+5=5	VII
VCP- 421	Veterinary Clinical Practice	0+5=5	VIII
VCP- 511	Veterinary Clinical Practice	0+5=5	IX
VLD- 411	Veterinary Clinical Biochemistry and Laboratory Diagnosis-I (To be taught jointly by VPB & VPP)	0+1=1	VII
VLD- 421	Veterinary Clinical Biochemistry and Laboratory Diagnosis-II (To be taught by VPB, VPP, VMC & VPT)	0+1=1	VIII
TVC- 421	Veterinarian in Society (Non Credit)	1+0=1	VIII
	Total	1+17=18	

17. INSTRUCTIONAL LIVESTOCK FARM COMPLEX

Course No	Course Title	Credit Hours	Semester
LFP- 211	Livestock Farm Practice (Non-Credit)	0+1=1	III
LFP- 221	Livestock Farm Practice (Non-Credit)	0+1=1	IV
	Total	0+2=2	

GRAND TOTAL

Courses: 65

Credits: Core Courses: 177(101+76)

Including Non Credit Courses: 1+0(Veterinarian in Society) and 2 credits (0+1) x 2(Livestock Farm Practice)

Non- Core Course: 4 Credits (tracking Programmes)

Group of subject-wise credit distribution:

1.	Basic Veterinary Subjects	23+15=38
2.	Production Subjects	23+15=38
3.	Pre-Clinical Subjects	27+14=41
4.	Clinical Subjects	27+13= 40
5.	Teaching Veterinary Clinical Complex	0+17= 17

	Total	100+74= 174

DEPARTMENT OF VETERINARY ANATOMY

SEMESTER-I

VETERINARY GROSS ANATOMY-I (OSTEOLOGY, ARTHROLOGY AND BIOMECHANICS)

VAN-111

Credit Hours 1+2=3

THEORY

Osteology: Definition of the terms used in Veterinary Anatomy in general and osteology in particular Classification, physical properties and structure of bones, Gross study of bones of appendicular and axial skeleton of Ox/ Buffalo as type species and comparison with Sheep/ Goat, Pig, Horse, Dog and Fowl with particular emphasis on their topography, contour, landmarks and functional anatomy from clinical and production point of view. Detail study of bones of head, neck, thorax, abdomen, pelvis, tail, forelimb and hind limb.

Arthrology: Classification and structure of joints. Articulation and ligaments of head, neck, thorax abdomen, pelvis, tail, forelimb and hind limb of Ox/ Buffalo as type species, their structure, functional anatomy and comparison with other domestic animals from clinical and production point of view.

Biomechanics: Biomechanics and its application with reference to quadruped locomotion, kinetics of locomotion, stress and strains falling on locomotor apparatus, landmarks, angulation and weight bearing bones of ox, buffalo and comparison with other animals particularly horse and dog.

PRACTICAL:

Comparative study of the bones of appendicular and axial skeleton, their structure, landmarks, angulation, weight bearing and function in Ox/ Buffalo and comparison with that of Sheep/ Goat, Pig, Horse, Dog and Fowl and relate them in live animals. Dissection of joints of all the body regions of Ox/ Buffalo to study the structure and function and comparison with other domestic animals. Biomechanics and kinetics of locomotion.

SEMESTER II
VETERINARY GROSS ANATOMY-II
(Myology, Neurology, Angiology and Aesthesiology)

VAN- 121

Credit Hours 2+2=4

THEORY

Myology: Structural and functional classification of muscles. Gross study of skeletal muscles of head, neck, thorax, abdomen, pelvis, tail, forelimb and hind limb with their origin, insertion and action and their structural and functional importance from clinical and production point of view in Ox/ Buffalo as a type species. Comparative study of muscles in other domestic animals.

Neurology: Study of central, peripheral and autonomic nervous system. Gross study of meninges, brain, spinal cord, cranial and spinal nerves and their functional importance from clinical and production point of view. Gross morphology and disposition of the nerves of head, neck, thorax, abdomen, pelvis, tail, forelimb and hindlimb in Ox/ Buffalo as a type and comparative study in other domestic animals.

Angiology: Gross morphology of heart and disposition of arteries, veins and lymphatic of head, neck, thorax, abdomen, pelvis, tail, forelimb and hindlimb in Ox/ Buffalo as type and comparison with that of sheep/ Goat, Pig, Horse, Dog and Fowl, their importance from clinical and production point of view.

Aesthesiology: Gross morphological study of the eye, ear, nose, hoof, horn and skin in Ox/ Buffalo, their functional importance and comparative study in other domestic animals. Computer simulation for dissection and study of body parts.

(Note: The general outline of muscular, circulatory and nervous system be taken up in the beginning of this course to be followed by gross disposition of group of muscles, arteries, veins and lymphatics simultaneously region-wise.)

PRACTICAL:

Demonstration of embalming of the carcass and preservation. Dissection/computer simulation models for dissection and demonstration of body parts.

Dissection of muscles of all body regions of Ox/ Buffalo, their location, functional role in the body and comparison with other species.

Study of brain and spinal cord in different domestic animals. Study of heart and major blood vessels in different species of animals. Area of auscultation of heart.

Dissection of blood vessels, lymphatics and nerves of head, neck, thorax, abdomen, pelvis, tail, forelimb and hindlimb in Ox/ Buffalo and comparative study in other domestic animals. Demonstration of palpable Lymph nodes of the body. Study of the sites of corneal, auriculo palpebral, peterson's infraorbital, radial, ulnar, median, paravertebral, epidural, pudendal, perineal and tibial nerve blocks and their clinical importance.

Dissection for study of eye, ear, nose, hoof and horn.

SEMESTER III VETERINARY HISTOLOGY AND EMBRYOLOGY

VAN- 211

Credit Hours 2+2=4

THEORY

General Histology: Structure of animal cell and basic tissues and their functional activity. Epithelia and their modifications. Connective tissue and its components including blood and bone. Muscular tissue types and their functional peculiarities. Neuron, nerve fibre and ganglion.

Systemic Histology: Study of microscopic structure of the organs of digestive, respiratory, urinary, reproductive, nervous and cardiovascular systems, sense organs, endocrines and lymphoid organs of domestic animals and birds.

Embryology: Gametogenesis, fertilization, cleavage, gastrulation, and the development of foetal membranes in birds and mammals. Structure and types of mammalian placenta. Development of the organs of digestive, respiratory, urogenital, cardiovascular, nervous and locomotor systems and organs of special sense and endocrine glands. Fetal circulation.

PRACTICAL

Microscopy and micrometry. Comparison of light and electron microscopy. Histological techniques. Processing of tissues for paraffin sectioning and Haematoxylin and Eosin staining.

Microscopic examination and identification of basic tissue and their components. Examination of histological sections of various organs/systems of domestic animals and birds.

Study of structure of mammalian ova and spermatozoa and egg of fowl. Study of the whole mount and serial sections of avian and mammalian embryo / foetus at different stages of development. Microscopic anatomy of fetal membranes and placenta of various domestic animals.

SEMESTER IV

VETERINARY SPLANCHNOLOGY AND APPLIED ANATOMY

VAN-221

Credit Hours 1+1=2

Gross morphological and topographical study of various organs of digestive, respiratory, urinary, male and female reproductive, lymphatic and endocrine systems, Pleura and Peritoneum in Ox / Buffalo as type and their comparison with that of Sheep/ Goat, Pig, Horse, Dog and Fowl.

Different Terminology used in applied Anatomy. Palpable Anatomical body structures and their use in Health and disease.

PRACTICAL

Demonstration and description of palpable anatomical structures on the body surface of live animal (head, neck, thorax, pectoral bones, pelvic bones, limbs). Outline of body cavities and study of organs of digestive, respiratory, urinary, reproductive, lymphatic and endocrine systems of Ox/ Buffalo and their comparative anatomy in other species. Pleural and peritoneal reflections. Comparative topographic anatomy in live animals. Nerve blocks and their sites.

Applied anatomy of sites for thoraco-centesis, auscultation, abdominocentesis, rumenotomy, laparotomy, splenectomy, enterotomy, palpation of anatomical structures in the abdominal and perineal regions. Radiographic visualization of gross anatomical features of various regions of the body.

(Note: Computer simulation model studies shall be used for better understanding of the subject.)

**DEPARTMENT OF VETERINARY PHYSIOLOGY AND
BIOCHEMISTRY**

**SEMESTER I
VETERINARY PHYSIOLOGY-I**

(Blood, Cardiovascular, Excretory system and Body Fluids)

VPB -111

Credit Hours 2+1=3

THEORY

Introduction to Blood: Properties of blood as a body fluid, metabolism and fate of R.B.C. Hemoglobin-chemical structure, synthesis, physiological functions, derivatives of hemoglobin.

Anemia; Plasma proteins, lipids – origin and function: Coagulation mechanisms and regulation of haemostasis; fibrinolysis; anticoagulation mechanism. Blood pH, blood volume and their determination. Osmotic fragility, erythrocyte sedimentation rate, haemtocrit and haemolysis. Leucocyte – phagocytic and immunogenic functions.

Heart- morphological characteristic, systemic excitability conduction & transmission processes. Cardiac Cycle: Regulation of cardiac output, coronary circulation; properties of pulse; metabolism & energetic of working myocardial cell, extrinsic and intrinsic regulation; ECG and its significance in Veterinary Sciences – Echocardiography.

Haemodynamics of circulation, circulatory mechanics, resistance to flow, vasoconstriction, nervous and circulating fluid volume controls of blood pressure, neurohormonal control of vascular smooth muscle. Circulatory controls – shock stresses, regional and fetal circulations. Capillary exchange, control of blood pressure. Adjustments of circulation during exercise.

Kidney:- Functional morphology of nephron, factors determining filtration pressure, determination of glomerular filtration rate (GFR) and renal plasma flow – Reabsorption mechanisms for glucose, protein, amino acids, electrolytes; ammonium mechanism, glomerulotubular balance, methods of studying renal functions: urine concentration: micturition, uraemia.

Fluid, water balance, fluid therapy, dehydration, water concentration mechanisms. Acid base balance and H⁺ regulation, correction and evolution of

imbalances, total osmotic pressure, potassium balance, electrolyte and water imbalances, thirst. Formation and excretion of urine in Birds.

Cerebrospinal fluid, synovial fluids – composition, formation and flow; joints. Regulations of bone metabolism and homeostasis.

PRACTICAL

Collection of blood samples – Separation of serum and plasma – Preservation of defibrinated blood – enumeration of erythrocytes, leucocytes – differential leucocytic count – platelet count – estimation of hemoglobin – haematocrit – erythrocyte sedimentation rate – packed cell volume – coagulation time – bleeding time – Erythrocyte fragility and viscosity – blood grouping – recording of ECG – measurement of arterial blood pressure (Sphygmomanometry). Recording of cardiogram of frog heart – Study the effect of heat and cold on heart – effect of vagus stimuli on heart – vagal escape – factors affecting blood flow through blood vessels – urine analysis – physiological constituents, pathological determinates, determination of GFR. Titrable acidity, determination of inorganic phosphorus, urine ammonia and creatinine in urine.

SEMESTER II

VETERINARY PHYSIOLOGY-II

(Neuromuscular, Digestive and Respiratory systems)

VPB-121

Credit Hours 2+1=3

THEORY

Muscle Physiology – basic muscle unit characteristics—electrical phenomenon in muscle cell – Membrane potential ionic basis of resting membrane potential, muscle action potential, excitation and propagation of impulse characteristics – latent period-refractive ness, threshold level-all & none characteristics – contractile mechanism – excitation – contraction coupling- neuro- muscular transmission, types of muscle contraction, phenomenon of fatigue, rigor mortis.

Organization of nervous system- Mechanism of information processing, hierarchical control. Major functional system- sensory, consciousness, emotion, motor and visceral control and basic functional unit neuron structure, type – functional characteristics of sub-units of neuron. Membrane potential-ionic basis of resting membrane potential (RMP) nerve action potential, excitation and propagation of impulse characteristics- latent period – refractive ness, threshold level-all & none characteristics. Degeneration and regeneration of nerve fibre. Synaptic and junctional transmission.

Functions of nervous system reflexes – control of posture and movements, autonomic nervous system and visceral control. Neurotransmitter wakefulness, sleep cycle. Higher function neurons system – learning memory. Familiarization with common equipments used in neurophysiology (oscilloscope, electroencephalography, machine stimulators etc.,)

Sense organs and receptors physiology of special senses – EYE: functional morphology, nourishment and protection neural pathway, receptors – optics, ocular muscles and movements, photochemistry, eye defects and eye examinations (as an aid to clinical evaluation). EAR: Physiology of hearing and common hearing impairment. Vestibule apparatus. Physiology of Olfaction and Taste.

Morphological characteristic of monogastric and poly gastric digestive system. Prehension, rumination, defaecation, vomition; regulation of secretory function of saliva, stomach, intestine, pancreas: bile secretion; hunger, appetite control, developmental aspects of digestion, luminous, membranous and microbial digestion in rumen and intestine; permeability characteristics of intestine, forces governing absorption, control intestinal transport of electrolyte and water, enzymatic digestion in monogastric and fermentative digestion in rumen, modification of toxic substances in rumen. Digestion in birds.

Functional morphology of respiratory apparatus. Mechanics of breathing. Transport of blood gases, foetal and neonatal oxygen transport, dissociation curves, pressures, recoil tendency, elasticity surfactants, pleural liquid, compliance, exchanges of gases in lungs and tissues, neural and chemical regulation of breathing, diffusion, perfusion, hypoxia. Frictional resistance to air flow, airways smooth muscle contraction, respiratory muscle work, panting, adaptation of respiration during muscles exercise high altitude hypoxia, Non-respiratory lung functions. Respiration in birds.

PRACTICAL

Counting of rumen motility estimation of volatile fatty acids and ammonia in rumen. Bacterial and protozoal count. *In-vitro* action of proteolytic enzymes – pepsin and trypsin.

Experimental physiology: Pithing of frog, preparation of nerve muscle-Recording of twitch response, effect of single stimulus- effect of heat and cold Fatigue- summation, tetanus. Recording of respiration, spirometry. Recording of volume and capacities in different physiological states including

determination of vital capacities. Recording of rumen/ intestinal movements (Demonstration)

SEMESTER IV

VETERINARY PHYSIOLOGY- III

(Endocrinology, Reproduction, Growth and Environmental physiology)

VPB-221

Credit Hours 3+1=4

THEORY

Hormone cell interaction, sub-cellular mechanisms-metabolism of hormones-methods of study of endocrine system; Receptors- mechanism of regulation; Chemistry of hypothalamo – hypophyseal hormones, target organ, pineal, thyroid, thymus, pancreas, adrenal, prostaglandins, hormones of calcium metabolism, disorders-rennin-angiotensin system, atrial natriuretic factors, erythropoietin, GI hormones, pheromones.

Genetic & endocrine control of gonadal development, modification of gonadotrophin release, ovarian functions follicular development, dynamics, endocrine and receptor profiles, sexual receptivity, ovarian cycle, post partum ovarian activity, ovum transport, capacitation, fertilization, reproductive cycles in farm animals – hormones present in the biological fluids during pregnancy and their uses for the diagnosis of pregnancy- maternal foetal placental participation in pregnancy & parturition, immunology of gestation, preparturient endocrine events.

Spermatogenic cycle and wave- function of sertoli cell-leydig cell- semen – composition- evaluation; Testosterone – function and regulation – cryptorchidism. Puberty – photoperiod – uses of androgens, progestogens, estrogens.

Functional and metabolic organization of mammary glands- structure and development; effect of estrogens and progesterone; hormonal control of mammary growth; lactogenesis and galctogenesis; biosynthesis of milk constituents – secretion of milk, mastitis and metabolism, prolactin and mammary tumours- lactation cycle.

Biochemical and genetic determinants of growth, regulation of growth, metabolic and hormone interactions, factors affecting efficiency of growth and production in ruminants and single stomach animals. Growth in meat producing animals & birds, growth curves. Recombinant gene transfer technologies for

growth manipulation- advantages and limitations. Protein deposition in animals and poultry.

Heat balance, heat tolerance, hypothermia, hyperthermia, thermo-regulation in farm animals, role of skin, responses of animals to heat and cold, fever, body temperature and hibernation. Temperature regulation in birds.

Climatology- various parameters and their importance. Effect of different environmental variables like temperature, humidity, light, radiation, altitude on animal performance. Acclimation, acclimatization- general adaptive syndrome. Clinical effect on endocrine- reproductive function, circadian rhythm.

Neurophysiology of behaviour, types of behaviour, communication, Learning and memory behavioural plasticity.

PRACTICAL

Estrus and phases of estrous cycle in animals (vaginal mucus). Behavioural signs of estrus. Bioassay for trophic hormone. Demonstration of hormone estimation. Rectal palpation of reproductive organs. Sperm motility, sperm concentration – live and dead – abnormal sperm count. Measurement of growth in various species. Measuring surface area of animals. Health parameters of animals – body temperature, pulse, respiration and heart rate. Measurement of animal environmental conditions. Behavior of animals- mating behaviour, milking behaviour, feeding behaviour (live/videographic/computer simulated demonstration).

SEMESTER I

GENERAL VETERINARY BIOCHEMISTRY

VPB-112

Credit Hours 1+1=2

THEORY

Scope and importance of biochemistry. Structure of biological membranes and transport across membranes. Donnan membrane equilibrium. Dissociation of acids, pH, buffer systems. Henderson- Hasselbalch equation.

Biochemistry of carbohydrates. Biological significance of important Monosaccharides (ribose, glucose, fructose, galactose, mannose and amino sugars. Disaccharides (maltose, isomaltose, lactose, sucrose & cellobiose), Polysaccharides (starch, dextrans, glycogen, cellulose, inulin, chitin) and Mucopolysaccharides including bacterial cell wall polysaccharides.

Biochemistry of lipids: Properties and biological significance of simple, compound and derived lipids and lipoproteins. Structure and functions of prostaglandins – Chemistry of bile and bile acids.

Biochemistry of proteins: Structure, properties and biological significance of proteins. Amino acids classification and structure of neutral, basic and acidic amino acids. Properties of amino acids- amphoteric nature, optical activity and peptide bond formation. Chemical reaction of proteins.

Biochemistry of nucleic acids: Chemistry of purines, pyrimidines, nucleosides and nucleotides. Biological significance of nucleosides & nucleotides. Structure and functions of deoxyribonucleic acid (DNA) and a typical ribonucleic acid (RNA).

PRACTICAL

Concentration of solutions – System International (S.I) Units. Preparation/standardization of acids & alkalies. Preparation of buffers and determination of pH. Titration curve of acid versus base. Reactions of mono- di- and polysaccharides and their identification. Estimation of lactose in milk. Determination of acid number of an oil. Colour reactions of proteins. Precipitation reactions of proteins. Estimation of amino acids (Sorensen's method)

SEMESTER II

VETERINARY INTERMEDIARY METABOLISM

VPB-122

Credit Hours 2+1=3

THEORY

Enzymes: Definition and classification, EC numbering of enzymes. Coenzymes, cofactors & iso-enzymes, Properties: Protein nature, enzyme-substrate complex formation, modern concept of the active center of enzyme. Specificity of enzyme action: Substrate specificity, group specificity, stereo or optical specificity. Factors influencing enzyme action: Effects of temperature, pH, concentration of substrate and enzyme. Enzyme units: International Units, katal, turnover number & specific activity.

Enzyme inhibition: Competitive, non-competitive, uncompetitive inhibition & suicidal inhibition. Allosteric enzymes.

Biological oxidation: Enzymes and coenzymes involved in oxidation and reduction viz. Oxidoreductases, oxidases, oxygenases, dehydrogenases, hydroperoxidases & cytochromes.

Respiratory chain/ electron transport chain, oxidative phosphorylation, inhibitors, uncouplers and other factors influencing electron transport chain.

Carbohydrate metabolism: Glycolysis, Krebs's cycle, glyoxylate cycle HMP shunt, gluconeogenesis, Cori cycle, glycogenesis, glycogenolysis, hormonal control of carbohydrate metabolism & regulation of blood sugar. Bioenergetics of carbohydrate metabolism.

Lipid metabolism: Beta oxidation of fatty acids, ketone body formation, biosyntheses of fatty acids, triacylglycerol, phospholipids & lipoprotein metabolism. Bioenergetics of lipid metabolism.

Protein metabolism: Biosynthesis and degradation, Deamination, transamination and decarboxylation of amino acids. Ammonia transport and urea cycle.

Nucleic acids: Metabolism of purines and pyrimidines. DNA & RNA biosynthesis. Integration of metabolism. Metabolic functions of macro and micro nutrients, Metabolic functions of lipid and water soluble vitamins. Uses of isotopes in metabolic studies.

PRACTICAL

Effect of pH and temperature on enzyme activity. Estimation of normal/ abnormal constituents of urine. Electrophoretic separation of proteins. Paper chromatography. Estimation of bilirubin, blood glucose, electrolytes and other metabolic intermediaries in blood (colorimetry/ spectrophotometry/ flame photometry).

**SEMESTER VI
ANIMAL BIOTECHNOLOGY**

VPB- 321

Credit Hours 2+1=3

THEORY

Definitions, basic concepts and scope of animal biotechnology. Recombinant DNA technology. Gene cloning, vectors and expression vectors. Transformation and transfection. Polymerised chain reaction (PCR), construction of genomic library and DNA library. DNA sequencing. Principles of transfer of nucleic acids and proteins (Southern, Northern and Western blotting). Nucleic acid hybridization, DNA probes and DNA fingerprinting.

Biotechnological application in animal improvements:

Embryo biotechniques, *in vivo* and *in vitro* embryo production and preservation, sexing, micromanipulation and cloning, transgenic animal and biopharming.

Mapping of genome and genome sequencing. Marker assisted selection. Gene banking.

Nutritional biotechnology including bioconversion of lignocellulose, genetic manipulation of microbes for improved feed utilization and health. Animal tissue culture, transformation and cell lines, tumor markers and acute phase proteins.

Molecular diagnosis including PCR and DNA probes. Hybridoma and monoclonal antibodies. New generation vaccines: Subunit, recombinant and recombinant vectored vaccines Fermentation process and technologies for milk, meat and leather. Ethics and regulatory issues in Biotechnology. IPR. Bioinformatics.

PRACTICAL:

DNA and plasmid isolation. Gel electrophoresis. PCR. Screening of gametes and embryo. Use of Multimedia and audio-visual aids for molecular biology aspects.

(The course is to be taught jointly with the Departments of Veterinary Microbiology and Veterinary Gynaecology and Obstetrics)

**DEPARTMENT OF VETERINARY PHARMACOLOGY AND
TOXICOLOGY
SEMESTER V**

GENERAL AND SYSTEMIC VETERINARY PHARMACOLOGY

VPT-311

Credit Hours 2+1=3

THEORY

Historical development, branches and scope of Pharmacology. Sources and nature of drugs. Pharmacological terms and definitions. Principles of drug activity: Pharmacokinetics – Routes of drug administration, absorption, distribution, biotransformation and excretion of drugs. Pharmacodynamics-concept of drug and receptor, dose-response relationship, terms to drug activity and factors modifying the drug effect and dosage. Fundamentals of drug-screening and assay of drugs. Adverse drug reactions, drug interaction, drug designing and development, bio prospecting of drugs. Introduction to biopharmaceutics and gene therapy.

Drugs acting on digestive system: Stomachics, antacids and antiulcers, prokinetics, carminatives, antizymotics, emetics, antiemetics, purgatives, antidiarrhoeals, cholerectics and cholagogues. Rumen pharmacology.

Drugs acting on Cardiovascular system: Cardiac glycosides, antiarrhythmic drugs, vasodilators and antihypertensive agents, haematinics, coagulants and anticoagulants.

Drugs acting on respiratory system: Expectorants and antitussives, respiratory stimulants, bronchodilators and mucolytics.

Drugs acting on urogenital system: Diuretics, urinary alkalizers and acidifiers, fluid therapy, ecbolics and tocolytics.

Pharmacotherapeutics of hormones and vitamins.

Drugs acting on skin and mucous membranes: Emollients, demulcents and counter irritants.

Bio-enhancers, Immunostimulants and immunosuppressants.

New drugs and drug formulations.

PRACTICAL

Pharmacy appliances. Principles of compounding and dispensing.

Metrology : Systems of weights and measures, pharmacy calculations. Pharmaceutical processes. Pharmaceutical dosage forms. Prescription writing, incompatibilities. Drug standards and regulations -Custody of poisons. Compounding and dispensing of powders, ointments, mixtures, liniments, lotions, liquors, tinctures, emulsions and electuaries.

SEMESTER VI
VETERINARY NEUROPHARMACOLOGY

VPT-321

Credit Hours 2+1=3

THEORY

Drugs acting on autonomic nervous system: Neurohumoral transmission, adrenoceptors agonists and antagonists-adrenergic neuron blockers, cholinceptors agonists and antagonists-ganglionic stimulants and blockers.

Autacoids: Histamine and antihistaminic agents. 5-Hydroxytryptamine and its antagonists, prostaglandins, angiotensin and bradykinin.

Drugs acting on central nervous system (CNS): Pharmacology of neurotransmitters. History of general anaesthetics and theories of anaesthesia. Inhalent, intravenous and dissociative anaesthetics: hypnotics and sedatives: tranquilizers, psychotropic drugs, anticonvulsants, opioid analgesic, non-steroidal anti-inflammatory drugs, analeptics and other CNS stimulants, central muscle relaxants.

Drugs acting on somatic nervous system: Local anaesthetics and peripheral muscle relaxants. New drugs and drug formulations.

PRACTICAL

Demonstration of the effect of CNS depressants, analgesics, CNS stimulants, muscle relaxants, anticonvulsants, local anaesthetics in laboratory animals.

Demonstration of the action of adrenergic and cholinergic agonists and antagonists on isolated and intact preparations of the animals.

Alternate use of animals as model for demonstration.

SEMESTER VII
VETERINARY CHEMOTHERAPY

VPT-411

Credit Hours 2+0=2

THEORY

Antibacterial agents: Classification, general principles in antibacterial chemotherapy, antibacterial resistance. Sulphonamides and their combination with diaminopyrimidines, sulfones, nitrofurans, nalidixic acid and fluoroquinolones.

Antibiotics: Penicillins and cephalosporins, aminoglycosides, tetracyclines, chloramphenicol, macrolides, polypeptides. Miscellaneous agents: methenamine, bacitracin. Rifampin, novobiocin, virginamycin lincosamides and vancomycin.

Antifungal agents: Topical and systemic agents including anti-fungal antibiotics.

Anthelmintics: Drugs used against cestodes, trematodes, nematodes, drug resistance, broad-spectrum anthelmintics.

Antiprotozoal agents: Drugs used in trypanosomosis, theileriosis, babesiosis, coccidiosis, amoebiosis, giardiosis and trichomonosis.

Ectoparasiticides-Antiviral and anticancer agents-Antiseptics and disinfectants-Growth promoters.

Common indigenous drugs of plant origin with proven pharmacological and therapeutic efficacies in various animal ailments.

New drugs and drug formulations.

SEMESTER VIII VETERINARY TOXICOLOGY

VPT-421

Credit Hours 2+0=2

THEORY

General Toxicology: Definitions, fundamentals and scope of toxicology. Sources and mode of action of poisons. Factors modifying toxicity. General approaches to diagnosis and treatment of poisoning.

Toxicity caused by metal and non-metals: Arsenic, lead, mercury, copper, selenium, molybdenum, phosphorus, nitrates and nitrites, common salt and fluoride.

Toxicity caused by plants and weeds: Cyanogenetic plants, abrus lantana, ipomoea, nerium, datura, nux-vomica, castor, selenium containing plants, oxalate producing plants, plants causing thiamine deficiency.

Drug toxicity and toxicity caused by agrochemicals: organophosphates, carbamates, chlorinated hydrocarbons, pyrethroids, herbicides, fungicides, rodenticides and urea.

Residue toxicology: Hazards of residues, concepts of withdrawal time and MRLs-minimizing drug and toxic residues in animal products.

Venomous bites and stings: Snake bite, scorpion, spider, wasp stings and toad poisoning. Radiation hazards and industrial toxicants. Toxicity caused by food additives and preservatives.

DEPARTMENT OF VETERINARY PARASITOLOGY

SEMESTER III GENERAL VETERINARY PARASITOLOGY AND HELMINTHOLOGY

VPA-211

Credit Hours 3+1=4

THEORY

Parasites and parasitism. Types of Parasitism. Commensalism, symbiosis and predatorism, Types of hosts: Final and Intermediate hosts, paratenic host and reservoir hosts, natural and unnatural hosts. Host parasite relationship; mode of transmission of parasites and methods of dissemination of the infective stages of the parasite. Parasite specificity in relation to species, breed, sex and location. Tissue reactions caused by parasites to the host. Resistance of hosts to parasitic infections/ infestation. Immunity against parasitic infections. Standardized Nomenclature of Animal Parasitic Diseases (SNOAPAD).

General description of helminth parasites affecting domestic animals and birds.

Classification of helminthes. Characteristics of phylum (Platyhelminthes, Nematelminthes and Acanthocephala). Salient morphological features of diagnostic importance. Life cycle of the helminthes in relation to transmission, pathogenesis, epidemiology, diagnosis, general control measures of following helminthes of animals and birds.

Trematodes:

Liver flukes (*Fasciola*, *Dicrocoelium* and *Opisthorchis*), intestinal flukes (*Fasciolopsis*), blood flukes (nasal schistosomosis), cercarial dermatitis (*Schistosoma* and *Ornithobilharzia*), visceral schistosomosis (*S. spindale*, *S. indica*, *S. incognitum*), Amphistomes/immature amphistomosis (*Paramphistomum*, *Cotylophoron*, *Gastrothylax*, *Gastrodiscus*, *Gigantocotyl*, *Gastrodiscoides*, *Pseudodiscus*), Lung flukes (*Paragonimus*) and oviduct flukes (*Prosthogonimus*), their importance in the diagnosis.

Cestodes:

Metacestodes (bladder worm), Ruminant tape worms (*Moniezia*, *Avitellina*, *Stilesia*), Dog tape worms (*Dipylidium*, *Taenia*, *Multiceps* and *Echinococcus*), Equine tape worms (*Anoplocephala*, *Paranoplocephala*) Poultry tape worms (*Davainea*, *Cotugnia*, *Raillietina*, *Amoebotaenia*) and Broad fish tape worms (*Diphyllobothrium*), Dwarf tape worm (*Hymenolepis*)

Nematodes:

Ascaris, Parascaris, Toxocara, Toxascaris, Ascaridia, Heterakis and Oxyuris. Bursate Worms (Strongyloides, Strongyles, Chabertia, Syngamus, Oesophagostomum), Kidney worms (Stephanurus, Dioctophyma), Hook worms. (Ancylostoma, Agriostomum, Bunostomum, Trichostrongylus, Ostertagia, Cooperia, Nematodirus). Stomach worms (Haemonchus, Mecistocirus). Tissue roundworms. (Habronema, Thelazia, Spirocerca, Gongylonema). Filarial worm Dirofilaria, Parafilaria, Onchocerca, Setaria, Stephanofilaria). Lung worms (Dictyocaulus, Mullerius and Protostrongylus). Guinea worms (Dracunculus). International regulations for control of different helminthic diseases.

PRACTICAL

Methods of collection, fixation, preservation and mounting of helminth parasites. Study of morphological characters of adults and their larval stages and damages caused by them. Identification of important trematodes, cestodes and nematode. Examination of faecal samples for eggs of trematode, cestode and nematode. Demonstration of the life cycle and development of the type species of Trematode, Cestode and Nematode.

**SEMESTER IV
VETERINARY ENTOMOLOGY AND ACAROLOGY****VPA-221****Credit Hours 1+1=2****THEORY**

General description of insecta and arachnida affecting domestic animals and birds. Arthropoda as direct/indirect parasites. Classification. Life Cycle and vector potentiality in relation to disease transmission, pathogenesis and control of following arthropods affecting animals and birds.

The biting midges (Culicoides), buffalo/Black fly, gnats (Simulium), sandflies (Phlebotamus). The mosquitoes (Culex, Anopheles and Aedes). Horse fly (Tabanus), Musca, Stomoxys, Sarcophaga, Warbles (Hypoderma) and bots (Gasterophilus), Nasal bot (Oestrus ovis), Myiasis, Wingless flies (Hippobosca, Melophagus), bugs, lice (Haematopinus, Linognathus, Trichodectus, Damalina, Menopon, Lipeuris, Menacanthus (Poultry lice). Fleas (Pulex, Ctenocephalides, Echidnophaga, Xenopsylla). Arachnids (Ticks and mites of Veterinary importance. Soft tick (Argasidae), (Argus, Orthinodorus and Otobius).

Hard ticks (Boophilus Hyalomma, Rhipicephalus, Haemophysalis, Amblyomma, Ixodes), Mites (Demodex, Sarcoptes, Psoroptes, Notoedrus, Chorioptes). Anti-tick immunoprophylaxis.

Damages to hide and skins due to ectoparasitic infestation.

PRACTICAL

Demonstration of the type representatives of various groups of insects, ticks and mites through charts, specimen and mounted slides. Demonstration of different characters of Insecta and Arachnida (Ticks and mites). Procedure for diagnosis of arthropod infestation to hides and skin. Demonstration of enteric myiasis, Procedures for the collection, fixation, preservation and mounting of arthropods parasites.

SEMESTER IV VETERINARY PROTOZOLOGY

VPA-222

Credit Hours 2+1=3

THEORY

Introduction and general description to protozoa and their development. Differentiation from protophyta, bacteria and rickettsia, Classification. Life cycle in relation to transmission, pathogenesis, diagnosis and control of protozoa of veterinary importance.

Kalazar (visceral and cutaneous leishmaniasis, Animal trypanosomosis (Surra), trypanosomosis (due to African Trypanosoma) in cattle and man.

Bovine and avian trichomonosis, black head in turkeys (Histomonas), Bovine amoebae (Entamoeba and Balantidium), Giardia sp, Coccidia and coccidiosis of poultry and animals. Cryptosporidiosis, Cyst forming coccidian (Toxoplasma, Sarcocystis), Neospora (Neospora caninum), Malaria parasite of animals and poultry (Plasmodium and Haemoproteus), Piroplasmosis (Babesia), Theileriosis (Theileria), Recent developments in protozoan vaccines for field use. International regulations for control of different protozoan diseases.

PRACTICAL

Examination of faecal materials for identification of intestinal protozoa, coccidian and flagellates. Preparation of blood smears, their staining and examination of slides for haemoprotozoan parasites. Methods of collection, fixation, preservation and mounting of protozoan parasites. Identification of representative slides of protozoan parasites.

DEPARTMENT OF VETERINARY MICROBIOLOGY
SEMESTER III
GENERAL VETERINARY MICROBIOLOGY

VMC-211

Credit Hours 1+1=2

THEORY

Introduction and history of Microbiology. Morphology, structure, growth and nutrition of bacteria. Classification and nomenclature of bacteria. Sources and transmission of infection. Pathogenicity, virulence and infection. Resistance and susceptibility of host, bacteraemia, septicaemia, toxemia, endotoxins and exotoxins; Bacterial genetics. Plasmids, Antibiotic resistance.

Introduction, morphology, growth, nutrition, reproduction in fungi, Classification of fungi.

Introduction to viruses: General properties, Replication, Cultivation and Purification of viruses. Cell-Virus interactions. Viral genetics. Interferon.

PRACTICAL

Equipment, Sterilization, disinfection and asepsis, Staining (simple & Grams, acid fast, lactophenol cotton blue), Special staining (metachromatic granules, capsular, spore). Bacterial motility, Preparation of culture media. Aerobic and anaerobic cultivation, Isolation of bacteria in pure culture, Morphological and cultural characteristics, biochemical characters, Antibigram, Phenol coefficient test, Slide culture technique for fungus.

SEMESTER IV
VETERINARY IMMUNOLOGY AND SEROLOGY

VMC-221

Credit Hours 1+1=2

THEORY

Concepts in Veterinary and Medical Immunology. Immune system: Organs, tissues and cells. Types of immunity. Development of humoral and cellular immune responses.

Antigens: definition, specificity, types and factors affecting immunogenicity, blood group antigens.

Antibodies: Structure, properties and function of different classes of immunoglobulins, Site, mechanism and theories of antibody production, Monoclonal antibodies.

Major histocompatibility complex, Complement system; Cytokines: Major types and functions. Serological reactions: Agglutination, precipitation, haemagglutination: Phagocytosis, opsonic index, cytolysis, Complement fixation, neutralization, toxin and antitoxin reaction, immunofluorescence;

Hypersensitivity: classification and mechanism of induction. Autoimmunity and immunotolerance. Immunisation of animals.

Biologicals: Role of conventional and modern vaccines in immunoprophylaxis. Adjuvants. Quality control of biologicals.

PRACTICAL

Preparation of antigen, Raising of antisera, Concentration of Immunoglobulins, Agglutination (plate, tube), Precipitation (Agar gel precipitation test (AGPT), Crossed immunoelectrophoresis (CIE), Rocket Immunoelectrophoresis (RIE), Indirect agglutination (Latex co-agglutination, Passive haemagglutination (PHA), Reversed passive haemagglutination (RPHA), Haemagglutination, Complement fixation test, immunoperoxidase test (IPT), Fluorescent antibody technique (FAT), Enzyme linked immunosorbent assay (ELISA), Cell mediated immune (CMI) response, Veterinary biologicals (visits and appraisal).

SEMESTER V

SYSTEMATIC VETERINARY BACTERIOLOGY AND MYCOLOGY

VMC-311

Credit Hours 2+1=3

THEORY

Study of following important pathogenic bacteria and fungi in relation to their morphology, isolation, growth, colonial, biochemical and antigenic characters. Pathogenicity and diagnosis of bacterial and fungal diseases caused by the following genera:

Bacteria: Staphylococcus, Streptococcus, Bacillus, Clostridium, Mycobacterium, Enterobacteriaceae (E.coli, Salmonella, Yersinia, Klebsiella and Proteus), Campylobacter, Brucella, Pasteurella and Mannheimia, Pseudomonas and Burkholderia, Moraxella, Haemophilus and Taylorella, Listeria, Actinobacillus, Actinomyces, Arcanobacterium and Corynebacterium, Nocardia, Dermatophilus, Spirochetes, Gram negative anaerobes, Mycoplasma, Rickettsia, Chlamydia and Chlamydophila.

Fungi : Dematophytes, Rhinosporidium, Sporotrichum, Candida, Mycetomal fungi. Cryptococcus, Aspergillus, Zygomycetes and Dimorphic fungi. Mycotic mastitis and abortion, Mycotoxicoses.

PRACTICAL

Laboratory identification of agents of Mastitis, Haemorrhagic septicaemia, Enteric infections, Brucellosis, Tuberculosis and Johne's disease, Clostridial infections, Wooden tongue and Lumpy jaw, Anthrax, Glanders, Aspergillosis, Dermatophytosis, Demonstration of other agents of importance (Phycomycetes, yeasts etc.,)

SEMESTER VI

SYSTEMATIC VETERINARY VIROLOGY

VMC-321

Credit Hours 2+1=3

THEORY

Brief history, classification and characteristics of various families of DNA and RNA viruses causing diseases in livestock and poultry, laboratory diagnostic techniques, immunity to viral infections, systemic virology including: DNA viruses: **Poxviridae** : Pox viruses of cow, sheep, goat and fowl. **Asfarviridae**: African swine fever, **Herpesviridae**: Aujeszky's disease, malignant catarrhal fever, infectious bovine rhinotracheitis, equine abortion, Marek's disease, infectious laryngotracheitis. **Adenoviridae** – Infectious canine hepatitis, egg drop syndrome (EDS), Inclusion body hepatitis – Hydropericardium syndrome (IBH- HPS). **Papillomaviridae**: Papillomatosis, **Parvoviridae**: Canine Parvovirus. **Circoviridae**: Chicken infectious anaemia. **RNA** viruses: **Orhomyxoviridae**: Swine, equine and Avian influenza.

Paramyxoviridae: Rinderpest, PPR, canine distemper and Ranikhet disease, **Flaviviridae**: Classical swine fever, bovine viral diarrhea. **Picornaviridae**: - foot and mouth disease (FMD), duck viral hepatitis, **Rhabdoviridae**:- Rabies, vesicular stomatitis, ephemeral fever, **Coronaviridae**: - Avian Infectious bronchitis, transmissible gastroenteritis, **Togaviridae**:- Equine encephalitis, **Arteriviridae**: equine viral arteritis, **Caliciviridae**: Vesicular exanthema, **Retroviridae**: Avian leucosis group. **Lentiviruses**- Equine infectious anemia virus, **Sheep pulmonary adenomatosis**, **Maedi/visna**. **Reoviridae**: African horse sickness and blue tongue, Calf Rotavirus, **Birnaviridae**: Infectious bursal disease. **Prions**, Exotic and emerging animal and poultry viruses.

PRACTICAL

Glassware and media preparation, Demonstration of Cell culture, Virus propagation by egg inoculation, animal inoculation and cell culture, study of cytopathogenesis, viral inclusions, diagnostic procedures, serological techniques, preservation and transportation of clinical samples for virological investigations. Diagnostic procedures for Peste des petits ruminants (PPR), FMD, Ranikhet disease (RD), Blue tongue, Infectious bronchitis (IB), Infectious bursal disease (IBD) and other viral agents.

DEPARTMENT OF VETERINARY PATHOLOGY

SEMESTER III GENERAL VETERINARY PATHOLOGY

VPP-211

Credit Hours 1+1=2

Introduction and scope of Veterinary Pathology, Brief outline of major intrinsic and extrinsic causes of disease. Pathology of hyperaemia, congestion, haemorrhage, edema, thrombosis, embolism, infarction and shock.

Acute cellular swelling and its variants. Glycogen overload and fatty change. Heat shock proteins and lysosomal storage diseases.

Causes and mechanism of reversible and irreversible cell injury, necrosis and its types, apoptosis, differences between post-mortem autolysis and necrosis. Gangrene. Major exogenous and endogenous pigments. Metastatic and dystrophic calcification.

Jaundice in animals. Photosensitization dermatitis. Aplasia, hypoplasia, atrophy, hypertrophy, hyperplasia, metaplasia and dysplasia. Inflammation; definitions, classification, various cell types and their functions, mediators, cardinal signs and systemic effects. Cell cycle and cyclins, soluble and insoluble mediators (including growth factors).

Wound healing by primary and secondary intention. Pathology of autoimmune diseases and amyloidosis. Definitions, general characteristics and classification of neoplasms. Differences between benign and malignant tumours, etiology and spread of neoplasms, immunity and neoplasia, effects and diagnosis of neoplasia, stages and grades of neoplasma.

PRACTICAL

Study of gross pathological specimens and recognition of pathological lesions. Post-mortem (P.M) techniques. Collection of morbid materials for pathological diagnosis. Techniques for preservation and dispatch of materials. Section cutting, staining and identification of microscopic lesions. Examination of slides depicting changes in cells and tissues. Study of histopathological slides showing haemorrhage, congestion, oedema, infarction, hyperplasia, metaplasia, hypertrophy, necrosis, cloudy swelling, amyloid degeneration, fatty changes, calcification, infiltration etc.. Examination and interpretation of oncological tissue slides.

SEMESTER IV
SYSTEMIC VETERINARY PATHOLOGY

VPP-221

Credit Hours 2+1=3

THEORY

Pathological changes including neoplasms in non-infectious disease conditions affecting Digestive System (mouth, pharynx, salivary glands, oesophagus, stomach, intestines, liver, gall bladder, pancreas), Respiratory System (nasal cavity, larynx, bronchi, trachea, lungs and pleura), Musculo-skeletal System (muscle, bone joints, ligaments, tendons), Cardio-vascular System (pericardium, myocardium, epicardium, endocardium, arteries, veins), Haematopoietic System (bone marrow), Lymphoid System (lymph nodes, vessels and spleen), Urinary System (kidneys, ureter, bladder and urethra), Reproductive System (male and female genital organs), Nervous System (brain spinal cord and peripheral nervous system), Endocrine System (adrenal, thyroid, thymus, pituitary, parathyroid and pancreas), Skin and Appendages (hoof and horn), Ear and Eye.

PRACTICAL

Post-mortem examination of large and small animals, recording of gross lesions and compiling the post-mortem report (including vetero-legal cases), despatch of morbid material in vetero-legal cases, study of gross specimens and histopathological slides pertaining to systemic pathology. Collection and examination of clinico-pathological specimens (blood, urine, body fluids, etc) for diagnosis of systemic affections.

SEMESTER V
SPECIAL VETERINARY PATHOLOGY

VPP-311

Credit Hours 2+1=3

THEORY

General pathology of viral infections. Pathogenesis, gross and microscopic pathology of Foot and mouth disease, Rinderpest, malignant catarrhal fever, blue tongue, infectious bovine rhinotracheitis, bovine viral diarrhoea, caprine encephalitis-arthritis complex, PPR, equine infectious anaemia, equine influenza, equine viral arteritis, equine rhinopneumonitis, African horse sickness, classical swine fever, Aujeszky's disease, swine influenza, rabies, canine distemper, infectious canine hepatitis, canine parvovirus, feline panleukopenia, maedi, jaagziekte, scrapie, bovine and feline spongiform encephalopathies, pox virus diseases in different animals. Vesicular stomatitis, vesicular exanthema, equine encephalomyelitis, diseases caused by rota and corona viruses.

General pathology of bacterial infections. Pathogenesis, gross and microscopic pathology of Tuberculosis, Johne's disease, actinomycosis, actinobacillosis, anthrax, clostridial group of diseases, streptococosis including strangles in horses, staphylococosis, glanders, pasteurellosis, leptospirosis, listeriosis, swine erysipelas, brucellosis, corynebacterium infections, nocardiosis, campylobacteriosis, Hemophilus, salmonellosis and colibacillosis in swine.

General pathology of mycoplasmal, chlamydial and rickettsial infections and their differentiation. Pathogenesis, gross and microscopic pathology of contagious bovine pleuropneumonia (CBPP), contagious caprine pleuropneumonia (CCPP), porcine enzootic pneumonia, chlamydial group of diseases and anaplasmosis, Q-fever and Ehrlichiosis.

General pathology of mycotic infections. Pathogenesis, gross and microscopic pathology of superficial and deep mycoses – ringworm, favus, aspergillosis, zygomycosis, histoplasmosis, cryptococosis and candidiasis.

General pathology of helminthic and protozoal infections. Pathogenesis, gross and microscopic pathology of fascioliasis, amphistomiasis, ascariasis, strongylosis, haemonchosis, spirocercosis, filariasis, hookworm, tapeworm infections, coccidiosis, toxoplasmosis, babesiosis, theileriasis and trypanosomiasis.

Pathological changes in nutritional and metabolic diseases: (deficiency/excess of carbohydrates, proteins, fats, minerals and vitamins and in conditions like milk fever, pregnancy toxemia, post-parturient haemoglobinuria, ketosis, hypomagnesemic tetany, azoturia, piglet anaemia and sway back/enzootic ataxia and Rheumatism like syndrome).

General pathology of toxicosis. Pathogenesis, gross and microscopic pathology of heavy metal toxicities like arsenic, copper, lead, mercury, cadmium, strychnine, nitrate/nitrite, hydrocyanic acid (HCN), fluoride, oxalate toxicities, insecticide/pesticide poisoning. Pathogenesis, gross and microscopic pathology of aflatoxicosis, ochratoxicosis, trichothecosis and ergototoxicosis. Pathology of exotic and emerging diseases.

PRACTICAL

Post-mortem examination of large and small animals for diagnosis of special diseases. Study of gross lesions particularly those of pathognomonic significance. Study of histopathological slides pertaining to special pathology including special staining of causative agents. Study of rapid diagnostic techniques like biopsy, exfoliative cytology, frozen sectioning.

SEMESTER VI AVIAN PATHOLOGY

VPP-321

Credit Hours 1+1=2

THEORY

Viral Diseases: Pathogenesis, gross and microscopic pathology of Ranikhet disease, infectious bursal disease, infectious bronchitis, infectious laryngotracheitis, fowl pox, avian influenza, Marek's disease, leucosis/scarcoma group of diseases, avian encephalomyelitis, inclusion body hepatitis, hydropericardium syndrome, chicken infectious anaemia. Avian nephritis, egg drop syndrome, infectious stunting syndrome, reovirus infections.

Bacterial Diseases: Pathogenesis, gross and microscopic pathology of Colibacillosis (colisepticaemia, yolk sac infection, egg peritonitis, coligranuloma), infectious coryza, clostridial diseases (botulism, necrotic enteritis, gangrenous dermatitis, ulcerative enteritis) salmonellosis (Pullorum disease, fowl typhoid, paratyphoid infection), fowl cholera, tuberculosis and spirochaetosis.

Mycoplasmal and Chlamydial Diseases: Pathogenesis, gross and microscopic pathology of Mycoplasma gallisepticum infection (chronic respiratory disease), Mycoplasma synoviae infection, Avian chlamydiosis (psittacosis).

Fungal Diseases: Pathogenesis, gross and microscopic pathology of aspergillosis, thrush and favus.

Mycotoxicosis: Pathogenesis, gross and microscopic pathology of Aflatoxicosis, ochratoxicosis and trichothecenes.

Parasitic Diseases: Pathogenesis, gross and microscopic pathology of Helminthic diseases (flukes, cestodes, nematodes), protozoal diseases (coccidiosis, histomoniasis), ectoparasites, Avian malaria.

Nutritional and metabolic diseases: Pathogenesis, gross and microscopic pathology of major diseases due to deficiency/excess of carbohydrates, proteins, minerals and vitamins in poultry.

Vices and Miscellaneous Diseases: Pathology of important vices and miscellaneous conditions. Pathology of exotic and emerging poultry diseases.

PRACTICAL

Post mortem examination and diagnosis of poultry diseases based upon clinical signs and gross lesions. Writing of postmortem report. Collection, preservation and despatch of morbid materials in poultry diseases. Clinical examination of blood, faeces and other tissues/fluids for poultry disease diagnosis. Submission of feed samples for analysis.

Study of gross specimens and histopathological slides of different diseases of poultry.

SEMESTER VI
AQUATIC ANIMAL DISEASES, HEALTH CARE AND MANAGEMENT

VPP-322

Credit Hours 1+1=2

THEORY

Introduction to aquatic animals, aquatic animal ecology and national economy. Fishery as a method of recycling animal and poultry wastes and feed surplus. Types of common aquatic animals, fresh and saline water fish, their collection. Care and breeding, egg and spawn management. Integrated aquaculture. Ornamental fisheries. Aquatic animal feeds and feeding. Economic production: Pond and nursery management. Inland and marine capture fisheries, Stock assessment and population dynamics. Fish harvesting and process technology, fish preservation, inspection, utilization of fish in animal feed. Anatomy, physiology, immunology and inflammatory response in finfish and shellfish (crustaceans and mollusks).

OIE regulations related to aquatic animal health.

Viral, bacterial, mycotic and parasitic diseases affecting aquatic animals. Nutritional and toxic pathology, Miscellaneous non-infectious diseases associated with physicochemical abnormalities of water. Neoplasia of teleosts.

Vaccines and vaccination.

PRACTICAL

Identification of culturable fishes. Techniques to study growth and age in fishes. Composite fish culture techniques. Management of artificial diets, induced breeding techniques. Determination of hydrological parameters, qualitative and quantitative analysis of phyto-and zoo-planktons. Fishing gears and crafts. Management of a typical fish farm.

Normal anatomy and histology of finfish and shellfish. Ante-mortem and post-mortem examination of fish. Haematology. Histopathology of important viral, bacterial, fungal and parasitic diseases. Visit to organized fishery.

(To be taught jointly with Departments of Livestock Production Management and Veterinary Medicine)

**DEPARTMENT OF VETERINARY PUBLIC HEALTH AND
EPIDEMIOLOGY**

SEMESTER V

MILK AND MEAT HYGIENE, FOOD SAFETY AND PUBLIC HEALTH

VPE-311

Credit Hours 2+1=3

THEORY

Milk hygiene in relation to public health. Microbial flora of milk and milk products. Sources of milk contamination during collection and transport of milk and processing of dairy products. Control of milk and milk product contamination. Hygienic handling/management of dairy equipment. Quality control of milk and milk products. Milk hygiene practices in India and other countries. Legislation and standards for milk and milk products. Milk as a source of disease transmission.

Pathological conditions associated with the transport of food animals. Elements of meat inspection. Hygiene in abattoirs. Ante-mortem inspection of meat animals. Humane slaughter of animals. Post-mortem inspection of meat animals. Methods of inspection of meat. Rigor mortis and examination of lymph nodes. Speciation of meat. Health implications of emergency and causality slaughter. Hygienic disposal of unsound meat. Inspection of poultry and aquatic foods (fish) for human consumption. Occupational health hazards in meat processing plants. Meat as a source of disease transmission.

Food safety, definition, hazard analysis and critical control point (HACCP) system and chemical and microbial toxicities associated with milk, meat and aquatic foods. Risk analysis, assessment and management and food safety measures. Toxic residues (pesticides, antibiotics, metals and hormones) and microbial toxins in food and their health hazards. Types of bio-hazards. Sanitary and phytosanitary measures in relation to foods of animal origin and aquatic foods. International and national food safety standards {Office International des Epizooties (OIE), World Trade Organisation (WTO), sanitary and Phytosanitary (SPS) and Codex Alimentarius}.

PRACTICAL

Sanitary collection of samples for chemical and bacteriological examination. Grading of milk by MBR test. Test for pasteurization and plant sanitation. Microbiological examination of raw and pasteurized milk, milk products and water. Standard plate, coliform, faecal streptococcal, psychrophilic, mesophilic and thermophilic counts. Detection of adulterants and preservatives in milk and milk products. Isolation and identification of organisms of public health significance from milk.

Visit to abattoirs, meat processing plants, marketing centers and food service establishments. Antemortem and post mortem inspection of food animals. Methods of slaughter (demonstration at the slaughter houses) Demonstration of speciation of meat. Physical and bacteriological quality of meat and aquatic foods (fish). Demonstration of toxic chemical and microbiological residues in milk and meat.

SEMESTER VI VETERINARY EPIDEMIOLOGY AND ZOOSES

VPE-321

Credit Hours 2+1=3

THEORY

Definitions and aims of epidemiology. Factors influencing occurrence of livestock diseases and production. Ecological basis and natural history of diseases. Sources, Storage, retrieval and representation of disease information/data. Epidemiological hypothesis. Epidemiological methods: descriptive, analytical (observational), experimental, theoretical (modeling), serological and molecular. Survey of animal diseases. Surveillance and monitoring of livestock diseases. Animal disease forecasting. Strategies of disease management, prevention, control and eradication. Economics of animal diseases. National and International regulations on livestock diseases. Role of OIE and laws on international trade on animals and animal products.

Definition, history and socio-economic impact of zoonotic diseases, Classification of zoonoses and approaches to their management. New, emerging, re-emerging and occupational zoonoses. Role of domestic, wild, pet and laboratory animals and birds in transmission of zoonoses. Zoonotic pathogens as agents of bio-terrorism. Reservoirs, clinical manifestations in animals and humans and the management of the following zoonoses: Rabies, Japanese Encephalitis. Kyasanur forest disease, influenza, anthrax, brucellosis, tuberculosis, leptospirosis, listeriosis, plague, rickettsiosis, chlamydiosis and dermatophytosis. Food borne zoonoses: salmonellosis, staphylococcosis, clostridial food poisoning, campylobacteriosis, helminthosis, toxoplasmosis and sarcocystosis. Veterinary Public Health Administration.

PRACTICAL

Collection of epidemiological samples. Measurement of disease: determination of morbidity and mortality rates/ratios. Generation of epidemiological protocols and reports. Demonstration of selected software programmes/models e.g EPIZOO, Handi STATUS and India-Admas-EPITRAK. Evaluation of vaccines and diagnostic tests. Determination of Associations and risks: relative risk, Odd's ratio and attributable risk. Survey of an animal disease on a farm.

Field Survey of zoonotic diseases. Concurrent isolation and identification of important pathogens of zoonotic importance from animal and human sources including foods of animal origin and their interpretation. Study of rural environment and health status of rural community. Visit to primary health centre/human hospital and study of the Common diseases affecting rural/urban population and probable relationships of these human disease conditions with animal diseases present in the area.

SEMESTER IX

ENVIRONMENT AND ENVIRONMENTAL HYGIENE

VPE-511

Credit Hours 2+1=3

THEORY

Definition, scope and importance. Ecosystem; types, structure and functions. Food chains. Bio-diversity: uses, threats and conservation. Natural resources: forest, mineral, soil and water-their uses and abuses. Environmental pollution-causes, and effects. Control measures of air, water, soil, marine, thermal and noise pollution. Nuclear hazards. Bio-safety and risk assessment. Environment Protection Acts and related issues. Disaster management.

Sources of water supply and water quality. Sources of water contamination. Bacteriology of water. Physical, chemical, microbiological and biological evaluation of water. Water purification. Disposal of sewage and farm wastes. Health implications of farm wastes. Sanitation and disinfection of animal houses. Recycling of farm wastes. Sources of air pollution within animal houses and its effect on animal health and production. Ventilation and ventilation systems within animal houses and specialized laboratories. Prevention and control of air and water-borne diseases. Problems of atmospheric pollution (acid rain, depletion of ozone layer, methane production, green house effect and global warming.) Tannery, wool, bone and blood meal industry pollution and its control. Stray and fallen animal management. Pollution due to industrial wastes.

PRACTICAL

Sampling of water for sanitary examination. Physical examination of water. estimation of colour, turbidity, total hardness, solids, alkalinity and acidity of water. Chemical and Microbiological evaluation of water quality. Disinfection of animal houses. Determination of the efficacy of disinfectants. Demonstration of water purification system. Disposal of carcasses. Pathogenic microbes in air. Demonstration of various ventilation systems in animal houses. Demonstration of toxic residues in water and air. Visit to local polluted sites and documentation of local environmental problems.

DEPARTMENT OF ANIMAL NUTRITION

SEMESTER I

PRINCIPLES OF ANIMAL NUTRITION AND FEED TECHNOLOGY

ANN-111

Credit Hours 2+1=3

THEORY

Importance of nutrients in animal production and health. Composition of animal body and plants. Nutritional terms and their definitions. Importance of minerals (major and trace elements) and vitamins in health and production, their requirements and supplementation in feed. Common feeds and fodders, their classification, availability and importance for livestock and poultry production. Measures of food energy and their applications- gross energy, digestible energy, metabolisable energy, net energy, total digestible nutrients, starch equivalent, food units, physiological fuel value. Direct and indirect calorimetry, carbon and nitrogen balance studies. Protein evaluation of feeds- Measures of protein quality in ruminants and non-ruminants, biological value of protein, protein efficiency ratio, protein equivalent, digestible crude protein. Calorie protein ratio. Nutritive ratio. Various physical, chemical and biological methods of feed processing for improving the nutritive value of inferior quality roughages. Preparation, storage and conservation of livestock feed through silage and hay and their uses in livestock feeding. Harmful natural constituents and common adulterants of feeds and fodders. Feed additives in the rations of livestock and poultry; Antibiotics and hormonal compounds and other growth stimulants, and their uses.

PRACTICAL

Familiarisation of various feed stuff, fodders and their selection. Preparation and processing of samples for chemical analysis- herbage, faeces, urine and silages. Weende's System of analysis – Estimation of dry matter, total ash, acid insoluble ash, crude protein, ether extract, crude fibre, nitrogen free extract, Calcium and phosphorus in feed samples. Demonstration of detergent methods of forage analysis. Qualitative detection of undesirable constituents and common adulterants of feed. Demonstration of laboratory ensiling of green fodders. Silage pit preparation.

SEMESTER II

APPLIED NUTRITION-I (RUMINANTS)

ANN-121

Credit Hours 2+1=3

THEORY

Importance of scientific feeding. Feeding experiments. Digestion and metabolism trial. Norms adopted in conducting digestion trial. Measurement of digestibility. Factors affecting digestibility of a feed. Feeding standards, their uses and significance, merit and demerits of various feeding standards with reference to ruminants. Nutrient requirement of livestock-energy and protein requirement for maintenance and production. Methods adopted for arriving at energy and protein requirements for maintenance and production in terms of growth, reproduction, milk, meat, wool and work. Balanced ration and its characteristics. General principles of computation of rations. Formulation of rations and feeding of dairy cattle and buffaloes during different phases of growth, development and production (neonate, young, mature, pregnant, lactating and dry animals, breeding bull and working animals). Formulation of ration and feeding of sheep and goat during different phases of growth, development and production (milk, meat and wool.) Use of NPN compound for ruminants.

PRACTICAL

Demonstration of conducting digestion trial in ruminants. Calculation of nutritive value of different feedstuffs in terms of digestible crude protein (DCP), total digestible nutrient (TDN), Nitrogen retention (NR) and starch equivalent (SE). Calculation of requirements of nutrients in terms of DCP, TDN and metabolisable energy (ME) for maintenance, growth and other types of production like meat, milk, wool, reproduction and work. Formulation of rations for different categories of livestock under different conditions. Demonstration of the methods for improving the nutritive quality of straws and other crop residues. Formulation of rations for feeding of livestock during scarcity periods. Visit to feed factories.

SEMESTER III

APPLIED NUTRITION-II

(NON-RUMINANTS, POULTRY AND LABORATORY ANIMALS)

ANN-211

Credit Hours 2+1=3

THEORY

Factors affecting digestibility of a feed. Nutrient requirements in poultry, swine and equine – Energy and protein requirement for maintenance and production. Methods adopted for arriving at energy and protein requirements for maintenance and production in terms of growth, reproduction and production (egg, meat and work). Formulation of rations as per Bureau of Indian Standards (BIS), National Research Council (NRC) and Agricultural Research Council (ARC) specifications. Feeding standards, their uses and significance, merit and demerits of various feeding standards with reference to monogastric animals and poultry. Feeding of swine (Piglets, Growers, Lactating and pregnant sows, Breeding boar, Fattening animals), equine (foal, yearling, broodmare, stallion and race horses) and poultry (Starter, Growers, Broilers, Layers) with conventional and unconventional feed ingredients. Feeding of ducks. Laboratory Animal Nutrition: Nutrient requirements of mice, rat, rabbit and guinea pig. Significance of carbohydrates, lipids, proteins and amino acids, minerals and vitamins in lab animal nutrition. Diet formulation and preparation and feeding practices, Feed supplements.

PRACTICAL

Calculation of requirements of nutrients in terms of DCP, TDN and ME for maintenance, growth, reproduction and other types of production like egg and meat. Formulation of rations for poultry and swine with conventional and unconventional feed ingredients. Principles of compounding and mixing of feeds. Visit to poultry farms.

DEPARTMENT OF ANIMAL GENETICS AND BREEDING

SEMESTER-I

BIO-STATISTICS AND COMPUTER APPLICATION

AGB-111

Credit Hours 2+1=3

THEORY

A. Basic Statistics:

Introduction and importance. Statistics, parameters, observation, recording and graphical representation of data. Probability and probability distributions: binomial, Poisson and normal. Measures of central tendency and measures of dispersion (simple and grouped data): Moments and skewness to kurtosis. Correlation and regression. Tests of hypothesis and t, Z, X^2 and F tests of significance and their interrelationship, Livestock census procedure and census. Introduction to sample survey methods for livestock and livestock products. Bioassay- meaning and uses.

B. Experimental designs:

Completely Randomized Design (C.R.D) and Randomized Block Design (R.B.D). Analysis of variance.

C. Computer application:

Computer and its components: Types of computers. Hardware, software, human ware and firm ware. Type of memories. Computer languages and their scope and limitations. Computer programming: Data types: Constants, variables, expressions, operations, functions, flow charts, commands, simple programs and their execution- scope and limitations. Data base management system: Storage of data, filing retrieving, reproduction. Use of computer in animal husbandry and veterinary practices.

PRACTICAL

Systematic approach of data, tabulation, simple probability problems. Estimation of measures of central tendency (mean, median, mode) and estimation of measures of dispersion (variance, standard deviation, standard error and coefficient of variation): for simple and grouped data. Graphical representation of data. Tests of significance-t,Z, X^2 and F tests. Estimation of correlation. Estimation of regression. Analysis of variance: C.R.D., R.B.D Computer basics and components of computer. Simple operations. Entering and saving biological data, database management systems. MS-Office. Spread sheet. Internet, e-mail and geographic information system (GIS).

DEMONSTRATION

Use of word processor and spreadsheet. Graphics and their uses. Data retrieving and analysis through computer (Data base) Use of local area network (LAN) and other network systems. Retrieving library information through network. G.I.S. and its use.

SEMESTER II

PRINCIPLES OF ANIMAL GENETICS AND POPULATION GENETICS

AGB- 121

Credit Hours 2+1=3

History of Genetics, Chromosome numbers and types in livestock and poultry. Mitosis, Meiosis and gametogenesis. Overview of Mendelian principles: Modified Mendelian inheritance: gene interaction: multiple alleles: lethals: sex-linked, sex limited and sex influenced traits: linkage and crossing over, Mutation, Chromosomal aberrations: Cytogenetics, Extra-chromosomal inheritance. Gene concept - classical and molecular.

Population genetics: Genetic structure of population: Gene and genotypic frequency: Hardy – Weinberg law and its application; Forces (e.g. Mutation, migration, selection and drift) changing gene and genotypic frequencies.

Quantitative genetics: Nature and properties: Values and means, Components of phenotypic and genotypic variance: Concept of genotype and environment interaction, Resemblance between relatives: Heritability, repeatability, genetic and phenotypic correlations.

PRACTICAL

Demonstration of karyotype of Farm animal species: Solving problems on inheritance of Mendelian traits, Linkage and Crossing over. Calculation of gene and genotypic frequencies, Testing a population for Hardy-Weinberg equilibrium: Calculation of effects of various forces that change gene frequencies: Computation of population mean: Estimation of heritability, repeatability, Most probable producing ability (MPPA), genetic and phenotypic correlations.

SEMESTER III

LIVESTOCK AND POULTRY BREEDING

AGB-211

Credit Hours 2+1=3

THEORY

History of Animal Breeding: Classification of breeds: Economic characters of livestock and poultry and their importance: Breeding/ Selection techniques for optimal production, selection: Response to selection and factors affecting it; Bases of selection individual, pedigree, family, sib, progeny and combined: Indirect selection: Multitrait selection.

Classification of mating systems: Inbreeding and outbreeding-genetic and phenotypic consequences viz., inbreeding depression and heterosis: Systems of utilization of heterosis: Selection for combining ability: Breeding methods for the improvement of dairy cattle and buffaloes [crossbreeding, sire evaluation, field progeny testing, open nucleus breeding system (ONBS)], sheep, goat, swine and poultry; Breed development; Conservation of germplasm, Current livestock and poultry breeding programmes in the state and country.

PRACTICAL

Description and measurement of economic traits of Livestock & poultry. Standardization of performance records, Computation of selection differential, generation interval and expected genetic gain; Construction of selection index: Sire indices, Measurement of inbreeding and relationship coefficients: Estimation of heterosis.

DEPARTMENT OF LIVESTOCK PRODUCTION MANAGEMENT

SEMESTER I

LIVESTOCK PRODUCTION MANAGEMENT-I (GENERAL PRINCIPLES AND RUMINANTS)

LPM- 111

Credit Hours 3+1=4

THEORY

Livestock in India- association of livestock to Indian society during vedic, medieval and modern era. Demographic distribution of livestock and role in economy. Animal holding and land holding patterns in different agro-ecologies.

Introductory animal husbandry. Common animal husbandry terms. Body conformation and identification. Dentition and ageing of animals. Transport of livestock by rail, road, air and on foot. Common farm management practices including disinfection, isolation, quarantine and disposal of carcass. Introduction to methods of drug administration. Common vices of animals, their prevention and care. Livestock production systems of different agro-climatic zones. Livestock resources and resources management. Livestock produce and products and their availability and their role in rural/urban health/economy. Organic livestock production.

General principles affecting the design and construction of building for housing for various livestock species. Selection of site. Arrangements of the building with special reference to Indian conditions.

Utilisation of local materials. Building materials used for construction of wall, roof and floor of animal houses, their characteristics, merits and demerits.

Demography of cattle and buffalo population. Breeds and descriptors of important breeds. Important traits of cattle and buffaloes. General management and feeding practices of calves, heifers, pregnant, lactating and dry animals and bulls and working animals. Draughtability of cattle and buffaloes. Raising of buffalo males for meat production. Housing systems, layout and design of different buildings for dairy animals including backyard dairy and mixed farms. Routine dairy farm operations and labour management. Methods of milking and precautions. Factors affecting quality and quantity of milk production. Clean milk production. Dairy milk production. Dairy farm accounts and records. concepts of input and output cost of dairy farming (small and large holdings).

Demography of sheep and goat population and their role in economy. Breeds and breed descriptors. Important traits for meat, milk and fibre. General management and feeding practices during different stages of growth, development and production (milk, meat and wool) in small and large holdings. Breeding schedule and management of ram and buck. Weaning and attending of lambs and kids. Glossaries of terms in wool industry. Shearing of sheep. Physical and chemical properties of wool. Impurities in wool. Factors influencing the quality of wool. Wool grading. Recovery of wool wax and its use. Housing systems, layout and design of different buildings for small ruminants.

Judging for the quality and confirmation of body parts of cattle, buffalo, sheep and goat. Culling of animals. Preparation of animals for show.

Problems and prospects of dairy, meat and wool industry in India. Animal and animal products market and marketing. Animal Fairs and Melas. Animal pounds and Goshalas.

PRACTICAL

Identification of various breeds of cattle, buffalo, sheep and goat. Familiarization with body points of animals. Approaching, handling and restraining of cattle, buffalo, sheep and goat. Clipping, shearing, dipping, spraying and spotting sick animals. Detection of vices. Feeding of animals. Methods of identification (marking, tattooing, branding, tagging and electronic chip). Determination of age. Determination of body weight using different measurements. Preparation of animals for show and judging. Layout plans for dairy and sheep/goat farms. Familiarization with routine farm operations. Selection and culling of animals. Milking of dairy animals. Training of breeding males. Detection of heat. Identification and care of pregnant animals. Care of neonatal and young stock. Maintenance, cost accounting, economic analysis and preparation of balance sheet of dairy and sheep/goat farm records. Structure of wool and its differentiation from hair fibre. Determination of staple length, crimps, diameter and strength of wool fibre. Sorting, packaging and grading of wool. Recovery of wax from wool. Scouring and carbonization of wool. Visit to different animal farms/ demonstration centres/ individual rural, urban and peri-urban animal units/wool production centres & industries/ wool, meat and live animal markets. Preparation of project proposals.

SEMESTER II
FODDER PRODUCTION AND GRASSLAND MANAGEMENT

LPM- 121

Credit Hours 1+1=2

THEORY

Importance of grasslands and fodders in livestock production. Agronomical practices for production of leguminous and non-leguminous fodders in different seasons. Soil and water conservation and irrigation drainage for fodder production. Farm power and agro-energy. Farm machinery and equipment. Harvesting and post harvest techniques for fodder preservation. Storage of feeds and fodders. Scarcity fodders. Feed and fodder management for individual animals. Fodder production for small units through inter cropping or back yard cultivation. Recycling of animals washings and wastes in fodder production.

PRACTICAL

Visit to the fodder farm. Familiarisation with the various types of fodder crops utilised in the state and the samples of fodder in India. Fodder cropping routines – familiarization. Collection, preservation and storage of feed and fodder, possible damages/loss and methods to prevent them. Cost calculations of fodder production. Familiarisations with the back yard fodder cropping and intercropping of fodder.

Livestock waste utilization and recycling. Calculation on the economic aspects of fodder cropping and procurement of feed.

SEMESTER II
LIVESTOCK PRODUCTION MANAGEMENT II
(MONOGASTRIC AND LABORATORY ANIMALS)

LPM-122

Credit Hours 1+1=2

THEORY

Introduction and scope of swine farming in the country. Demography of swine population. Breeds and their role in economy. Management of different categories of swine for optimal production: breeding and pregnant sows: sows at farrowing and after farrowing; pig-lets, growing stock, lactating sows, feedlot stock. Mating technique in swine. Housing of swine. Swine feeds and feeding. Economics of pig farming. Equine population of India. Horses, donkey and mules and their utility. Identification of breeds of horses. Handling, restraining, care and routine for horse, donkeys and mules. Vices of horses.

Care of stallion. Mating of Horses broodmare and its care. Foaling and care of newborn. Breeding mules. Care of race horses and preparing horses for show. Doping and its detection. Visit to races, polo, horses show.

Importance of laboratory animal breeding care and housing standards of mice, rats and guinea pigs. General considerations on feeding and breeding of laboratory animals. Prophylactic measures for commonly occurring laboratory animal diseases. Concept of production of specific pathogen free (SPF) and germ free laboratory animals.

Scope of rabbit farming in the country, breeds and their distributions in India and abroad. Limitation of rabbit animal production. Selection, care, and management of breeding stock for commercial purpose. Identification. Care and management of kindling animals and kindling. Care of new born, growing stock. Harvesting of products. Breeding and selection techniques for optimal production. Feeds and feeding for rabbit production. Housing of rabbit. Shearing/slaughtering and preservation of products. Diseases and parasite control, hygienic care. Disposal, utilization and recycling of wastes etc. Economic aspects of rabbit production, accounting their expenditure, income etc. Manpower requirements and personnel/labour management. Preparing projects for micro (backyard) mini, and major rabbit farms.

PRACTICAL

Identification of Indian and exotic breeds of swine, handling of swine; routine inspection, Identification of diseases, examination and control of parasites, vaccination, Identification of pregnant animals. Care during pregnancy, isolation and care of farrowing sows, care of pig lings, Castration, culling, tooth cutting. Calculation of profits and preparation of feasibility reports and projects for piggery. Layout plans of swine houses; routine operations of swine farms. Marketing of swine. Feeding of swines. Preparation of swines for show and judging.

Identification of body parts and handling of laboratory animals. Housing system and space requirements for laboratory animals. Weighing, sexing and weaning of laboratory animals. Marking for identification of laboratory animals for purpose of their individual recording. Computation and compounding of balanced diet for laboratory animal mainly Mice, Rats, Guinea – pigs and Rabbits. Feeding schedule of laboratory animals for high breeding efficiency. Maintenance of breeding records of laboratory animals. Prophylactic measures against common disease of lab animals. Hygienic care and control of parasites (routines).

Visit to the University Rabbitary. Handling and restraint. Body parts. Identification of breeds. Judging. Feeds and feeding. Housing requirement and equipment. Farrowing. Care of newly born young ones tagging, tattooing for identification. Shearing. Dressing of carcass.

Horse riding: walking, trotting, cantering and galloping. Preparation of equines for show and judging. Layout plans for stables.

SEMESTER III

AVIAN PRODUCTION MANAGEMENT

LPM- 211

Credit hours 1+1=2

THEORY

Indian Poultry Industry-brief outline of the different segments-poultry statistics. Classification of poultry, common breeds of poultry including duck, quail, turkey & guinea fowl and their descriptions. Description of indigenous fowls. Reproduction in fowl, male and female reproduction systems, formation of eggs, structure of eggs. Important economic traits of poultry, egg production, egg weight, egg quality, growth, feed consumption and feed efficiency, fertility and hatchability, plumage characteristics and comb types. Scavenging system of management: raising of chicks, scavenger feed base of village. Low input technology; backyard and semi intensive unit of various sizes; their description, management and economic achievements.

New colored feathered birds developed in public and private sectors for meat and egg production for rural poultry; their acceptability and assimilation in rural eco-system.

Mixed farming and poultry raising. Concept of self-local market unit. Brooding and rearing practices used for chicken, duck, quail, turkey and guinea fowl.

Economic production of chicken, and other classes of poultry. Hatching and feeding norms for different species of poultry. Marketing of poultry and poultry products.

Setting of farms for different classes of poultry. Organic and hill farming.

PRACTICAL

Morphological description of common exotic poultry breeds like White Leghom (WLH), Rhode Island Red (RIR), Plymouth Rock, Cornish and New Hampshire. Diagrammatic illustration of body parts of chicken, duck, quail,

guinea fowl and turkey. Descriptive specialties of indigenous birds, listing of its advantageous value in rural areas. Diagrammatic representation of scavenging, backyard and semi intensive units; with habitats, feed base and shelter. Conservation of indigenous germ plasm; listing of conservation techniques. Demonstration of newly developed breeds in rural environment. Housing, equipments, nesting and brooding requirements. Vaccination, medication and incubation requirements. Preparation of projects for rural people on poultry and other species (duck, quail, guinea fowl and turkey).

SEMESTER IV

COMMERCIAL POULTRY PRODUCTION AND HATCHERY MANAGEMENT

LPM-221

Credit hours 1+1=2

THEORY

HOUSING – Location of poultry. Types of poultry houses. Different types of rearing- advantages and disadvantages. Space requirement for different age groups under different rearing systems. Environmentally controlled housing. **BROODING MANAGEMENT-** Brooding: Types of brooders; preparation of shed to receive chicks; importance of environment (temperature, humidity and ventilation), Feeding and vaccination in early stage of chicks.

REARING AND MANAGEMENT- Care and management of growing, laying/broiler birds of both breeders and commercial categories of poultry. Battery cage management: different types and sizes. Poultry judging.

LITTER MANAGEMENT- Litter materials, litter-borne diseases and control; potential for poultry litter used as fertilizers; recycling for livestock feeding and power generation; Special management care in adverse weather conditions/ stress; summer management; modification of housing light reflectors; insulators, sprinklers, foggers and other methods; dietary modification to minimize heat stress; special management during rainy and winter season; other stress management-vices in poultry and its remedial measures.

WATER MANAGEMENT- Standard for drinking water in terms of total solids, pH, minerals levels, sanitizers and water sanitations, diseases spread through water contamination-prevention.

BIOSECURITY- Proactive measures to minimize entry of infections in farm premises-farm fencing, disinfectant pits, personnel management, restriction of movement, etc. Poultry welfare and behaviour.

FEEDING- digestive system and digestion in chicken. Classification, selection of common feed ingredients and their nutrient composition. Nutrient requirement for different age groups. Feed formulation, economics of feed formulation-cost / unit nutrient. Feeding systems and feeding management, economization of poultry feeding. Feed restriction, separate male feeding, non-nutrient feed additives including herbal bio-enhancers; anti-nutritional factors and toxins.

HEALTH CARE- Common poultry diseases: bacterial, viral, fungal, parasitic and nutritional deficiencies. Vaccination schedule for commercial layers and broilers: factors that govern vaccination schedule; vaccination principles type, methods, pre and post vaccination care. Medication: Types of administration-general principles and precautions with emphasis on administering medication through water and feed; commonly used drugs in poultry diseases. Disinfection; Types of disinfectants; mode of action; recommended procedure; precaution and handling.

ECONOMICS- Economics of layer and broiler production; Projects reports layer in different systems of rearing. Projects reports for broilers. Feasibility studies on poultry rearing- in context of small units and their profitability. Designer meat and egg production. Export/import of poultry and poultry products.

BREEDER FLOCK MANAGEMENT- Layer and broiler breeder flock management, housing & space requirements. Different stage of management during life cycle; Light management during growing and laying period, Artificial insemination.

Feeding: Feed restriction, separate male feeding. Nutrient requirement of layer and broiler breeders of different age groups. Healthcare: vaccination of breeder flock; difference between vaccination schedule of broilers and commercial birds. Common diseases of breeders (Infectious and metabolic disorders)-prevention. Fertility disorder- etiology, diagnosis and corrective measures. Selection and culling of breeder flocks. Economic parameters on returns from breeders- for example saleable chicks/hen/production cycle etc.

HATCHERY PRACTICES – Management: principles of incubation. Factors affecting fertility and hatchability, selection, care and incubation of hatching eggs. Fumigation; sanitation and hatchery hygiene. Disposal of hatchery waste; Sexing, grading, packing and dispatch of day old chicks. Economics of hatchery business; Trouble shooting hatch failure: importance of hatchery records, break even analysis of unhatched eggs. Biosecurity in the hatchery. Computer applications for hatchery management.

PRACTICAL

Male and female reproductive system. Artificial insemination. Selection of breeder flock. Working of hatchery incubation requirement; incubators working, care. Hatchery layout and equipments. Handling of eggs prior and during incubation. Candling. Fumigation. Project reports of setting up a hatchery. Hatchery records and maintenance. Exposure to commercial broiler and layer farms-different system of housing. Demonstration of litter and cage rearing systems. Feed equipments and maintenance; hammer mill, mixture, pellet mill-types, principle of working, comparison of different types, premix preparations, quality control of raw materials. Feed mill operation. Demonstration of different types of feeder, waterer, fogger, sprinklers etc. Maintenance of farm records. Medication –demonstration of routinely employed methods of administration. Vaccination practice in general and demonstration of different routes of administration in particular.

SEMESTER-IV LIVESTOCK PRODUCTION MANAGEMENT (REGIONAL INTEREST)

LPM -222

Credit Hours: 1+1=2

Course Contents to be developed by the University/Veterinary College on the basis of regional Interest.

THEORY:

Existing Livestock Systems in Andhra Pradesh: Small holder production systems. Mixed farming. Specialized farms. Mixed diversified farms. Integrated farming systems. Backyard keeping Organic livestock farming etc.

Small holder production systems: Livestock holdings and resources; optimum herd, flock size: constraints and Merits of the system: measures of optimize productivity and economy.

Mixed farming: Concept of mixed farming. Successful combinations of components in mixed farming. Relative merits.

Specialized farms: Concepts optimum conditions for specialized farms. Relative merits.

Mixed diversified farms: Concept of diversification in mixed farming suitability and optimum conditions relative merits.

Integrated farming systems: Integration of livestock in various farming system of agriculture. Horticulture. Floriculture and pisciculture constraints optimum conditions and combinations.

Backyard keeping: Species suitable; resources utilization role of women.

Organic livestock farming: indiscriminate use of synthetic fertilizers. Pesticides. Insecticides. feed additives on human and livestock health economic value of organic livestock products milk, meat, egg, etc.

Role of organic livestock farming in environmental protection. Bio-diversity enhancement. Reduced energy use and Co₂ emission globally and sustainable resource use. increased productivity without over-reliance on costly external inputs.

Legal specifications of organic livestock farming and livestock products certifying agencies and modalities in certification of organic livestock products.

PRCTICALS

Visit to different systems of farming. Data collection on the economics and resource utilization/exchange in different systems.

Data collection on the animal performance in different systems of farming and calculation of economics. Preparation of project reports on farming systems.

Assessment of quality of organic livestock products. Techniques involved in certification of organic produce.

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

SEMESTER V

MILK AND MILK PRODUCTS TECHNOLOGY

LPT -311

Credit Hours 1+1=2

THEORY

Milk industry in India. Layout of milk processing plant and its management, Composition and nutritive value of milk and factors affecting composition of milk. Physico-chemical properties of milk, Microbiological deterioration of milk and milk products. Collection, chilling, standardization, pasteurization, homogenization, bactofugation. Principles of dehydration. Preparation of butter, paneer/channa, ghee, khoa, lassi, dahi, ice-cream, cheddar cheese and dairy by products, Good Manufacturing Practices. Implementation of HACCP. Toxic/pesticides residues in milk and milk products. Packaging, transportation, storage and distribution of milk and milk products. Organic milk food products. Legal and BIS standards of milk and milk products. Sanitation in milk plant.

PRACTICAL

Sampling of milk, estimation of fat, solid not fat (S.N.F.) and total solids. Platform tests. Cream separation. Detection of adulteration of milk. Determination of efficiency of pasteurization. Microbiological quality evaluation of milk and milk products. Preparation of milk products like curd, ghee, paneer/channa, khoa, ice-cream, milk beverages. Visit to Modern milk processing and milk manufacturing plants.

SEMESTER V

ABATTOIR PRACTICES AND ANIMAL PRODUCTS TECHNOLOGY

LPT -312

Credit Hours 1+1=2

THEORY

Layout and management of rural, urban and modern abattoirs. BIS standards on organization and layout of abattoirs, Pre-slaughter care, handling and transport of meat animals including poultry. Ante-mortem and post-mortem examination. Slaughtering and dressing of carcasses. Evaluation, grading and fabrication of dressed carcasses including poultry.

Abattoir byproducts: meat, bone, fish meal and byproducts of pharmaceutical value. Skin and hides: methods of flaying defects and preservation Management of organic wastes emanating from animal industries, fallen animals and abattoir effluent HACCP concepts in abattoir management.

Introduction to wool, fur, pelt and specialty fibers with respect to processing industry. Glossary of terms of wool processing. Basic structure and development of wool follicle. Post shearing operations of wool, classification

and grading of wool, physical and chemical properties of wool. Impurity of wool, factors influencing the quality of wool. Brief outline of processing of wool. Tests for identification of wool.

PRACTICAL

Methods of ritual and humane slaughter, flaying and dressing of food animals including poultry. Carcass evaluation. Determination of meat yield, dressing percentage, meat bone ratio and cut up parts. Preparation of different abattoir byproducts. Visit to leather processing unit and slaughterhouses/meat plants.

Wool sampling techniques, determination of fleece density, fiber diameter, staple length, crimp and modulation percentage, scouring/clean fleece yield. Visit to wool production/processing centre.

SEMESTER VI MEAT SCIENCE

LPT -321

Credit Hours 1+1=2

THEORY

Retrospect and prospect of meat industry in India, Structure and composition of muscle (including poultry muscle), conversion of muscle to meat, nutritive value of meat. Fraudulent substitution of meat, preservation of meat and aquatic foods – drying, salting, curing, smoking, chilling, freezing, canning, irradiation, antibiotic and chemicals. Ageing of meat. Modern processing technologies of meat and meat products. Packaging of meat and meat products. Formulation and development of meat and sea foods – kabab, sausages, meat balls/patties, tandoori chicken, soup, pickles, surimi, smoked fish. Physico-chemical and microbiological quality of meat and aquatic food and food products. Basics of sensory evaluation of meat products. Nutritive value, preservation, packaging of egg and egg products. Laws governing national/international trade in meat and meat products. Organic meat food products. Food products of genetically modified animal and marine origin.

PRACTICAL

Chilling/freezing of meat, meat products and aquatic foods. Ageing of meat, preservation and packaging of meat, aquatic foods and shell eggs and their products. Determination of microbial loads in various animal food products, estimation of deteriorative changes in meat and meat products. Preparation of ready-to-eat meat/poultry products. Evaluation of external and internal egg quality, preservation technique of eggs.

**DEPARTMENT OF VETERINARY GYNAECOLOGY AND
OBSTETRICS**

SEMESTER VII

VETERINARY GYNAECOLOGY

VGO -411

Credit Hours 2+1=3

THEORY

Clinical evaluation and abnormalities of reproductive tracts in domestic animals. Delayed Puberty and sexual maturity. Estrus detection. Aberrations of estrus and estrous cycle. Seasonal breeding. Pregnancy diagnosis- different methods- in different species. Superfoetation and Superfecundation Fertility, Infertility & sterility- Anatomical, hereditary, nutritional, managerial, hormonal and infectious causes. Anoestrus, ovulatory defects and cystic ovarian degeneration. Repeat breeding: Fertilization failure, early embryonic mortality. Specific & non-specific infections affecting genital organs-endometritis, cervicitis, vaginitis. Fertility parameters. Sexual health control and reproductive health management. Clinical use of hormones in female infertility. Breeding management, mismating, pseudopregnancy, transmissible venereal tumor (TVT) in bitches. Induction of estrus, Synchronization of estrus, Follicular Dynamics, Ovulation, Superovulation, and Embryo Transfer Technology. Immuno-modulation for enhancement of fecundity.

PRACTICAL

Study of female genitalia and its biometry. Methods of estrus detection in farm and companion animals including vaginal cytology. Collection and examination of vaginal mucus by various techniques. Demonstration of different hormonal preparations and their uses. Different protocols for induction and Synchronization of estrus, superovulation and embryo transfer. Pregnancy diagnosis and its differential diagnosis. Use of gynaecological instruments and appliances. Evaluation of female animals for breeding soundness. Demonstration of reproductive pathological conditions using museum specimens. Sexual health control, life history card for the female, recording system for reproductive performance. Demonstration of ultrasonographic imaging of reproductive organs and pregnancy, Oocyte collection and grading.

SEMESTER VIII

VETERINARY OBSTETRICS

VGO 421

Credit Hours 1+1=2

THEORY

Types and functions of placenta in different species. Diseases & accidents during gestation- Abortion in domestic animals-diagnosis & control. Dropsy of

fetal membranes and fetus. Fetal mummification, maceration, pyometra and mucometra. Prolonged gestation. Teratology. Premature birth. Uterine torsion. Cervico-vaginal prolapse. Termination of pregnancy. Parturition. Puerperium and involution of uterus in domestic animals. Care and management of dam and newborn. Dystocia- Types of dystocia – maternal & fetal- approach, diagnosis and treatment. Epidural & other anesthesia in obstetrical practice. Obstetrical operations- mutation, forced extractions, fetotomy and cesarean section. Injuries and diseases in relation to parturition.

Postpartum diseases and complications: uterine prolapse, retention of fetal membranes, metritis, postpartum paraplegia.

Animal birth control-ovariohysterectomy and non surgical interventions.

PRACTICAL

Study of pelvis and Pelvimetry. Assessment of fetal age. Demonstration of different types of placenta. Use of obstetrical instruments. Epidural and other obstetrical anaesthesia. Manipulation of fetal malpresentation in Phantom Boxes. Approach and treatment of obstetrical cases. Handling of prolapse of genitalia-application of vulvar sutures. Foetotomy. Caesarean section Post operative care and management of obstetrical cases. Demonstration of ovariohysterectomy.

SEMESTER IX

VETERINARY ANDROLOGY AND REPRODUCTIVE TECHNIQUES

VGO-511

Credit Hours 1+1=2

THEORY

Introduction to Andrology. Development of male genitalia and gonads. Puberty, sexual maturity, sexual behaviour and libido. Factors affecting maturity and sex drive in bulls. Form of male infertility. Factors causing infertility in male, its diagnosis and treatment. Abnormalities, malformations, diseases of male genitalia and coital injuries, their diagnosis and treatment. Testicular hypoplasia and degeneration. Disease of the accessory sex glands. Introduction, history, development, advantages and limitations of artificial insemination (A.I.). Methods of semen collection in various species. Factors affecting quality and quantity of semen. Macroscopic/physical, microscopic, biochemical and biological tests for evaluation of semen. Extenders used for semen preservation. Extension of semen, preservation of semen at different temperatures. Storage and shipment of semen. Technique of A.I.

PRACTICAL

Planning and organization of A.I. Centre. Selection, care, training and maintenance of breeding bulls for A.I. Andrological investigations for breeding soundness of bulls. Castration in different species, preparation of teaser bulls. Care, sterilization, storage and upkeep of equipments used for artificial Insemination. Preparation of A.V. Collection of semen. Evaluation of semen (Macroscopic/physical microscopic, biochemical and biological tests). Preparation of extender and Extension of semen. Preservation techniques at different temperatures. Freezing of semen. Insemination techniques for chilled and frozen semen. Recording Systems. Handling and shipment of frozen semen and liquid nitrogen containers at field level.

DEPARTMENT OF VETERINARY SURGERY AND RADIOLOGY

SEMESTER VII

GENERAL VETERINARY SURGERY, ANAESTHESIOLOGY AND DIAGNOSTIC IMAGING

VSR -411

Credit Hours 2+2=4

General Surgery

THEORY

Introduction, history, classification, surgical terminology and development of veterinary surgery. Asepsis-antisepsis, their application in veterinary surgery. Surgical risk and judgement. Management of shock, haemorrhage. Principles of fluid therapy in surgical patients. Differential diagnosis and surgical treatment of abscess, tumors, cyst, haematoma, necrosis, gangrene, burn. Wound: classification, symptoms, diagnosis and treatment; complications, their treatment and prevention.

PRACTICAL

Surgical instruments and equipment. Operation theatre routines. Surgical pack: Preparation, sterilization and handling. Familiarisation with suture materials, surgical knots, suture patterns and their use. Familiarisation to live surgery haemostasis.

Anaesthesiology

THEORY (Region specific)

Preanaesthetic considerations and preanaesthetics. Anaesthesia, local analgesia /anaesthesia, General anaesthesia, anaesthetic agents (like barbiturates, dissociative agents). Inhalation anaesthesia and agents, maintenance and monitoring of general anaesthesia. Anaesthetic emergencies and their management. Only awareness of neuroleptanalgesia, electro-anaesthesia, acupuncture, hypothermia, muscle relaxants. Post operative pain management. General principles of chemical restraint of wild / Zoo animals and anaesthesia of lab animals.

PRACTICAL

Familiarisation with anaesthetic apparatus, endotracheal tubes. Laryngoscope, gadgets for monitoring. Preanaesthetic preparation, induction of general anaesthesia in small and large animals and endotracheal intubation in dogs.

Demonstration of inhalant anaesthesia, monitoring of general anaesthesia and the management of anaesthetic emergencies. Use of artificial / assisted respiration. Various methods of local infiltration anaesthesia and regional block, for surgical procedures of different regions of body in Large and Small animals. Chemical restraint of lab and wild animals (Visit of a wild animals facility and audiovisual aids).

Diagnostic Imaging

THEORY

Production and properties of X-rays. Factors influencing production of X-ray. Principles of viewing and interpreting X-ray films, classification of radiographic lesions. Contrast radiography: classification, materials, uses, indications and contra indications. Biological effects of radiation, radiation hazards and their prevention by adoption of safety measures. Principles of ultrasonography and its applications in veterinary practice. Awareness on principles of radiation therapy, Isotopes and their uses in diagnosis and therapy; Principles and application of CT scan, MRI, echocardiography, scintigraphy, gamma camera, xeroradiography and Doppler.

PRACTICAL

Familiarization with operation of the X-ray equipment, X-ray accessories and adoption of safety measures in radiography. Dark room equipments, X-ray film and its processing. Intensifying screen and its uses. Radiographic technique-positioning of small and large animals. Handling, viewing and interpretation of X-ray films.

Familiarization with film contrasts, density and detail, common defects of X-ray films. Radiographic anatomy and interpretation of radiographic lesions. Demonstration of contrast technique in small animals. Familiarisation with ultrasonography of small and large animals (demonstration).

SEMESTER VIII REGIONAL SURGERY VETERINARY

VSR-421

Credit Hours 2+1=3

THEORY

Head and Neck

Affections of the lips and cheek and their treatment. Affections of the tongue and their treatment. Treatment of cleft palate. Nasal polyps. Affections and treatment of Guttural pouch, empyema, chondroids, tympanitis. Sinusitis, pus in the sinus. Affections of the horn and their treatment (avulsion of the horn, fracture of the horn, horn cancer and fissure in horn). Debudding and amputation of the horn Affections of the teeth and their treatment: congenital abnormalities, irregular molars. (shear mouth, sharp teeth, wave form mouth, step formed mouth) dental tartar and dental caries, dental tumor and periodontal disease. Bishoping, Affections of salivary glands and their treatment (Trauma, sialoliths, salivary cysts, salivary fistula). Affections of the upper and lower jaw

and treatment. Affections of the ear and their treatment. (haematoma and chronic otorrhoea). Eye: Clinical examination of the eye. Surgical affections of the eye: Entropion, ectropion, tumor of eyelid. Conjunctiva: Conjunctivitis, occlusion of nasolacrimal duct, squint. Eyeball: affections of the eye: hydrophthalmia, glaucoma, tumors of eye, panophthalmia, injuries and infections of anterior and posterior chambers. Worm in the eye. Affections of esophagus: choke, esophageal stenosis, dilation and diverticulum. Tracheal injuries and tracheal collapse. Affections of pharynx and larynx. Foreign bodies (Oral cavity).

Thorax And Abdomen

Fracture of rib. Perforated wounds, sternal fistula, pneumocele, traumatic pneumothorax. Hernia: classification, etiology, diagnosis and treatment, (umbilical, ventral, inguinal, perineal, diaphragmatic). Surgical affections of the stomach in dogs (cardia, pyloric stenosis, torsion). Surgical affections, diagnosis and treatment of stomach in ruminants (ruminal impaction, traumatic reticulitis, diaphragmatic hernia, abomasal displacement, omasal impaction). Surgical affections of intestines: intestinal obstruction, intussusception, strangulation (volvulus) in large and small animals. Caecal dilation, torsion, Affections of rectum: prolapse, rectal tear, anal adenitis. Congenital anomalies of colon, rectum, anus. Surgical affections of liver, spleen. Surgical affections of kidney, ureters, urinary bladder. Urolithiasis and urethral stenosis their sequelae and surgical treatment. Surgical affections of penis and sheath, affections of testicle, scrotum. Surgical affections of udder and teat. Canine mammary neoplasms.

PRACTICAL

Head and Neck

Demonstration of following: Examination of oral cavity. Location of trephining of sinus in equines. Bovine: Amputation of horn, Debudding. Ligation of Stenson's duct, Tooth rasping / floating, otoscopy in dogs, ear haematoma, tracheotomy, tracheostomy, oesophagotomy. Ophthalmoscopy, tests for blindness, operation for ectropion, and entropion, enucleation / extirpation of the eye.

Thorax And Abdomen

Demonstration of followings: Surgical approaches to the thorax and abdomen in animals with landmarks for approach to various organs. Thoracocentesis, abdominocentesis. Rumenoctomy, gastrotomy, enterotomy, enteroanastomosis, urethrotomy, vasectomy, ovariohysterectomy, spaying, cystotomy and cystorrhaphy, Caesarean section, Amputation of tail.

SEMESTER IX
VETERINARY ORTHOPAEDICS AND LAMENESS

VSR-511

Credit Hours 1+1=2

THEORY

Body conformation of the horse in relation to lameness (trunk, fore limb and hind limb) Lameness: definition, classification and diagnosis. Shoulder slip (sweeny), bicipital bursitis, omarthritis, capped elbow, radial paralysis, carpalitis, bent knee, and knock-knee. Hygroma of knee, open knee, blemished knee. Fracture of carpal bone, fracture of accessory carpal, contraction of digital flexors, splints, sore skin, wind puffs, sesamoiditis. Osslets, ringbone, quitter, side bone, Navicular disease, pyramidal disease. Laminitis, sand crack, seedy toe, fractures of third phalanx pedal osteitis, and sole penetration. Canker, thrush and corn, Monday morning disease, cording up, myositis of psoas, iliac thrombosis, Crural paralysis, subluxation of sacroiliac joint, rupture of round ligament, trochantric bursitis. Upward luxation fixation of patella, stringhalt, gonitis, chondromalacia of patella, rupture of tendoachilles, rupture of peroneus tertius, fibrotic myopathy and ossifying myopathy. Thoroughpin, bog spavin, spavin, curb, capped hock. Bovine lameness: contusion of sole, ulceration of sole, septic laminitis, avulsion of hoof and subluxation of patella. Interdigital fibroma, cyst, and sand crack, hoof deformities. Specific joint disease (septic arthritis, osteochondritis dessicans, degenerative joint disease) in large animals and their treatment. Specific joint disease in dogs and their treatment. (Intervertebral) disc protrusion, spondylosis) elbow and hip dysplasia. Rupture of cruciate ligament. Fracture and dislocation: Classification and general principles of fracture repair. Application of external and internal immobilization for different bone fractures in small and large animals. Complications of fracture healing. Affections of tendon, tendon sheath, bursa and ligaments. Principles of physiotherapy, classification, scope and limitations.

PRACTICAL

Examination of the horse for confirmation body (head, trunk, fore limbs and hind limbs) and diagnosis of lameness. Demonstration of equine shoeing. First aid in orthopaedic patients (splint application, Robert Jones's bandage) Plaster of paris cast- application in dogs and calves. Hanging pin and transfixation pinning (demonstration) intra medullary pinning in dogs (demonstration). Diagnostic nerve block in equine (demonstration). Demonstration of: claw trimming of bovine foot, neurological examination for evaluation of spinal trauma, tenectomies of lateral digital extensor – tendon, medial patellar desmotomy, Techniques and application of diathermy, electrical stimulators, ultrasonic, therapy, infra red and ultra – violet rays.

(Courses on Zoo/Wild Animal Breeding, Nutrition, Management and Health Care under VMD – 512 (2+1) and Pet/Companion Animal Breeding, Feeding, Management and Health Care under VMD – 513 (1+1) shall be taught jointly by Departments of Veterinary Medicine, Livestock Production Management, Animal Genetics and Breeding, Animal Nutrition, Veterinary Pathology, and Veterinary Surgery and Radiology).

DEPARTMENT OF VETERINARY MEDICINE

SEMESTER VII

VETERINARY CLINICAL MEDICINE-I

(GENERAL & SYSTEMIC)

VMD-411

Credit Hours 2+1=3

THEORY

History and scope of Veterinary Medicine, Concept of animal diseases. Concepts of diagnosis, differential diagnosis and prognosis. General systemic states, hyperthermia, hypothermia, fever, septicemia, toxemia, shock and dehydration. Aetiology, clinical manifestations, diagnosis, differential diagnosis, treatment, prevention and control of the following diseases of cattle, buffalo sheep/goat, equine, pig and pet animals. Diseases of digestive system with special reference to rumen dysfunction and diseases of stomach in non-ruminants. Affections of peritoneum, liver and pancreas. Diseases of respiratory and cardiovascular systems including blood and blood forming organs. Diseases of uro-genital system & lymphatic system. Emergency medicine and critical care.

PRACTICAL

Clinical examination and diagnosis: Methods of clinical examination of individual ailing animals including history taking. Examination of animal including behaviour and general appearance: demeanour, voice, eating, drinking, defecation, urination, posture, gait, condition of skin and body coats. Inspection of body: examination of head and neck, thorax, respiratory rates, rhythm, respiratory depth, type of respiration, cardiac sounds, chest symmetry, abdomen, external genitalia, mammary glands and limbs. Physical examination: temperature taking, palpation, percussion, auscultation. Examination of ears, eyes, conjunctiva, eye balls, mouth, submaxillary and other superficial lymph nodes, jugular furrow, oesophagus, trachea. Passing of stomach tube for locating obstruction if any. Examination of specific condition of thorax: pneumothorax, haemothorax and hydrothorax. Percussion/ auscultation of lung and cardiac areas. Examination of abdomen: ruminal motility, consistency, microbial population and their motility in ruminal fluid, use of trochar and canula, Examination of liver and kidneys. Liver and kidney function tests.

SEMESTER VII

VETERINARY PREVENTIVE MEDICINE-I

(BACTERIAL, FUNGAL & RICKETTSIAL DISEASES)

VMD-412

Credit Hours 2+0=2

THEORY

Clinical manifestation, diagnosis, prevention and control of infectious diseases, namely mastitis, haemorrhagic septicaemia, brucellosis, tuberculosis, Johne's

disease, black quarter, tetanus, listeriosis, leptospirosis, campylobacteriosis, actinomycosis, actinobacillosis, enterotoxaemia, glanders, strangles, ulcerative lymphangitis, colibacillosis, fowl typhoid, pullorum disease, fowl cholera, avian mycoplasmosis, ulcerative lymphangitis, colibacillosis, fowl typhoid, pullorum disease, fowl cholera, avian mycoplasmosis, spirochaetosis, salmonellosis, swine erysipelas. Other important bacterial diseases of regional importance (e.g. contagious caprine pleuropneumonia, contagious bovine pleuropneumonia etc.). Bacterial diseases of bio terrorism importance – anthrax, botulism etc. Chlamydiosis, Q fever, anaplasmosis. Dermatophilosis, aspergillosis (brooders pneumonia), candidiasis, histoplasmosis, sporotrichosis, coccidiomycosis, mycotoxicosis, etc.

SEMESTER VIII
VETERINARY CLINICAL MEDICINE-II
(METABOLIC & DEFICIENCY DISEASES)

VMD-421

Credit Hours 2+0=2

THEORY

Aetiology, clinical manifestations, diagnosis, differential diagnosis, treatment, prevention and control of metabolic disorders/production diseases. Milk fever, acute parturient hypocalcaemia in goats, sows and bitches, osteodystrophy fibrosa, lactation tetany in mares, downer cow syndrome, ketosis, hypomagnesaemia in cattle and buffalo, azoturia in equines, hypothyroidism and diabetes in dogs. Diagnosis and management of diseases caused by deficiency of iron, copper, cobalt, zinc, manganese, selenium, calcium, phosphorus, magnesium, vitamin A, D, E, B. complex, K and C in domestic animals and poultry. Nutritional haemoglobinuria. Diseases of neonates. Diseases of skin, musculo-skeletal system, nervous system and sense organs of domestic animals. Management of common clinical poisonings. Role of alternative/integrated/ethno veterinary medicine in animal disease management.

SEMESTER VIII
VETERINARY PREVENTIVE MEDICINE –II
(VIRAL & PARASITIC DISEASES)

VMD-422

Credit Hours 2+0=2

THEORY

Clinical manifestation, diagnosis, prevention and control of infectious diseases, namely foot and mouth disease, rinderpest, bovine viral diarrhoea, malignant catarrhal fever, infectious bovine rhinotracheitis, enzootic bovine leucosis, ephemeral fever, blue tongue, sheep and goat pox, PPR, classical swine fever. Important exotic diseases for differential diagnosis – African swine fever, swine vesicular disease, vesicular stomatitis, Rift valley fever, Aujeszky's disease.

Rabies, African horse sickness, equine influenza, equine infectious anaemia, equine rhinopneumonitis, canine distemper, infectious canine hepatitis, canine parvoviral disease. Highly pathogenic avian influenza, Newcastle (Ranikhet) disease, Marek's disease, avian leucosis, infectious bronchitis, infectious laryngotracheitis, avian encephalomyelitis, fowl pox, infectious bursal disease, inclusion body hepatitis-hydropericardium syndrome. Other emerging and exotic viral diseases of global importance. Amphistomosis, fascioliosis, gastrointestinal nematodiasis, schistosomosis, echnococcosis, tapeworm infestations (cysticercosis), verminous bronchitis, coeneurosis, trichomonosis, blood protozoan infections (trypanosomosis, theileriosis, babesiosis etc.), canine eperythrozoon infection, coccidiosis.

SEMESTER IX

ANIMAL WELFARE, ETHICS AND JURISPRUDENCE

VMD-511

Credit Hours 2+0=2

THEORY

Definition of animal welfare and ethics. Human and animal welfare in relation to ecosystem and environmental factors. Role of veterinarians in animal welfare. Animal welfare organizations, Animal Welfare Board of India – their role, functions and current status. Rules, regulations, laws on animal welfare. Prevention of Cruelty to Animals (PCA) Act, 1960 (59 of 1960). Role and function of Committee for the purpose of Controlling and Supervising Experiments in Animals (CPCSEA). Protection of wild life in nature and captivity. Protection and welfare of performing animals. Welfare of animals during transportation. Animal welfare in commercial livestock farming practices. Protection and welfare of working animals. Pet and companion animal welfare. Animal welfare during natural calamities and disaster management. Legal duties of veterinarians, Forensic and State Medicine laws. Common offences against animals and laws related to these offences. Examination of living and dead animals in criminal cases. Cruelty to the animals and bestiality. Legal aspects of : Examination of animals for soundness, examination of injuries and post-mortem examination. Causes of sudden death in animals. Collection and dispatch of materials for chemical examination, detection of frauds-doping, alternation of description, bishoping etc. Cattle slaughter and evidence procedure in courts. Provincial and Central Acts relating to animals. Glanders and Farcy Act, 1899 (13 of 1899). Dourine Act 1910 (5 of 1910), Laws relating to offences affecting Public Health. Laws relating to poisons and adulteration of drugs. Livestock Importation Act. Evidence, liability and insurance. Code of Conduct and Ethics for veterinarians – the Regulations made under Indian Veterinary Council Act, 1984.

SEMESTER IX
ZOO/WILD ANIMAL BREEDING, NUTRITION, MANAGEMENT AND
HEALTH CARE

VMD-512

Credit Hours 1+1=2

THEORY

Taxonomy of various genera of wild/zoo animals of India along with their descriptions. Ethology of wild life species. Basic principles of habitat and housing of various classes of wild and zoo animals. Population dynamics of wild animals, effective population size of wild animals in captivity/zoo/natural habitats. Planned breeding of wild animals. Controlled breeding and assisted reproduction. Breeding for conservation of wild animals. Feeding habits, feeds and feeding schedules of zoo animals. Nutrients requirements of wild animals. Diet formulation and feeding of various age group, sick and geriatric animals. Restrain, capture, handling, physical examination and transport of wild and zoo animals. Principles of anaesthesia, anaesthetics, chemicals of restraining, common surgical interventions. Capture myopathy. Principles of zoo hygiene, public health problems arising from zoos. Prevention, control and treatment of infectious, parasitic, nutritional and metabolic diseases in zoo and wild animals. Acts and Rules related to Zoo and wild animals. National and international organizations and institutions interlinked to wild and zoo animals – role and functioning.

PRACTICAL

Visit of nearby wildlife sanctuary/zoo/wild animal centres to study the care and management, restraint examinations, administration of medicines etc. in zoo animals. To study the housing, feeds and feeding schedule of zoo animals. To study the implementation of various Acts and Rules related to Zoo animals care and management Post mortem examination of wild and zoo animals. Handling, processing and interpretation of pathological materials from zoo and wild animals. Attending to common surgical interventions on zoo and wild animals. Planning for balanced feeding. Diet charts, preparation of balanced diet for new born, growing and sick animals as oral and intravenous feeds. Preparation of modified diet under selected conditions. Hygienic preparation, preservation and storage of foods.

(This course shall be taught jointly with the Departments of Livestock Production Management, Animal Nutrition, Animal Genetics and Breeding, Veterinary Pathology, and Veterinary Surgery and Radiology)

**SEMESTER IX
PET/ANIMAL BREEDING,
MANAGEMENT, NUTRITION AND HEALTH CARE**

VMD- 513

Credit Hours 1+1=2

THEORY

Breeds of dogs-international pedigree breeds and those commonly seen in India. Pedigree sheet and major breed traits. Detection of oestrus and Breeding of dogs. Selecting a breed to keep, selection of a pup.

Feeding of dogs-nutritional requirements of important breeds and different age groups. Management of dogs-kennels, care of pups and pregnant bitch. Dog shows-preparation for the shows, kennel clubs, important characters for judgement. Whelping. Utility of dogs-guarding, defence, patrolling, riot control, scouting, espionage, mine detection, tracking, guiding, hunting, races, retrieving, rescue, and other uses. Principles of training of dogs.

Common diseases affecting dogs (bacterial, viral, parasitic, fungal, nutritional etc.) – their clinical manifestations, diagnosis, treatment and control. Vaccination/ deworming schedules. Common surgical interventions in dogs-docking, ear cropping, nail cutting, sterilization. Common anaesthetics and anaesthesia in dogs. Common breeds of cats, their habits, feeding and management. Common diseases of cats-their diagnosis, treatment and control. Common surgical interventions in cat. Common pet birds seen in India. Introduction to their caging, breeding, feeding, management, disease control and prevention.

PRACTICAL

Recognising various breeds. Handling of dogs. Types and use of leads and collars. Brushing/grooming and bathing of dogs. Restraining of dogs for examination/medication. Detection of oestrus, mating, whelping (through demonstration). Care of pups, weaning, administration of medicine. Nail and tooth care, clipping of hairs for show purposes. Hygiene of kennel/pens, feeding utensils. Visit to dog show. Vaccination and surgical interventions (nail clipping, docking, sterilization). Common breeds of cats, handling, restraint, examination, medication and surgical intervention in cats and kittens. Identification of common pet birds. Handling of pet birds, their examination and administration of medicines.

(This course shall be offered jointly by the Departments of Veterinary Medicine, Livestock Production Management, Animal Nutrition, Animal Genetics and Breeding, Veterinary Pathology, and Veterinary Surgery and Radiology).

**DEPARTMENT OF VETERINARY & ANIMAL HUSBANDRY
EXTENSION EDUCATION**

SEMESTER V

**PRINCIPLES AND TECHNIQUES OF VETERINARY
AND ANIMAL HUSBANDRY EXTENSION**

VAE-311

Credit Hours 2+1=3

THEORY

Concept of Sociology, Man-animal relationship (Society, Community, Association, Institution). Difference in livestock production practices of rural, urban and tribal communities including rearing patterns. Social change and factors of change. Social groups, its types and functions. Social transformation in relation to animal rearing. Evolution of veterinary and animal husbandry extension in India. Extension education: definition, philosophy and principles. Concept of Community development. Teaching learning process, steps of teaching. Extension teaching methods; their classification and use. Information delivery system in Veterinary and Animal Husbandry extension. Information communication technology. Role of animals in economy, health and socio-psychology of rural, semi urban and urban society. Client and stakeholder dealings: techniques and procedures including tools for data collection, analysis, history taking, follow-up and appraisal on prognosis. Adoption and diffusion of livestock innovations. Leadership and role of leaders in animal husbandry extension. Farming in rural India – large and small scale farming, mixed farming, co-operative and collective farming, contractual farming, Co-operative Farming for Live Stock Production, Advantages and limitations of co-operatives. Economic principles underlying co-operative societies, co-operative milk unions in India. Social survey and its types. Social sampling. Identification of key communicators and operating through them. Identifying organizational difficulties in the way of organizing animal husbandry extension programmes. Identification of constraints in the adoption of improved animal husbandry practices. Animal Husbandry programme planning and evaluation. Feedback evaluation of extension programmes and their impact analysis. Panchayati Raj institutions, Krishi Vigyan Kendra (KVK), Animal Husbandry Development Programmes in Cattle, buffalo, sheep, goat, poultry, rabbit and piggery.- Key village scheme, Gosadan/Goshala, Integrated Cattle Development Programme (ICDP), Integrated Rural Development Programme (IRDP), Agricultural Technology Management Agency (ATMA). Gender considerations in Veterinary practice. Changing expectations from new recruits to the profession and employers of veterinarians. Growing changes in corporate, client influence and changes in work ethics. Information communication technologies. Virtual class room and self learning. E-learning. Information kiosks. Agriculture

portals. E-commerce-scope and local application. Computer aided teaching/learning, web-sites dedicated to veterinary and animal sciences education, web directories and virtual learning institutions (e-institutions).

PRACTICAL

Audio-visual equipments. Principles and use of overhead. slide and multimedia projectors, digital video/still camera. Preparation and use of visual aids like posters, charts, flash cards, flipcharts, etc. Use of literature and media in Extension. Identification of key elements in social sampling of data. Collection and analysis of data. Identification of key communicators and operation programme. Enumeration of organizational difficulties in animals husbandry extension programmes. Identification of constraints in the adoption and improved animal husbandry practices. Constraint analysis.

Group discussions, techniques and procedures for awareness campaigns on different veterinary and animal husbandry practices – signs of disease, preservation of eggs, clean milk production, controlling of ectoparasites pail feeding of calves, sexing and culling of birds, first aid for minor wounds, disinfection of byres, branding, use of horn cauterization, timely A.I., choice of good progeny, care in pregnancy, infertility, environmental hygiene, preparation of feeds and feeding schedules, deworming, preventive hygiene, vaccination etc. Organization of animal welfare camps, exhibition, livestock shows etc. Hands on training in the use of computers for teaching and information dissemination. Rapid Rural Appraisal/Participatory Rural Appraisal in identifying livestock production/health care practices.

SEMESTER VI

LIVESTOCK ECONOMICS, MARKETING AND BUSINESS MANAGEMENT

VAE – 321

Credit Hours 2+1=3

THEORY

Economics:

Introduction, definition and scope (production, consumption, exchange and distribution) of economic principles as applied to livestock. Common terms – wants, goods, wealth, utility, price, value, real and money income. Important features of land, labour, capital and organization.

Livestock produce and products. Livestock contributions to national economy. Demand projections of livestock produce. Theory of consumer behaviour: law

of diminishing marginal utility and indifference curve analysis. Theory of demand; meaning, types of demand, demand curve and law of demand, individual and market demand, elasticities of demand and factors affecting demand, Laws and types of supply. Elasticity of supply. Cost concepts and principle of fixed and variable costs: Theory of production, law of diminishing returns, laws of returns to scale and concept of short and long run periods Economics of animal disease and disease losses.

Marketing:

Livestock business- concepts, nature and scope. Components, characteristic of small business. Marketable livestock commodities. Concept of market; meaning and classification of markets. Market price and normal price, price determination under perfect competition in short and long run.

Marketing of livestock, and perishable and non-perishable livestock products. Merchandising – product planning and development. Marketing functions; exchange functions- buying, selling and demand creation. Physical functions- grading, transportation, storage and warehousing. Facilitative functions – standardization, risk bearing, market information and market intelligence. Market opportunities – marketing channels of livestock and livestock products, organized/unorganized markets and cattle fairs. Import and export of animal and animal products. International Agreements/Regulations (WTO and General Agreement on Trade and Tariff-GATT) for marketing/trade of live animals and products.

Management:

Resource Management-Organizational aspects of livestock farms, sources and procurement of inputs and financial resources. Break-even – analysis. Personnel (Labour) Management- Identification of work and work (job) analysis/division of labour.

Accounting :

Definition, objectives, common terms, Different systems of book keeping-single and double entry system. Various types of account books including books of original entry. Classification of accounts and rules of debit and credit. Recording of business transactions. Analysis of financial accounts-income and expenditure accounts, trading account, profit and loss accounts.

PRACTICAL

Book keeping; general entry, writing of journal and ledger, cash book (two and three column), purchase-sale and purchase-sale return registers, trading account, profit and loss accounts, income and expenditure accounts, balance sheet, bills of exchange (bill of receivable and bill of payable), bank reconciliation statement.

Economics of a dairy unit, poultry, piggery, sheep and goat units. Visit to farms, markets and cattle fairs, backyard units and preparation of report.

SEMESTER IX LIVESTOCK ENTREPRENEURSHIP

VAE-511

Credit Hours 1+0=0

THEORY

Livestock Entrepreneurship. Avenues of entrepreneurship/employment in private and public sectors. Key concepts and theories of self-employment and entrepreneurship. Essential criteria for development of entrepreneurship in livestock sector – basic requirements for entrepreneurship initiatives in livestock and allied sectors (i.e. techno economic feasibility of the enterprises under different conditions, training and management skills, business acumen, business communication, inter-personnel skills for establishing an enterprise, etc.). Entrepreneurial training / development programmes at the State and National level. Animal Insurance. Bank support for entrepreneurship. Financial credit and financial management-general Principles and practices, analyzing project appraisals and reports, capital expenditure decisions, re-investment and payback. Preparing projects for bank appraisal, banking requirements. Assessing project profits. Procurement management, quality issues, standardization, grading and packaging. Marketing channels. Retail marketing, sales operations and management, advertising, marketing of services. Expectations from a Veterinary professional. Eco-jobs and sustainable development through livestock. Approach to preparation of Entrepreneurial Project on livestock.

TEACHING VETERINARY CLINICAL COMPLEX (TVCC)

A. VETERINARY CLINICAL PRACTICE

VCP-411(Semester-VII)	Credit Hour-0+5=5
VCP-421(Semester-VIII)	Credit Hours-0+5=5
VCP-511 (Semester-IX)	Credit Hour-0+5=5

Total: 15

The students shall be imparted the training on rotation basis in the following sections of Teaching Veterinary Clinical Complex (TVCC):

1. Ambulatory Section

Handling, examination, diagnosis and treatment of sick animals under field conditions under the supervision of faculty designated for Ambulatory Clinical activity. Ambulatory Clinics shall be operated by small groups of students and faculty through an equipped mobile unit in which the departments of Veterinary Medicine, Veterinary Gynaecology and Obstetrics and Veterinary **Surgery** and Radiology shall be involved.

2. Diagnostic Laboratory Section

The Clinical Diagnosis Laboratory will form an important component of Teaching Veterinary Clinical Complex. The Diagnostic Laboratory will impart training to groups of students for laboratory evaluation and interpretation of clinical samples leading to diagnosis/comparative diagnosis of diseases. This activity will involve training in examining clinical samples (biochemical, toxicological, pathological, parasitological and bacteriological) at the clinical complex, analyzing and correlating with clinical findings and interpreting the results.

Note: The Laboratory shall be run in collaboration with the Department of Pathology.

3. Medicine Section

Orientation to Veterinary Clinics including hospital set up, administration and functioning. Methods of record keeping. Retrieval, processing, analysis and interpretation of data. Hospital management involving out patient department (OPD), Indoor patient, Critical care/intensive care unit, sanitation, up keeping, practice management etc. Doctor client interaction: orientation to local language/dialect/local terminology of the diseases.

Registration, filling up registration cards, history taking. Relating generic and trade names of drugs along with their doses, indications and contraindications to prescribed treatment regimens. Familiarization and practice of first aid procedures and emergency medicine. Practice of collection, labeling, packaging and evaluation of laboratory samples.

Clinical practice comprising of clinical examination of the patient, with emphasis on history taking, examination techniques- palpation, percussion and auscultation, systematic examination of various systems, recording of clinical

observations viz. temperature, respiration, pulse, cardiac sounds, cardiac function, pulmonary function, functional motility of digestive system, routes and techniques of administration of medicaments. Diagnosis and treatment of common clinical cases like pharyngitis, laryngitis, stomatitis, indigestion, ruminal impaction, tympany, enteritis, traumatic reticulo-peritonitis, traumatic pericarditis, pneumonia, haemoglobinuria, haematuria, milk fever, ketosis, rickets, osteomalacia, common poisoning, and others.

Collection of materials like urine, faeces, skin scraping, blood, milk and other body fluids for laboratory tests. Preparation of case records; follow-up records etc. Treatment of causalities and other emergencies. Screening of livestock/poultry through tests, mass diagnostic campaigns. Vaccination and other disease prevention and control programmes in the field.

Practice of feeding of sick animals: Acts and regulations pertaining to generation and disposal of biomedical wastes in veterinary institutions. Biomedical waste generation, handling, storage, sorting, coding, transportation and disposal. Hazards of biomedical waste, and impact of biomedical waste on the environment.

4. Gynecology & Obstetrics Section:

Practice of pregnancy diagnosis, examination of cases of anoestrus, silent oestrus and conception failure. Treatment of cases of metritis, cervicitis and vaginitis. Handling of case of retention of placenta. Management of Ante and post partum prolapse of vagina. Examination and preliminary handling of dystocia cases, faetotomy, caesarian operation castration of male calves. Breeding soundness evaluation of bulls. Collection of cervical and vaginal mucus for cytology. Rectal examination of genitalia, vaginal examination. Familiarization with common drugs & hormones used in reproductive disorders, epidural and local anaesthesia for gynaecological cases. Filling of clinical case records and their maintenance.

5. Surgery & Radiology Section

Familiarization with equipments used in different sections of the Hospital. Restraining and positioning of different species of animals for examinations, diagnosis and surgical treatment. Prescription of common drugs, their doses and uses in clinical surgical practice. Filling of clinical case records and their maintenance. Preparation of surgical packs, sterilization procedures for surgical instruments, drapes, operation theaters. Passing of stomach tube and gastric tube. Catheterization and urine collection.

Techniques of examination of neuromuscular and skeletal functions, Familiarisation with antiseptic dressing techniques, bandaging, abdomino-centesis, thoracocentesis. Topography anatomy of Cattle, Horse and Dog. Radiographic positioning and terminology.

Treatment and Management of inflammation, wounds, abscess, cysts, tumors, hernia, haematoma, hemorrhage, sinus, fistula, necrosis, gangrene, burn, sprain and tendinitis. First aid in fractures and dislocations and other affections of joints, facial paralysis, Eye worm & other minor affections of Eye. Irregular teeth and their rasping. tail amputation, knuckling, upward fixation of patella (medial patellar desmotomy) etc.

Familiarisation with the landmarks for the approach to various visceral organs, thoraco-centesis, abdominocentesis. Laparotomy, palpation and visualization of viscera. Urethrotomy, castration, vasectomy, caudectomy, ovario-hysterectomy, thoracotomy, cystotomy, cystorraphy and splenectomy. Examination of horse for soundness and preparation of certificate for soundness. Tenotomies, suturing of tendon, shortening of tendon.

Note: The skills required for the Comprehensive Examination of Core Competence to be held for the purpose of assessment/evaluation of Internship shall be imparted under these courses.

**SEMESTER VII
VETERINARY CLINICAL BIOCHEMISTRY AND LABORATORY
DIAGNOSIS –I**

B. 1. VLD-411

Credit Hours 0+1=1

Training in examining clinical samples (biochemical, pathological, parasitological and bacteriological). Analyzing and correlating with clinical findings and interpreting the results. Collection, labeling, transportation, and preservation of body fluid samples. Writing results and report. Interpretation of data in relation to specific diseases.

Clinical significance and interpretation of serum glucose, lipids, proteins, blood urea nitrogen, creatinine, uric acid, ketone bodies, bilirubin & electrolytes from samples.

Clinical significance and interpretation of examination of urine samples.

Clinical evaluation of blood (Haemoglobin, packed cell volume, total erythrocytic count, erythrocytic sedimentation rate, total leukocytic count and differential leucocytic count) from clinical samples.

Laboratory evaluation and diagnosis of samples for parasitic diseases (routine faecal examination - direct smear method, simple sedimentation and floatation methods, Quantitative faecal examination, pastural larval counts), Examination of skin scrapings, examination of blood smear/blood for diagnosis of blood protozoan disease.

SEMESTER VIII
VETERINARY CLINICAL BIOCHEMISTRY AND
LABORATORY DIAGNOSIS-II

B.2.VLD-421

Credit Hours 0+1=1

Evaluation of acid-base balance and interpretation. Biochemical aspects of digestive disorders, endocrine functions. Liver, kidney and pancreatic function tests. Role of enzymes for detection of tissue / organ affections.

Preparation of microscopic slides from tissue collected for diagnosis and its' histopathological interpretation. Examination of biopsy and morbid material for laboratory diagnosis.

Orientation to a clinical Microbiology laboratory, Collection, transport and processing of specimens from clinical cases for diagnosis of important bacterial, fungal and viral diseases. Isolation of bacteria from clinical samples, Identification of bacteria by Grams staining and cultural/biochemical characteristics. Drug sensitivity and rationale for therapy. Diagnosis of diseases by employing tests like Agar Gel precipitation Test. Enzyme linked immunosorbent assay, Dot immuno-assay, tube agglutination test, slide agglutination tests etc.

Practice for separation of toxic materials from samples. Detection of arsenic, lead, antimony, mercury, copper, zinc. fluorides. Nitrates/nitrites cyanides and tannins in body fluids/tissues of animals. Evaluation of samples of toxic residues. Appreciation and differentiation of symptoms caused by various types o toxic materials including agrochemicals plants and drugs.

SEMESTER VIII
VETERIANARIAN IN SOCIETY

C.TVC-421

Non-Credit Courses : 1+ 0 =1

Man-Animal and Society. Social – ecological interactions in animal rearing. Client oriented approach to physical examination of animals. Concepts in interaction with animal owner/Clients. Bio-medical ethics and clinical evaluation. Communication skills. Animal /owner information management. Human-animal bonds. Health maintenance in individual animals and population. Veterinary public health as component of society. Professional development. Societal responsibilities of veterinarians. Societal responsibilities with respect to Private and Public Hospital and practice management. Social conduct and personality profiles in management of clinical practice. Veterinary professional interactions with Health Authorities, Drug and Food Regulatory Authorities, Zoo/Animal Welfare organizations and Civil Administration. Role of Veterinarian in Natural Calamities and Disaster Management.

SEMESTER III and IV

INSTRUCTIONAL LIVESTOCK FARM COMPLEX

LFP-211 and LFP-221 Non-Credit Course: (0+1) x 2=2 Credits

Hands on training of the students on the overall farm practices of livestock management including cleaning, feeding, watering, grooming, milking, routine health care, record keeping, sanitation housing, fodder production.

These courses shall be non-credit courses and the performance of students shall be assessed and recorded as grades: A- Excellent B- Good, c- Average and recorded on the Degree Transcript.

ANNEXURE – I

TRACKING PROGRAMMES

These programmes have been developed to allow students to exercise more control over the specific direction of their profession and motivate them for self-learning through virtual classroom, distant learning, internet etc. A student has to compulsorily take any two programmes of two credits each (2x2=4 credits) any time (one semester duration each) during third year to fifth year of B.V.Sc & A.H Degree Course under the supervision of one faculty member as designated by the Associate Dean of the College for that programme. Evaluation of the students for this programme shall be done internally on Grade basis (A-Excellent, B-Good, C-Average). In case of unsuccessful candidates, the programme can be carried over to the next semester/year. List of the Tracking Programmes is given below:

- i. Feline Medicine
- ii. Cryobiology of Gametes
- iii. Neurosciences
- iv. Clinical/Interventional Nutrition
- v. Dermatology/Integument Science
- vi. Alternate Veterinary Medicine
- vii. Ophthalmology
- viii. Anesthesiology
- ix. Small Animal Critical Care
- x. Non-Mammalian Medicine
- xi. Sports Animal Medicine
- xii. Drug designing
- xiii. To be decided by the college/university.

These will be Non-Credit courses but shall be mentioned in the Degree Transcript along with the grades obtained.

ANNEXURE – II

STUDY CIRCLES

Each student of B.V.Sc & A.H. degree course shall have to enroll himself/herself for activities two Study Circle activities during the third to fifth year of B.V.Sc. & A.H. degree course out of the proposed Study Circles as listed below.

- i. Livestock and Livelihood Study Circle
- ii. Production Systems Study Circle
- iii. Ecosystems and Livestock Study Circle
- iv. Equine Study Circle
- v. Canine Study Circle
- vi. Diagnostic Study Circle
- vii. Alternate Animal Use Study Circle
- viii. Fun/Sport Animal Study Circle
- ix. Law and Veterinary Science Study Circle

The College shall designate an Advisor for each of the above Study Circle activities who shall supervise, guide, monitor and evaluate the activities of the Study Circles. Each enrolled student shall have to present seminar on the topics of his/her Study Circle any time during the semester. The date and time of the Seminar shall be notified inviting participation of all students. The Study Circle shall also put up news, wall papers, drawings, exhibits of their subject in the college. The Dean of the college shall coordinate the activities with the Advisors for each of the above Study Circles. The evaluation of the student for each of the registered Study Circles be done by the Advisor who will grade them as A-Excellent, B-Good, C-Average as per their performance. The same shall be recorded in the Degree, Transcript along with the grades obtained. No student shall be allowed to change the Circles during the professional year.

STUDY CIRCLE PROGRAMMES

Department	III year I Semester	III year II Semester	IV year I Semester	IV Year II Semester
Microbiology	--	--	Alternative Animal use	--
Pathology	--	--	--	Diagnostic study circle
L.P.M / IFLC	Ecosystem and Livestock study circle	--	Production Systems	--
Animal Husbandry Extension	--	--	Livestock and livelihoods	--
L.P.M / R.V.C	Equine study circle	--	--	--
Clinical Medicine	Law and Veterinary Science	--	--	Canine Study Circle

ANNEXURE – III

ENTREPRENEURIAL TRAININGS

Each student of B.V.Sc. & A.H. degree course shall be required to compulsorily undertake one of the activities of Entrepreneurial Trainings as listed below during third to fifth year of the degree course. This training is aimed at developing entrepreneurial skill for self employment. The university/college shall provide interest free loans out of a revolving fund (not less than Rs. 3.00 lakhs in a college) to student groups (team of up to five students), technical support and infrastructure for these activities. Inputs, day-to-day work and financial accounting shall be undertaken by the students. The profits/loss, if any, shall be kept/borne by the students. However, in case of loss, the Associate Dean of the college through the Entrepreneurship Committee consisting of four faculty members (at least one subject matter specialist) may evaluate the reasons of such loss and provide compensation in case it is found that the loss has been inadvertent. Proposed List of 16 Entrepreneurial activities is as follows:

- i. Goat Production
- ii. Sheep Production
- iii. Pig Production
- iv. Broiler and Egg Production
- v. Pet Production
- vi. Dairy Production
- vii. Meat Production and Processing
- viii. Fish Production
- ix. Feed Production-Mineral Mixture
- x. Milk Products
- xi. Food safety- residue Analysis
- xii. Clinical Investigatory laboratory
- xiii. Quality Control-Evaluation (Microbial)
- xiv. Shoeing and Shoe Manufacture
- xv. Production of Diagnostics
- xvi. Pharmaceutical Formulations

Besides, the Colleges/institutions may also offer the facilities for 'Entrepreneurial Training' involving the activities of regional interest

ENTERPRENEURIAL TRAINING

Department	III year I Semester	III year II Semester	IV year I Semester	IV Year II Semester
Animal Nutrition	1) Feed Production 2) Mineral Mixture Preparation	1) Feed Production 2) Mineral Mixture Preparation	--	--
Veterinary Public Health	--	Food Safety	--	--
R.V.C	--	Shoeing and shoe manufacturing	--	--
Microbiology	--	--	--	Production of Diagnostics
Pathology	--	--	--	Clinical Investigatory Laboratory
Poultry Science	Broiler / Quail Production	-	--	--
L.P.M / IFLC	1) Sheep Production 2) Pig Production	Calf rearing	Milch cattle rearing	--
LPT	--	--	1) Meat and egg products processing 2) Milk and milk products processing	--

SELECTION, CONDUCT AND EVALUATION OF TRACKING PROGRAMMES, STUDY CIRCLE COURSES AND ENTERPRENEURIAL TRAINING PROGRAMS

SELECTION OF STUDENTS

1. There are 12 tracking programs offered by 6 departments, 9 study circle courses by 5 departments and 13 entrepreneurial trainings by 8 departments. Following guidelines are framed for (a) equal distribution of work among the concerned departments to the extent possible and (b) as equal as possible opportunity for the students to get exposed to programs offered by different departments.
2. From among the total students registering for tracking programs during a semester maximum of $1/6^{\text{th}} + 1$ shall be allowed to register for any single course. Similarly the restriction shall be $1/5^{\text{th}} + 1$ for study circle and $1/8^{\text{th}} + 1$ for entrepreneurial training programs.
3. One semester in advance of registering a program all the students shall submit their choice to the Associate Dean through their advisors. Each student shall give his / her order of preference for all the programs offered during that semester.
4. After receiving the student choices, the Associate Dean shall organize a meeting of the course advisors / concerned Head of Departments who shall make all efforts to accommodate students in the programs of their choice as per the guideline 2 above. Where the number of interested students are more than the number and that could be accommodated in any one course, the allocation shall be made on basis of random numbers.
5. After the allocation of courses under these programs, students may be permitted to make mutual exchanges with the concurrence of the course advisor, concerned Head of Department and the Associate Dean.
6. All tracking programs (2), study circle (2) and entrepreneurial programs (1) must be completed prior to registering for internship.

CONDUCT AND EVALUATION

1. Tracking and Study circle programs shall be treated as 0+2 courses. However, every student must be ready to spend additional hours as prescribed by the course advisor.
2. The course advisor shall ensure that each student shall spend a minimum of 4 hours / week on each tracking / study circle / entrepreneurial programs.
3. Study evaluation in these programs shall be undertaken by the course advisor based on presentations, assignments etc.,
4. Grades awarded shall be as follows:

A	Excellent
B	Good
C	Average
I	Incomplete*

* Students obtaining incomplete grade in any course / courses must undergo assessment by the concerned course advisor(s) during the subsequent semesters and complete the course subjective to the guideline No.6 above.

ANNEXURE - IV

INTERNSHIP

- (a) As per regulation 13.2(c) of these regulations, every student of B.V.SC. & A.H. degree course shall be required after passing the fifth annual examination to undergo compulsory rotating internship to the satisfaction of the University for a minimum period of six calendar months so as to be eligible for the award of the degree of B.V.Sc. & AH. and for registration with the Veterinary Council.
- (b) Compulsory rotating internship shall include a full time training ,in veterinary and animal husbandry services (Including emergencies and night duties, Sundays and holidays)" The intern will devote whole time to the training and will not be allowed to accept a whole time or part time appointment paid or otherwise.
- (c) Internship shall be undertaken only after completion of all credit requirements of veterinary curriculum including Tracking Programmers, Study Circles, Entrepreneurial Training and R.V.C. Squadron/N.C.C Equestrian/N.S.S./Sports and games as prescribed under these regulations.
- (d) The university shall issue a provisional course completion certificate of having passed all the professional examinations and having successfully completed course work.
- (e) The State Veterinary Council will grant provisional registration to the candidate on production of provisional B.V.Sc. & AH. Course completion certificate. The provisional registration will be for a minimum period of six months and maximum of eight months.
- (f) After provisional registration with the State Veterinary Council or Veterinary Council of India, the candidate shall register for internship of six calendar months.
- (g) Interns will be actively involved in rendering veterinary service under the supervision of an experienced teacher.
- (h) They shall assist the teacher in all activities of the units they are posted in.
- (i) During the period of internship they shall be provided accommodation/lodging and paid consolidated remuneration in the form of internship allowance as may be decided by the University/Institution from time to time
- (j) Attendance will be compulsory. The candidate will be entitled for 10 days casual leave. The leave cannot be claimed as a matter of right until and unless the sanctioning authority sanctions it. If an intern willfully absents from the training programme even if for part of a day or during off hours duty (including Sundays/holidays) he/ she may be treated absent for that day. The candidate will be required to undergo training for the additional days in lieu of the absence period and internship allowance will not be paid for these additional days.
- (k) The internship programme shall be monitored by a Committee constituted by the Associate Dean under his/her chairmanship including among others the Head of TVCC and Head of ILFC as members. This Committee shall monitor effective implementation of the internship training programme from time to time.

- (l) In case of unsatisfactory work performance and/or shortage of attendance, the period of compulsory rotating internship shall be extended by not more than two months by the appropriate authority. If this period is more than two months, the intern has to re-register afresh for internship programme for entire six calendar months including registration with the State Veterinary Council.
- (m) Internship allowance will be paid only for six calendar months. No internship allowance will be paid for the period of absence/unsatisfactory performance/extended period.
- (n) The compulsory rotating internship for six calendar months shall be done in teaching and approved Veterinary Polyclinics / Veterinary Hospitals, Veterinary Biological Centers, Technology Centers, Farms and Veterinary Disease Investigation Centers. The internship programme can be undertaken at approved veterinary institutions in India.
- (o) The compulsory rotating internship shall be in the following 'areas:
 - (i) Clinical training covering veterinary medicine, surgery and radiology, animal reproduction, gynecology and obstetrics, clinical emergencies, indoor ward care, hospital management record keeping etc. for three months.
 - (ii) Livestock production and management training, covering farm routines of cattle and buffalo farms, piggery/rabbitary, sheep and goat farms, and equine/ camel unit etc. for one month.
 - (iii) Poultry production and-management covering layer and broiler production, hatchery and chick management, quail, turkey, duck units etc., as well as fishery or any other recycling unit where feasible, for one month.
 - (iv) Livestock technology and service covering familiarization in biological product units, disease control campaigns (disease investigation and sample collection and disease vaccination, mass testing etc.) in plant training in meat plants, milk plants, etc. training in zoo/wild life centers, national parks, for one month.
- (p) Details of day to day work, posting and duration needs to be worked out by the Veterinary Institution as per its needs and infrastructure facilities.
- (q) Where an Intern is posted to a recognized Veterinary hospital for training, a representative of the college and the Incharge of the Veterinary hospital shall regulate the training of such interns.
- (r) Every Intern shall render professional veterinary service, skill and knowledge under supervision and guidance of a registered veterinary practitioner working in the approved Veterinary Institution.
- (s) Function, responsibilities and duties of interns :
 - i. Participation with clinical faculty in the hospital practice.
 - ii. Shares the emergency and night duties on rotation in the larger and small animal hospitals including Sundays & holidays.
 - iii. Participation with staff of the place of posting in Veterinary Practice (production or technology).
 - iv. The intern responsibilities include hands-on diagnostic and treatment procedures for hospitalized cases under the supervision of the attending veterinarian.
 - v. Participation in the tutorial instructional program of the Veterinary College

- vi. The intern will administer primary care to emergency cases and participate in service such as anesthesia, radiology, ultrasonography, endoscopy, laboratory and diagnostic procedures. Medicine and Surgery rounds are held periodically allowing the interns to present cases and participate in topic discussion.

- (t) The training shall be supplemented by weekly sessions of clinical conference, farm operation and data analysis, preparation of feasibility reports, project report, campaigns/ discussions in clinical training, farm training and technology and services respectively
- (u) For the purpose of internship all necessary inputs like accommodation, transport, adequate clinical facilities etc. shall be provided.
- (v) The intern shall maintain a log book of day to day work which may be verified & certified by the supervisor under whom he/she works. In addition the interns will prepare a brief project report on the basis of his/ her case study, case analysis, survey reports etc. This shall be based on his/ her own study during the internship. Such reports can be supervised by more than one teacher, if required. The interns shall present such report in seminar organized for the purpose.
- (w) The grading shall be based upon the evaluation of log book, their performance reports from all the minimum prescribed training postings, project report and comprehensive examination in core competence in veterinary skills conducted at the end of the programme by an Evaluation Committee comprising of the four Teachers involved in the Internship Programme to be nominated by the Associate Dean one each from Teaching Veterinary Clinical Complex/Clinical Departments, Para clinical Departments (Veterinary Pathology/Veterinary Parasitology/Veterinary Biochemistry/Veterinary Microbiology), Instructional Livestock Farm Complex/Production Departments (Livestock Production Management/Poultry Science/Animal Nutrition/Animal Genetics and Breeding) and Livestock Products Technology of the concerned college and one Assistant Director(A.H) involved in the Internship Training from Veterinary Hospital nominated by the Director of Animal Husbandry.
- (x) Every Intern shall have to submit an Entrepreneurial Project during the Internship Programme.

ANNEXURE – V

COMPREHENSIVE EXAMINATION ON CORE COMPETENCE IN VETERINARY SKILLS

The competence in veterinary skills examination shall be based on an evaluation of core competence in professional skills as detailed below :

- i. Restraint of cow, sheep, horse, dog and pig. Haltering, snaring, muzzling, tail switch, bandaging of horse for exercise and stable bandaging
- ii. Animal identification, Dentition and ageing of animals
- iii. Housing layout/requirements of livestock and poultry
- iv. Computation of ration of livestock of different breeds and age groups in health and disease.
- v. Fodder management and interpretation of feed quality evaluation
- vi. Physical evaluation of livestock health parameters (auscultation, percussion, recording of temperature, pulse, heart rate, respiration rate etc.)
- vii. Recording and interpretation of cardiovascular response
- viii. Testing of milk and milk products for quality, clean milk production
- ix. Carcass quality evaluation (ante-mortem & post-mortem examination)
- x. Specific diagnostic tests for zoonotic diseases
- xi. Sample collection, handling and dispatch of biological materials for laboratory examination
- xii. Staining techniques for routine clinico-pathological examinations
- xiii. Relating post-mortem lesions to major livestock diseases
- xiv. Hematological evaluation (total leukocyte count, differential leukocyte count, hemoglobin, packed cell volume, erythrocyte sedimentation rate etc.) and interpretation
- xv. Tests and their interpretation for haemoprotozoan diseases
- xvi. Body fluids collection, examination and interpretation as an aid to diagnosis
- xvii. Urine evaluation procedures and interpretation as indicators for diagnosis of diseases
- xviii. Fecal examination – procedures and interpretation
- xix. Examination of skin scrapings and interpretation
- xx. Interpretation of blood chemistry profile in diseases
- xxi. Deworming procedures and doses for different species of animals/birds
- xxii. Managing and outbreak of infectious/contagious disease
- xxiii. Approach to diagnosis of a given disease condition
- xxiv. Pre-anesthetic administration and induction, maintenance of general anesthesia and dealing with anesthetic emergencies
- xxv. Local anesthetic administration
- xxvi. Nerve blocks-sites, functional application
- xxvii. Suture material, suture pattern and tying knots

- xxviii. Common surgical procedure including dehorning, docking, caesarian section, ovario-hysterectomy, castration, rumenotomy
- xxix. Application of plaster cast/splint for fracture immobilization and other bandaging procedure in large and small animals.
- xxx. Soundness in horses
- xxxi. Rectal examination – palpation of pelvic/abdominal organs in cattle/horses/buffaloes,
- xxxii. Detection of estrus, artificial insemination, pregnancy diagnosis,
- xxxiii. Management of vaginal/uterine prolapse and dystocia
- (xxxiv) Andrological examination of bull, handling, preservation and evaluation of semen
- (xxxv) Vaccination procedures, vaccination schedules and vaccine types for different diseases
- (xxxvi) Handling of radiograph, interpretation of a given radiograph of large and small animals
- (xxxvii) Client management
- (xxxviii) Managing a clinical practice, ambulatory van, transporting a sick animal requirements, etc.
- (xxxix) Dosage regimens of important drugs
- (xi) Drug administration techniques in different species of animals-oral, parenteral, rectal, intra-peritoneal and intra-uterine
- (xii) Identification of major livestock/ poultry breeds
- (xiii) Measuring climatic parameters and their interpretation
- (xiiii) Communication technology tools

There shall be no marks for this examination. Every intern shall be graded as ‘Satisfactory’ or as ‘Unsatisfactory’ based on the evaluation of this examination and submission of Entrepreneurship Project. The Associate Dean shall then issue the certificate of satisfactory completion of internship training as prescribed by the veterinary council of India. In case of unsatisfactory performance in the comprehensive examination for core competence in professional skills, the candidate has to repeat the entire internship programme.

The candidate will become eligible for registration with State Veterinary Council only on the award of the B.V.Sc & A.H degree or production of a provisional degree certificate by the University.

FORMAT – I
(REGULATION 7.0)
SRI VENKATESWARA VETERINARY UNIVERSITY
COLLEGE OF VETERINARY SCIENCE TIRUPATI /
GANNAVARAM/PRODDATUR/

B.V.Sc.. & A.H Course

REGISTRATION AND AWARD BOOK

Name of the Student :
I.D.No. :
Inner front page :
Name of the student in full :
I.D.No. :
Father's Name & Occupation :
Permanent Address :

Postal Address :

Local address, if residing
Outside the Hostel :

Name & Address of guardian :
if any

Name of the Institute last :
studied

Signature of the student

Particulars of the Advisor/s

Name :

Designation :

Department :

Signature of the Advisor

FIRST YEAR

Academic Year 20 - 20					
Sl.No.	Paper	Course No.	Credit Hours	Grade point	Remarks *(SA/AB/F/P)
1	2	3	4	5	6
1.	Vety. Anatomy Paper I	VAN-111 VAN-121			
2.	Vety. Physiology Paper I	VPB-111 VPB-121			
3.	Vety. Biochemistry Paper I	VPB-112 VPB-122			
4.	Animal Genetics, Breeding Paper I	AGB-111 AGB-121			
5.	Livestock Production Management Paper I	LPM-111 LPM-121 LPM122			
6.	Animal Nutrition Paper-I	ANN-111 ANN-121			
GPA					

RE-EXAMINATION TAKEN

1	2	3	4	5	6
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G.P.A

OGPA

*SA = Shortage of attendance : AB = Absent; F = Failed; P = Pass

Signature of the Advisor

SECOND YEAR

Academic Year 20 - 20					
Sl. No.	Paper	Course No.	Credit Hours	Grade point	Remarks *(SA/AB/F/P)
1	2	3	4	5	6
1.	Vety. Anatomy Paper II	VAN-211 VAN-221			
2.	Vety. Physiology Paper II	VPB-221			
3.	Vety. Parasitology Paper – I	VPA-211 VPA-221 VPA-222			
4.	Vety. Microbiology Paper – I	VMC-211 VMC-221			
5.	Vety. Pathology Paper-I	VPP-211 VPP-221			
6.	Livestock Production Management Paper-II	LPM-211 LPM-221 LPM-222			
7.	Animal Genetics & Breeding Paper-II	AGB-211			
8.	Animal Nutrition Paper-II	ANN-211			

GPA

RE-EXAMINATION TAKEN

1	2	3	4	5	6

G.P.A
OGPA

*SA = Shortage of attendance : AB = Absent; F = Failed; P = Pass

Signature of the Advisor

THIRD YEAR

Academic Year 20 - 20					
Sl. No.	Paper	Course No.	Credit Hours	Grade point	Remarks *(SA/AB/F/P)
1	2	3	4	5	6
1.	Vety. Pharmacology Paper –I	VPT-311 VPT-321			
2.	Vety. Microbiology Paper-II	VMC-311 VMC-321			
3.	Vety. Pathology Paper-II	VPP-311 VPP-321 VPP-322			
4.	Vety. Public Health & Epidemiology Paper-I	VPE-311 VPE-321			
5.	Vety. Biochemistry Paper-II	VPB-321			
6.	Livestock Products Technology Paper-I	LPT-311 LPT-312 LPT-321			
7.	Vety. & A.H. Extension Paper-I	VAE-311 VAE-321			
GPA					

RE-EXAMINATION TAKEN

1	2	3	4	5	6
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G.P.A
OGPA

*SA = Shortage of attendance : AB = Absent; F = Failed; P= Pass

Signature of the Advisor

FOURTH YEAR

Academic Year 20 - 20					
Sl. No.	Paper	Course No.	Credit Hours	Grade point	Remarks *(SA/AB/F/P)
1	2	3	4	5	6
1.	Vety. Pharmacology Paper-II	VPT-411 VPT-421			
2.	Vety. Surgery & Radiology Paper-I	VSR-411 VSR-421			
3.	Vety. Gynaecology & Obstetrics Paper-I	VGO-411 VGO-421			
4.	Vety. Clinical Medicine Paper-I	VMD-411 VMD-421			
5.	Vety. Preventive Medicine Paper-I	VMD-412 VMD-422			
6.	Vety. Laboratory Diagnosis Paper-I	VLD-411 VLD-421			
7.	Vety. Clinical Practice Paper-I	VCP-411 VCP-421			

RE-EXAMINATION TAKEN

1	2	3	4	5	6

G.P.A
OGPA

*SA = Shortage of attendance : AB = Absent; F = Failed; P = Pass

Signature of the Advisor

FIFTH YEAR

Academic Year 20 - 20					
Sl. No.	Paper	Course No.	Credit Hours	Grade point	Remarks *(SA/AB/F/P)
1	2	3	4	5	6
1.	Vety. Surgery & Radiology Paper-II	VSR-511			
2.	Vety. Gynaecology & Obstetrics Paper-II	VGO-511			
3.	Vety. Clinical Medicine Paper-II	VMD-511 VMD-512 VMD-513			
4.	Vety. Public Health & Epidemiology Paper-II	VPE-511			
5.	Vety. & A.H. Extension Paper-II	VAE-511			
6.	Vety. Clinical Practice Paper-II	VCP-511			
RE-EXAMINATION TAKEN					
1	2	3	4	5	6

G.P.A
OGPA

*SA = Shortage of attendance : AB = Absent; F = Failed; P = Pass

Signature of the Advisor

Total External Paper = 34
Total Courses = 65

SRI VENKATESWARA VETERINARY UNIVERSITY, TIRUPATI



**FACULTY OF VETERINARY, DAIRY & FISHERY
SCIENCE**

VOLUME-I

**Common & Supporting Courses
syllabus**

**(As per ICAR Regulations-2021 and Committee
recommendations)**

CONTENTS

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2. Supporting Courses for P.G.	5 - 17
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Dairy & Fishery Sciences	31 - 44
4. Common Courses	31 - 34
5. Supporting Courses	35 - 44

VOLUME-I

**Common & Supporting Courses
Veterinary Science**

Common Courses for P.G.

Course Code	Course Title	Credits
PGS 601	Library and Information Services	0+1
PGS 602	Technical writing and communication skills	0+1
PGS 603	Intellectual Property and its management	1+0
PGS 604	Basic concepts in laboratory techniques	0+1
PGS 605	Agricultural research, research ethics and rural development programmes	1+0

*A student shall be required to register for all the 5 credit hours core courses

Supporting Courses as suggested by the committee

Course Code	Course Title	Credit Hours
P. G		
AGB 600	Statistical method for Animal Sciences	2+1
AGB618	Experimental Designs	2+1
AGB619	Basic sampling Techniques	2+1
AGB620	Applied regression analysis	2+1
AGB 621	Data analysis using statistical packages	2+1
EXT 613	Information Technology in Agriculture	2+1
BCT 600	Basic Biochemistry	2+1
BCT 614	Techniques in Biochemistry	1+2
VSR 614	Clinical Oncology	2+1
LPT 600	Meat and Poultry Plant Practices	2+1
LPM 600	Biosecurity of Livestock Farms	2+1
Ph. D		
RPE 700*	Research and Publication Ethics	1+1
VSR 714	Biomaterials & Tissues Engineering	2+1
VSR 715	Nanotechnology & Stem Cell Therapy in Veterinary Practice	2+1
EXT 714	Technology Commercialization and Incubation	2+1
EXT 700	Farm Journalism and Public Relations	2+1
LPT 700	Advances in Poultry Products Technology	2+1
VPE-700	Advances in Veterinary Epidemiology and Disease Forecasting	2+1
BCT 700	Methods in Protein Analysis	2+1
*Compulsory course		

Common Courses for P.G

Course Content

PGS 601 LIBRARY AND INFORMATION SERVICES (0+1)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e- resources access methods.

PGS 602 TECHNICAL WRITING AND COMMUNICATIONS SKILLS (0+1)

Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;
- Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
- Writing of abstracts, summaries, précis, citations, etc.;
- Commonly used abbreviations in the theses and research communications;

- Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;
- Presentation of scientific papers.

Suggested Readings

1. Barnes and Noble. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
2. *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
3. *Collins' Cobuild English Dictionary*. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. *Technical Writing*. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
6. James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
7. Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
8. Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
9. Richard WS. 1969. *Technical Writing*.
10. Sethi J and Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
11. Wren PC and Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 603 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE

(1+0)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge- based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPs Agreement; Intellectual Property and

Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

1. Erbisch FH and Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
 2. Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
 3. *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC and Aesthetic Technologies.
 4. Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
 5. Rothschild M and Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
 6. Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

PGS 604 BASIC CONCEPTS IN LABORATORY TECHNIQUES (0+1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;

- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
2. Gabb MH and Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

PGS 605 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of

animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

1. Bhalla GS and Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
2. Punia MS. *Manual on International Research and Research Ethics*. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.
4. Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

SUPPORTING COURSES FOR PG

Course Content

AGB 600 STATISTICAL METHODS FOR ANIMAL SCIENCES (2+1)

Objective

This course is meant for students who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I

Introduction, Collection, Classification and tabulation of data, Frequency

Distribution – Number of Classes, Class Width, Tally Marks, Frequency, Class mid point, Cumulative Frequencies for Exclusive and Inclusive Types. Diagrammatic representation of data, Graphical representation of data – Histogram, Frequency Curve, Frequency Polygon, Pie chart and Ogives. Descriptive Statistics – Measures of Central Tendency – Definition, Properties of Ideal Average. Arithmetic Mean, Median, Mode, Geometric mean and Harmonic mean for ungrouped and grouped data, Merits and Demerits, Measures of Dispersion – Definition, formulae, computation and applications of Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, Coefficient of Variation, Definitions, formulae, Calculation, applications and uses, Moments, Skewness and kurtosis

UNIT II

Elementary Probability – Definition, Mutually exclusive events, independent events and dependent events, Addition and multiplication theorems of probability, fitting of binomial distribution, Poisson distribution – properties and fitting of the Poisson distribution, Normal distribution – Standard normal distribution – Properties of normal distribution Fitting of the normal distribution, Tests of hypothesis – Introduction – level of significance, degrees of freedom, types of error – one-sided and two-sided tests of hypothesis – Power of the test – One sample and two sample Z-test, Student's t-distribution – Properties – one-sample and two-sample t-tests, Student's t-distribution – paired t-test, Chi-square distribution and Tests of goodness of fit-Yates Correction, 2x2 and R x C Contingency Tables, Analysis of variance – components of variance – One way and two-way classification – CD test

UNIT III

Simple correlation – Definition, Positive and Negative correlation – test of significance of correlation coefficient, coefficient of determination, Partial correlation coefficient estimation of parameters, Multiple correlation coefficient, spearman's rank correlation – estimation of parameters, Regression – Simple model and estimation of parameters – Regression vs correlation, Multiple liner regression – Principle, procedure and method, Predicted values and residuals, test of significance of regression coefficients- Coefficient of determination

UNIT IV

Experimental designs – Concepts – Replication, Randomization and local control

Completely Randomized Design (CRD) – Salient features and procedure – Critical difference test Randomized Block Design (RBD) – Salient features – procedure – Least Significant Difference Test (LSD) Latin square Design (LCD) – Salient features – procedure Transformations – Square root transformation, Arc sin transformation and Logarithmic transformation – principles and procedures Analysis of covariance – principle and procedure Sampling methods – Introduction, principles -Simple random sampling and stratified random sampling - Cluster sampling, two stage sampling – applications and uses Revision and recapitulation

Practical

Construction of frequency distribution table – Inclusive and exclusive methods of grouping Continuous and discrete variables distribution, Diagrammatic representation of the data – bar diagram, component bar diagram, multiple bar diagram, pictograms. Graphical representation of data by histogram, frequency polygon, frequency curve and cumulative frequency curves, Computation of arithmetic mean and median for grouped and ungrouped data, Computation of mode, geometric mean and harmonic means, Computation of range, variance, standard deviation, standard error and coefficient of variation, Normal distribution – Fitting of the normal distribution, Test of hypothesis – One sample and two sample Z-test, Mean comparison – one sample and two sample t-test, Paired t-test – testing goodness of fit – Yates correction, 2 x 2 and R x C contingency tables, Chi-square test – testing goodness of fit – Yates correction, 2 x 2 and R x C contingency tables, Analysis of variance – one way and two way classifications – CD test, Computation of simple and multiple correlations and Spearman's rank correlation coefficient, Estimation of simple linear regression coefficient, fitting regression equation and test of significance of regression coefficient, Fitting of multiple regression equations, Problems on CRD and RBD, Problems on Latin square design – estimation of components of covariance

Suggested Readings

- Anderson TW. 1958. *An Introduction to Multivariate Statistical Analysis*. John Wiley.
- Dillon WR & Goldstein M. 1984. *Multivariate Analysis - Methods and Applications*. John Wiley.
- Goon AM, Gupta MK & Dasgupta B. 1977. *An Outline of Statistical Theory*. Vol. I. The World Press.
- Goon AM, Gupta MK & Dasgupta B. 1983. *Fundamentals of Statistics*.

Restriction enzymes, DNA cloning, applications of cloning, transgenics.

Practicals

- Preparation of standard and buffer solutions
- Detection of carbohydrates, amino acids and proteins
- Extraction and estimation of sugars
- Extraction and estimation of amino acids
- Extraction and estimation of proteins
- Estimation of acid value of fat/oil
- Estimation of peroxide value of fat/oil
- Estimation of saponification value in fats and oils
- Fatty acid composition in fat/oil by GC
- Estimation of DNA and RNA by spectroscopic methods
- Estimation of Ascorbic acid
- Separation of biomolecules by TLC and Paper chromatography
- Estimation of alpha amylase activity

Suggested Reading

- Nelson DL and CoX MM. 2017. Lehninger Principles of Biochemistry. 7th edition. W. H. Freeman & Co Ltd
- Satyanarayana U and Chakrapani U. 2017. Biochemistry. 5th edition, Elsevier
- Moran LA, Horton HR, Scrimgeour KG and Perry MD. 2012. Principles of Biochemistry. 5th edition Pearson.
- Voet D and Voet JG. 2011. Biochemistry. 4th edition John Wiley.
- Pratt CW and Cornely K. 2014. Essential Biochemistry. 3rd Edition. Wiley
- Moorthy K. 2007. Fundamentals of Biochemical Calculations. 2nd edition. CRC Press
- Conn EE, Stumpf PK, Bruening G and Doi RH. 2006. Outlines of Biochemistry. 5th edition Wiley.

BCT 614

TECHNIQUES IN BIOCHEMISTRY

(1 +2)

Theory

Unit 1: Chromatography techniques (4 Lectures)

Principles and applications of paper, thin layer, gel filtration, ion-exchange, affinity, column & HPTLC, GC, HPLC and FPLC.

Unit.2: Electrophoretic technique (3 Lectures)

General principles, paper and gel electrophoresis, native and SDS-PAGE, 2D-PAGE, capillary electrophoresis.

Unit 3: Hydrodynamic methods (2 Lectures)

Hydrodynamic methods of separation of biomolecules such as viscosity and sedimentation velocity, - their principles.

Unit 4: Centrifugation (2 Lectures)

Basic principles of sedimentation, type, care and safety aspects of centrifuge preparative and analytical centrifugation.

Unit 5 Spectrophotometry (3 Lectures)

Principles and applications of UV-visible, Fluorescence, IR and FTIR, Raman, NMR and FTNMR, ESR and X-Ray spectroscopy.

Unit 6: Atomic absorption spectrophotometry (2 Lectures)

Principle, function and instrumentation of atomic absorption spectrophotometry.

Practicals

- Expression of concentration in terms of dilution, molarity, normality, percent expression
- pH measurement and buffer preparation
- Determination of absorption maxima of biomolecules
- Estimation of biomolecules through spectrophotometry and other methods
- Separation of carbohydrates and amino acids by paper chromatography
- Separation and analysis of fatty acids/lipids by GC
- Separation/estimation of biomolecules through HPLC and FPLC
- Separation of proteins using ion exchange, gel filtration and affinity chromatography
- Electrophoretic separation of proteins and nucleic acids
- Centrifugation- differential and density gradient
- $(\text{NH}_4)_2\text{SO}_4$ precipitation and dialysis
- Use of radioisotopes in metabolic studies
- PCR
- ELISA
- Western blotting/ Dot blotting

Suggested Reading

- Boyer R. 2011. *Biochemistry Laboratory: Modern Theory and Techniques* 2nd Edition. Pearson
- Hofmann A and Clokie S. 2010. *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*. 7th edition. Cambridge University Press.
- Sawhney SK and Singh R. 2000. *Introductory Practical Biochemistry*. 2nd Ed. Narosa
- Katoch R. 2011. *Analytical Techniques in Biochemistry and Molecular Biology*. Springer
- Boyer R. 2009. *Modern Experimental Biochemistry*. Fifth impression. Pearson
- Lottspeich F and Engels JW. (Eds). 2018. *Bioanalytics: Analytical Methods and Concepts in Biochemistry and Molecular Biology*. Wiley-VCH
- Wilson K and Walker J. 2010. *Principles and Techniques of Biochemistry and Molecular Biology*, 7th Edition. Cambridge University Press

AGB 618

EXPERIMENTAL DESIGNS

(2+1)

Objective

Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

UNIT II

Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Concept of confounding

UNIT IV

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

Practical

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD; Analysis of factorial experiments; Analysis with missing data; Split plot and strip plot designs.

Suggested Readings

- Cochran WG and CoX GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
- Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley.
- Federer WT. 1985. Experimental Designs. MacMillan.
- Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
- Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.
- www.drs.icar.gov.in.

AGB 619**BASIC SAMPLING TECHNIQUES****(2+1)****Theory****Unit I**

Concept of sampling, sample survey vs complete enumeration, planning of sample survey, sampling from a finite population.

Unit II

Simple random sampling with and without replacement, sampling for proportion, determination of sample size, inverse sampling, Stratified sampling.

Unit III

Cluster sampling, Multi-stage sampling, systematic sampling; Introduction to PPS sampling,

Unit IV

Use of auxiliary information at estimation, Ratio product and regression estimators. Double Sampling, sampling and non-sampling errors.

Practical

- Random sampling ~ use of random number tables, concepts of unbiasedness, variance, etc.;
- Simple random sampling, determination of sample size, inverse sampling, stratified sampling, cluster sampling and systematic sampling;

- Estimation using ratio and regression estimators;
- Estimation using multistage design, double sampling.

Suggested Reading

- Cochran WG. 1977. Sampling Techniques. John Wiley.
- Murthy MN. 1977. Sampling Theory and Methods. 2nd Ed. Statistical Publ. Soc., Calcutta.
- Singh D, Singh P and Kumar P. 1982. Handbook on Sampling Methods. IASRI Publ.
- Sukhatme PV, Sukhatme BV, Sukhatme S and Asok C. 1984. Sampling Theory of Surveys with Applications. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.
- Cochran WG. 2007. Sampling Techniques, 3rd Edition. John Wiley & Sons Publication

AGB 620

APPLIED REGRESSION ANALYSIS

(2+1)

Theory

Unit I

Introduction to correlation analysis and its measures, Correlation from grouped data, correlation, Rank correlation, Testing of population correlation coefficients; Multiple and partial correlation coefficients and their testing.

Unit II

Problem of correlated errors; Auto correlation; Heteroscedastic models, Durbin Watson Statistics; Removal of auto correlation by transformation; Analysis of collinear data; Detection and correction of multi collinearity, Regression analysis; Method of least squares for curve fitting; Testing of regression coefficients; Multiple and partial regressions.

Unit III

Diagnostic of multiple regression equation; Concept of weighted least squares; regression equation on grouped data; Various methods of selecting the best regression equation.

Unit IV

Concept of nonlinear regression and fitting of quadratic, exponential and power curves; Economic and optimal dose, Orthogonal polynomial.

Practical

- Correlation coefficient, various types of correlation coefficients, partial and multiple, testing of hypotheses;
- Multiple linear regression analysis, partial regression coefficients, testing of hypotheses, residuals and their applications in outlier detection;
- Handling of correlated errors, multi collinearity;

- Fitting of quadratic, exponential and power curves, fitting of orthogonal polynomials.

Suggested Reading

- Kleinbaum DG, Kupper LL, Nizam A. 2007. Applied Regression Analysis and Other Multivariable Methods (Duxbury Applied) 4th Ed.
- Draper NR and Smith H. 1998. Applied Regression Analysis. 3rd Ed. John Wiley.
- Ezekiel M. 1963. Methods of Correlation and Regression Analysis. John Wiley.
- Koutsoyiannis A. 1978. Theory of Econometrics. MacMillan.
- Kutner MH, Nachtsheim CJ and Neter J. 2004. Applied Linear Regression Models. 4th Ed. With Student CD. McGraw Hill.

AGB 621 DATA ANALYSIS USING STATISTICAL PACKAGES (2+1)

Theory

Unit I

Introduction to various statistical packages: Excel, R, SAS, SPSS. Data Preparation; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

Unit II

Test for normality; Testing of hypothesis using chi-square, t and F statistics and Z-test.

Unit III

Data preparation for ANOVA and ANCOVA, Factorial Experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

Unit IV

Analysis of mixed models; Estimation of variance components; Correlation and regression analysis, Probit, Logit and Tobit Models.

Unit V

Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Neural networks.

Practical

- Use of software packages for summarization and tabulation of data, obtaining descriptive statistics, graphical representation of data;
- Testing the hypothesis for one sample t-test, two sample t-test, paired t-test, test for large samples - Chi-square test, F test, one-way analysis of variance;
- Designs for Factorial experiments, fixed effect models, random effect models, mixed effect models, estimation of variance components;
- Linear regression, Multiple regression, Regression plots;
- Discriminant analysis - fitting of discriminant functions, identification of important variables;

- Factor analysis. Principal component analysis - obtaining principal component.

Suggested Reading

- Anderson C.W. and Loynes R.M. 1987. The Teaching of Practical Statistics. John Wiley.
- Atkinson A.C. 1985. Plots Transformations and Regression. Oxford University Press.
- Chambers J.M., Cleveland W.S., Kleiner B and Tukey P.A. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmont, California.
- Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall. Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall.
- Cleveland W.S. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California.
- Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley.
- Erickson B.H. and Nosanchuk T.A. 1992. Understanding Data. 2nd Ed. Open University Press, Milton Keynes.
- Snell E.J. and Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses. Chapman and Hall.
- Sprent P. 1993. Applied Non-parametric Statistical Methods. 2nd Ed. Chapman & Hall.
- Tufte ER. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, Conn.
- Velleman PF and Hoaglin DC. 1981. Application, Basics and Computing of Exploratory Data Analysis. DuXbury Press.
- Weisberg S. 1985. Applied Linear Regression. John Wiley.
- Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall.
- Cleveland WS. 1994. The Elements of Graphing Data, 2nd Ed., Chapman & Hall
- <http://freestatistics.altervista.org/en/learning.php>.
- <http://freestatistics.altervista.org/en/stat.php>.
- http://www.cas.lancs.ac.uk/glossary_v1.1/main.html.
- <http://www.stat.sc.edu/~grego/courses/stat706/>.
- www.drs.icar.gov.in.

EXT 613 INFORMATION TECHNOLOGY IN AGRICULTURE (2+1)

Theory

Unit I

Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions,

Unit II

Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications,

Unit III

Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops,

Computer- controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.,

Unit IV

Geospatial technology for generating valuable Agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions, Preparation of contingent crop-planning using IT tools.

Practicals

Study of various ICT tools in livestock development

Suggested Reading

- Vanitha G. 2011. Agro-informatics
- <http://www.agrimoon.com>
- <http://www.agriinfo.in>
- <http://www.eagri.org>
- <http://www.agriglance.com>
- <http://agritech.tnau.ac.in>

VSR 614

CLINICAL ONCOLOGY

(2+1)

Theory:

Unit-I:

Introduction – Etiology and Epidemiology of Cancer In Animals Classification- TNM Staging -Pathophysiology Of Neoplasms – Tumor Biology -Clinical Symptoms -Biopsy Procedures- Imaging Of Tumors – Cytopathology - Molecular Diagnosis-

Unit-II:

Principles Of Chemotherapy- Principles Of Oncological Surgery- Immunotherapy- Tumors Of Different Body Systems In Animals- Oncological Emergencies- Cancer Pain Management- Cancer Nutrition- Clinical Trial

Practicals:

- Clinical examination
- TNM staging
- Imaging of tumors (radiography- ultrasound-endoscopy etc.)
- Biopsy procedures
- Cytopathological examination
- Basics of cancer therapy in clinical cases and management
- Recording of data and presentation.

LPT 600 MEAT AND POULTRY PLANT PRACTICES (2+1)

Theory

Unit I

Transportation of Livestock and Poultry. Pre-slaughter care and handling of Livestock and Poultry. Ante-mortem and Post-mortem inspection of animals. Different stunning methods for slaughter of Livestock and poultry. Scientific and hygienic Slaughter and dressing Technology of different species like cattle, buffaloes, sheep, goats, pigs and Poultry.

Unit II

Fabrication of carcasses of different species. Grading and evaluation of Carcasses. Preparation of different primary and secondary Animal by – products. Effluent treatment Plant (ETP) management.

Practical

Organization, sanitation and maintenance of meat and poultry plant, Ante-mortem inspection of food animals and poultry. Post-mortem inspection of food animals and poultry .Estimation of carcass yield, meat bone ratio. Evaluation and grading of carcasses, Quality maintenance of meat, HACCP application in meat and poultry plants, Proximate analysis, microbiological and sensory evaluation of meat

LPM-600 BIOSECURITY OF LIVESTOCK FARMS (2 +1)

Theory

Unit I

Livestock biosecurity, Principles of biosecurity of animals, Disease transmission in biosecurity. Disease prevention in biosecurity of animals, Disease control in biosecurity of animals, Disease management in biosecurity of animals, Epidemiology in biosecurity of animals, Three levels of biosecurity of animals, Developing a biosecurity program for animals -Bio exclusion, Surveillance and Biocontainment, Bio exclusion- Primary, secondary and Tertiary control zones, Biosecurity measures for animal entry to farms, Sources of pathogen and risk transmission in livestock farms,

Unit II

Biosecurity measures during transportation, Biosecurity fundamentals for visitors to livestock farms, Sanitation - Employees, Equipment and vehicle transport,

Biosecurity Management- animal, feed and facilities, Manure handling at livestock farms, Disposal of dead animals / carcasses, Disease prevention and control in biosecurity of animals, Handling of disease outbreaks in animals, Biosecurity measures for animal health, Biosecurity systems for hatcheries and poultry farms

Practicals

Visit to commercial dairy farms, poultry farms and hatcheries, Visit to environment controlled farms, Layout plans for different livestock units-Cattle, Sheep & Goat and Poultry, Utilization of smart devices for livestock management and security

SUPPORTING COURSES FOR Ph. D

Course Content

BCT 700 METHODS IN PROTEIN ANALYSIS (2+1)

Objective

Discussions on contemporary information on techniques in Protein research.

Theory

Unit I

Separation, purification and characterization of proteins in ECF and membrane.

Unit II

Subcellular organization of proteins fused with green fluorescent protein. High throughput methodologies for determining protein structure. Investigating protein with mass spectrometry. Method of determining three dimensional structure of protein. Use of atomic force microscopy in visualizing protein complexes and membrane surfaces.

Unit III

Use of FRET (fluorescence resonance energy transfer) to measure transient changes in second messenger or protein kinase activity in living cell. Proteomics.

Practical

Proteomics, protein quantification.

Suggested Readings

Selected articles from journals

EXT 700 FARM JOURNALISM AND PUBLIC RELATIONS (2+1)

Objective

To sensitize students about the role of mass media, news papers, magazines, radio, T.V. and internet for promoting animal husbandry.

Theory

Unit I

Concept of farm journalism and communication. Journalism as a means of mass-communication and its role in livestock development. Opportunities, strength and limitations. Ethics and principles of journalism for effective writing.

Unit II

Art of writing, news items, news stories, feature articles, success stories, magazines, bulletins, folders etc. Fundamentals of lay-out in writing. Writing of research papers and popular articles in journals and farm magazines.

Unit III

Methods and techniques of broadcasting of farm programmes. Writing scripts for radio and televisions. Importance of public relations in veterinary and animal husbandry extension.

Unit IV

Rapport building with different categories of clients involved in veterinary and animal husbandry extension programmes. Art of speaking. Importance of listening and reading. Relations with press media.

Unit V

Event management, Organization of press meet. Qualities of a good public relation manager. Writing for press news.

Practical

Designing and preparation of news stories, feature articles, success stories related to animal husbandry. Designing and preparation of magazines, folders, popular research articles, radio and T.V. scripts. Visit to agricultural information and communication center to record the activities of preparation, editing and publication of news articles and research publications. Exercise on the art of good speaking in class-room and field situations.

Suggested Readings

Selected articles from journals

**VPE-700 ADVANCES IN VETERINARY EPIDEMIOLOGY
AND DISEASE FORECASTING**

(2+1)

Objective

To learn about survey and surveillance methods, data collection and analysis and the development of suitable disease forecasting systems.

Theory

Unit I

Review of epidemiological concepts and applications, recent concepts. Epidemiology of economically important diseases in the region (haemorrhagic septicemia, foot and mouth disease, surra, brucellosis, PPR, swine fever, IBD and fowl typhoid).

Unit II

Geographical Information System and its applications in epidemiology, various expert systems and their role in epidemiology. Modeling and application of various models in disease forecasting. Epidemiological software.

Unit III

Classification of data, sources of data, data collection, questionnaires. Data storage, computerized and non-computerized recording techniques. Veterinary recording schemes, veterinary information systems and databases. Presenting numerical data: some basic definitions. Displaying numerical data

Unit IV

Over-view of concepts of survey and surveillance, purpose and method of sampling, size of sample, questionnaires. Goals and types of surveillance, difference from monitoring, mechanism of surveillance and surveillance network. Disease/data recording and reporting.

Practical

Epidemiology exercises of economically important diseases in the region, use of Geographical Information System in epidemiology, various expert systems, modeling and various models used in disease forecasting, use of various epidemiological soft-wares. Development of questionnaires Survey among livestock farmers to find out usefulness/effectiveness of vaccination/ artificial insemination/ other practices, surveillance of important diseases. Collection, storage, analysis and Development of suitable software for diseases, Methods of presentation

of data.

Suggested Readings

Noordhuizen JPTM, Frankena K, Thrusfield MV & Gruat EAM. 2003. Application of Quantitative Methods in Veterinary Epidemiology. International Book Distr. Co.

LPT 700 ADVANCES IN POULTRY PRODUCTS TECHNOLOGY (2+1)

Objective

Discussion on latest development in processing, preservation, quality control, packaging, regulations and standards of poultry meat.

Theory

Unit I

Indian scenario of poultry processing industry Advances in poultry dressing, meat yield, preservation, microbiology and quality control methods. Automation in broiler farming, catching, transporting, control of shrinkage and methods of slaughter.

Unit II

Preservation techniques, Room temperature preservation of poultry fast foods by multi hurdle technology critical evaluation of application of refrigeration, tenderization, canning, dehydration, irradiation, curing, smoking and cooking techniques in poultry processing and development of additional processed products.– Regulation of CAC and European standards of poultry meat and meat products.

Unit III

Recent trends in packing and marketing of poultry and poultry products. Modified atmosphere packaging- Different packing materials for meat and cooked products.

Unit IV

Policies and marketing trends in poultry meat -Regulations, specifications, standards and use of additives in poultry products.

Unit V

Poultry product development formulation and profitability.

Practical

Cooked and uncooked meat quality standards- sensory evaluation of poultry meat- packaging material- Modified Atmosphere Packaging-Factors influencing meat quality at different freezing temperatures and thawing.

Suggested Readings

Selected articles from journal

EXT 714 TECHNOLOGY COMMERCIALISATION AND INCUBATION (2+1)

Theory

Block 1: Technology Commercialization and the Modern Context

Unit 1: Basics of technology commercialization

Technology - Definition, functions, process of technological advancement – invention, discovery, innovation and technology; types of innovation - Basic research, Breakthrough innovation, Disruptive Innovation and Sustaining Innovation; Technology transfer and commercialization

Unit 2: Nature of Agricultural Technology

Agricultural technology – meaning, types; technology generation system; technology life cycle

Unit 3: Basics of Technology transfer and commercialization

Technology transfer Vs Commercialization; Technology commercialization process – elements, models, systems and processes; Technology transfer model – research, disclosure, development and commercialization

Block 2: Intellectual Property Resources (Ipr) Management

Unit 1: Overview of Intellectual Property Resources

Introduction to IPR; Overview & Importance; Genesis; IPR in India and IPR abroad; Patents, copyrights, trademarks & trade secrets, geographical indication, industrial design; Emergence of IPR Regimes and Governance Frameworks - Trade-Related Aspects of Intellectual Property Rights (TRIPS), Convention on Biological Diversity (CBD), Cartagena Protocol, International Union for Protection of New Plant Varieties (UPOV), and BIMSTEC.

Unit 2: Systems for Protecting IP

IPR protection laws and systems – National IPR Policy; and IPR laws; procedures for filing IP protection; Systems of IP protection and management in agricultural universities and research institutions and also by stakeholders

Unit 3: Management of IPR

Mechanisms of IPR Management – Institutional arrangement, IP Management processes – invention disclosure; IP portfolio management; Infringement management

Unit 4: Protection and Management of Biological Resources

Introduction; National Biodiversity Act (2002); Protection of Plant Varieties and

Farmers Rights Act (2001); Guidelines for registration and transfer of biological resources; Farmers rights; Mechanisms of documenting/ collecting, protecting and commercializing farmers varieties and other biological resources; National Biodiversity Authority, PPVFRA and other agencies involved in management of biological resources in India. Access to Genetic Resources and Sharing of Benefits

Unit 5: Protection, Management and Commercialization of Grassroot and Farmers Innovations, Traditional and Indigenous Knowledge

Traditional and Indigenous Knowledge, Grassroot and Farmers Innovations – Meaning, forms and importance; Systems of documentation, registration, protection and commercialization. Documentation of traditional indigenous knowledge - Traditional Knowledge Digital Library (TKDL), Community Biodiversity Registers (CBRs), People’s Biodiversity Registers (PBRs), Plant Biodiversity Register, and Honeybee Network.

Unit 6: Geographical Indications (GI) and Appellation of Origin

Geographical indications and appellation of origin – meaning, origin; Geographical Indications of Goods (Registration and Protection) Act (1999); Documentation, registration and commercialization of GI protected materials and processes.

Unit 7: Genetically Modified Organisms (GMO), Agriculture and Biosafety

The Global Concerns on Use of Genetically Modified Organisms in Food and Agriculture; The Cartagena Protocol on Bio-safety; Regulation of GMO in India - Recombinant DNA Advisory Committee (RDAC), Institutional Bio-safety Committee (IBSC), Review Committee on Genetic Manipulation (RCGM), Genetic Engineering Approval Committee (GEAC), State Bio-safety Coordination Committee (SBCC) and District Level Committee (DLC). Laws and Acts for regulation of GMO - Guidelines for Research in Transgenic Plants, 1998; Seed Policy, 2002; Plant Quarantine Order, 2003; Regulation for Import of GM Products Under Foreign Trade Policy, 2006; National Environment Policy, 2006

Block 3: Technology Commercialization

Unit 1: Technology Assessment and Refinement

Meaning; Importance; Approaches and methods of assessment and refinement of various technologies – stakeholder oriented approaches including participatory technology assessment and refinement; assessment and refinement of traditional and indigenous knowledge and grassroot innovations

Unit 2: Technology Valuation

Returns to investment; IP Valuation-Oxford context, IP Valuation methods - Cost approach; Income approach - Discounted Cash Flow, Risk-Adjusted Net Present Value, Net Present Value with Monte Carlo Simulation and Real Options Theory; Market approach - Industry Standards Method, Rating/Ranking Method, Rules of Thumb Approach and Auction Method; Hybrid approaches; Royalty rate method

Unit 3: Technology Commercialization Strategies

Meaning- approaches for technology commercialization – technology scaling up, technology licensing, handholding, agripreneur development, technology business incubation

Unit 4: Scaling up of Technologies

Meaning, types and stages of technology scaling up; mechanisms

Unit 5: Technology Licensing

Meaning and types - Procedures of licensing, preparing licensing documents; Management of technology licensing process

Unit 6: Technology Takers and Entrepreneurship

Meaning; types of technology takers; Technology Taking as a Strategy; Types of entrepreneurships – agripreneurs, startups, small businesses, Producer Organizations, Self Help Groups, Clusters and other forms of entrepreneurship

Unit 7: Policy support for Technology Commercialization and Entrepreneurship Development

Policy support for entrepreneurship development in India - National Policy on Skill Development and Entrepreneurship and other policies; Government of India Support for Innovation and Entrepreneurship – Startup India, Make in India, Digital India, Atal Innovation Mission and others; Entrepreneurship policy and schemes at different states of India; Organizations promoting entrepreneurship in India

Block 4: Technology Incubation

Unit 1: Basics of Technology Incubation

Meaning, functions and types; stakeholder-oriented incubation process – Livelihood incubation, village incubators

Unit 2: Technology Incubation in India

System of technology incubation- incubation process; its effectiveness; Managing profit oriented and non-profit incubators; Schemes for promoting incubators in India

Block 5: Technology Promotion And Essential Skills For Technology Commercialization

Unit 1: Technology Promotion

Technology promotion – meaning, types, business meetings, scientist-industry/ entrepreneur meets, technology conclave, business plan competition, farmers fairs, technology shows

Unit 2: Dealing with Entrepreneurs, Agripreneurs and Other Stakeholders

Business communication; Business Etiquette; business networking

Block 6: Emerging Approaches in Technology Commercialization and Incubation

Unit 1: Technology Scouting

Technology Scouting and Innovations in technology incubation

Practicals

- Understanding the technology commercialization process – Visit to Technology Commercialization Unit of ICAR Institute/ Agricultural University
- Understanding the IPR protection practices – Visit to Patent Attorney office
- Hands-on experience in drafting IPR application – Patent/Copyright/ Trademark
- Understanding protection of biological resources including plant varieties – Visit to PPVFRA Branch office/ ICAR Institute or Agricultural University involved in plant variety protection
- Documenting Traditional and indigenous knowledge – Field experience in using various protocols of using traditional and indigenous knowledge
- Protecting unique local goods through Geographical Indications – Hands on experiences in documenting and registering Geographical indications
- Technology assessment/ validation of traditional and indigenous knowledge – QuIK and other methods
- Hands on experience in technology valuation
- Hands on experience in technology licensing process including drafting agreements
- Understanding the Technology Business Incubation – Visit to Agri Business Incubator or Technology Business incubator
- Hands on experience in planning and organizing technology promotion events
- Hands on experience in various techniques in business communication and Business etiquette

Suggested Reading

Bandopadhyay D. 2018. Securing Our Natural Wealth: A Policy Agenda for Sustainable Development in India and for Its Neighbouring Countries. Singapore; Springer.

Ghosh, S. and Joshi, A. 2017. Handbook for Non-Profit Incubator Managers. New Delhi: Deutsche Gesellschaft für Internationale.

Gupta AK. 2016. Grassroots Innovation: Minds on the margin are not marginal minds. Gurgaon: Penguin Books.

ICAR.2018. ICAR Guidelines for Intellectual Property Management and Technology Transfer/ Commercialization (Revised in 2018). Indian Council of Agricultural Research, New Delhi.

Pandey N and Dharni K. 2014. Intellectual Property Rights. Delhi. PHI Learning Pvt. Ltd. Sharma G and Kumar H. 2018. Intellectual property rights and informal sector innovations: Exploring grassroots innovations in India. The Journal of World Intellectual Property. 1- 17. DOI: <https://doi.org/10.1111/jwip.12097>.

Stevens AJ. 2016. Intellectual property valuation manual for academic institutions (Report No. CDIP/17/INF/4). Geneva: Committee on Development and Intellectual Property (CDIP).

WIPO and ITC. 2010. Exchanging Value – Negotiating Technology Licenses, A Training Manual. World Intellectual Property Organization (WIPO).

VSR 714 BIOMATERIALS AND TISSUE ENGINEERING (2+1)

Theory:

Unit-I

Introduction – Classification--- skin substitutes - Bone substitutes -Biopolymers – organic absorbable- non absorbable sutures- metallic biomaterials ceramics adhesives synthetic non synthetic materials etc.- wound dressings materials- scaffolds- synthesis- characterization – Physico chemical properties- evaluation-therapeutic application in skin and bone tissue conditions collagen- fibrin - bone matrix egg shells -starch etc

Practicals

- Preparation of various Biomaterials from different sources
- Characterization
- Evaluation based on clinical physical chemical mechanical methods
- Application on laboratory animals
- Application on clinical Cases

VSR 715 NANOTECHNOLOGY AND STEM CELL THERAPY IN (2+1)
VETERINARY PRACTICE

Theory

Unit I

Introduction to nanotechnology -scope- advantages- different types of nano tools- preparation- characterization of materials application in drug delivery – disease diagnosis- therapeutics- oncology- orthopedics- scaffolds Theranostics- Nanosensors- types of stem cells-adult vs embryonic stem cells- cultivation- custom made stem cells-

differentiating pathways- clinical application- regenerative medicine vs traditional medicine

Practicals

- Approaches For Nano Material Preparation
- Preparation of silver nano particles
- Preparation of Nano Zinc oxide by chemical process.
- Preparation of chitosan nano particles
- Preparation of Nano cellulose
- Characterization
- Evaluation
- Culturing of stem cells
- Clinical application on animals.

RPE-700 RESEARCH AND PUBLICATION ETHICS (1+1)

Theory

RPE 01: Philosophy and Ethics

- Introduction to philosophy: definition, nature and scope, concept, branches
- Ethics: definition, moral philosophy, nature of moral judgements and reactions

RPE 02: Scientific Conduct

- Ethics with respect to science and research
- Intellectual honesty and research integrity
- Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
- Redundant publications: duplicate and overlapping publications, salami slicing
- Selective reporting and misrepresentation of data

RPE 03: Publication ethics

- Publication ethics: definition, introduction and importance
- Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.
- Conflicts of interest
- Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
- Violation of publication ethics, authorship and contributorship
- Identification of publication misconduct, complaints and appeals
- Predatory publishers and journals

Practice

RPE 4: Open Access Publishing

- Open access publications and initiatives
- SHERPA/ RoMEO online resource to check publisher copyright and self-archiving policies
- Software tool to identify predatory publications developed by SPPU
- Journal finder/ journal suggestion tools, viz., JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

RPE 05: Publication Misconduct

A. Group Discussions

- Subject specific ethical issues, FFP, authorship
- Conflicts of interest
- Complaints and appeals: examples and fraud from India and abroad

B. Software tools

- Use of plagiarism software like Turnitin, Urkund and other open source software tools

RPE 06: Databases And Research Metrics

A. Databases

- Indexing databases
- Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

- Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score
- Metrics: h-index, g index, i10 index, altmetrics

Common & Supporting Courses
Dairy & Fishery Sciences

Common Courses

For Master's degree programme.

Course Code	Course Title	Credits
PGS 501	Library and Information Services	0+1
PGS 502	Technical writing and communication skills	0+1
PGS 503	Intellectual Property and its management	1+0
PGS 504	Basic concepts in laboratory techniques	0+1
PGS 505	Agricultural research, research ethics and rural development programmes	1+0

*A student shall be required to register for all the 5 credit hours core courses

Supporting Courses

Course Code	Course Title	Credit Hours
P.G		
STAT 502	Statistical Methods for Applied Sciences	2+1
STAT 511	Experimental Designs	2+1
STAT 512	Basic Sampling Techniques	2+1
STAT 521	Applied Regression Analysis	2+1
STAT 522	Data Analysis Using Statistical Packages	2+1
MCA 511	Introduction to communication technologies, computer networking and internet	1+1
MCA 512	Information Technology in Agriculture	1+1
Ph. D		
RPE-600*	Research and Publication ethics	1+1
*Compulsory course		

Common Courses

Course Content

PGS 501 LIBRARY AND INFORMATION SERVICES (0+1)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e- resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS (0+1)

Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;
- Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
- Writing of abstracts, summaries, précis, citations, etc.;
- Commonly used abbreviations in the theses and research communications;
- Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;

- Presentation of scientific papers.

Suggested Readings

12. Barnes and Noble. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
13. *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
14. *Collins' Cobuild English Dictionary*. 1995.
15. Harper Collins. Gordon HM and Walter JA. 1970. *Technical Writing*. 3rd Ed.
16. Holt, Rinehart and Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
17. James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
18. Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
19. Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
20. Richard WS. 1969. *Technical Writing*.
21. Sethi J and Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
22. Wren PC and Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (1+0)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge- based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

7. Erbisch FH and Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
8. Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
9. *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC and Aesthetic Technologies.
10. Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol.

- V. Technology Generation and IPR Issues. Academic Foundation.
11. Rothschild M and Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
 12. Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES (0+1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vascupets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
 - Weighing and preparation of solutions of different strengths and their dilution;
 - Handling techniques of solutions;
 - Preparation of different agro-chemical doses in field and pot applications;
 - Preparation of solutions of acids;
 - Neutralisation of acid and bases;
 - Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

3. Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
4. Gabb MH and Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security,

reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

5. Bhalla GS and Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
6. Punia MS. *Manual on International Research and Research Ethics*. CCS Haryana Agricultural University, Hisar.
7. Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.
8. Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

Supporting Courses

Course Content

STAT 502 STATISTICAL METHODS FOR APPLIED SCIENCES (2+1)

Objective

This course is meant for students who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I

Classification, tabulation and graphical representation of data. Descriptive statistics. Exploratory data analysis; Theory of probability. Random variable and mathematical expectation.

UNIT II

Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications, Kurtosis and skewness. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Large sample theory.

UNIT III

Introduction to theory of estimation and confidence-intervals. Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination. Probit regression analysis by least squares and maximum likelihood methods, confidence interval for sensitivity; Testing for heterogeneity.

UNIT IV

Non-parametric tests - sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

UNIT V

Introduction to multivariate analytical tools- Hotelling's T^2 Tests of hypothesis about the mean vector of a multinormal population. Classificatory problems and discriminant function, D^2 -statistic and its applications; Cluster analysis, principal component analysis, canonical correlations and Factor analysis.

Practical

Exploratory data analysis, Fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F ; Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution; Correlation and regression analysis, fitting of orthogonal polynomial regression;; Non-parametric tests.

Suggested Readings

- Anderson TW. 1958. *An Introduction to Multivariate Statistical Analysis*. John Wiley.
- Dillon WR & Goldstein M. 1984. *Multivariate Analysis - Methods and Applications*. John Wiley.
- Goon AM, Gupta MK & Dasgupta B. 1977. *An Outline of Statistical Theory*. Vol. I. The World Press.
- Goon AM, Gupta MK & Dasgupta B. 1983. *Fundamentals of Statistics*. Vol. I. The World Press.

cluster sampling and systematic sampling; Estimation using ratio and regression estimators; Estimation using multistage design, double sampling and PPS sampling.

Suggested Readings

- Cochran WG. 1977. *Sampling Techniques*. John Wiley.
Murthy MN. 1977. *Sampling Theory and Methods*. 2nd Ed. Statistical Publ. Soc., Calcutta.
Singh D, Singh P & Kumar P. 1982. *Handbook on Sampling Methods*. IASRI Publ.
Sukhatme PV, Sukhatme BV, Sukhatme S & Asok C. 1984. *Sampling Theory of Surveys with Applications*. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.

STAT 521 APPLIED REGRESSION ANALYSIS (2+1)

Objective

The students would be exposed to the concepts of correlation and regression. Emphasis will be laid on diagnostic measures such as autocorrelation, multicollinearity and heteroscedasticity. This course would prepare students to handle their data for analysis and interpretation.

Theory

UNIT I

Introduction to correlation analysis and its measures; Correlation from grouped data, Biserial correlation, Rank correlation; Testing of population correlation coefficients; Multiple and partial correlation coefficients and their testing.

UNIT II

Problem of correlated errors; Auto correlation; Durbin Watson Statistics; Removal of auto correlation by transformation; Analysis of collinear data; Detection and correction of multicollinearity; Regression analysis; Method of least squares for curve fitting; Testing of regression coefficients; Multiple and partial regressions.

UNIT III

Examining the multiple regression equation; Concept of weighted least squares; regression equation on grouped data; Various methods of selecting the best regression equation; regression approach applied to analysis of variance in one way classification.

UNIT IV

Heteroscedastic models, Concept of nonlinear regression and fitting of quadratic, exponential and power curves; Economic and optimal dose, Orthogonal polynomial.

Practical

Correlation coefficient, various types of correlation coefficients, partial and multiple, testing of hypotheses; Multiple linear regression analysis,

partial regression coefficients, testing of hypotheses, residuals and their applications in outlier detection; Handling of correlated errors, multicollinearity.

Suggested Readings

- Draper NR & Smith H. 1998. *Applied Regression Analysis*. 3rd Ed. John Wiley.
- Ezekiel M. 1963. *Methods of Correlation and Regression Analysis*. John Wiley.
- Kleinbaum DG, Kupper LL, Muller KE & Nizam A. 1998. *Applied Regression Analysis and Multivariable Methods*. Duxbury Press.
- Koutsoyiannis A. 1978. *Theory of Econometrics*. MacMillan.
- Kutner MH, Nachtsheim CJ & Neter J. 2004. *Applied Linear Regression Models*. 4th Ed. With Student CD. McGraw Hill.

STAT 522 DATA ANALYSIS USING STATISTICAL PACKAGES (2+1)

Objective

This course is meant for exposing the students in the usage of various statistical packages for analysis of data. It would provide the students an hands on experience in the analysis of their research data. This course is useful to all disciplines.

Theory

UNIT I

Use of Software packages for: Summarization and tabulation of data; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

UNIT II

Fitting and testing the goodness of fit of discrete and continuous probability distributions; Testing of hypothesis based on large sample test statistics; Testing of hypothesis using chi-square, t and F statistics.

UNIT III

Concept of analysis of variance and covariance of data for single factor, multi-factor, one-way and multi-classified experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

UNIT IV

Analysis of mixed models; Estimation of variance components; Testing the significance of contrasts; Correlation and regression including multiple regression.

UNIT V

Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Time series data.

Practical

Use of software packages for summarization and tabulation of data,

obtaining descriptive statistics, graphical representation of data. Robust Estimation, Testing linearity and normality assumption, Estimation of trimmed means etc., Cross tabulation of data including its statistics, cell display and table format and means for different sub-classifications; Fitting and testing the goodness of fit of probability distributions; Testing the hypothesis for one sample t -test, two sample t -test, paired t -test, test for large samples - Chi-squares test, F test, One way analysis of variance, contrast and its testing, pairwise comparisons; Multiway classified analysis of variance - cross-classification, nested classification, factorial set up, fixed effect models, random effect models, mixed effect models, estimation of variance components; Generalized linear models - analysis of unbalanced data sets, testing and significance of contrasts, Estimation of variance components in unbalanced data sets - maximum likelihood, ANOVA, REML, MINQUE; Bivariate and partial correlation; Linear regression, Multiple regression, Regression plots, Variable selection, Regression statistics, Fitting of growth models - curve estimation models, examination of residuals.

Suggested Readings

- Anderson CW & Loynes RM. 1987. *The Teaching of Practical Statistics*. John Wiley.
- Atkinson AC. 1985. *Plots Transformations and Regression*. Oxford University Press.
- Chambers JM, Cleveland WS, Kleiner B & Tukey PA. 1983. *Graphical Methods for Data Analysis*. Wadsworth, Belmont, California.
- Chatfield C & Collins AJ. 1980. *Introduction to Multivariate Analysis*. Chapman & Hall.
- Chatfield C. 1983. *Statistics for Technology*. 3rd Ed. Chapman & Hall.
- Chatfield C. 1995. *Problem Solving: A Statistician's Guide*. Chapman & Hall.
- Cleveland WS. 1985. *The Elements of Graphing Data*. Wadsworth, Belmont, California.
- Ehrenberg ASC. 1982. *A Primer in Data Reduction*. John Wiley.
- Erickson BH & Nosanchuk TA. 1992. *Understanding Data*. 2nd Ed. Open University Press, Milton Keynes.
- Snell EJ & Simpson HR. 1991. *Applied Statistics: A Handbook of GENSTAT Analyses*. Chapman & Hall.
- Sprent P. 1993. *Applied Non-parametric Statistical Methods*. 2nd Ed. Chapman & Hall.
- Tufte ER. 1983. *The Visual Display of Quantitative Information*. Graphics Press, Cheshire, Conn.
- Velleman PF & Hoaglin DC. 1981. *Application, Basics and Computing of Exploratory Data Analysis*. Duxbury Press.
- Weisberg S. 1985. *Applied Linear Regression*. John Wiley.
- Wetherill GB. 1982. *Elementary Statistical Methods*. Chapman & Hall.
- Wetherill GB. 1986. *Regression Analysis with Applications*. Chapman & Hall.
- Learning Statistics:

<http://freestatistics.altervista.org/en/learning.php>. Free Statistical Softwares: <http://freestatistics.altervista.org/en/stat.php>. Statistics Glossary http://www.cas.lancs.ac.uk/glossary_v1.1/main.html.
Course on Experimental design:
<http://www.stat.sc.edu/~grego/courses/stat706/>.
Design Resources Server:
www.iasri.res.in/design. Analysis of Data:
Design Resources Server.
<http://www.iasri.res.in/design/Analysis%20of%20data/Analysis%20of%20Data.html>.

MCA 511 INTRODUCTION TO COMMUNICATION TECHNOLOGIES, COMPUTER NETWORKING AND INTERNET (1 + 1)

Objective

This course intends to appraise the students about communication technologies and understanding computer networking paradigms and versatile usage of internet.

Theory

UNIT-I

Communications technology: Concept, elements & their characteristics. Methods of communication: meaning and function. Forms of communication. Functional elements of communication. Role of Mass Media in dissemination of farm technology. Modern communication media: electronic video, tele-text, tele-conference, computer assisted instruction.

UNIT-II

Concept of information system and networking, advantages of networking; Components of information system, information resources, Types of networks: LAN, WAN, PAN, AGRISNET, Indian National Agricultural Research database. PC Based Network: Intranet and Internet; Servers and Clients, Introduction to Network Media, line configuration, transmission modes, topology and protocol.

UNIT III

World Wide Web: Introduction of IP address, World Wide Web: Architecture, HTTP, usage of Internet & Emailing: connecting to internet, ISP, dialup, broadband, leased lines, Concept of Internet, applications of Internet, searching, email accounts, sending and receiving mails, attachments, searching.

Practical

Related to Theory part.

Suggested Readings

Anonymes.2002. Handbook of Livestock Development. ICAR
Andrew S. Tannenbaum, Computer Networks, Pearson Education, 2003.

Arnon, I, 1989. Aricultural research and Technology Transfer. Elsevier Science Publications. Kurose, Computer Networking, Pearson.England.
A.S. Sandhu, 2004. Text book on Agricultural communication process and methods.
Oxford & TBH.
G.L. Ray, 2006. Extension communication and management. Kalyani Publ.
Peterson & Davie, Computer Networks, 4th Ed. ELSEVIER.
Sharma, GRK.2005. Cyber Livestock Communication & Extension Education. Concept Publications, New Delhi.
Stallings, Data & Computer Communication, 8th Ed., Pearson.

MCA 512 INFORMATION TECHNOLOGY IN AGRICULTURE (1 + 1)

Objective

To acquaint the students with scope of information technology and use of various ICT tools in agriculture.

Theory

UNIT-I

Introduction and history of information technology – Scope, need and significance of information technology in Agriculture – Information technology & its components in livestock development (input, output and network devices etc). National Policies on information technology in Agricultural Extension. Information technology for livestock and rural development and community development applications, research and education applications

UNIT-II

Digitization and simulation models(computer & scale). Database management system. Farmer Call Centre, m-krishi, e-Krishi, e-Agrik (e-Agriculture), e-chopal, i-KISAN, KISSAN (Karshaka Information Systems Service and Networking), Touch Screen Information Kiosk, Livestock expert Systems, Village Knowledge Centre /Community Information centres: Introduction, concept, process for setting VKCs. Web Portals: AGRISNET, ICTs for market information and Agri-Business: AGMARKNET.

UNIT-III

Potential advantages of information communication technologies in extension, problems and prospects, constraints and opportunities. Technology led livestock extension systems – a government initiatives (Rythu Bharosa Kendras), initiatives by ICAR and SAUs, IT programmes in livestock development

Practical

Study of various ICT tools in livestock development.

Suggested Readings

A.S. Sandhu, 2004. Text book on Agricultural communication process and methods.

Oxford & TBH.
 B Jirli, Deepak De & GCKendadamth 2005. Information and communication technology and sustainable development, Ganga Kaveri Publ. House, Varanasi.
 Friedrich Kuhlmann. IT Applications in Agriculture: Some Developments and Perspectives, Institute of Agricultural and Food Systems Management, Germany
 G.L. Ray, 2006. Extension communication and management. Kalyani Publ.
 Langley, Dennis, Shain Michael (1985): Dictionary of Information Technology.
 R Saravanan 2010. ICTs for agricultural extension, New India Publ. Agency.
 Sharma, GRK.2005. Cyber Livestock Communication & Extension Education. Concept Publications, New Delhi.
 S.C. Mittal. Role of Information Technology in Agriculture and its scope in India.
 Shaik N Meera, 2008. ICTs in agricultural extension tactical to practical. Ganga Kaveri

RPE 600 RESEARCH AND PUBLICATION ETHICS (1+1)

Overview

This course has total 6 units focusing on basics of philosophy of science and ethics, Research integrity, Publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, Research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

Theory

RPE 01: Philosophy and Ethics

- Introduction to philosophy: definition, nature and scope, concept, branches
- Ethics: definition, moral philosophy, nature of moral judgements and reactions

RPE 02: Scientific Conduct

- Ethics with respect to science and research
- Intellectual honesty and research integrity
- Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
- Redundant publications: duplicate and overlapping publications, salami slicing
- Selective reporting and misrepresentation of data

RPE 03: Publication Ethics

- Publication ethics: definition, introduction and importance
- Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.
- Conflicts of interest

- Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
- Violation of publication ethics, authorship and contributorship
- Identification of publication misconduct, complaints and appeals
- Predatory publishers and journals

Practice

RPE 4: Open Access Publishing

- Open access publications and initiatives
- SHERPA/ RoMEO online resource to check publisher copyright and self-archiving policies
- Software tool to identify predatory publications developed by SPPU
- Journal finder/ journal suggestion tools, viz., JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

RPE 05: Publication Misconduct

A. Group Discussions

- Subject specific ethical issues, FFP, authorship
- Conflicts of interest
- Complaints and appeals: examples and fraud from India and abroad

B. Software tools

- Use of plagiarism software like Tunitin, Urkund and other open source software tools

RPE 06: Databases And Research Metrics

A. Databases

- Indexing databases
- Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

- Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score
- Metrics: h-index, g index, i10 index, altmetrics

SRI VENKATESWARA VETERINARY UNIVERSITY, TIRUPATI



FACULTY OF VETERINARY SCIENCE

VOLUME-II **P G & Ph. D Course Curriculum**

(As per ICAR Regulations-2021)

VOLUME II
P G & Ph. D Course Curriculum
Veterinary Sciences

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3. Livestock Production and Management	681
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4. Livestock Products Technology	717
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VOLUME II A

Basic Veterinary Sciences

Veterinary Anatomy

Veterinary Biochemistry

Veterinary Biotechnology

Veterinary Extension Education

Veterinary Physiology

Suggested list of specified minor subjects (Departments)

Major Subjects	Minor Subjects
Veterinary Anatomy	Vety. Biochemistry, Vety. Physiology, Vety. pathology, Animal Reproduction, Gynecology & Obstetrics, Vety. Biotechnology, Veterinary Surgery and Radiology
Veterinary Biochemistry	Veterinary Physiology, Vety. Biotechnology, veterinary medicine, Animal Nutrition, Animal Genetics & Breeding, Livestock Production Management, Veterinary Microbiology, Veterinary Pharmacology and Toxicology, Veterinary Parasitology, Veterinary pathology, Animal Reproduction, Gynecology & Obstetrics
Veterinary Physiology	Animal Nutrition, Vety. Biochemistry Animal Reproduction, Gynecology & Obstetrics, Animal Genetics & Breeding, Vety. Biotechnology, Veterinary Surgery and Radiology, Livestock Production Management, Veterinary Pharmacology and Toxicology, Veterinary Anatomy, Veterinary Medicine, Poultry Science, Veterinary Pathology
Veterinary Biotechnology	Vety. Biochemistry, Vety. Microbiology, Vety. Physiology, Livestock Product Technology Animal Reproduction, Gynecology & Obstetrics, Animal Nutrition, Animal Nutrition, Veterinary Parasitology, Veterinary Pharmacology and Toxicology, Veterinary Surgery and Radiology, Veterinary Medicine, Veterinary Public Health and Epidemiology, Wild Life
Veterinary Extension Education	Animal Nutrition, Livestock Product Technology, Livestock Production Management. Poultry Science, Veterinary Public Health and Epidemiology, Livestock Economics, Statistics

Basic Veterinary Sciences

– Veterinary Anatomy



Preamble

(Veterinary Anatomy)

To enhance the comprehension, the courses of Veterinary Anatomy have been redesigned facilitating learning of Regional Anatomy and to encourage hands on training to PG students. Major emphasis in re-designed courses has been clinical application of the basic knowledge of Anatomy and Histology. Wild life and Forensic Anatomy course and Clinical Anatomy course have been newly introduced at Masters level in view of the importance of wild life and Forensic applications and clinical approaches. Courses like Cross sectional Anatomy first of its kind in Veterinary Anatomy and Animal alternatives in Veterinary Anatomy which is important in view of ban on usage of animas for dissection have been introduced at doctorate level. Similarly some courses are reorganized.



Course Title with Credit Load M.V.Sc. in Veterinary Anatomy

Course Code	Course Title	Credit Hours
ANA 601*	Comparative osteology and arthrology	1+2
ANA 602*	Comparative splanchnology	2+2
ANA 603*	Myology, angiology, neurology and aesthesiology of Ox	2+2
ANA 604	Gross, histological and histochemical techniques	1+3
ANA 605	Clinical anatomy	0+1
ANA 606*	General histology and ultrastructure	1+1
ANA 607*	Systemic histology and ultrastructure	3+1
ANA 608*	Developmental anatomy	2+1
ANA 609	Wild life and forensic anatomy	1+0
ANA 610	Master's seminar	1+0
ANA 611	Master's research	0+30

*Core Courses



Course Contents

M.V.Sc. in Veterinary Anatomy

- I. Course Title** : **Comparative Osteology and Arthrology**
II. Course Code : **ANA 601**
III. Credit Hours : **1+2**

IV. Aim of the course

To make a student well versed with the bones and joints of different domestic animals.

V. Theory

Unit I

Technical terms, structure, chemical composition and classification of bones.

Unit II

Bones of appendicular skeleton of ox as a type and their comparison with those of horse, sheep, goat, dog, pig and poultry.

Unit III

Bones of axial skeleton of ox as a type and their comparison with those of horse, sheep, goat, dog, pig and poultry.

Unit IV

Classification and detailed study of different joints of the body.

Unit V

Study the various indices for estimating race, sex and age of different animals. Basics of biomechanics of the locomotor system. Radiography of normal and developing bones.

VI. Practical

Demonstration of all bones and dissection of joints of buffalo/ Cattle. Radiographic study of bones and joints

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Technical terms, structure, chemical and physical composition and classification of bones	1
2.	Study on scapula and humerus of ox, horse, dog, pig, sheep, goat and poultry (including clavicle and coracoid).	1
3.	Study on radius and ulna of ox, horse, dog, pig, sheep, goat and poultry.	1
4.	Study on carpals of ox, horse, dog, pig, sheep, goat and poultry.	1
5.	Study on metacarpals and digits including sesamoids of ox, horse, dog, pig, sheep, goat and poultry.	1



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6. Comparative study on os-coxae including pelvimetry and femur of oX, horse, dog, pig, sheep, goat and poultry.	1
7. Comparative study on tibia and fibula of oX, horse, dog, pig, sheep, goat and poultry.	1
8. Comparative study on tarsal and metatarsal of oX, horse, dog, pig, sheep, goat and poultry.	1
9. Study on the ethmoid, occipital and sphenoid bone of oX, horse, dog, pig, sheep, goat and poultry.	1
10 Study on the frontal, parietal, interparietal and temporal bones of oX, horse, dog, pig, sheep, goat and poultry.	1
11 Study on the maxilla, premaxilla, palatine, pterygoid, nasal, lacrimal and malar bones of oX, horse, dog, pig, sheep, goat and poultry.	1
12 Study on vomer, hyoid and mandible bones of oX, horse, dog, pig, sheep, goat and poultry	1
13 Study on cervical, thoracic, lumbar, sacral and coccygeal vertebrae of oX, horse, dog, pig, sheep, goat and poultry	1
14 Study on ribs and sternum of oX, horse, dog, pig, sheep, goat and poultry.	1
15 Detailed study of different joints of the body	2
16 Biomechanics of the locomotor system	1
17 Radiographic anatomy	1
Total	18

Practical

1 Topographic terms.	1
2 Classification of bones	1
3-4 Comparative study on scapula and humerus	2
5-6 Comparative study on radius and ulna	2
7-8 Comparative study on carpals	2
9-10 Comparative study on metacarpals and digits	2
11 Comparative study on os-coxae and femur	1
12-13 Comparative study on tibia and fibula	2
14 Comparative study on tarsal and metatarsal	2
15-16 Comparative study on the ethmoid, occipital and sphenoid bone	3
17-18 Comparative study on the frontal, parietal, interparietal and temporal bones	2
19-20 Comparative study on the maxilla, premaxilla, palatine pterygoid, nasal, lacrimal and malar bones	2
21-22 Comparative study on vomer, hyoid and mandible bones	2
23-24 Comparative study on cervical and thoracic vertebrae	2
25-27 Comparative study on bones of lumbar, sacral and coccygeal vertebrae.	2
28-30 Comparative study on ribs and sternum	2
31-32 Classification and detailed study of different joints of the body.	2
33-34 Biomechanics of the locomotor system	2
35-36 Radiographic anatomy	2
Total	36

I. Course Title : Comparative Splanchnology

II. Course Code : ANA 602

III. Credit Hours : 2+2

IV. Aim of the course

To give a detailed overview of different systems constituting splanchnology.



V. Theory

Unit I

Overview of different systems constituting descriptive anatomy of various organs of digestive system and associated glands of ox and their comparison with those of horse, sheep, goat, dog, pig and poultry. Study of formation of thoracic, abdominal and pelvic cavities; reflection of these cavities.

Unit II

Study of various organs/ structures and associated glands constituting the respiratory system of ox and their comparison with those of horse, sheep, goat, dog, pig and poultry.

Unit III

Detailed study of organs and associated glands comprising the urinary system of ox as a type and their comparison with those of horse, sheep, goat, dog, pig and poultry.

Unit IV

Complete study of various organs and associated glands of male and female genital systems.

Unit V

Surgical sites for various operations and clinically significant areas for performing auscultation, percussion and for carrying out surgical procedures such as laryngotomy, oesophagotomy, gastrotomy, rumenotomy, cystotomy, urethrotomy, caesarian section, exploratory laparotomy, mastectomy, thoracotomy, thoracocentesis, etc.

Unit VI

Study of various endocrine organs of ox and their comparison with horse, sheep, goat, dog, pig and poultry

VI. Practical

Demonstration of structure and placement of organs in body cavities of all the animals. Sonographic appearance of different organs.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction	1
2.	Study of topographic anatomy and reflection of thoracic, abdominal and pelvic cavities in ox, horse, dog, pig, sheep, goat and poultry	2
3.	Comparative anatomy of oral cavity in ox, horse, dog, sheep, goat and pig.	2
4.	Comparative anatomy of dentition in ox, horse, dog, sheep, goat and pig,	1
5.	Comparative anatomy of tongue in ox, horse, dog, sheep, goat and pig.	1
6.	Comparative anatomy of esophagus in different species	1
7.	Study of the salivary glands of various species	1
8.	Study of ruminant stomach along with omentum	2
9.	Study of monogastric stomach and omentum of various species	2
10.	Comparative anatomy of small intestines of various species	1
11.	Comparative anatomy of large intestines of various species	1



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S. No.	Topic	No. of Lectures/ Practicals
12.	Study of liver and gall bladder of various species	1
13.	Study of spleen and pancreas of various species	1
14.	Study of digestive system of poultry	1
15-16.	Study of nasal cavity in ox, horse, dog, sheep, goat and pig	2
17.	Study of larynx of various species	1
18.	Study of trachea of various species	1
19.	Comparative anatomy of lungs of various species	2
20.	Study of digestive system of fowl	1
21.	Study of kidneys of various species	1
22.	Study of ureter and urinary bladder	1
23.	Study of urethra	1
24.	Study of male genital system and associated organs of various species	1
25.	Study of female genital system and associated organs of various species	2
26.	Study of male and female genital system of fowl	1
27.	Study of udder of different species of animals	1
28.	Study of body cavities	1
	Total	35
Practical		
1.	Introduction	1
2.	Study of topographic anatomy of thoracic, abdominal and pelvic cavities in different animals.	2
3.	Comparative anatomy of oral cavity in ox, horse, dog, sheep, goat and pig.	2
4.	Comparative anatomy of dentition in ox, horse, dog, sheep, goat and pig,	1
5.	Comparative anatomy of tongue in ox, horse, dog, sheep, goat and pig.	1
6.	Comparative anatomy of esophagus in different species	1
7.	Study of the salivary glands of various species.	1
8.	Study of ruminant stomach along with omentum	2
9.	Study of monogastric stomach and omentum of various species	2
10.	Comparative anatomy of small and large intestines and anus of various species	2
11.	Study of liver and gall bladder, spleen, pancreas of various species	2
12.	Study of larynx of various species	1
13.	Comparative anatomy of lungs of various species	2
14.	Study of body cavities	2
15-16.	Study of urinary system and associated organs of various species	2
17.	Study of male genital system and associated organs of various species	2
18.	Comparative study of accessory sex glands in different species	1
19.	Study of female genital system and associated organs of various species	2
20.	Study of endocrine organs of various species	2
21.	Study of udder of different species of animals	1
	Total	32

- I. Course Title : Myology, Angiology, Neurology and Aesthesiology of Ox**
II. Course Code : ANA 603
III. Credit Hours : 2 +2
IV. Aim of the course



To give a thorough knowledge about

the muscles, course of blood vessels and



nerves of the body in addition to various organs of circulatory, nervous and sensory systems of ox as a type animal.

V. Theory

Unit I

Classification of muscle fibres. Origin, insertion and relations of muscles of different body parts.

Unit II

Topographic anatomy of the vascular system comprising of heart, arteries, veins and lymphatics.

Unit III

Study of various components of central nervous system, peripheral nervous system and autonomic nervous system.

Unit IV

Complete study of the gross anatomy of various sense organs.

Unit V

Study of different nerve blocks, intravenous sites and enucleation of eye ball.

VI. Practical

Dissection of heart, different vessels, brain, cranial nerves, brachial plexuses and lumbo-sacral plexus. Dissection of eye, ear, hoof and horn of buffalo/ cattle.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Myology and organization of various types of muscles	2
2.	Heart and pericardium	4
3.	Muscles and blood supply to the head and neck	3
4.	Muscles and blood supply to the forelimb	3
5.	Muscles of thorax and abdomen and thoracic aorta, abdominal aorta and its branches	2
6.	Muscles and blood supply to the hind limb	2
7.	Venous system	2
8.	Lymph glands and its afferent and efferent vessels	2
9.	Study of brain	2
10.	Study of cranial nerves	2
11.	Study of spinal cord and spinal nerves	2
12.	Brachial and lumbo-sacral plexus	2
14.	Structure of eye ball	2
15.	Structure of external, middle and internal ear of different species	2
16.	Study of hoof	2
17.	Study of horn	2
	Total	36
Practical		
1.	Introduction to general myology	1
2.	Structure of heart	2
3.	Brachiocephalic trunk, course of aorta, coronary arteries and pulmonary trunk	1
4.	Bicarotid trunk	1



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S. No.	Topic	No. of Lectures/ Practicals
5	Blood supply to the forelimb	1
6	Thoracic aorta and its branches abdominal aorta	1
7	Abdominal aorta and its branches	1
8	Blood supply to the hind limb	1
9	Meninges	1
10	Dorsal and ventral aspect of brain and ventricles of brain, sagittal sections of brain of different species	1
11	Cranial nerves,	1
12	Spinal cord and spinal nerves	1
13	Brachial plexus	1
14	Lumbo-sacral plexus	1
15	Venous drainage and lymphatic system	1
16	Blood supply to the brain	2
17	Study of eye	1
18	Study of ear	1
19	Autonomic nervous system	1
20	Muscle of face, larynx, mastication, soft palate, tongue, pharynx and ear	4
21	Muscles of neck	2
22	Muscles of fore limb	2
23	Muscles of thorax	1
24	Muscles of, abdomen	1
25	Muscles of hip and thigh	2
26	Extensors and flexors of hind limb	1
27	Muscles of tail and penis	1
Total		34

I. Course Title : Gross, Histological and Histochemical Techniques

II. Course Code : ANA 604

III. Credit Hours : 1+3

IV. Aim of the course

Hands-on training for preparation of gross anatomical specimens and processing of tissues to demonstrate structural components by different stains for research and teaching purposes.

V. Theory

Unit I

Preparation of tissues for microtomy and light microscopy using different fixatives.

Unit II

Different staining methods for routine light microscopy and special staining methods.

Unit III

Frozen sectioning techniques and staining methods for enzymes, carbohydrates, lipids, proteins, pigments, etc.

Unit IV

Silver staining techniques for nervous tissue.



Unit V

Preparation of tissue for electron microscopic studies

VI. Practical

Embalming fluids, embalming of animals, maceration and preparation of skeletons. Gross staining of brain sections. Demonstration of sites of ossifications. Preparation of transparent specimens, preparation of casts of various organs, blood vessels and ducts, etc. Study of different techniques for collection, fixation and processing of animal tissues; preparation of paraffin and frozen sections; handling and care of microtomes. Demonstration of staining of carbohydrates, lipids, proteins, nucleic acids and enzymes.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Embalming fluid and its preparation	1
2	Embalming techniques, formalin and modified gravity feed embalming technique.	1
3	Maceration and preparation of skeletons; taxidermy, burial method, chemical method (sodium hydroxide method) gross staining of brain specimens different species; Tompsett 1955, Mulligam 1931 for gray matter, Waldman and Michaels (1954) for white matter, Hewitt method	1
4	Demonstration of sites of ossifications alizarin red technique	1
5	Preparation of transparent specimens of various organs, plastination	1
5	Preparation of transparent specimens of various organs, plastination	1
7	Chemical composition of a living cell	1
8	Fixation of tissue samples with different fixatives and post fixation of tissue samples	1
9	Embedding, block preparation and paraffin sectioning.	1
10	Natural and synthetic dyes	1
11	Metachromasia and supravital staining	1
12	Routine hematoxylin and eosin staining	1
13	Special staining for connective, muscular and nervous tissue.	1
14	Staining for carbohydrates and proteins and lipids.	1
15	Special stain for demonstration of nucleic acids	1
16	Special staining for cytoplasmic granules and pigments and minerals	1
17	Differential staining for cell types	1
18	Demonstration of silver staining techniques	1
	Total	18
Practical		
1	Embalming fluid and its preparation	2
2	Embalming techniques, formalin and modified gravity feed embalming technique.	2
3	Maceration and preparation of skeletons; taxidermy, burial method, chemical method (sodium hydroxide method) gross staining of brain specimens different species; Tompsett 1955, Mulligam 1931 for gray matter, Waldman and Michaels (1954) for white matter, Hewitt method	2
4	Demonstration of sites of ossifications alizarin red technique	2
5	Preparation of transparent specimens of various organs, plastination	2
6	Preparation of casts of various organs, vinyl acetate cast	2
7	Chemical composition of a living cell	2



8 Fixation of tissue samples with

different fixatives



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S. No.	Topic	No. of Lectures/ Practicals
9	Post fixation of tissue samples	2
10	Embedding, block preparation and paraffin sectioning.	4
11	Natural and synthetic dyes	2
12	Metachromasia and supravital staining	2
13	Routine hematoxylin and eosin staining	2
14	Special staining for connective: elastic, reticular and collagen fibres, muscular and nervous tissue.	4
15	Staining for carbohydrates: pas, amp and proteins.	2
16	Special stain for demonstration of nucleic acids, lipids and enzymes	2
17	Special staining for cytoplasmic granules	2
18	Special staining for pigments and minerals	2
19	Differential staining for cell types	2
20	Demonstration of silver staining techniques	2
	Total	48

I. Course Title : Clinical Anatomy

II. Course Code : ANA 605

III. Credit Hours : 0+1

IV. Aim of the course

To give exposure to different clinical conditions.

V. Practicals

Clinical examination of animal in health and disease, auscultation of different organs, different types of nerve blocks, surgical conditions of different body systems, radiographical techniques and post-mortem examination.

S. No.	Topic	No. of Lectures/ Practicals
Practical		
1.	Clinical examination of animal by palpation, percussion and auscultation	1
2.	Site to record temperature, pulse, palpable lymph nodes, collection of blood and pregnancy diagnosis in domestic animals	1
3.	Area of auscultation for lungs and heart, passing of probang	1
4.	Preferable site for injections in domestic animals (intradermal, subcutaneous, intramuscular, intravenous, intracardiac, intratracheal, subconjunctival, intra-articular, epidural)	1
5.	Nerve blocks of head region (frontal, infraorbital, mandibulo-alveolar, mental, retrobulbar, Peterson, auriculopalpebral and cornual) for different surgical conditions (extraction of tooth, trephining of frontal and maxillary sinuses, extirpation of eye ball, amputation of horn, haematoma)	2
6.	Surgical conditions of respiratory system (catheterization of guttural pouch, ventriculectomy in horse, tracheotomy, thoracocentesis)	1
7.	Paravertebral nerve block, paracentesis, rumenocentesis. Surgical conditions of digestive system (passing of stomach tube, ligation of parotid duct, oesophagotomy, abdominocentesis, rumenotomy, laparotomy/ celiotomy, gastrotomy, splenectomy, enterotomy, extirpation	



of anal sacs in dog)

2



S. No.	Topic	No. of Lectures/ Practicals
8.	Surgical conditions of urinary system (urethrotomy, puncturing of urinary bladder, catheterization of urinary bladder, cystotomy)	1
9.	Surgical conditions of genital system (hysterotomy/ caesarean section, ovario-hysterectomy (spaying), castration, vasectomy, caponing in fowl)	1
10.	Nerve blocks of fore limb (radial, median, ulnar, volar digital nerves) for surgical affections	1
11.	Nerve blocks of hind limb (tibial, peroneal, saphenous, plantar digital nerves) for surgical affections including patellar desmotomy	1
12.	Nerve blocks (pudic, cranial epidural, caudal epidural) for surgical affections including docking	1
13.	Radiographical techniques, contrast radiography	1
14.	Radiographic visualization of organs of thoracic and abdominal cavity	1
15.	Radiographic visualization of organs of pelvic cavity	1
16.	Post-mortem examination and collection of material for teaching and research	1
	Total	16

I. Course Title : General Histology and Ultrastructure

II. Course Code : ANA 606

III. Credit Hours : 1+1

IV. Aim of the course

To understand basic principles of light microscopy and light and ultrastructure of four basic tissues.

V. Theory

Unit I

Light and ultrastructural details of animal cell.

Unit II

Light and ultrastructural details of epithelial tissue.

Unit III

Light and ultrastructural details of muscular tissue.

Unit IV

Light and ultrastructural details of connective tissue.

Unit V

Light and ultrastructural details of nervous tissue.

VI. Practical

Demonstration of different components of cells and intercellular substances of the above referred tissues by special staining through the use of light, phase contrast, dark field, fluorescent and electron microscopes.



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S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to animal cell and Study of plasma membrane	1
2.	Study of nucleus and nuclear membrane and Study of mitochondria and endoplasmic reticulum	1
3.	Study of Golgi apparatus, centriole, lysosomes, microtubules, microfilaments, etc.	1
4.	Cell division and Cell wall modifications and junctional complexes	1
5.	Light and ultrastructural study of different types of epithelial tissue and glands	2
6.	Light and ultrastructural study of different types of muscular tissue	1
7.	Introduction to different types of connective tissue and Detailed study of connective tissue fibres; collagen, reticular and elastic	1
8.	Study of different cell types of connective tissue, constituents of ground substance	1
9.	Study of different types of connective tissues	1
10.	Light and ultrastructural details of different cartilages; hyaline, elastic and fibrous cartilage	1
11.	Light and ultrastructural details of bone	1
12.	Structural details of blood and its different constituents	2
13.	Light and ultrastructural study of neurons and neuroglial cells of CNS and PNS, nerves, ganglion, etc.	2
	Total	16
Practical		
1.	Study on electron micrographs of an animal cell to distinguish different organelles	1
2.	Study of electron micrographs of plasma membrane, nucleus and nuclear membrane	2
3.	Study of electron micrographs of mitochondria, Golgi apparatus and endoplasmic reticulum	1
4.	Study of different types of epithelial tissues by light microscope	1
5.	Study of different types of epithelial tissues and glands by electron micrographs	1
6.	Study of different types of Muscle tissues by light microscope	1
7.	Study of different types of Muscle tissues by electron micrographs	1
8.	Study of different types of connective tissue fibres and cells	1
9.	Study of different types of connective tissues	3
10.	Study of different types of cartilages	1
11.	Study of Bone; ground bone and decalcified bone	1
12.	Study of different constituents of blood	1
13.	Light and ultrastructural study of nervous tissue	2
	Total	17

- I. Course Title : Systemic Histology and Ultrastructure**
II. Course Code : ANA 607
III. Credit Hours : 3+1
IV. Aim of the course



To understand and identify
organs of different body systems

arrangement of four basic tissues in



V. Theory

Unit I

Light and ultrastructure of different organs of digestive system of ruminants with differential features among domestic animals.

Unit II

Light and ultrastructure of different organs of respiratory, lymphoid and cardiovascular systems.

Unit III

Light and ultrastructure of different organs of urino-genital systems.

Unit IV

Light and ultrastructure of different sense organs and nervous system.

Unit V

Light and ultrastructure of different organs of endocrine system

VI. Practical

Study of histological structure of organs of digestive, respiratory, urinary, genital and cardiovascular systems of buffalo, horse and dog/ cat.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	General organization of the wall of tubular organs	1
2.	Light microscopic and ultra structural study of tongue, lip and cheek	2
3.	Light microscopic and ultra structural study of salivary gland	2
4.	Light microscopic and ultra structural study of pharynx and oesophagus	2
5.	Light microscopic and ultra structural study of rumen, reticulum and omasum	2
6.	Light microscopic and ultra structural study of abomasum	2
7.	Light microscopic and ultra structural study of small intestine	2
8.	Light microscopic and ultra structural study of large intestine	2
9.	Light microscopic and ultra structural study of liver	2
10.	Light microscopic and ultra structural study of pancreas and gall bladder	2
11.	Light microscopic and ultra structural study of nasal cavity	1
12.	Light microscopic and ultra structural study of larynx and trachea	2
13.	Light microscopic and ultra structural study of lungs	2
14.	Light microscopic and ultra structural study of cardiovascular system including heart	2
15.	Light microscopic and ultra structural study of lymphoid organs	2
16.	Light microscopic and ultra structural study of ovary	2
17.	Light microscopic and ultra structural study of oviduct and uterus	2
18.	Light microscopic and ultra structural study of cervix, vagina and mammary glands	2
19.	Light microscopic and ultra structural study of testes	2
20.	Light microscopic and ultra structural study of epididymis and vas deferens	1
21.	Light microscopic and ultra structural study of urethra and accessory sex glands and penis	2



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S. No.	Topic	No. of Lectures/ Practicals
22.	Light microscopic and ultra structural study of kidney	2
23.	Light microscopic and ultra structural study of ureter, urinary bladder and urethra	1
24.	Light microscopic and ultra structural study of endocrine glands; thyroid, pituitary, adrenal gland, parathyroid, pineal gland	2
25.	Light and ultrastructural details of Spinal cord, cerebrum and cerebrium	1
26.	Light microscopic and ultra structural study of integument	1
27.	Light microscopic and ultra structural study of eye	2
28.	Light microscopic and ultra structural study of ear	2
	Total	50

Practical

1.	Light microscopic and ultra structural study of lip and cheek, tongue and salivary glands	1
2.	Light microscopic and ultra structural study of pharynx and oesophagus	1
3.	Light microscopic and ultra structural study of rumen, reticulum, Omasum and abomasum	1
4.	Light microscopic and ultra structural study of small intestine	1
5.	Light microscopic and ultra structural study of large intestine	1
6.	Light microscopic and ultra structural study of liver, pancreas and gall bladder	1
7.	Light microscopic and ultra structural study of larynx and trachea	1
8.	Light microscopic and ultra structural study of lungs	1
9.	Light microscopic and ultra structural study of cardiovascular system including heart	1
10.	Light microscopic and ultra structural study of lymphoid organs	1
11.	Light microscopic and ultra structural study of ovary and oviduct	1
12.	Light microscopic and ultra structural study of uterus, cervix, vagina and mammary glands	1
13.	Light microscopic and ultra structural study of male reproductive system	1
14.	Light microscopic and ultra structural study of kidney, ureter, urinary bladder and Urethra	1
15.	Light microscopic and ultra structural study of endocrine glands; thyroid, pituitary, adrenal gland, parathyroid, pineal gland	1
16.	Light and ultrastructural study of Spinal cord, cerebrum and cerebrium	1
17.	Light microscopic and ultra structural study of sense organs	1
	Total	17

I. Course Title : Developmental Anatomy

II. Course Code : ANA 608

III. Credit Hours : 2+1

IV. Aim of the course

To understand the developmental processes of different body systems at various stages of pregnancy.

V. Theory

Unit I

Gametogenesis, Classification of eggs, fertilization, cleavage and gastrulation



Unit

Development of foetal membranes and placenta in domestic animals.

Unit III

Histogenesis of nervous system, sense organs, lymphoid organs, endocrine organs and cardiovascular system

Unit IV

Embryonic development of digestive, respiratory, uro-genital and musculoskeletal system.

VI. Practical

Study of serial sections of the chick and pig embryos at different stages of development.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to Embryology, history of embryology, term used in embryology Gametogenesis; Spermatogenesis	2
2.	Oogenesis; classification of eggs, structure of mammalian and avian eggs	2
3.	Fertilization, Cleavage Implantation Placentation	2
4.	Blastulation Gastrulation, formation of extra embryonic membranes	2
5.	Formation of extra embryonic membranes	2
6.	Organogenesis and histogenesis of nervous system,	2
7.	Development of sense organs	2
8.	Development of endocrine organs	2
9.	Cardiovascular system including fetal circulation.	2
10.	Embryonic development of gastro-intestinal tract	2
11.	Development of liver, pancreas and gall bladder	2
12.	Development of Respiratory system	2
13.	Development of urinary system	2
14.	Male reproductive system	2
15.	Female reproductive system	2
16.	Musculoskeletal system	2
	Total	32
Practical		
1.	Study of sperm and ova	1
2.	Cleavage, Blastulation and Gastrulation	1
3.	Study of whole mount sections of chick embryo and serial sections of chick embryo	1
4.	Organogenesis, Development of nervous system	1
5.	Organogenesis, Development of digestive system	2
6.	Organogenesis. Development of respiratory system	2
7.	Organogenesis, Development of cardiovascular system	2
8.	Organogenesis, Development of endocrine system	1
9.	Organogenesis, Development of urinary system	2
10.	Organogenesis, Development of male and female reproductive system	2
11.	Determination of age of different species of embryo	1



Total

16



- I. Course Title : Wild Life and Forensic Anatomy**
II. Course Code : ANA 609
III. Credit Hours : 1+0

IV. Aim of the course

To give exposure to different body systems of wild animals of local region for the forensic purpose.

V. Theory

Unit I

Importance of anatomy of wild animals in veterinary anatomy.

Unit II

Anatomy of different body systems of wild animals.

Unit III

Anatomy of different body systems of wild birds.

Unit IV

Application of wild life anatomy in forensic veterinary medicine

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction, scope and importance of anatomy of wild animals	1
2.	Origin, evolution and classification of wild mammals and birds	1
3.	Morphological adaptations of wild mammals and birds	1
4.	Radiography and ultrasonography as a tool to study wild life anatomy	1
5.	Anatomy of skeletal system of Elephants with special emphasis on dentition and ageing and sexual dimorphism	1
6.	Anatomy of digestive, respiratory, reproductive and urinary systems of elephants	1
7.	Anatomy of skeletal system of wild carnivores including lion, tiger, leopard, cheetah, wolf and fox.	1
8.	Anatomy of digestive, respiratory, reproductive and urinary systems of wild carnivores	1
9.	Anatomy of skeletal, digestive, respiratory, reproductive and urinary systems of wild ruminants	1
10.	Anatomy of skeletal, digestive, respiratory, reproductive and urinary systems of wild primates	1
11.	Anatomy of skeletal system of Cervidae family	1
12.	Anatomy of digestive, respiratory, reproductive and urinary systems of Cervidae family	1
13.	Anatomy of cardio-vascular system of wild animals	1
14.	Anatomy of nervous system of wild animals	1
15.	Anatomy of sense organs of wild animals	1
16.	Anatomy of wild birds	1
17.	Application of wild life anatomy in forensic veterinary medicine	1
18.	Clinical anatomy of captive wild animals	1
	Total	18



Course Title with Credit Load Ph.D. in Veterinary Anatomy

Course Code	Course Title	Credit Hours
ANA 701	Myology, angiology, neurology and aesthesiology of equine, canine and porcine	2+1
ANA 702	Principles and applications of biomechanics	1+0
ANA 703	Avian anatomy*	1+1
ANA 704	Neuroanatomy*	2+1
ANA 705	Comparative endocrine anatomy	1+1
ANA 706	Theory and applications of electronmicroscopy	1+1
ANA 707	Histoenzymology and immunocytochemistry	2+1
ANA 708	Applied embryology and teratology	1+1
ANA 709	Functional veterinary anatomy	1+0
ANA 710	Gross anatomy of laboratory animals	1+1
ANA 711	Cross sectional anatomy of ox*	0+1
ANA 712	Animal alternatives in veterinary anatomy	1+1
ANA 713	Special problem	0+2
ANA 714	Doctoral seminar- I	1+0
ANA 715	Doctoral seminar- II	1+0
ANA 716	Doctoral research	0+75

*Compulsory Major course for Doctorate programme..



Course Contents

Ph.D. in Veterinary Anatomy

- I. Course Title** : **Myology, Angiology, Neurology And Aesthesiology Of Equine, Canine And Porcine**
- II. Course Code** : **ANA 701**
- III. Credit Hours** : **2+1**

IV. Aim of the course

To teach students about anatomy of muscles, blood vessels, nervous tissue and sense organs in equine, canine and porcine.

V. Theory

Unit I

Comparative study of myology of horse, dog and pig.

Unit II

Comparative study of angiology of horse, dog and pig.

Unit III

Comparative study of neurology of horse, dog and pig.

Unit IV

Comparative study of aesthesiology of horse, dog and pig.

VI. Practical

Dissection of different body regions with respect to muscles, blood vessels and nerves; and see the topographic positioning of different organs in different body cavities in equine, canine and porcine.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Comparative study of muscles of head and neck of horse, dog and pig	2
2.	Comparative study of muscles of forelimb: shoulder and arm	1
3.	Comparative study of extensor and flexors of forelimb	1
5.	Comparative study of muscles of abdomen	1
7.	Comparative study of muscles of pelvic region, hind limb and tail	2
8.	Comparative study of topography and structure of heart, blood supply to heart	2
9.	Study of arterial supply to head and neck	2
10.	Comparative study of blood supply to the forelimb	1
11.	Study of the collateral and terminal branches of aorta	2
12.	Comparative study of blood supply to the hind limb	2
13.	Comparative study of venous system	1
14.	Study the lymphatic system	1
15.	Comparative study of brain and spinal cord	2



16. Study of cranial nerves

2



S. No.	Topic	No. of Lectures/ Practicals
17.	Study of brachial plexus and its branches	1
18.	Study of cervical, thoracic and lumbar nerves	1
19.	Comparative study of lumbo-sacral plexus	2
20.	Comparative study of eye	1
21.	Comparative study of ear	1
22.	Comparative study of hoof	1
23.	Comparative study of gustatory and olfactory organs	1
	Total	32
Practical		
1.	Comparative study of muscles of head and neck of horse, dog and pig	1
2.	Comparative study of muscles of forelimb: shoulder, arm extensors and flexors	1
3.	Comparative study of muscles of abdomen	1
4.	Comparative study of muscles of pelvic region, hind limb and tail	1
5.	Comparative study of topography and structure of heart, blood supply to heart	1
6.	Study of arterial supply to head and neck	1
7.	Comparative study of blood supply to the forelimb	1
8.	Study of the collateral and terminal branches of aorta	1
9.	Comparative study of blood supply to the hind limb	1
10.	Comparative study of venous and lymphatic system	1
11.	Comparative study of brain and spinal cord	1
12.	Study of cranial nerves	1
13.	Study of brachial plexus and its branches	1
14.	Study of cervical, thoracic and lumbar nerves	1
15.	Comparative study of lumbo-sacral plexus	1
16.	Comparative study of eye and ear	1
17.	Comparative study of hoof	1
18.	Comparative study of gustatory and olfactory organs	1
	Total	18

I. Course Title : Principles and Applications of Biomechanics

II. Course Code : ANA 702

III. Credit Hours : 1+0

IV. Aim of the course

To sensitize the student about the importance of biomechanics.

V. Theory

Unit I

Biomechanics, its definition and scope with reference to anatomy and physiology of domestic animals and musculo-skeletal dynamics.

Unit II

Locomotion and clinical applications. Biomechanics of cortical and trabecular bones.

Unit III



Biomechanics of fracture fixation. Instrumentation and techniques in locomotion and their applications in lameness.



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S. No.	Topic	No. of Lectures
Theory		
1.	Definition of Biomechanics and its classification.	1
2.	Scope Biomechanics of with reference to anatomy and physiology of domestic animals	1
3.	Musculo-skeletal dynamics	2
4.	Locomotion and its type in domestic animals	2
5.	Instrumentation and techniques in locomotion and their applications in lameness.	2
6.	Biomechanics of microscopic structures	1
7.	Polariscope, its principle and application	2
8.	Biomechanics of cortical and trabecular bones.	1
9.	Biomechanics of articular cartilages	2
10.	Biomechanics of mammalian body; bow and string theory	2
11.	Biomechanics of fracture fixation	1
12.	Biomechanics of heart	1
	Total	18

I. Course Title : Avian Anatomy

II. Course Code : ANA 703

III. Credit Hours : 1+1

IV. Aim of the course

To give detailed overview of poultry anatomy.

V. Theory

Unit I

The study of the gross features of different body systems of domestic fowl.

Unit II

The study of microscopic features of different body systems of domestic fowl.

VI. Practical

Dissection and demonstration of various body systems of fowl and different domestic birds. Microscopic examination of slides of various organ systems of fowl.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	The study of gross features of axial and appendicular skeleton of domestic fowl	1
2	Study of various joints of axial and appendicular skeleton of domestic fowl	2
3	Gross and microscopic study of muscular system of domestic fowl	1
4	Gross and microscopic study of digestive system of domestic fowl.	2
5	Gross and microscopic study of respiratory organs of domestic fowl.	1
6	Gross and microscopic study of urinary organs of domestic fowl.	1
7	Gross and microscopic study of reproductive system of domestic fowl.	1
8	Study of the blood of domestic fowl.	2
9	Gross and microscopic study of circulatory system of domestic fowl.	1
10	Gross and microscopic study of nervous system of domestic fowl.	1



S. No.	Topic	No. of Lectures/ Practicals
11	Gross and microscopic study of eye and its appendages of domestic fowl.	1
12	Gross and microscopic study of ear of domestic fowl.	1
13	Gross and microscopic study of skin and its appendages of domestic fowl.	1
14	Gross and microscopic study of lymphoid organ of domestic fowl.	1
15	Gross and microscopic study of endocrine system of domestic fowl.	1
	Total	18
Practical		
1	The study of gross features of axial and appendicular skeleton of domestic fowl and turkey	1
2	Study of various joints of axial and appendicular skeleton of domestic fowl	2
3	Gross and microscopic study of muscular system of domestic fowl	1
4	Gross and microscopic study of digestive system of domestic fowl.	2
5	Gross and microscopic study of respiratory organs of domestic fowl.	1
6	Gross and microscopic study of urinary organs of domestic fowl.	1
7	Gross and microscopic study of reproductive system of domestic fowl.	1
8	Study of the blood of domestic fowl.	2
9	Gross and microscopic study of circulatory system of domestic fowl.	1
10	Gross and microscopic study of nervous system of domestic fowl.	1
11	Gross and microscopic study of eye and its appendages of domestic fowl.	1
12	Gross and microscopic study of ear of domestic fowl.	1
13	Gross and microscopic study of skin and its appendages of domestic fowl.	1
14	Gross and microscopic study of lymphoid organ of domestic fowl.	1
15	Gross and microscopic study of endocrine system of domestic fowl.	1
	Total	18

I. Course Title : Neuroanatomy

II. Course Code : ANA 704

III. Credit Hours : 2+1

IV. Aim of the course

To provide in-depth knowledge of nervous system.

V. Theory

Unit I

The gross and microscopic anatomy of the brain and spinal cord.

Unit II

Study of various cranial and spinal nerves along with their associated nuclei and ganglia.

Unit III

Motor and sensory pathways, different ascending and descending tracts of brain and spinal cord and autonomic nervous system.

VI. Practical

Gross dissection and microscopic examination of the brain and spinal cord; demonstration of the nerves, nerve plexuses, ganglia of cranial importance, study of the serial sections of the brain and spinal cord in domestic animals.



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S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	The gross and microscopic study of anatomy of brain, limbic system, reticular formation, lemniscal system, pyramidal system, extrapyramidal system	5
2.	Study of cranial nerves along with their associated nuclei and ganglia	5
3.	The gross and microscopic study of spinal cord including tracts and pathways	4
4.	Study of spinal nerves along with their associated nuclei and ganglia	4
5.	Hypothalamo-hypophysial system	4
6.	Brachial plexus	3
7.	Lumbo-sacral plexus	3
8.	Study of autonomic nervous system	5
	Total	33
Practical		
1.	The gross and microscopic study of anatomy of brain, limbic system, reticular formation, lemniscal system, pyramidal system, extrapyramidal system	2
2.	Study of cranial nerves along with their associated nuclei and ganglia	2
3.	The gross and microscopic study of Spinal cord including tracts and pathways	2
4.	Study of spinal nerves along with their associated nuclei and ganglia	2
5.	Hypothalamo-hypophysial system	2
6.	Brachial plexus	2
7.	Lumbo-sacral plexus	2
8.	Nerve blocks	2
9.	Study of autonomic nervous system	2
	Total	18

I. Course Title : Comparative Endocrine Anatomy

II. Course Code : ANA 705

III. Credit Hours : 1+1

IV. Aim of the course

To project the importance and details of endocrine glands.

V. Theory

Unit I

Advanced gross and microscopic anatomy of the pituitary gland.

Unit II

Advanced gross and microscopic anatomy of the thyroid, parathyroid and thymus.

Unit III

Advanced gross and microscopic anatomy of the adrenal gland, islets of Langerhans, corpus luteum, Leydig cells, pineal body and other tissues associated with endocrine secretions

VI. Practical

Demonstration of the topographic anatomy in the embalmed specimens and microscopic examination of the endocrine glands of ruminants.



S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction and general characteristics of endocrine gland	2
2.	Gross, microscopic and ultra structural study of Pituitary gland	1
3.	Gross, microscopic and ultra structural study of thyroid gland	1
4.	Gross, microscopic and ultra structural study of parathyroid gland	2
5.	Gross, microscopic and ultra structural study of thymus	2
6.	Gross, microscopic and ultra structural study of adrenal gland	1
7.	Gross, microscopic and ultra structural study of hypothalamus and Pineal	1
8.	Microscopic and ultra structural study of islets of Langerhans	2
9.	Gross, microscopic and ultra structural study of endocrine glands of male reproductive system	1
10.	Gross, microscopic and ultra structural study of endocrine glands of female reproductive system including corpus luteum	2
11.	Study of paraganglia, diffused endocrine system cells, endocrine cells of heart and kidney	2
12.	Advances in gross and microscopic anatomy of endocrine glands of gastro-intestinal tract	1
	Total	18
Practical		
1.	Introduction and general characteristics of endocrine gland	1
2.	Gross, microscopic and ultra structural study of Pituitary gland	2
3.	Gross, microscopic and ultra structural study of thyroid gland	1
4.	Gross, microscopic and ultra structural study of parathyroid gland	1
5.	Gross, microscopic and ultra structural study of thymus	1
6.	Gross, microscopic and ultra structural study of adrenal gland	1
7.	Gross, microscopic and ultra structural study of hypothalamus and Pineal	2
8.	Microscopic and ultra structural study of islets of Langerhans	1
9.	Gross, microscopic and ultra structural study of endocrine glands of male reproductive system	2
10.	Gross, microscopic and ultra structural study of endocrine glands of female reproductive system including corpus luteum	2
11.	Study of paraganglia, diffused endocrine system cells, endocrine cells of heart and kidney	2
12.	Advances in gross and microscopic anatomy of endocrine glands of gastro-intestinal tract	2
	Total	18

I. Course Title : Theory and Applications of Electron Microscope

II. Course Code : ANA 706

III. Credit Hours : 1+1

IV. Aim of the course

To give an overview of the electron microscope.

V. Theory

Unit I

Introduction and principles of electron microscopy.

Unit II



Methods for transmission

electron microscopy.

**Unit III**

Methods for scanning electron microscopy.

VI. Practical

Preparation of blocks and demonstration of various techniques used for carrying out TEM and SEM.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction of the electron microscope	1
2.	Principles of transmission electron microscopy	1
4.	Collection and fixation of samples for electron microscopy, various fixatives used in electron microscopy	2
5.	Principles of scanning electron microscopy and processing of samples for transmission electron microscopy	1
6.	Processing of samples for scanning electron microscopy	1
9.	Ultramicrotomy (semithin and ultra thin sections)	1
10.	Coating of grids with supportive films	1
11.	Staining of semi thin and ultra thin sections	1
12.	Negative staining	1
13.	Applications of scanning and transmission electron microscopy	1
14.	Cryo-electron microscopy	1
15.	Immuno electron microscopy	1
16.	Strategies in immunolabelling	1
17.	Applications in nano science	1
	Total	19
Practical		
1.	Collection of tissue samples for em	1
2.	Fixation of samples for electron microscopy	1
3.	Processing of samples for scanning electron microscopy	2
4.	Processing of samples for transmission electron microscopy	2
5.	Ultramicrotomy (semithin and ultra thin sections)	2
6.	Coating of grids with supportive films	2
7.	Staining of semi thin and ultra thin sections	1
8.	Negative staining	1
9.	Cryo-electron microscopy	2
10.	Immunolabelling	2
11.	Atomic force microscope	1
	Total	17

I. Course Title : Histoenzymology and Immunocytochemistry

II. Course Code : ANA 707

III. Credit Hours : 2+1

IV. Aim of the course

To give a student hands-on practice for various advanced histoenzymic and histochemical techniques.

V. Theory**Unit I**



Classification of enzymes –
methods.

Principles of enzymes histochemistry

**Unit II**

Substrates –combination–coupling azo-dye methods –capture reagents.

Unit III

Localization of enzymes and controls in enzyme histochemistry.

Unit IV

Fluorescence microscopy in enzyme histochemistry. Principles and techniques of immunohistochemistry.

VI. Practical

Preparation of fixatives and buffers used in histochemistry. Methods of preparations and microscopical examination of routine and special preparations showing different cell organelles and inclusions. Methods for tryptophan-SS, SH groups; Glycogen-glycoproteins; Mucopolysaccharides and lipids. Methods and identification of alkaline and acid phosphatases-succinic dehydrogenase, cytochrome-oxidase, choline-esterase, catecholamines by fluorescence microscopy. Immunohistochemistry-principles and techniques.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Classification of enzymes	3
2.	Principles of enzyme histochemistry methods	3
3.	Substrate and coenzymes	2
4.	Different methods of enzyme study	3
5.	Hydrolytic enzyme histochemistry	2
6.	Alkaline and acid phosphatase	2
7.	Oxidases and peroxidases	2
8.	Diaphorases and dehydrogenases	2
9.	Peptidases	2
10.	Fluorescence microscopy	2
11.	Principles of immunohistochemistry	3
12.	Techniques in immunohistochemistry	3
13.	Study of part different parts of cryotome and their functions	3
	Total	32
Practical		
1.	Preparation of fixatives and buffers	3
2.	Demonstration of alkaline and acid phosphatase	2
3.	Demonstration of succinic dehydrogenase	2
4.	Demonstration of cytochrome oxidase	2
5.	Localization of diaphorases and choline esterase	2
6.	Fluorescence microscopy	2
7.	Principles and techniques in immunohistochemistry	3
	Total	16

- I. Course Title : Applied Embryology and Teratology**
II. Course Code : ANA 708
III. Credit Hours : 1+1
IV. Aim of the course



To apprise the students about the

current trends in developmental processes.



V. Theory

Unit I

Principles of experimental embryology and teratology.

Unit II

Factors affecting the developmental mechanisms of embryo.

Unit III

Use of organizers implants, chemical and hormonal preparations in the developmental models and available literature on teratogenic experimentation.

VI. Practical

Collection and study of various teratological specimens from domestic animals. Class discussions on experimental models and available literature on teratogenic experimentation. To apprise the students about the current trends in developmental processes.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to embryology and teratology.	1
2.	Principles of experimental embryology and teratology.	2
3.	Factors affecting the developmental mechanisms of embryo.	2
4.	Developmental anomalies of cardiovascular system	2
5.	Immunodeficiency and inherited defects in natural immunity	1
6.	Developmental anomalies of brain and spinal cord	2
7.	Developmental anomalies of skeletal system	1
8.	Developmental anomalies of digestive system	2
9.	Developmental anomalies of urinary system	1
10.	Developmental anomalies of male and female reproductive system	1
11.	Congenital malformations of face and oral cavity	1
12.	Congenital and inherited defects of skin	1
13.	Genetic, chromosomal and environmental factors adversely affecting prenatal development	1
	Total	18
Practical		
1.	Discussion on principles and factors affecting developmental embryology and teratology in the available literature.	2
2.	Study on different teratological models/ specimens of cardiovascular system	2
3.	Immunodeficiency and inherited defects in natural immunity	1
4.	Study on different teratological models/ specimens of brain and spinal cord	2
5.	Study on different teratological models/ specimens of skeletal system	1
6.	Study on different teratological models/ specimens of digestive system	2
7.	Study on different teratological models/ specimens of urinary system	1
8.	Study on different teratological models/ specimens of male and female reproductive system	2
9.	Congenital malformations of face and oral cavity	1
10.	Congenital and inherited defects of skin	1
11.	Study on mutations and chromosomal abnormalities	1
12.	Study of teratogenic agents	1
13.	Assessing the aetiology of different congenital diseases	1
	Total	18



- I. Course Title : Functional Veterinary Anatomy**
II. Course Code : ANA 709
III. Credit Hours : 1+0

IV. Aim of the course

To make the student understand the functional anatomy of various organs/ systems in relation to structure.

V. Theory

Unit I

The relationship of structure to form and function.

Unit II

The relationship of structure for adaptation and behaviour.

Unit III

Relationship of structure in relation to clinical conditions/ applications.

S. No.	Topic	No. of Lectures
Theory		
1.	Introduction to functional anatomy	1
2.	Tissue organization and function	1
3.	Functional anatomy of digestive system: mouth cavity, tongue, salivary gland, esophagus and stomach including mastication, regurgitation	2
4.	Functional anatomy of digestive system: small intestine, large intestine, liver, gall bladder and pancreas	2
5.	Study of functional anatomy of respiratory system	1
6.	Functional anatomy of urinary system	1
7.	Functional anatomy of reproductive system	1
8.	Functional anatomy of mammary gland	1
9.	Functional anatomy of cardiovascular system	1
10.	Functional anatomy of central nervous system	1
11.	Functional anatomy of peripheral and autonomic nervous system	1
12.	Functional anatomy of special senses (vision, hearing)	1
13.	Functional anatomy of skeleton system including synovial fluid	1
14.	Functional anatomy of muscular system	1
15.	Functional anatomy of endocrine system	1
16.	Functional anatomy of integumentary system	1
	Total	18

- I. Course Title : Gross Anatomy of Laboratory Animals**
II. Course Code : ANA 710
III. Credit Hours : 1+1

IV. Aim of the course

To give an overview of different body systems of laboratory animals.

V. Theory

Unit I

Study of different organs of digestive system of different laboratory animals.



Unit II

Detailed study of urinary, male and female reproductive systems of different laboratory animals.

Unit III

Complete study of respiratory system of different laboratory animals.

Unit IV

Study of organs of circulation and nervous system of different laboratory animals.

Unit V

Descriptive anatomy of endocrine glands of different laboratory animals.

VI. Practical

Demonstration of placement and relations of different organs in the body cavities of different laboratory animals.

S. No.Topic	No. of Lectures/ Practicals
Theory	
1. An overview of skeleton of rabbit, guinea pig, mice and rat	1
2. Digestive system of rabbit and guinea pig	1
3. Digestive system of mice and rat	1
4. Respiratory system of rabbit and guinea pig	1
5. Respiratory system of mice and rat	1
6. Urinary system of rabbit and guinea pig	1
7. Urinary system of mice and rat	1
8. Male reproductive system of rabbit and guinea pig	1
9. Male reproductive system of mice and rat	1
10. Female reproductive system of rabbit and guinea pig	1
11. Female reproductive system of mice and rat	1
12. Endocrine glands of rabbit and guinea pig	1
13. Endocrine glands of mice and rat	1
14. Circulatory system of rabbit and guinea pig	1
15. Circulatory system of mice and rat	1
16. Nervous system of rabbit and guinea pig	1
17. Nervous system of rat and mice	1
18. Lymphoid organs of laboratory animals	1
Total	18
Practical	
1. Study of skeleton of rabbit, guinea pig, mice and rat	1
2. Study of digestive system of rabbit and guinea pig	1
3. Study of digestive system of mice and rat	1
4. Study of respiratory system of rabbit and guinea pig	1
5. Study of respiratory system of mice and rat	1
6. Study of urinary system of rabbit and guinea pig	1
7. Study of urinary system of mice and rat	1
8. Study of male reproductive system of rabbit and guinea pig	1
9. Study of male reproductive system of mice and rat	1
10. Female reproductive system of rabbit and guinea pig	1
11. Study of female reproductive system of mice and rat	1
12. Study of endocrine glands of rabbit and guinea pig	1



13. Study of endocrine glands of

mice and rat



S. No.	Topic	No. of Lectures/ Practicals
14.	Study of circulatory system of rabbit, guinea pig, rat and mice	1
15.	Study of circulatory system of mice and rat	1
16.	Study of nervous system of rabbit and guinea pig	1
17.	Study of nervous system of rat and mice	1
18.	Lymphoid organs of laboratory animals	1
	Total	18

I. Course Title : Cross Sectional Anatomy of Ox

II. Course Code : ANA 711

III. Credit Hours : 0+1

IV. Aim of the course

To study Gross cross sectional profiles of various parts in ox

V. Practical

Demonstration and topographic anatomy of various structures and organs at different levels of cross sections of the body. Correlation of different structures in different cross sections.

S. No.	Topic	No. of Practicals
Practical		
1.	Cross sectional profile of head at the level of 4 th incisor and first cheek tooth	1
2.	Cross sectional profile of head at the level of third cheek tooth and 6 th cheek tooth	1
3.	Cross sectional profile of head at the level of orbit and external acoustic meatus	1
4.	Cross sectional profile of the neck at the level of upper third and middle third.	1
5.	Cross sectional profile of the neck at the level of lower third	1
6.	Cross sectional profile of the thoracic inlet.	1
7.	Cross sectional profile of the thorax at the level of 3 rd rib	1
8.	Cross sectional profile of the thorax at the level of 6 th rib and 12 th rib	1
9.	Cross sectional profile of the abdomen at the level of 2 nd lumbar and 5 th lumbar	1
10.	Cross sectional profile of the mid pelvis and tail.	1
11.	Cross sectional profile at the middle and lower level of the shoulder and middle level of the arm.	1
12.	Cross sectional profile at the proximal level of forearm, lower level of the forearm and mid level of metacarpus.	1
13.	Cross sectional profile at the mid level of the first phalanges and mid level of second phalanges	1
14.	Cross sectional profile at the upper and middle and lower levels of the thigh	1
15.	Cross sectional profile at the lower levels of the thigh	1
16.	Cross sectional profile at the upper and middle levels of the leg.	1
17.	Cross sectional profile at the lower level of the leg and mid level of metatarsus	1
	Total	17



- I. Course Title : Animal Alternatives in Veterinary Anatomy**
- II. Course Code : ANA 712**
- III. Credit Hours : 1+1**

IV. Aim of the course

Alternatives of animals in veterinary anatomy teaching to avoid usage of Animals.

V. Theory

Unit I

Introduction and ethical issues, scope, advantages and disadvantages of alternatives.

Unit II

Plastination, 2D and 3D Models.

Unit III

Taxidermy, computer simulations.

Unit IV

Maannequins, interactive multimedia.

Unit V

Museum specimen preparation.

VI. Practical

Techniques of Plastination, 2D and 3D Models, Taxidermy, computer simulations
Maannequins, interactive multimedia.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to animal alternatives	1
2.	Ethical issues on alternatives used	1
3.	Necessity of animal alternatives- advantages and disadvantages of alternatives	1
4.	Scope for animal alternatives	1
5.	Plastination, basic principles	1
6.	Methodology involved in plastination	1
7.	Types of plastination- advantages, disadvantages of plastination	1
8.	Three-D, Two-D models as alternatives in veterinary anatomy: advantages/ disadvantages of models used	1
9.	Drawings, Charts, Power points as self explanatory alternatives in Veterinary anatomy-An overview	1
10.	Taxidermy in veterinary anatomy-methodology involved-limitations	1
11.	Computer simulation-screen based simulations	1
12.	Virtual lab.-E-learning as alternatives	1
13.	Interactive digital tool-multimedia and Videos as effective audio visual tools- benefits and weakness of digital alternatives	1
14.	Mannequins as alternatives in veterinary anatomy, advantages and disadvantages -scope for mannequins in veterinary anatomy	1
15.	Museum specimen preparation	1
16.	Procedures involved in museum preservation- advantages and disadvantages involved in museum specimens	1
	Total	16



S. No.	Topic	No. of Lectures/ Practicals
Practical		
1	Methodology involved in plastination and preparation of plastinated specimens	3
2	Three-D, Two-D Models as alternatives in veterinary anatomy	2
3	Methodology involved taxidermy -preparation of specimens	2
4	Computer Simulation-screen based simulations	2
5	Virtual lab -E-learning as alternatives	2
6	Interactive digital tool-multimedia and Videos	1
7	Mannequins as alternatives in veterinary anatomy	2
8	Museum specimen preparation	2
	Total	16

I. Course Title : Special Problem

II. Course Code : ANA 713

III. Credit Hours : 0+2

IV. Aim of the course

To provide expertise in handling practical research problem(s).

V. Practical

S. No.	Topic	No. of Practical
1.	Short research problem(s) involving contemporary issues and research techniques.	32

VI. Recommended list of Books

Gross Anatomy

- Dyce KM, Sack WO and Wensing CJG. 1996. *Text Book of Veterinary Anatomy*. W.B. Saunders Co.
- Konig HE and Liebich HG. 2004. *Veterinary Anatomy of Domestic Animals: Textbook and Colour Atlas*. 1stedn., Stuttgart, Schattauer Co., Germany.
- Nickel R, Schummer A, Seiferle E, Freewin J and Wills KH. 1986. *The Locomotor System of Domestic Mammals*. Verlag Paul Parey.
- Schummer A, Nickel R and Sack WO. 1979. *The Viscera of the Domestic Mammals*. Verlag Paul Parey.
- Seiferle E. 1975. *Nervous System, Sensory Organs, Endocrine Glands of Domestic Mammals*. Verlag Paul Parey.
- Sisson S and Grossman JD. 1975. *The Anatomy of the Domestic Animals*. Vols. I, II. W.B. Saunders Co.

Histology

- Banks WJ. 1993. *Applied Veterinary Histology*. Mosby Year Book, USA.
- Dellmann HD. 1993. *Textbook of Histology*. Lea and Febiger, USA.
- DiFiore MS, Mancini R and Derbertis EDP. 2006. *New Atlas of Histology*. Williams and Wilkins, Lippincott, USA.
- Eurell JA and Frappier BL. 2006. *Dellmann's Textbook of Veterinary Histology*. 6thedn., Blackwell Publishing, Ames, Iowa, USA.
- Greep RO. 1977. *Histology*. McGraw-Hill Book Co., New York, USA.



- Ham AW and Cormack DH. 1979. *Histology*. J.B. Lippincott, Philadelphia, USA.
- Stinson AW and Calhoun ML. 1993. *Text book of Veterinary Histology*. 4th edn., Lea and Febiger, Philadelphia, USA.

Embryology

- Arey LB 1965. *Developmental Anatomy*. W.B. Saunders.
- Freeman WH and Brace Girdle B. 1967. *Atlas of Embryology*. Heilemann Edu. Books Ltd.
- Langman J. 1976. *Medical Embryology*. William and Wilkin, Lippincott, USA.
- Latshaw WK. 1984. *Veterinary Developmental Anatomy; A Clinically Oriented Approach*. B.C. Decker Inc., Philadelphia, USA.
- Patten BM. 1985. *Foundation of Embryology*. Tata McGraw-Hill Book Co., USA.
- Patten BM. 2014. *Foundation of Embryology*. 6th edn., Tata McGraw-Hill Education, India.
- Tuchmann-Duplessis, MH David G, and Haegel P. 1972. *Illustrated Human Embryology*. Vol. I, II. Embryogenesis. Springer Verlag, USA.

Anatomical Techniques

- Durry RAB and Wallington EA. 1967. *Carleton's Histological Techniques*. Oxford University Press, London.
- Luna LG 1968. *Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology*. McGraw-Hill Book Co., USA.
- Pearse AGE. 1968. *Histochemistry-Theoretical and Applied*. 3rd edn., Vol. I, Churchill Livingstone, London.
- Tompsett DH and Wakeley SC. 1956. *Anatomical Techniques*. E. and W. Living Stone, London.
- Bancroft JD and Stevens A. 1977. *Theory and Practice of Histological Techniques*. Churchill Livingstone.
- Thomson SW and Hunt RD. 1968. *Selected Histochemical and Histopathological Methods*. Charles C. Thomas Publication, Springfield, Illinois, USA.

List of Journals

- *Acta Anatomica*
- *American Journal of Anatomy*
- *Anatomia Histologia and Embryologia*
- *Anatomical Record*
- *Anatomy and Embryology*
- *Indian Journal of Veterinary Anatomy*
- *Journal of Anatomy*

e-Resources

- <http://www.interscience.wiley.com/journal/117927935/grouphome/home>. (American Journal of Anatomy)
- <http://www.ovid.com/site/catalog/Journal/1057.jsp> (Journal of Anatomy)
- <http://www.interscience.wiley.com/jpages/0003-276X/>(Anatomical Record)
- <http://www.blackwellpublishing.com/submit.asp> (Anatomia Histologia and Embryologia)



SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Basic Veterinary Sciences

– Veterinary Biochemistry





Preamble

(Veterinary Biochemistry)

At Masters level in Veterinary Biochemistry new courses, Biophysical Chemistry, Analytical Techniques and Instrumentation in Biochemistry, Intermediary Metabolism and Regulation, Molecular Biochemistry, Biochemistry of Ruminants and Wild Animals and Introduction to Bioinformatics and Computational Biology are introduced. Similarly at Doctorate level new courses, Applied Molecular Biochemistry and Systems Biology, Diagnostic Techniques in Clinical Biochemistry, Bioinformatic Tools in Biochemistry, Environmental and Toxicological Biochemistry, Biochemistry of Diseases and Disorders and Immuno-Biochemistry are introduced keeping latest trends and requirements in mind.



Course Title with Credit Load M.V.Sc. in Veterinary Biochemistry

Course Code	Course Title	Credit Hours
BCT 601	Biophysical Chemistry	2 + 0
BCT 602	Biochemistry of Biomolecules*	2 + 0
BCT 603	Enzymology*	2 + 1
BCT 604	Analytical Techniques and Instrumentation in Biochemistry*	1 + 1
BCT 605	Clinical Biochemistry of Animals*	2 + 1
BCT 606	Intermediary Metabolism and Regulation*	3 + 0
BCT 607	Molecular Biochemistry*	2 + 1
BCT 608	Nutritional and Industrial Biochemistry	2 + 0
BCT 609	Endocrinology and Reproductive Biochemistry*	2 + 0
BCT 610	Biochemistry of Ruminants and Wild Animals	1 + 1
BCT 611	Introduction to Bioinformatics and Computational Biology	1 + 1
BCT 612	Master's Seminar	1 + 0
BCT 613	Master's Research	0 + 30

*Core courses



Course Contents

M.V.Sc. in Veterinary Biochemistry

- I. Course Title** : **Biophysical Chemistry**
II. Course Code : **BCT 601**
III. Credit Hours : **2 + 0**

IV. Aim of the course

Teaching of principles of physical chemistry as applicable to veterinary sciences.

V. Theory

Unit I

Physical properties of water-the medium of life, Acids and bases, ionic strength and activity, Henderson-Hasselbach equation, pH, indicators and buffers, Colloids and their properties, Mechanism of osmosis, osmotic pressure, Donnan membrane equilibrium, Viscosity, surface tension, surface forces, Adsorption and light scattering, Membrane filtration, dialysis, diffusion coefficient and partial specific volume.

Unit II

Laws of thermodynamics, Concepts of enthalpy, free energy and entropy in biochemical reactions. High energy compounds, Redox potential and free energy changes, Bioenergetics and biological oxidation, Components of mitochondrial electron transport chain. Formation of ATP and ATP cycle. Energy transformation in living cells.

Unit III

Basic Methods in Biophysical Chemistry: Basic Optical Principles, Optical Properties of Biomolecules, Optical spectroscopy, Basic Fluorescence Techniques, Chiroptical and Scattering Methods; Conventional and Confocal Fluorescence Microscopy, Basics of Super-Resolution Fluorescence Microscopy, Fluorescence spectroscopy, Patch Clamping.

VI. Suggested Reading

- David L Nelson and Cox Michael M. 2008. *Lehninger's Principles of Biochemistry*. 5th Ed. Freeman.
- James P Allen. 2008. *Biophysical Chemistry*. 1st Ed. Wiley-Blackwell Publication.
- Peter Jomo Walla. 2014. *Modern Biophysical Chemistry: Detection and Analysis of Biomolecules*. 2nd Ed. Wiley-VCH Publication.

Course Outline

S. No.	Topic	No. of Lectures
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Theory

1. Physical properties of water-the medium of life, Acids and bases,



- ionic strength and activity 2
2. Henderson-Hasselbach equation, pH, indicators and buffers 2



S. No.	Topic	No. of Lectures
3.	Colloids and their properties, Mechanism of osmosis, osmotic pressure, Donnan membrane equilibrium, Viscosity, surface tension, surface forces, Adsorption and light scattering	3
4.	Membrane filtration, dialysis, diffusion coefficient and partial specific volume.	2
5.	Laws of thermodynamics, Concepts of enthalpy, free energy and entropy in biochemical reactions, High energy compounds, Redox potential and free energy changes	3
6.	Bioenergetics and biological oxidation, Components of mitochondrial electron transport chain. Formation of ATP and ATP cycle. Energy transformation in living cells	4
7.	Basic Methods in Biophysical Chemistry: Basic Optical Principles, Optical Properties of Biomolecules, Optical spectroscopy	4
8.	Basic Fluorescence Techniques	2
9.	Chiroptical and Scattering Methods	2
10.	Conventional and Confocal Fluorescence Microscopy	3
11.	Basics of Super-Resolution Fluorescence Microscopy	2
12.	Fluorescence spectroscopy.	2
13.	Patch Clamping	1
	Total	32

I. Course Title : Biochemistry of Biomolecules

II. Course Code : BCT 602

III. Credit Hours : 2 + 0

IV. Aim of the course

Teaching molecular basis of structure and functional aspects of carbohydrates, lipids, amino acids and nucleic acids.

V. Theory

Unit I

Carbohydrates: Structure and biological significance of important monosaccharides: Ribose, Glucose, Fructose, Galactose, Mannose and Amino Sugars; Chemical reactions of monosaccharides; Isomerism of carbohydrates; Structure and biological significance of Disaccharides (Maltose, Isomaltose, Lactose, Sucrose and Cellobiose); Structure and biological significance of polysaccharides (Starch, Dextrins, Dextrans, Glycogen, Cellulose, Inulin, Chitin), and Mucopolysaccharides including Blood group substances and Bacterial cell wall polysaccharides. Glycoconjugates in cell surface, extra cellular matrix, sugar code functions, peptidoglycan-specific antibiotics; Basic principles of separation, purification and characterization of carbohydrates; Methods of structural analysis of carbohydrates.

Unit II

Lipids: Definition, Classification, Properties and Biological significance of simple, compound and derived lipids; Fat indices; Structure and functions of prostaglandins, steroids, steroid hormones and fat soluble vitamins. Basic principles of extraction and analysis of lipids; Lipid bilayers, lipid motility, integral membrane proteins, lipid linked proteins, peripheral membrane proteins, fluid mosaic model, membrane



skeleton, lipid asymmetry, cardiac glycosides, abnormalities in cell membrane fluidity, signaling biomolecules.

Unit III

Proteins: Amino acids - Structure and classification. Physical and chemical properties of amino acids - amphoteric nature, acid-base property, optical activity and peptide bond formation; Structure and geometry of peptide bond. Chemical synthesis of polypeptide and Oligopeptides of biological significance; Classification of proteins; Structure – primary, secondary, tertiary and quaternary; Physico-chemical, acid-base and colloidal properties of proteins; Biological significance of proteins; Denaturation, extraction and purification criteria for proteins.

Unit IV

Nucleic acids: Chemistry of purines, pyrimidines, nucleosides and nucleotides. Biological significance of nucleosides and nucleotides. Structures and functions of Watson-crick model of deoxyribonucleic acid (DNA) and a typical ribonucleic acid (RNA). Different types of DNA, acid-base properties, sedimentation behaviour, hyperchromic effect, melting of DNA, Chemical and enzymatic hydrolysis of nucleic acids. Base sequence analysis of DNA, Nucleic acid- protein interaction - histone and non-histone proteins.

VI. Suggested reading

- David L Nelson and Cox Michael M. 2017. *Lehninger's Principles of Biochemistry*. 7th Ed. Freeman.
- Voet D, Voet JG and Pratt CW. 2016. *Fundamentals of Biochemistry of Life at the Molecular Level*. 5th Ed. John Wiley and Sons.
- Berg JM, Tymoczko JL, Stryer L and Clarke ND 2015. *Biochemistry*. 8th Ed. WH Freeman and Co.
- Zubay GL. 1998. *Biochemistry*. 4th Ed. WCB London.

Course Outline

S. No.	Topic	No. of Lectures
Theory		
1	Carbohydrates: Structure and Biological Significance of Important Monosaccharides: Ribose, Glucose, Fructose, Galactose, Mannose and Amino Sugars;	1
2	Chemical reactions of monosaccharides; Isomerism of carbohydrates; Structure and Biological Significance of Disaccharides (Maltose, Isomaltose, Lactose, Sucrose and Cellobiose);	1
3	Structure and Biological Significance of Polysaccharides (Starch, Dextrins, Dextrans, Glycogen, Cellulose, Inulin, Chitin), and Mucopolysaccharides including Blood group substances and Bacterial Cell Wall polysaccharides;	1
4	Glycoconjugates in cell surface, extra cellular matrix, sugar code functions, peptidoglycan-specific antibiotics;	2
5	Basic principles of separation, purification and characterization of carbohydrates;	1
6	Methods of Structural analysis of carbohydrates.	1
7	Definition, Classification, Properties and Biological Significance of simple, compound and derived lipids;	1
8	Fat indices; Structure and functions of prostaglandins, steroids, steroid hormones and fat soluble vitamins;	2



S. No.	Topic	No. of Lectures
9	Basic principles of extraction and analysis of lipids;	1
10	Lipid bilayers, lipid motility, integral membrane proteins, lipid linked proteins, peripheral membrane proteins;	2
11	Fluid mosaic model, membrane skeleton, lipid asymmetry, cardiac glycosides, abnormalities in cell membrane fluidity, signaling biomolecules.	3
12	Amino acids – Structure and classification.	1
13	Physical and chemical properties of amino acids – amphoteric nature, acid-base property, optical activity and peptide bond formation.	1
14	Structure and geometry of peptide bond; Chemical synthesis of polypeptide; Oligopeptides of biological significance;	2
15	Classification of proteins; Structure – primary, secondary, tertiary and quaternary; Physico-chemical, acid-base and colloidal properties of proteins;	2
16	Biological significance of proteins; Denaturation, extraction and purification criteria for proteins.	1
17	Chemistry of purines, pyrimidines, nucleosides and nucleotides;	1
18	Biological significance of nucleosides and nucleotides;	1
19	Structures and functions of Watson-crick model of deoxyribonucleic acid (DNA) and a typical ribonucleic acid (RNA).	1
20	Different types of DNA, acid-base properties, sedimentation behaviour;	2
21	Hyperchromic effect, melting of DNA; Chemical and enzymatic hydrolysis of nucleic acids;	2
22	Base sequence analysis of DNA, Nucleic acid- protein interaction – histone and non-histone proteins.	2
	Total	32

I. Course Title : Enzymology

II. Course Code : BCT 603

III. Credit Hours : 2 + 1

IV. Aim of the course

To give thorough knowledge of molecular basis of enzyme action in relation to diagnostic importance.

V. Theory

Unit I

Introduction and historical perspective, Enzyme nomenclature and classification, enzyme compartmentalization in cell organelles, measurement of enzyme activity. ribozymes, isozymes, abzymes, restriction endonucleases.

Unit II

Enzyme structure, enzyme specificity, active site, active site mapping, mechanism of enzyme catalysis. cofactors, coenzymes- their structure and role.

Unit III

Enzyme kinetics, enzyme inhibition and activation, multienzyme complexes, allosteric enzymes and their kinetics, regulation of enzyme activity. qualitative description of “concerted” and “sequential” models for allosteric enzymes. Half site



reactivity, Flip-flop mechanism, positive and negative co-operativity. Monod Koshland Model.

Concept of ES complex, active site, specificity derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of K_m and V_{max} and their physiological significances. Importance of K_{cat}/K_m . Kinetics of zero and first order reactions. Significance and evaluation of energy of activation.

Unit IV

Isolation, purification and characterization of enzymes, Applications of enzymes in chemical and feed industry, enzyme immobilization, biosensors, clinical and diagnostic applications of enzymes.

VI. Practical

- Enzyme assay by taking any model enzyme like alpha-amylase or alkaline phosphatase.
- Isolation, purification and characterization of any model enzyme like B-galactosidase or acid phosphatase.
- Study of the effect of enzyme and substrate concentrations and determination of K_m and V_{max} .
- Determination of pH and temperature optima of alkaline phosphatase.
- To study the effect of various inhibitors of enzymatic activity.
- Determination of the pH and temperature stability of alkaline phosphatase.
- Assay of Diagnostic enzymes from Clinical samples.
- Application of enzymes in ELISA and Western Blotting

VII. Suggested Reading

- Bergmeyer HU. 1983. *Methods of Enzymatic Analysis*. Vol. II. Verlag Chemie, Academic Press.
- Dixon M, Webb EC, Thorne CJR and Tipton KF. 1979. *Enzymes*. 3rd Ed. Longman.
- Maragoni AG. 2003. *Enzyme Kinetics - A Modern Approach*. John Wiley.
- Palmer T. 2001. *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry*. 5th Ed. Horwood Publ.
- Price NC and Stevens L. 2003. *Fundamentals of Enzymology*. Oxford Univ. Press.
- Wilson K and Walker J. (Eds.). 2000. *Principles and Techniques of Practical Biochemistry*. 5th Ed. Cambridge Univ. Press.
- David L Nelson and Cox Michael M. 2008. *Lehninger's Principles of Biochemistry*. 5th Ed. Freeman.
- Kaneko JJ, Harvey JH and Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Introduction and historical perspective, Enzyme nomenclature and classification	2
2	Enzyme compartmentalization in cell organelles	1
3	Ribozymes, isozymes, abzymes, restriction endonucleases.	2
4	Enzyme structure	1
5	Enzyme specificity, active site, active site mapping,	2
6	Mechanism of enzyme catalysis.	2



S. No.	Topic	No. of Lectures/ Practicals
7	Cofactors, coenzymes- their structure and role.	2
8	Enzyme kinetics	1
9	Enzyme inhibition and activation	2
10	Multienzyme complexes, allosteric enzymes and their kinetics, regulation of enzyme activity.	2
11	Qualitative description of “concerted” and “sequential” models for allosteric enzymes. Half site reactivity, Flip-flop mechanism, positive and negative co-operativity. Monod Koshland Model.	3
12	Concept of ES complex, active site, specificity derivation of Michaelis-Menten equation for uni- substrate reactions.	2
13	Different plots for the determination of Km and Vmax and their physiological significances. Importance of Kcat/ Km.	2
14	Kinetics of zero and first order reactions. Significance and evaluation of energy of activation.	2
15	Isolation, purification and characterization of enzymes	2
16	Applications of enzymes in chemical and feed industry	2
17	Enzyme immobilization, biosensors, clinical and diagnostic applications of enzymes.	2
	Total	32
Practical		
1	Enzyme assay by taking any model enzyme like alpha-amylase or alkaline phosphatase.	1
2	Isolation, purification and characterization of any model enzyme like β -galactosidase or acid phosphatase.	3
3	Study of the effect of enzyme and substrate concentrations and determination of Km and Vmax.	2
4	Determination of pH and temperature optima of alkaline phosphatase.	2
5	To study the effect of various inhibitors of enzymatic activity.	2
6	Determination of the pH and temperature stability of alkaline phosphatase.	2
7	Assay of Diagnostic enzymes from Clinical samples.	1
8	Application of enzymes in ELISA and Western Blotting.	3
	Total	16

I. Course Title : Analytical Techniques and Instrumentation in Biochemistry

II. Course Code : BCT 604

III. Credit Hours : 1 + 1

IV. Aim of the course

To make students well versed with certain basic methodologies used in biochemistry to carry out independent research.

V. Theory

Unit I

Solutions and Buffers: Units of expression of concentration of solutions - Preparation of solutions - Preparation of Buffers - Henderson-Hasselbalch equation in the



preparation of buffers. Spectroscopy: Theory and applications of Colorimetry and Spectrophotometry; Major components of the following instruments and their functions: UV-Visible Spectrophotometer, Spectrofluorometer, Flame photometer, Atomic absorption spectrophotometer, Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES).

Unit II

Chromatographic Techniques: Basic principle and applications of Paper, Column and Thin layer chromatography including HPTLC; Factors affecting chromatographic resolution; Methods of preparation of biological samples for chromatographic analysis and common methods for qualitative and quantitative chromatography of amino acids, lipids and sugars including elution and densitometry. Molecular Sieving and its application in Biochemistry – General properties of dextran, acrylamide, agar and other media used for gel filtration. Principles and applications of chromatographic techniques, viz., ion-exchange, gel-filtration, affinity, hydrophobic interaction chromatography, metal chelate chromatography, planar chromatography, lateral flow immunochromatographic assays, Introduction to GLC and HPLC (Normal and Reverse Phase).

Unit III

Theory and applications of Electrophoresis: Factors affecting migration of charged particles – Moving boundary, paper and gel electrophoresis - Electrophoresis of amino acids, proteins and nucleic acids – Use of SDS PAGE in molecular weight determination. Isoelectric focusing and Isotachopheresis - Densitometry procedures and quantitative assays. Introduction to 2-D gel electrophoresis; Immuno-electrophoresis and other techniques like ELISA, RIA and Immuno-blotting.

Unit IV

Theory and applications of Centrifugation: Basic principle of sedimentation – Types, care and safety aspects of Centrifuges – Preparative centrifugation and Analytical centrifugation - Introduction to Ultracentrifugation - Fractionation of sub-cellular components - Density Gradient centrifugation – Determination of relative molecular mass.

N.B.: GLC and HPLC at length are to be discussed under BCT 705 (Ph.D. course); here only introduction.

VI. Practical

- Preparation of solutions and buffers; Solving problems using Henderson-Hasselbalch equation, pH, pKa and buffer concentration, normality; Verification of Beer's – Lambert's law; Estimation of glucose and total cholesterol in serum; Determination of absorption maxima and molar extinction coefficient of p-Nitrophenol from its absorption spectrum; Estimation of proteins using biuret, foilncioalteau methods and UV spectrophotometry; Estimation of enzyme activity by spectrophotometry (Kinetic mode).
- Separation of Lipids/ amino acids using paper chromatography and TLC; Fractionation of proteins by ammonium sulphate precipitation and desalting by dialysis; Separation of proteins using Ion-exchange chromatography, affinity chromatography and gel-filtration chromatography; Demonstration of separation of fatty acid methyl esters using GLC.



- Electrophoretic analysis of albumin using non-denaturing and denaturing conditions – Detection of molecular weight of protein by SDS-PAGE - Characterization of immunoglobulins by PAGE - Demonstration of sub-cellular fractionation by centrifugation.

VII. Suggested Reading

- David L Nelson and Cox Michael M. 2017. *Lehninger's Principles of Biochemistry*. 7th Ed. Freeman.
- Wilson K and Walker J. (Eds.). 2010. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th Ed. Cambridge Univ. Press.
- Willard *et al.* 1988. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Pub Co.
- Garrity S. 1999. *Experimental Biochemistry*. 3rd Ed. Academic Press.
- Gowenlock AH. 2002. *Varley's Practical Clinical Biochemistry*. 6th Ed. CBS.
- Holme DJ and Hazel P. 1998. *Analytical Biochemistry*. 3rd Ed. Longman.
- George W. Latimer, Jr. 2016. *Official Methods of Analysis of AOAC International*, 20th Ed. AOAC International.
- Carl A. Burtis, Edward R. Ashwood and David E. Burns, 2014. *Tietz Textbook of clinical Biochemistry and Molecular Diagnostics*. 5th Edition. Elsevier

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Concentration of Solutions and units of expression, preparation of solutions and buffers, Henderson-Hasselbalch equation and its significance in preparation of buffers	1
2	Introduction to Spectroscopy and Principle of Colorimetry and Spectrophotometry, basic components, principle and applications of UV-Visible Spectrophotometer, Reflectance Spectrophotometer and Spectro-fluorometer	1
3	Basic components, principle and applications of Flame photometer and Atomic Absorption Spectrophotometer	1
4	Basic components, principle and applications of Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES)	1
5	Introduction to Chromatography – Principle, types and applications; Theory, components and applications of Paper Chromatography, TLC and HPTLC	1
6	Theory, components and applications of Column Chromatography, factors affecting chromatographic resolution and methods of preparation of biological samples for chromatographic analysis	1
7	Methods for qualitative and quantitative chromatography of amino acids, lipids and sugars including elution and densitometry	1
8	Molecular sieving and its application in biochemistry, general properties of dextran, acrylamide, agar and other media used for gel filtration	1
9	Principles and applications of ion-exchange, gel-filtration, hydrophobic interaction, planar chromatography and lateral flow immuno-chromatographic assays	1
10	Introduction to GLC and HPLC (Normal and Reversed Phase)	1
11	Introduction to Electrophoresis - Principle, types and applications, factors affecting migration of charged particles	1
12	Principle and applications of Moving boundary, paper and gel electrophoresis, Common methods for electrophoresis of amino acids,	



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S. No.	Topic	No. of Lectures/ Practicals
	proteins and nucleic acids with the components of electrophoretic apparatus	1
13	Use of SDS-PAGE in molecular weight determination, Isoelectric focusing, Isotachopheresis, densitometry procedures and quantitative assays applied to electrophoresis, introduction to Immuno-electrophoresis and 2-D gel electrophoresis	1
14	ELISA, RIA and Immuno-blotting	1
15	Basic principle of sedimentation – Types, care and safety aspects of Centrifuges – Preparative and Analytical; introduction to Ultracentrifugation and Fractionation of sub-cellular components	1
16	Density Gradient centrifugation and Determination of relative molecular mass	1
	Total	16
Practical		
1	Preparation of solutions and buffers – dil. Acids, bases, phosphate buffer, etc.	1
2	Problem solving based on Henderson-Hasselbalch equation	1
3	Verification of Beer-Lambert’s Law	1
4	Estimation of glucose and total cholesterol in serum	1
5	Determination of absorption maxima and molar extinction coefficient of p-Nitrophenol from its absorption spectrum	1
6	Estimation of proteins using biuret, foiln-cioalteau methods and UV spectrophotometry	1
7	Estimation of enzyme activity by spectrophotometry - kinetic mode	1
8	Separation of amino acids by TLC/ paper chromatography	1
9	Separation of proteins by Affinity chromatography	1
10	Separation of proteins by Ion-exchange chromatography	1
11	Separation of proteins by Gel filtration chromatography	1
12	Demonstration of GLC for separation of fatty acids	1
13	Electrophoretic analysis of albumin using non-denaturing and denaturing conditions	1
14	Detection of molecular weight of protein by SDS-PAGE	1
15	Salt fractionation, dialysis and PAGE of immunoglobulins	1
16	Demonstration of sub-cellular fractionation by Ultra Centrifugation	1
	Total	16

I. Course Title : Clinical Biochemistry of Animals

II. Course Code : BCT 605

III. Credit Hours : 2 + 1

IV. Aim of the course

To give a detailed overview of role of biomolecules in health and diseases and aid in diagnosis and prognosis of diseases in animals and poultry.

V. Theory

Unit I

Quality control and automation in clinical biochemistry. Disturbance in water, electrolytes and acid-base balance - electrolyte abnormalities - respiratory acidosis



and alkalosis - metabolic acidosis and alkalosis – compensation – biochemical tests for diagnosis.

Unit II

Disorders of Carbohydrate metabolism: Diabetes mellitus, hyperinsulemia, galactosemia, hypoglycaemia, Glycogen storage disease and glycosylated proteins. Carbohydrate and protein balance for optimum rumen microflora. Ruminant ketosis – Ketosis associated with fasting, diabetes, pregnancy, lactation and post-exercise.

Unit III

Disorders of Lipid metabolism: Hypercholesterolemia, atherosclerosis, hyperlipidemia in canine, feline, equine – pathophysiology of ketonemia. Disorders of proteins, amino acids and nucleic acids metabolism: Normal and abnormal plasma proteins – Dysproteinemia – acute phase proteins – inborn errors of amino acid metabolism– Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia – defect in collagen biosynthesis. Abnormalities in Nitrogen Metabolism – Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance. Composition and diagnostic significance of cerebrospinal fluid and amniotic fluid. Doping in horses.

Unit IV

Liver function tests - indications and limitations - classification of tests – Biochemical tests for liver function - serum enzyme activities to assess liver function - Hepatic encephalopathy – Hepatic photosensitivity – Ascites. Renal function: Direct and indirect test for glomerular filtration – tests for tubular function – test for kidney damage Gastrointestinal function: Disturbances in gastrointestinal function – disturbance in rumen function.

Unit V

Clinical enzymology - functional and non-functional plasma enzymes - plasma enzymes of diagnostic importance - ALP, CK, LDH, AST, ALT, OCT - Iso-enzymes and their diagnostic importance. Oxidative Stress: Biochemical basis of disease progression and diagnostic enzymes. Biochemical markers of cardiac diseases: Hypertension, myocardial infarction and heart failure. Respiratory distress syndrome, COPD, Ischemia, shock.

Unit VI

Disorders of mineral metabolism: Hypercalcaemia, hypocalcaemia, normocalcaemia, hypophosphataemia, hyperphosphataemia. Biochemistry of tumours and various types of tumour markers for the diagnosis of prostate cancer, ovarian cancer, mammary tumour, lymphoma, bladder cancer and pancreatic cancer.

Unit VII

Biochemical basis and diagnosis of prevalent diseases and metabolic disorders in wild animals, and poultry.

VI. Practical

Urine analysis - Physical and chemical tests for normal and pathological constituents of urine. Quality Control-Precision, Accuracy, Sensitivity and Specificity; Estimation of Blood glucose - Serum biochemical parameters – Total protein, A/G ratio, Cholesterol, urea, uric acid, bilirubin, creatinine – Serum enzymes – ALP, ACP,



AST and ALT – Electrophoresis of plasma proteins - Separation of Iso-enzymes. Estimation of Ca, Mg, P, K, Na in serum samples. Estimation of Vit C, D and E.

VII. Suggested Reading

- David L Nelson and Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.
- Kaneko JJ, Harvey JH, Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press.
- Racek J and Rajdl D. 2016. *Clinical Biochemistry*. 1st Ed. Karolinum Press.
- Voet D, Voet JG and Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley and Sons.
- Kaneko JJ, Harvey JH, Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Quality control and automation in clinical biochemistry	1
2	Disturbance in water, electrolytes and acid-base balance - electrolyte abnormalities	1
3	Respiratory acidosis and alkalosis: compensation and biochemical tests for diagnosis.	1
4	Metabolic acidosis and alkalosis: compensation and biochemical tests for diagnosis.	1
5	Diabetes mellitus, classification and diagnosis	1
6	Hyperinsulemia, galactosemia, hypoglycaemia of baby pigs	1
7	Glycogen storage disease and glycated proteins	1
8	Carbohydrate balance in ruminants.	1
9	Biochemical alterations in body fluids of ruminants in hypoglycaemia	1
10	Ruminant ketosis – Ketosis associated with fasting, diabetes, pregnancy, lactation and post-exercise	1
11	Disorders of Lipid metabolism: Hypercholesterolemia, atherosclerosis, hyperlipidemia in canines, felines and equines	1
12	Pathophysiology of ketonemia.	1
13	Disorders of proteins, amino acids and nucleic acids metabolism: Normal and abnormal plasma proteins – Dysproteinemias, acute phase proteins	1
14	Inborn errors of amino acid metabolism– Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia – defect in collagen biosynthesis	1
15	Abnormalities in Nitrogen Metabolism – Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance	1
16	Composition and diagnostic significance of cerebrospinal fluid and amniotic fluid	1
17	Doping in horses	1
18	Liver function tests - indications and limitations	1
19	Classification of tests – Biochemical tests for liver function - serum enzyme activities to asses liver function	1
20	Hepatic encephalopathy – Hepatic photosensitivity – Ascites	1
21	Renal function: Direct and indirect test for glomerular filtration – tests for tubular function – test for kidney damage	1



S. No.	Topic	No. of Lectures/ Practicals
22	Gastrointestinal function: Disturbances in gastrointestinal function – disturbance in rumen function	1
23	Clinical enzymology - functional and non-functional plasma enzymes	1
24	Plasma enzymes of diagnostic importance - ALP, CK, LDH, AST, ALT, OCT - Iso-enzymes and their diagnostic importance	1
25	Oxidative Stress: Biochemical basis of disease progression and diagnostic enzymes	1
26	Biochemical markers of cardiac diseases: Hypertension, myocardial infarction and heart failure.	1
27	Respiratory distress syndrome, COPD, Ischemia, shock	1
28	Disorders of mineral metabolism: Hypercalcaemia, hypocalcaemia, normocalcaemia, hypophosphataemia, hyperphosphataemia.	1
29	Biochemistry of tumours and various types of tumour markers	1
30	Role of tumour markers for the diagnosis of prostate cancer, ovarian cancer, mammary tumour, lymphoma, bladder cancer and pancreatic cancer	3
31	Biochemical basis and diagnosis of prevalent diseases and metabolic disorders in wild animals	1
32	Biochemical basis and diagnosis of prevalent diseases and metabolic disorders in poultry	1
	Total	34

Practical

1.	Urine analysis - volume, colour, acidity, pH, specific gravity - normal urinary constituents - pathological constituents and sediments	2
2.	Quality Control - Precision, Accuracy, Sensitivity and Specificity	1
3.	Estimation of Blood glucose	1
4.	Estimation of Total protein and A/G ratio	1
5.	Estimation of Cholesterol from serum	1
6.	Estimation of urea from serum	1
7.	Estimation of uric acid from serum	1
8.	Estimation of bilirubin from serum	1
9.	Estimation of creatinine from serum	1
10.	Estimation of serum enzymes: ALP, ACP, AST, ALT	1
11.	Electrophoresis of plasma proteins	1
12.	Separation of Isoenzymes	1
13.	Estimation of Ca, Mg, P, K, Na in serum samples	1
14.	Estimation of Vit C	1
15.	Estimation of Vit D and Vit E	1
16.	Estimation of total antioxidant activity	1
	Total	17

I. Course Title : Intermediary Metabolism and Regulation

II. Course Code : BCT 606

III. Credit Hours : 3 + 0

IV. Aim of the course

To teach regulatory mechanisms concerned with the metabolism of carbohydrates, lipids, amino acids, proteins and nucleotides in health and diseases and to give exposure in inter-relationship of cellular metabolism of various macromolecules.



V. Theory

Unit I

Carbohydrate metabolism and regulation - Major pathways - Glycolysis - Reactions, functions and its control - Metabolism of other sugars - Fructose, Galactose, Mannose and Lactose - Pyruvate dehydrogenase and reactions of Citric acid cycle - Anaplerotic reactions - Energetics of glucose oxidations. Alternate pathways of glucose metabolism - HMP pathway and its importance - Glucuronic acid cycle - Gluconeogenesis - Substrates - pathway and control of amino sugar - Glycogen metabolism - Glycogenolysis and Glycogenesis reactions - Metabolic disorders - Glycogen storage diseases (GSD).

Unit II

Lipid metabolism and regulation - Lipid transport and storage - Plasma lipoproteins - Role of liver and adipose tissue in fat metabolism - Role of brown adipose tissue in thermogenesis - Catabolism of triacylglycerols - Beta oxidation of fatty acids - Ketogenesis and utilization of ketone bodies - Biosynthesis of fatty acids, triacylglycerols, phospholipids and cholesterol - Production of Bile acids - Metabolism of Eicosanoids - Lipid storage diseases.

Unit III

Amino acids metabolism - Protein turnover and regulation - amino acid pools and absorption of amino acids - catabolism of amino acids - Deamination, transamination. Ammonia carriers; Excretion of nitrogen - urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to specialized products - Heme Biosynthesis - Physiologically active amines. Biosynthesis of non-essential amino acids. Metabolic disorders.

Unit IV

Catabolism and regulation of purine and pyrimidine nucleotides/ deoxynucleotides - Biosynthesis and regulation of purine and pyrimidine nucleotides - Biosynthesis of nucleotide coenzymes and regulation - Inhibitors of purine and pyrimidine metabolism and role in cancer therapy - Metabolic disorders.

Unit V

Structural and functional relationships of specialized tissues and organs; Organ specialization in fuel metabolism: Brain, muscle, adipose tissue, liver, kidney; Inter organ metabolic pathways, hormonal control of fuel metabolism. Tracing metabolic fates, perturbing the system. Metabolic interrelationships in obesity, diabetes, cancer, aerobic and anaerobic exercise in horses, pregnancy, lactation and stress injury.

VI. Suggested Reading

- Berg JM, Tymoczko JL, Stryer L and Clarke ND 2015. *Biochemistry*. 8th Ed. WH Freeman and Co.
- David L Nelson and Cox Michael M. 2017. *Lehninger's Principles of Biochemistry*. 7th Ed. Freeman.
- Kaneko JJ, Harvey JH and Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press.
- Metzler DE. *Biochemistry*. John Wiley.
- Swenson MJ and Reece WO. 2015. *Dukes' Physiology of Domestic Animals*. 13th Ed. Panima.
- Voet D, Voet JG and Pratt CW. 2016. *Fundamentals of Biochemistry of Life at the Molecular Level*. 5th Ed. John Wiley and Sons.
- Zubay GL. 1998. *Biochemistry*. 4th Ed. WCB London.



Course

S. No.	Topics	No. of Lectures
Theory		
1.	Glycolysis - Reactions, functions and its control	1
2.	Metabolism and regulation of other sugars – Fructose and Galactose	1
3.	Metabolism and regulation of other sugars - Mannose and Lactose	1
4.	Pyruvate dehydrogenase Complex, Reactions of Citric acid cycle and its regulation	1
5.	Anaplerotic reactions - Energetics of Glucose oxidations;Introduction to Alternate pathways of Glucose metabolism.	1
6.	Reactions of HMP pathway and its regulation	1
7.	Glucuronic acid cycle and its regulation	1
8.	Gluconeogenesis with its regulation – Substrates - Pyruvate and Lactate	1
9.	Gluconeogenesis with its regulation – Substrates - Glucogenic amino acids, Glycerol and Propionate	1
10.	Glycogen metabolism – Reactions and regulation of Glycogenolysis.	1
11.	Glycogen metabolism - Reactions and regulation of Glycogenesis.	1
12.	Metabolic disorders – Glycogen Storage Diseases (GSD)	1
13.	Lipid transport and storage – Metabolism of Plasma Lipoproteins	1
14.	Role of liver and adipose tissue in fat metabolism	1
15.	Role of brown adipose tissue in thermogenesis	1
16.	Catabolism of Triacylglycerols and its regulation	1
17.	Beta oxidation of Fatty acids and its regulation	1
18.	Ketogenesis and utilization of ketone bodies	1
19.	Biosynthesis of Fatty acids and its regulation	1
20.	Biosynthesis of Triacylglycerols and Phospholipids and their regulation	1
21.	Biosynthesis of Cholesterol and its regulation – Production of Bile acids	1
22.	Metabolism of Eicosanoids	1
23.	Lipid Storage Diseases	1
24.	Introduction to protein turnover and amino acid pools – Meister cycle	1
25.	Catabolism of amino acids - Deamination, transamination reactions and Ammonia carriers/ transport	1
26.	Excretion of nitrogen - Urea cycle and its regulation	1
27.	Catabolism of carbon skeletons of amino acids and its regulation	2
28.	Conversion of amino acids to specialized products - Heme Biosynthesis	1
29.	Conversion of amino acids to specialized products - Physiologically active amines	1
30.	Biosynthesis of non-essential amino acids and its regulation	1
31.	Metabolic disorders – phenylketonuria, methyl malonic aciduria, alkaptonuria, maple syrup urine disease, parkinson's disease, homocystinuria, hartnup's disease.	1
32.	Catabolism and regulation of Purine nucleotides	1
33.	Catabolism and regulation of Pyrimidine nucleotides	1
34.	Biosynthesis and regulation of Purine nucleotides	1
35.	Biosynthesis and regulation of Pyrimidine nucleotides	1
36.	Biosynthesis of nucleotide coenzymes and regulation	1
37.	Inhibitors of purine and pyrimidine metabolism – Role in Cancer therapy	1
38.	Metabolic disorders-hyperuricemia and gout.	1
39.	Structural and functional relationships of specialized tissues and organs, viz., Brain, muscle, adipose tissue, liver and kidney	2
40.	Organ specialization in fuel metabolism of brain, muscle, adipose	2

tissue, liver and kidney



2



S. No.	Topics	No. of Lectures
41.	Inter-organ metabolic pathways	1
42.	Hormonal control of fuel metabolism	1
43.	Tracing metabolic fates - perturbing the system.	1
44.	Metabolic interrelationships in obesity, diabetes, cancer, aerobic and anaerobic exercise in horses, pregnancy, lactation and stress injury	2
	Total	48

I. Course Title : Molecular Biochemistry

II. Course Code : BCT 607

III. Credit Hours : 2 + 1

IV. Aim of the course

To provide knowledge regarding genes, their functions, expression, regulation and transfer in heterologous systems.

V. Theory

Unit I

Historical development of molecular biology, nucleic acids as genetic material, chemistry and structure of DNA and RNA, Genome organization in prokaryotes and eukaryotes, repetitive and non-repetitive DNA, satellite DNA; chromatin structure and function.

Unit II

DNA replication mechanisms in prokaryotes and Eukaryotes, DNA polymerases, Topoisomerases, DNA ligase, Reverse transcriptase, Transcription mechanisms in Prokaryotes and Eukaryotes, RNA polymerases, RNA editing, post transcriptional RNA processing. Recombination mechanisms, DNA repair mechanisms, Telomeres, Telomerase, Role of Telomeres in Cancer.

Unit III

Ribosomes - structure and function, organization of ribosomal proteins, genetic code, aminoacyl tRNA synthases, Inhibitors of replication, transcription and translation; Translation mechanisms in Eukaryotes and Prokaryotes and Post - translational modification; Nucleases and restriction enzymes, regulation of gene expression in prokaryotes and eukaryotes.

Unit IV

DNA sequencing techniques, Recombinant DNA technology, Plasmid biology, Cloning Vectors, Expression vectors, selection of recombinants, Heterologous protein expression systems, Recombinant protein purification, Polymerase Chain Reaction and its variants; Site Directed Mutagenesis, *In-vitro* transcription, Gene Silencing. Transgenic Animals, Introduction to Systems Biology.

VI. Practical

Isolation and purification of DNA - Plasmid isolation- Isolation and purification of RNA – Determination of concentration of DNA and RNA by spectrophotometry -



Determination of T_m of DNA by Spectrophotometry - Restriction
Digestion of DNA, Agarose gel electrophoresis - RAPD analysis of DNA - cDNA
synthesis using PCR



VII. Suggested Reading

- Jocelyn E Krebs *et al.* 2017. *Lewin's Genes XII*. Jones and Bartlett Publishers Inc.
- Watson JD *et al.* 2017. *Molecular Biology of the Gene*. 7th Ed. Pearson Education.
- Eberhard. O. Voit. 2017. *A First Course in Systems Biology*, 2nd Edition. Garland Science Publishers.
- *Genome Editing and Engineering: From TALENs, ZFNs and CRISPRs to Molecular Surgery*, Ed. Krishnarao Appasani, Cambridge University Press, 2018
- *Molecular Cell Biology*, 8th Ed, Lodish *et al.* WH Freeman and Co., 2016
- *Molecular Biology of the Cell*, 6th Ed. Bruce Alberts *et al.*, WW Norton and Company, 2014
- *Transgenic Animal Technology: A laboratory handbook*, 3rd Edition, Ed. Carl. A. Pinkert, Academic Press, 2014.
- *Molecular Biology*, 4th Ed, Robert F. Weaver, McGraw Hill Higher Education, 2007.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Historical Development of Molecular Biology	1
2.	Nucleic acids as genetic material, Chemistry and Structure of DNA and RNA	1
3.	Genome organization in prokaryotes and eukaryotes	1
4.	Repetitive and non-repetitive DNA, Satellite DNA	1
5.	Chromatin structure and function	1
6.	DNA replication mechanisms in prokaryotes and Eukaryotes, DNA polymerases, DNA ligase	1
7.	Topoisomerases	1
8.	Transcription mechanisms in Prokaryotes and Eukaryotes, RNA Pol.	1
9.	RNA editing	1
10.	Post-transcriptional RNA processing	1
11.	Recombination mechanisms	1
12.	DNA repair mechanisms	1
13.	Reverse transcriptase	1
14.	Telomeres, Telomerase, Role of Telomeres in Cancer	1
15.	Translation mechanisms in Eukaryotes and Prokaryotes	1
16.	Post - translational modification	1
17.	Ribosomes - structure and function, organization of ribosomal proteins,	1
18.	Genetic code	1
19.	Aminoacyl tRNA synthases	1
20.	Inhibitors of replication, transcription and translation	1
21.	Regulation of gene expression in prokaryotes and eukaryotes	1
22.	Recombinant DNA technology - Introduction	1
23.	Plasmid biology, Cloning Vectors, selection of recombinants	1
24.	Nucleases and restriction enzymes	1
25.	Polymerase Chain Reaction and its variants	1
26.	Expression vectors	1
27.	Heterologous protein expression systems	1
28.	Recombinant protein purification	1
29.	Site Directed Mutagenesis, <i>In-vitro</i> transcription,	1
30.	Gene Silencing	1
31.	Transgenic Animals	1
32.	Introduction to Systems Biology	1
	Total	32



S. No.	Topic	No. of Lectures/ Practicals
Practical		
1.	Isolation and purification of DNA	2
2.	Plasmid isolation	2
3.	Isolation and purification of RNA	2
4.	Determination of concentration of DNA and RNA by spectrophotometry	1
5.	Determination of TM of DNA by Spectrophotometry	1
6.	Polymerase chain reaction	2
7.	Restriction Digestion of DNA	2
8.	Agarose gel electrophoresis	1
9.	RAPD analysis of DNA	2
10.	cDNA synthesis using PCR	2
	Total	17

I. Course Title : Nutritional and Industrial Biochemistry

II. Course Code : BCT 608

III. Credit Hours : 2 + 0

IV. Aim of the course

To give exposure about biochemical principle as applicable to nutrition in animals and industry.

V. Theory

Unit I

Introduction - Nutrients and their importance in ruminants, non-ruminants and poultry - Energy value of various nutrients their importance and calorimetry - Nutrient absorption and biochemical changes involved - Introduction to BMR, SDA, PER and Biological value for protein - Requirements of different nutrients in animals - Role of nutrients in growth and production of animals – Bio-availability of nutrients in different food sources.

Unit II

Metabolic role of Nutrients - Overview of metabolism of different nutrients and regulation of nutrient absorption and utilization - Alterations that occur in nutritional requirements during diseases and biochemical reactions due to Toxic factors in feed - Biochemical role of Macro and micro minerals in animal production - Vitamins and their role as co enzymes in metabolism – Nutrient deficiencies and metabolic disorders in animals - Biochemical alterations occurring due to phyto-toxins in ruminants - Biochemical importance of different feed additives - Agonists and antagonists of minerals and vitamins - Nutrient control of gene expression - Clinical issues of micro mineral metabolism - Nutrients (minerals) that resist digestion process in animals - Energy releasing and hematopoietic water soluble vitamins.

Unit III



Industrial biochemistry - applications of biological molecules for medical, industrial, environmental, agricultural or analytical purposes - Generation of gene-mediated industrial/ medical products - Introduction and application of fermentation



technology for ethanol and biogas production - conversion of sunlight into biomass (bioreactors and biophotolysis) - Significance of pharmaceuticals products of animal origin (sex hormones- oestrogens, progesterone; corticosteroids) - Significance of pharmaceuticals of plant origin (alkaloids, atropine, morphine, cocaine, ergot alkaloids, flavonoids, xanthenes and terpenoids) - Physical, chemical and biological treatment of waste water, bioremediation of contaminated soils.

VI. Suggested Reading

- *Nutritional Biochemistry*, 2nd Edition, Tom Brody, Elsevier pub.2009
- *Text book of Biochemistry with clinical correlations*. 6th edition, Thomas M Devlin, Wileys-liss. Press.
- *A textbook of industrial microbiology* 2nd edition, Crueger W and Crueger A. 2000, Panima Publishing Corp.
- *Principle of fermentation technology*, 1997, Stanbury PF, Ethitaker H, Hall S, Aditya Books (P) Ltd.
- *Bioprocess Engineering: Basic Concepts*. Shuler M and Kargi F. Second Edition. Pearson Education. 2002
- *Nutritional Biochemistry of the vitamins*, by David a Bender, 2nd Edition, Cambridge University Press.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Nutrients and their importance in ruminants.	1
2.	Nutrients and their importance in Non ruminants and poultry	1
3.	Energy value of various nutrients their importance and calorimetry.	1
4.	Nutrient absorption and biochemical changes involved.	1
5.	Introduction to BMR, SDA, PER and Biological value for protein.	1
6.	Requirements of different nutrients in animals	1
7.	Role of nutrients in growth and production of animals	1
8.	Bio-availability of nutrients in different food sources	1
9.	An overview of metabolism of different nutrients.	1
10.	An overview of regulation of nutrient absorption and utilization.	1
11.	Alterations that occur in nutritional requirements during diseases.	1
12.	Alterations in biochemical reactions due to Toxic factors in feed.	1
13.	Biochemical role of Macro minerals in animal production	1
14.	Biochemical role of Micro minerals in animal production.	1
15.	Vitamins and their role as co enzymes in metabolism	1
16.	Deficiencies of nutrients that cause metabolic disorders in animals	1
17.	Biochemical alterations occurring due to phyto toxins in ruminants	1
18.	Biochemical importance of different feed additives	1
19.	Agonists and antagonists of minerals.	1
20.	Agonists and antagonists of vitamins.	1
21.	Nutrient control of gene expression	1
22.	Clinical issues of micro mineral metabolism.	1
23.	Nutrients (minerals) that resist digestion process in animals.	1
24.	Energy releasing and hematopoietic water soluble vitamins.	1
25.	Industrial biochemistry- applications of biological molecules for medical, industrial, environmental, agricultural or analytical purposes.	1
26.	Generation of gene-mediated industrial/ medical products.	1
27.	Introduction and application of fermentation technology for ethanol and biogas production.	1



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S. No.	Topic	No. of Lectures/ Practicals
28.	Introduction to industrial microorganisms and products, growth and product formation in biocatalysis.	1
29.	Conversion of sunlight into biomass (bioreactors and bio-photolysis)	1
30.	Significance of pharmaceuticals products of animal origin, sex hormones, oestrogens, progesterone, corticosteroids.	1
31.	Significance of pharmaceuticals of plant origin, Alkaloids, atropine, morphine, cocaine, ergot alkaloids, flavonoids, xanthenes and terpenoids;	1
32.	Physical, chemical and biological treatment of waste water, bioremediation of contaminated soils.	1
	Total	32

I. Course Title : Endocrinology and Reproductive Biochemistry

II. Course Code : BCT 609

III. Credit Hours : 2 + 0

IV. Aim of the course

To impart knowledge on the role of hormones in signalling and their biochemical role in reproduction of animals.

V. Theory

Unit I

Endocrinology - Classification, secretion, transport and regulation of hormones - Mechanism of hormone action and intracellular signalling after receptor activation - Releasing factors from hypothalamus and their effects on pituitary gland and metabolism - Synthesis, secretion, regulation, metabolic functions and physio-pathology of Hormones from Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal and Pineal Glands.

Unit II

Endocrinology of Gonads and Reproductive Biochemistry - Female hormonal system - Synthesis, secretion, regulation, functions, and physio-pathology of ovarian hormones and male sex hormones - Prostaglandins: chemistry, functions and clinical importance - Endocrine aspects of reproduction status in domestic animals - Endocrine aspects of reproduction in poultry - Hormones involved in the development of ductal and lobule-alveolar system of mammary gland - Endocrine control of biosynthesis of milk.

VI. Suggested Reading

- *Dukes' Physiology of Domestic Animals*, 13th edition/ editor, William O Reece, Wiley Blackwell.
- *Guyton and Hall Textbook of Medical Physiology*, 13th edition/ editor, John E Hall, Elsevier.
- *Applied Animal Endocrinology*, E. James Squires, CABI
- *Endocrinology: An Integrated Approach*, by SS Nussey, SA Whitehead, 1st edition, CRC Press.
- *Biochemistry of Lactation*, TB Mepham, Elsevier

**Course Outline**

S. No.	Topics	No. of Lectures
Theory		
1.	Classification, secretion, transport and regulation of hormones.	2
2.	Mechanism of hormone action and intracellular signalling after receptor activation.	2
3.	Releasing factors from hypothalamus and their effects on pituitary gland and metabolism.	2
4.	Hormones from Pituitary, secretion, regulation, metabolic functions and physio-pathology.	2
5.	Synthesis, secretion, regulation, metabolic functions and physio-pathology of Thyroid hormones.	1
6.	Parathyroid gland, its hormone and effect on calcium and phosphate concentrations in the extracellular fluid	2
7.	Endocrine Pancreas: Hormone synthesis, secretion, regulation, metabolic functions and physio-pathology.	2
8.	Endocrine Adrenal: Hormone synthesis, secretion, regulation, metabolic functions and physio-pathology.	2
9.	The Pineal Gland and Melatonin secretion, regulation and function.	1
10.	Female hormonal system - Effect on ovaries - Synthesis, secretion, regulation, functions, and physio-pathology of ovarian hormones.	2
11.	Synthesis, secretion, regulation, metabolic functions and physio-pathology of male sex hormones.	2
12.	Prostaglandins: Chemistry, Functions and Clinical Importance	2
13.	Hormones concerned with animal production.	2
14.	Endocrine aspects in reproduction status in domestic animals	2
15.	Hormones concerned with poultry production.	2
16.	Endocrine aspects of reproduction in poultry	2
17.	Hormones involved in development of Ductal and Lobule-Alveolar System of mammary gland - Endocrine control of milk secretion and its biosynthesis	2
	Total	32

I. Course Title : Biochemistry of Ruminants and Wild Animals

II. Course Code : BCT 610

III. Credit Hours : 1 + 1

IV. Aim of the course

To acquaint the students about comparative metabolism in ruminant species and the common metabolic disorders in ruminants; to impart a basic knowledge about biochemistry of wild animals.

V. Theory**Unit I**

Biochemistry of Ruminants - An overview of metabolism of carbohydrates, proteins and lipids in ruminants - Metabolism of nutrients by rumen microflora - Blood biochemistry of ruminants - Disorders associated with carbohydrates, proteins and



lipid metabolism in ruminants -

Liver and Kidney function tests -

Diseases associated with major and trace elements in ruminants.

**Unit II**

Biochemistry of Wild Animals - Blood biochemistry and blood typing of wild animals
 - Fluid balance and electrolyte maintenance in wild animals - Biomarkers for assessment of diseases in wild animals - Diabetes mellitus in primates - Neurological diseases in cheetah

VI. Practical

Methods of examining fluids and tissue in wild animals, Pancreatic function test, Estimation of Serum amylase, Estimation of Serum Bilirubin, Estimation of serum Inorganic Phosphate, Estimation of serum Calcium, Estimation of serum Magnesium, Estimation of Vitamin A, Estimation of serum LDH, Estimation of rumen volatile fatty acid, Estimation of rumen lactic acid, Estimation of Cellulolytic activity, Estimation of milk ketone bodies (acetone) by microdiffusion method, Estimation of milk lactose.

VII. Suggested reading

- Dvorak AM and Harris W. 1991. *Blood Cell Biochemistry*. 2nd Ed. Plenum.
- *Clinical Biochemistry of Domestic Animals*, 6th Edition/ Editors: Jiro Kaneko John Harvey Michael Bruss, Elsevier.
- *Lipid Metabolism in Ruminant Animals*, 1st Edition/ Editors: William W Christie, Elsevier.
- *Digestive Physiology and Metabolism in Ruminants*, Editors: Ruckebusch Y, Thivend.
- *Energy Nutrition in Ruminants*, Editors: Orskov ER.
- *Zoo and Wild Animal Medicine (Current Therapy 3)* by Murray E Fowler, 5th edition.
- *Textbook of Veterinary Biochemistry*, by RS Dhanotiya, JAYPEE.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Comparative metabolism of carbohydrates, proteins and lipids in ruminants	2
2.	Metabolism of nutrients by rumen microflora	1
3.	Blood biochemistry of ruminants	1
4.	Disorders associated with carbohydrate, protein and lipid metabolism	2
5.	Liver dysfunction and tests	1
6.	Kidney dysfunction and tests	1
7.	Diseases associated with major and trace elements	2
8.	Blood biochemistry and blood typing of wild animals	1
9.	Fluid balance and electrolyte maintenance in wild animals	2
10.	Biomarkers for assessment of diseases in wild animals	1
11.	Diabetes in primates	1
12.	Neurological diseases in cheetah	1
	Total	16
Practical		
1.	Methods of examining fluids and tissue in wild animals	1
2.	Pancreatic function test	1
3.	Estimation of Serum amylase	1
4.	Estimation of Serum Bilirubin	1
5.	Estimation of serum Inorganic Phosphate	1
6.	Estimation of serum Calcium	1
7.	Estimation of serum Magnesium	1



8. Estimation of Vitamin A	1
9. Estimation of serum LDH	1
10. Estimation of rumen volatile fatty acid	1
11. Estimation of rumen lactic acid	1
12. Estimation of Cellulolytic activity	1
13. Estimation of milk ketone bodies (acetone) by microdiffusion method	1
14. Estimation of milk lactose	1
Total	14



- I. Course Title : Introduction to Bioinformatics and Computational Biology**
- II. Course Code : BCT 611**
- III. Credit Hours : 1 + 1**

IV. Aim of the course

To impart an introductory knowledge of Bioinformatics and Computational biology to postgraduate students studying any discipline of veterinary/ agricultural science.

V. Theory

Unit I

Introduction to bioinformatics, scope and applications of bioinformatics; biological databases: primary, secondary and structural; basic concept of Protein and Gene Information Resources-PIR, SWISS-PROT, PDB, GenBank, DDBJ; Basic concept of computational biology, applications in different subfield of biology, software tools.

Unit II

Basic concept of sequence search algorithm and alignment tools: BLAST and FASTA; DNA and protein sequence analysis, local and global alignment; Algorithms: Dot Matrix method, dynamic programming methods; Pairwise and multiple sequence alignment and its application; Tools of Multiple sequence alignment: ClustalW.

Unit III

Basic concept of Phylogeny study; cDNA libraries and EST, EST analysis; database search engines: introduction and application; Commercial databases and software packages, GPL software for Bioinformatics.

Unit IV

Computer aided drug design: basic principles, docking; QSAR, 2DQSAR, 3DQSAR, their basic concept and applications, machine learning tools for QSAR.

VI. Practical

- Basic computing: Introduction to LINUX and Windows
- Nucleotide information resource: EMBL, GenBank, DDBJ
- Protein information resource: SwissProt, TrEMBL, Uniprot
- Structure databases: PDB, MMDB
- Search Engines: Entrez, ARSA, SRS
- Usage of NCBI resources
- Retrieval of sequence/ structure from databases
- Database searching
- Visualization of structures of DNA and Proteins using Rasmol
- Sequence similarity search using BLAST
- Multiple sequence alignment
- Primer designing

VII. Suggested Reading

- *Introduction to Bioinformatics* 2003. Attwood TK and Parry-Smith DJ, Pearson Education.
- *Essential bioinformatics* 2006. Xin Xiong. Cambridge University Press.
- *Bioinformatics: Concepts, Skills and Applications* 2004. Rastogi SC, Mendiratta N and Rastogi P. CBS.
- *Principles of Genome Analysis and Genomics* 2003. SB Primrose and RM Twyman, Blackwell Publishing.



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- *Molecular Analysis and Genome Discovery* 2004. Ralph Rapley and Stuart Harbron (Eds.), John Wiley and Sons.
- *Bioinformatics* 2001. Andreas D Baxevanis and BF Francis Ouellette (Eds.)
- *Wiley Interscience Proteins and Proteomics* 2003. Richard J. Simpson, Cold Spring Harbor Laboratory.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to bioinformatics - Scope and applications of bioinformatics	1
2.	Introduction to biological databases: primary, secondary and structural databases	1
3.	Basic concept of Protein and Gene Information Resources-PIR, SWISS-PROT, PDB, GenBank, DDBJ	1
4.	Basic concept of computational biology, applications in different subfields of biology	1
5.	Basic concept of sequence search algorithm and alignment tools: BLAST and FASTA; DNA and protein sequence analysis, local and global alignment	1
6.	Dot Matrix method, dynamic programming methods	1
7.	Pairwise and multiple sequence alignment and its application	1
8.	Tools of Multiple sequence alignment: ClustalW	1
9.	Basic concept of Phylogeny study	1
10.	cDNA libraries and EST, EST analysis	1
11.	Database search engines-introduction and application	1
12.	Commercial databases and software packages, GPL software for Bioinformatics	1
13.	Computer aided drug design-basic principles	1
14.	Introduction of Molecular docking and QSAR	1
15.	2DQSAR, 3DQSAR, their basic concept and applications	1
16.	Machine learning tools for QSAR	1
	Total	16
Practical		
1.	Basic concept of computer hardware and software, computer operating systems: Linux and windows	2
2.	Nucleotide information resource: EMBL, GenBank, DDBJ	1
3.	Protein information resource: SwissProt, TrEMBL, Uniprot	1
4.	Structure databases: PDB, MMDB	1
5.	Basic concept of molecular search Engines: Entrez, ARSA, SRS	1
6.	Usage of NCBI resources	2
7.	Retrieval of sequence/ structure from databases	1
8.	Database searching	1
9.	Visualization of structures of DNA and Proteins using Rasmol	1
10.	Sequence similarity search using BLAST	1
11.	Multiple sequence alignment tools: ClustalW, Bioedit, etc.	2
12.	Phylogeny study using different software tools	1
13.	Primer designing using different software tools	1
	Total	16



Course Title with Credit Load Ph.D. in Veterinary Biochemistry

Course Code	Course Title	Credit Hours
BCT 701	Applied Molecular Biochemistry and Systems Biology	2 + 1
BCT 702	Membrane Biochemistry*	2 + 0
BCT 703	Recent trends in Enzymology*	2 + 1
BCT 704	Diagnostic Techniques in Clinical Biochemistry*	0 + 2
BCT 705	Recent Trends in Biochemical Techniques and Instrumentation	2 + 1
BCT 706	Developmental Biochemistry	2 + 0
BCT 707	Bioinformatics Tools in Biochemistry	1 + 1
BCT 708	Environmental and Toxicological Biochemistry	2 + 0
BCT 709	Biochemistry of Diseases and Disorders*	2 + 0
BCT 710	Immuno-Biochemistry	2 + 0
BCT 711	Special Problem	0 + 2
BCT 712	Doctoral Seminar-I	1 + 0
BCT 713	Doctoral Seminar-II	1 + 0
BCT 714	Doctoral Research	0+75

*Compulsory Major courses for Doctorate programme. The other credits can be registered from remaining 700 Series courses listed above

The minor courses should be taken from the other than major disciplines/department of the same group of Basic veterinary sciences only limiting to credits prescribed as decided by the Chairman of Advisory Committee of the student.



Course Contents

Ph.D. in Veterinary Biochemistry

- I. Course Title** : **Applied Molecular Biochemistry and Systems Biology**
II. Course Code : **BCT 701**
III. Credit Hours : **2 + 1**
IV. Pre-requisite

Should have studied BCT-607: Molecular Biochemistry (2+1) or other equivalent courses with similar syllabi/ content at Master's level.

V. Aim of the course

To impart latest information on the molecular biochemistry of isolation, transfer and expression of genes and biochemical approaches employed in gene therapy and computational approaches to biology/ synthetic biology.

VI. Theory

Unit I

Organization of prokaryotic genome, nuclear and organelle genes, concept of genome mapping and Organization, Molecular evolution, Prokaryotic and Eukaryotic gene regulation, RNA editing.

Unit II

Comparative genomics, functional genomics, transcriptomics and transcriptional network, Application of genomics, Livestock genomics, Buffalo Genome Initiative, Dog genome projects, Role of genomics in Wild life conservation and Reconstruction of species, Bioethics and biosafety guidelines and IPR in recombinant DNA research.

Unit III

Transgenics, Gene Knock – out technology, Site specific nucleases, Zinc – Fingers, TALENS and CRISPR – Cas 9, Applications of Gene knock out, Development of Knock - out Animal models, Gene silencing, Antisense oligos, Ribozymes, RNAi, 3'UTR and miRNA, Applications of gene silencing, Site directed mutagenesis, gene targeting and gene therapy.

Unit IV

Nucleic acid sequencing: Various methods of sequencing including automated sequencing and Microarrays, Whole Genome Sequencing, epigenetic regulation, Protein sequencing, Peptide synthesis, Peptide arrays, protein engineering, Directed evolution of proteins.

Unit V

Mathematical modelling, Static Network models, Mathematics of Biological systems, Parameter estimation, Gene systems, Gene regulation models, Protein systems, Metabolic systems, Signalling systems, Population systems, Physiological modelling, Systems biology in Medicine and Drug development, Basic design of biological systems,



Introduction to nutrigenomics
Veterinary Science.

and pharmacogenomics, Applications in



VII. Practical

DNA methylation protocols, Genome Editing protocols, *in-vitro* Site Directed Mutagenesis, Gene silencing protocols, Next Generation sequencing platforms, Quantitative PCR, SAGE, Massively Parallel Signature Sequencing (MPSS), Oligonucleotide synthesis and quality control, Cap Analysis of Gene Expression (CAGE)/ deep CAGE, Chip-Chip assay Proteomics - 2D-PAGE, MSMS, MALDI-TOF, and Protein-protein interaction (Hybrid assay, DNA-Protein interaction and gene regulation (EMSA and Chip assay), DNA Microarrays, Protein sequencing protocols.

VIII. Suggested Reading

- *Molecular Biology of the Gene*, 7th Ed. JD Watson *et al.*, Pearson Education, 2017
- *Lewin's Genes XII*, Jocelyn E Krebs *et al.*, Jones and Bartlett Publishers Inc., 2017
- *A First Course in Systems Biology*, 2nd Edition, Eberhard. OVoit, Garland Science publishers 2017
- *Directed Enzyme Evolution: Advances and Applications*, Ed. Miguel Alcalde, Springer International Publishing, 2017
- *Genome Editing in Animals: Methods and Protocols*, Ed. Izuho Hatada, Springer Protocols, 2017
- *Genome Editing and Engineering: From TALENs, ZFNs and CRISPRs to Molecular Surgery*, Ed. Krishnarao Appasani, Cambridge University Press, 2018
- *Molecular Cell Biology*, 8th Ed, Lodish *et al.*, WH Freeman and Co., 2016
- *Nutrigenomics*, Eds. Carsten Carlberg, Stine Marie Ulven and Ferdinand Molnar, Springer Intl. Pub, 2016
- *CRISPR: Methods and Protocols*, Eds. Magnus Lundgren, Emmanuelle Charpentier, Peter C Finan, Humana Press, 2015
- *Genome Analysis: Current Procedures and Applications*, Ed Maria S Poptava, Caister Academic Press, 2014
- *Transgenic Animal Technology: A laboratory handbook*, 3rd Edition, Ed. Carl A Pinkert, Academic Press, 2014
- *Molecular Biology of the Cell*, 6th Ed. Bruce Alberts *et al*, WW Norton and Company, 2014
- *Bovine Genomics*, Ed. James E Womack, Wiley Blackwell, 2012
- *The Genetics of the Dog*, Eds. Elaine A Ostrander and Anatoly Ruvinsky, CABI press, 2012
- *An Introduction to Systems Biology*. Ed. Sangdun Choi, Humana Press, 2010
- *Genome Mapping and Genomics in Domestic Animals*, Eds. Noelle E Cockett, Chittaranjan Kole, Springer Verlag, 2009.
- *Gene Knockout protocols*, Eds. Ralf Kuhn, Wolfgang Wurst, 2009, Springer
- *Molecular Biology*, 4th Ed, Robert F. Weaver, McGraw Hill Higher Education, 2007
- *Comparative Genomics*, Ed. Nicholas H Bergman, Humana press, 2007
- *Molecular Biology and Genomics*, Cornel Mulhardt, Academic Press, 2007
- *The Dog and Its Genome*, Eds. Elaine A. Ostrander, Urs Giger, Kerstin Lindblad-Toh, CSHL press, 2006
- *Life: An Introduction to Complex Systems Biology*, Springer, 2006
- *An Introduction to Systems Biology: Design principles of Biological circuits*, Uri Alon, 2006, Chapman and Hall/ CRC
- *Directed molecular Evolution of Proteins: or How to improve Enzymes for Biocatalysis*, Eds. Susanne Brakmann, Kai Johnsson, Wiley VCH Verlag GmbH, 2003
- *Directed Evolution Library Creation*, Eds. Frances H Arnold, George Georgiou, Humana Press, 2003.
- Selected articles from journals.

**Course Outline**

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Organization of prokaryotic genome	1
2.	Nuclear and organelle genes.	1
3.	Concept of genome mapping and Organization	1
4.	Molecular evolution	1
5.	Prokaryotic and Eukaryotic gene regulation	1
6.	RNA editing	1
7.	Comparative genomics	1
8.	Functional genomics	1
9.	Transcriptomics and transcriptional network	1
10.	Application of genomics, Livestock genomics, Buffalo Genome Initiative, Dog genome projects, Role of genomics in Wild life conservation and Reconstruction of species	1
11.	Bioethics and biosafety guidelines and IPR in recombinant DNA research	1
12.	Transgenics, Gene Knock-out technology.	1
13.	Site specific nucleases, Zinc-Fingers, TALENS and CRISPR – Cas 9,	1
14.	Applications of Gene knock out, Development of Knock-out Animal models	1
15.	Gene silencing, Applications of gene silencing	1
16.	Antisense oligos, Ribozymes	1
17.	RNAi, 3'UTR and miRNA, Site directed mutagenesis	1
18.	gene targeting and gene therapy	1
19.	Nucleic acid sequencing: Various methods of sequencing including automated sequencing and Microarrays	1
20.	Whole Genome Sequencing, epigenetic regulation	1
21.	Protein sequencing, Peptide synthesis	1
22.	Peptide arrays	1
23.	Protein engineering	1
24.	Directed evolution of proteins	1
25.	Mathematical modelling, Static Network models	1
26.	Mathematics of Biological systems, Parameter estimation	1
27.	Gene systems, Gene regulation models	1
28.	Protein systems, Metabolic systems	1
29.	Signalling systems, Population systems	1
30.	Physiological modelling	1
31.	Systems biology in Medicine and Drug development	1
32.	Basic design of biological systems	1
33.	Introduction to Nutrigenomics - Applications in Veterinary Science	1
34.	Pharmacogenomics - Applications in Veterinary Science	1
	Total	34
Practical		
1.	DNA methylation protocols	2
2.	Genome Editing protocols, <i>In-vitro</i> Site Directed Mutagenesis	2
3.	Gene silencing protocols	2
4.	Next Generation sequencing platforms	1
5.	Quantitative PCR, SAGE, Massively Parallel Signature Sequencing (MPSS)	1
6.	Oligonucleotide synthesis and quality control	2
7.	Cap Analysis of Gene Expression (CAGE)/ deep CAGE	2



8. Chip-Chip assay Proteomics

1



S. No.	Topic	No. of Lectures/ Practicals
9.	2D-PAGE, MSMS, MALDI-TOF	2
10.	Protein-protein interaction (Hybrid assay, DNA-Protein interaction and gene regulation (EMSA and Chip assay), DNA Microarrays, Protein sequencing protocols	2
	Total	17

I. Course Title : Membrane Biochemistry

II. Course Code : BCT 702

III. Credit Hours : 2 + 0

IV. Pre-requisite

Should have studied BCT -602: Biochemistry of Biomolecules (3+0) or other equivalent courses with similar syllabi/ content at Master's level.

V. Aim of the course

To teach structure and functions of biomembranes, structure-function relationships, membrane biogenesis.

VI. Theory

Unit I

Concept of biomembranes and their classification based on cellular organelles; physico-chemical properties of different biological and artificial membranes, Membrane biogenesis and differentiation, Trafficking of Membrane Components - lipids, carbohydrates and proteins, cell surface receptors and antigen.

Unit II

Distribution and organization of membrane components-lipids; proteins- intrinsic and extrinsic: their arrangement; carbohydrates in membranes and their function. Cell membrane structure and the Fluid-mosaic model. Restoration and maintenance of cell membrane integrity and permeability. Methods for analysis of plasma membrane integrity. Separation of different membrane components.

Unit III

Molecular basis of biochemical behaviours of membranes, Various membrane movements; transport across membrane-Active transport, passive transport, diffusion, osmosis, exocytosis and endocytosis, Fick's law of diffusion and its physiological importance, energy transduction.

Unit IV

Role of membrane in cellular metabolism, cell recognition and cell -to -cell interaction; signal transduction, Molecular mechanisms, ion translocating antibiotics, valinomycin, gramicidin, ouabain, group translocation, ionophores, electrical gradient, energy coupling mechanism, recent trends and tools in membrane research.

VII. Suggested Reading

- Alberts B, Johnson A, Lewis J, Raff M, Roberts HK and Walter P. *Molecular Biology of the Cell. Garland Science*, Taylor and Fransis Group.
- Cooper GM and Hausam RE. 2015. *The Cell: A Molecular Approach*. Oxford University Press. ISBN: 9781605352909



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- Lodish H, Berk A, Zipursky SA, Matsudaira P, Baltimore D and Darnel J. 1999. *Molecular Cell Biology*. WH Freeman.
- Nelson DL and Cox MM. 2000. *Lehninger Principles of Biochemistry*. 3rd Ed. Replika Press Pvt. Ltd., New Delhi for Worth Publ., New York.
- Selected articles from journals.

Course Outline

S. No.	Topics	No. of Lectures
Theory		
1.	Concepts of bio membranes and their classification based on cellular organelles	2
2.	Physico-chemical properties of different biological and artificial membranes	1
3.	Membrane biogenesis and differentiation	2
4.	Trafficking of Membrane Components - lipids, carbohydrates and proteins	2
5.	Cell surface receptors and antigen	1
6.	Distribution and organization of membrane components-lipids; proteins, intrinsic and extrinsic: their arrangement	2
7.	Cell membrane structure and the Fluid-mosaic model	1
8.	Restoration and maintenance of cell membrane integrity and permeability	1
9.	Methods for analysis of plasma membrane integrity.	2
10.	Separation of different membrane components.	1
11.	Molecular basis of biochemical behaviours of membranes	2
12.	Various membrane movements	1
13.	Transport across membrane-Active transport, passive transport, diffusion, osmosis, exocytosis and endocytosis	2
14.	Fick's law of diffusion and its physiological importance	1
15.	Energy transduction	1
16.	Role of membrane in cellular metabolism	1
17.	Role of membrane in cell recognition	1
18.	Cell to cell interaction	2
19.	Signal transduction	2
20.	Molecular mechanisms, ion translocating antibiotics, valinomycin, gramicidin, ouabain, group translocation, ionophores, electrical gradient, energy coupling mechanism.	2
21.	Recent trends and tools in membrane research	3
Total		33

I. Course Title : Recent Trends in Enzymology

II. Course Code : BCT 703

III. Credit Hours : 2 + 1

IV. Pre-requisite

Should have studied BCT-603: Enzymology (2+1) or other equivalent courses with similar syllabi/ content at Master's level.

V. Aim of the course

To teach current developments in actions of enzymes and their applications.



VI. Theory

Unit I

Enzyme: Structure, mechanism, and Regulation. Three dimensional structure of enzyme, flexibility and conformational mobility of enzymes, enzyme families, dehydrogenase and dinucleotide fold, Multienzyme complexes, features and mapping of active site of enzymes, methods of examining enzyme-substrate complexes, reaction mechanism of lysozyme, chymotrypsin, carboxypeptidase A and ribonuclease A. Regulation of enzyme activity by zymogen activation, covalent modification and feed back inhibition. Allosteric enzyme with special reference to aspartate trans carbomylase. Concerted and sequential models of allosteric enzymes.

Unit II

Enzyme catalysis: general acid-base, covalent electrostatic and metal ion catalysis, orbital steering, principles of kinetic equivalence and kinetic isotopic effects, transition state theory-application and significance of enzyme catalysis. Hammond postulate

Enzyme kinetics and inhibition: factors influencing enzyme reaction velocity, steady-state kinetic of enzyme catalyzed reaction, significance of Michaelis-Menten parameters, Extension and modification of the Michaelis-Menten mechanism. K_{cat}/K_m and kinetic perfection in enzyme catalysis, kinetics of multi-substrate system-random, sequential, ordered, Theorell-chance and the ping-pong mechanisms. Competitive, non-competitive enzyme inhibition, suicide substrates and anti-metabolites.

Unit III

Recent developments: Industrial application of Enzymes, Enzyme immobilization methods and application. Restriction endonucleases, enzyme engineering, use of site-directed mutagenesis for detection of enzyme mechanisms, Abzymes and ribozymes, Enzyme linkerage. Biosensors.

Unit IV

Diagnostic enzymology: Assay of enzymes in clinical cases, Enzymes in Pathogenesis, Enzyme histochemistry and cytochemistry, Application of microscopy in enzymology, Enzyme immuno diagnostics, Cholinesterase, lipase, amylase, GGT, GPX, arginase, AST, ALT and SDH in diagnosis of diseases of animals. Therapeutic Enzymes.

VII. Practical

- Estimation of AntioXidant Enzymes (Superoxide dismutase, Glutathione Peroxidase, Catalase, Glutathione S-transferase) from tissue samples.
- Isolation, purification and characterization of enzymes from biological samples.
- Application of enzymes in competitive bioassays (ELISA, RIA)
- Determination of Enzyme activity in Native Gel Electrophoresis.
- Estimation of Diagnostic enzymes from Clinical samples.
- Application of Restriction enzymes in cloning experiments.

VIII. Suggested Reading

- David L Nelson and Cox Michael M. 2008. *Lehninger's Principles of Biochemistry*. 5th Ed. Freeman.
- Kaneko JJ, Harvey JH and Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press.
- Maragoni AG. 2003. *Enzyme Kinetics - A Modern Approach*. John Wiley.



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- Palmer T. 2001. *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry*. 5th Ed. Horwood Publ.
- Price NC and Stevens L. 2003. *Fundamentals of Enzymology*. Oxford Univ. Press.
- Voet D, Voet JG and Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley and Sons.
- Wilson K and Walker J. (Eds.). 2000. *Principles and Techniques of Practical Biochemistry*. 5th Ed. Cambridge Univ. Press.
- Selected articles from standard journals.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Enzyme: Structure, mechanism, and regulation.	3
2.	Three dimensional structure of enzyme, flexibility and conformational mobility of enzymes	2
3.	enzyme families, dehydrogenase and dinucleotide fold, Multienzyme complexes	1
4.	Features and mapping of active site of enzymes, methods of examining enzyme-substrate complexes	2
5.	reaction mechanism of lysozyme, chymotrypsin, carboxypeptidase A and ribonuclease A.	1
6.	Regulation of enzyme activity by zymogen activation, covalent modification and feedback inhibition.	1
7.	Allosteric enzyme with special reference to aspartate trans carbomylase. Concerted and sequential models of allosteric enzymes.	2
8.	Enzyme catalysis: general acid-base, covalent electrostatic and metal ion catalysis, orbital steering	2
9.	Principles of kinetic equivalence and kinetic isotopic effects, transition state theory-application and significance of enzyme catalysis. Hammond postulate	2
10.	Enzyme kinetics and inhibition: factors influencing enzyme reaction velocity, steady-state kinetic of enzyme catalyzed reaction, significance of Michaelis-Menten parameters	2
11.	Extension and modification of the Michaelis-Menten mechanism. K_{cat}/K_m and kinetic perfection in enzyme catalysis	2
12.	Kinetics of multi-substrate system-random, sequential, ordered Theorell-chance and the ping-pong mechanisms.	2
13.	Competitive, non-competitive enzyme inhibition, suicide substrates and anti-metabolites.	1
14.	Recent developments: Industrial application of Enzymes	1
15.	Enzyme immobilization methods and application.	1
16.	Restriction endonucleases	1
17.	Enzyme engineering, use of site-directed mutagenesis for detection of enzyme mechanisms	1
18.	Abzymes and ribozymes, Enzyme linking. Biosensors.	1
19.	Diagnostic enzymology: Assay of enzymes in clinical cases	1
20.	Enzymes in Pathogenesis, Enzyme histochemistry and cytochemistry	1
21.	Application of microscopy in enzymology	1
22.	Enzyme immuno diagnostics, Cholinesterase, lipase, amylase, GGT, GPX, arginase, AST, ALT and SDH in diagnosis of diseases of animals. Therapeutic Enzymes.	2
	Total	33



S. No.	Topic	No. of Lectures/ Practicals
Practical		
1.	Estimation of AntioXidant Enzymes (Superoxide dismutase, Glutathione PeroXidase, Catalase, Glutathione S-transferase) from tissue samples	3
2.	Isolation, purification and characterization of enzymes from biological samples.	4
3.	Application of enzymes in competitive bioassays (ELISA, RIA)	2
4.	Determination of Enzyme activity in Native Gel Electrophoresis.	2
5.	Estimation of Diagnostic enzymes from Clinical samples.	2
6.	Application of Restriction enzymes in cloning experiments.	3
	Total	16

I. Course Title : Diagnostic Techniques in Clinical Biochemistry

II. Course Code : BCT 704

III. Credit Hours : 0 + 2

IV. Pre-requisite

Should have studied BCT-605: Clinical Biochemistry of Animals (2+1) or other equivalent courses with similar syllabi/ content at Master's level.

V. Aim of the course

To give exposure about biochemical changes in diseases of animals and current developments of diagnostic techniques in clinical biochemistry.

VI. Practical

Unit I

Scope of diagnostic techniques in disease diagnosis. Fractionation of cell organelles. Molecular basis of cell injury and diseases; Molecular basis of autoimmunity, immunodeficiency, Immunochemical techniques: Immunochemical protein analysis: immunoelectrophoresis, immunofixation and immunoassays. Oncogenesis and tumour markers.

Unit II

Comparative ruminant metabolism, metabolism of various nutrients by micro flora. Post-ruminal digestion of dietary and microbial biomolecules. Metabolic disorders of rumen and recent development in disorders of ruminants associated with protein, carbohydrate, fat (LDL, HDL, VLDL, apoproteins, etc. and triglycerides), mineral and electrolyte metabolism.

Unit III

Photometric methods: spectrophotometry (UV, visible) atomic reflectometry, turbidimetry, nephelometry, spectrofluorometry, atomic emission, etc. Spectrometric methods: AAS, mass spectrometry, nuclear magnetic resonance (NMR), infra-red (IR) spectroscopy.

Unit IV

Functional tests: Nucleic acid extraction, DNA finger printing, micro and mini

satellites, PCR, RT-PCR, RFLP,
genome



Fluorescent In-situ hybridization (FISH),



mapping, DNA microarrays, biomolecular prospecting and molecular designing in clinical biochemistry.

Unit V

Tests for cardiovascular diseases: Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin. Myocardial infarction and shock; enzyme patterns and marker proteins.

Unit VI

Diagnostic use of serum enzyme assays and radioactive isotopes. LFT, KFT and tests for drugs of abuse.

Unit VII

Case Based Learning and selected articles from journals pertaining to disease diagnosis.

VII. Suggested Reading

- Bishop ML, Fody EP and Schoeff LE. 2004. *Clinical Chemistry: Principles, Procedures, Correlations* 5th edition, Lippincott Williams and Wilkins Press
- Nelson DL and Cox MM. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.
- Kaneko JJ, Harvey JH and Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press.
- Voet D, Voet JG and Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley and Sons.
- Racek J and Rajdl D. 2016. *Clinical Biochemistry*. 1st Ed. Karolinum Press.

Course Outline

Sl. No.	Topics	No. of Practical
Practical		
1.	Scope of diagnostic techniques in disease diagnosis. Fractionation of cell organelles	2
2.	Molecular basis of cell injury and diseases	1
3.	Molecular basis of autoimmunity, immunodeficiency, Immunochemical techniques -Immunochemical protein analysis-immunoelectrophoresis, immunofixation and immunoassays	3
4.	Oncogenesis and tumour markers	2
5.	Comparative ruminant metabolism, metabolism of various nutrients by micro flora	1
6.	Postruminal digestion of dietary and microbial biomolecules.	1
7.	Metabolic disorders of rumen and recent development in disorders of ruminants associated with protein	1
8.	Metabolic disorders of rumen and recent development in disorders of ruminants associated with carbohydrates	2
9.	Metabolic disorders of rumen and recent development in disorders of ruminants associated with fat, mineral and electrolyte metabolism.	2
10.	Photometric methods: spectrophotometry (UV, visible) atomic reflectometry, turbidimetry, nephelometry, spectrofluorimetry, atomic emission, etc.	1
11.	Spectrometric methods: AAS, mass spectrometry, nuclear magnetic resonance (NMR), infra-red (IR) spectroscopy.	1



S. No.	Topics	No. of Practical
12.	Functional tests: Nucleic acid extraction, DNA finger printing, micro and mini satellites	1
13.	PCR, RT-PCR, RFLP, Fluorescent In-situ hybridization (FISH)	1
14.	Genome mapping, DNA microarrays	1
15.	Biomolecular prospecting and molecular designing in clinical biochemistry	1
16.	Tests for cardiovascular diseases: Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin	2
17.	Myocardial infarction and shock; enzyme patterns and marker proteins.	1
18.	Diagnostic use of serum enzyme assays	1
19.	Radioactive isotopes in radiodiagnosis	1
20.	Liver function tests (LFT)	1
21.	Liver function tests (KFT)	1
22.	Tests for drugs of abuse	1
23.	Case Based Learning and selected articles from journals pertaining to disease diagnosis	1
	Total	30

I. Course Title : Recent Trends In Biochemical Techniques And Instrumentation

II. Course Code : BCT 705

III. Credit Hours : 2 + 1

IV. Pre-requisite

Should have studied VBC-604: Analytical Techniques and Instrumentation in Biochemistry (2+1) or other equivalent courses with similar syllabi/ content at Master's level.

V. Aim of the course

To expose students about current developments in techniques used in animal biochemistry.

VI. Theory

Basic components of the Instrument, principle and applications of the following analytical techniques:

Unit I

Separation, purification and quantification of biomolecules:

Gas Chromatography (GC) and High performance liquid chromatography (HPLC)
- Types of pumping systems and their essential features; Column packing; Normal and modified stationary phases; Detection systems;

Blotting techniques (Western), 2-D gel electrophoresis – IPG-DALT, IEF-SDS PAGE

Unit II

Structural elucidation of biomolecules and quantification:

NMR spectrometry, X-ray crystallography, ESR Spectroscopy, CD Spectroscopy and Mass Spectrometry (LC/ MS, GC/ MS, MALDI-TOF, SELDI-TOF).

Microscopy – Electron microscopy – SEM/ TEM/ STEM; Atomic force microscopy (AFM) or scanning force microscopy (SFM); Scanning Tunnelling Microscope (STM).

**Unit III**

Other Analytical techniques: Radiotracer techniques: Radiotracers in study of biological processes.

Tissue Culture: Setting up a cell culture laboratory; Principles of aseptic handling;; Cell line derivation; Cell freezing and quantitation; Contamination control; Cell freezing and thawing; Cell culture media constituents and their functions; Designing serum-free medium. Techniques for short-term and long-term culture of organs. Any other current technique with relevance to biochemistry.

VII. Practical

Demonstration of feasible techniques available at the department/ institute/ other institutes.

VIII. Suggested Reading

- Burtis CA, Ashwood ER and Burns DE. 2014. *Tietz Textbook of clinical Biochemistry and Molecular Diagnostics*. 5th Edition. Elsevier
- Nelson DL and Cox MM. 2017. *Lehninger's Principles of Biochemistry*. 7th Ed. Freeman.
- Garrity S. 1999. *Experimental Biochemistry*. 3rd Ed. Academic Press.
- Gowenlock AH. 2002. *Varley's Practical Clinical Biochemistry*. 6th Ed. CBS.
- George W Latimer Jr. 2016. *Official Methods of Analysis of AOAC International*, 20th Ed. AOAC International.
- Holme DJ and Hazel P. 1998. *Analytical Biochemistry*. 3rd Ed. Longman.
- Wilson K and Walker J. (Eds.). 2010. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th Ed. Cambridge Univ. Press.
- Willard *et al.* 1988. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Pub Co.
- Selected articles from standard journals.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Gas Chromatography (GC) - Types of pumping systems and their essential features;S Column packing; Normal and modified stationary phases; Detection systems	4
2.	High performance liquid chromatography (HPLC) - Types of pumping systems and their essential features; Column packing; Normal and modified stationary phases; Detection systems	4
3.	Western blotting of proteins	1
4.	2-D gel electrophoresis of proteins – IPG-DALT, IEF-SDS PAGE	1
5.	NMR spectrometry	2
6.	X-ray crystallography	2
7.	ESR Spectroscopy	2
8.	CD Spectroscopy	2
9.	Mass Spectrometry (LC/ MS, GC/ MS, MALDI-TOF, SELDI-TOF)	3
10.	Electron microscopy – SEM/ TEM/ STEM	3
11.	Atomic force microscopy (AFM)	1
12.	Scanning Tunneling Microscopy (STM)	1
13.	Radiotracers in study of biological processes	2
14.	Tissue Culture: Setting up a cell culture laboratory; Principles of aseptic handling;; Cell line derivation; Cell freezing and quantitation; Contamination control; Cell freezing and thawing; Cell culture media	



S. No.	Topic	No. of Lectures/ Practicals
	constituents and their functions; Designing serum-free medium.	
	Techniques for short-term and long-term culture of organs, etc.	3
15.	Any other current technique	1
	Total	32
Practical		
	1. Gas Chromatography (GC)	1
	2. High performance liquid chromatography (HPLC)	1
	3. Western blotting of proteins	1
	4. 2-D gel electrophoresis of proteins	1
	5. NMR spectrometry	1
	6. X-ray crystallography	1
	7. ESR Spectroscopy	1
	8. CD Spectroscopy	1
	9. Mass Spectrometry (LC/ MS, GC/ MS, MALDI-TOF, SELDI-TOF).	1
	10. Electron microscopy – SEM/ TEM/ STEM	1
	11. Atomic force microscopy (AFM)	1
	12. Scanning Tunneling Microscopy (STM)	1
	13. Radiotracers	1
14-16.	Tissue Culture	3
	Total	16

I. Course Title : Developmental Biochemistry

II. Course Code : BCT 706

III. Credit Hours : 2 + 0

IV. Pre-requisite

Should have studied VBC-609: Endocrinology and Reproductive Biochemistry or other equivalent courses with similar syllabi/ content at Master's level.

V. Aim of the course

To understand the developmental processes in embryogenesis and its gene expression.

VI. Theory

Unit I

Biochemistry of fertilization - Sperm-egg structure - Acrosome reaction and capacitation, Sperm-egg interaction –receptors involved; sperm entry into egg; zygote formation. Formation of multicellular and multi-layered embryo: factors affecting cleavage of zygote; Types of cleavage; blastula formation; gastrulation; neurulation; somite formation and cell migration; factors affecting cell migration; cell-cell interactions and their expression; involvement of extracellular matrix during development(cell movement and regulation of shape); growth factors and their role; organogenesis-biochemistry and molecular biology. Application of "OMICS" techniques in developmental biology.

Unit II

Development and differentiation: Genes involved in the development of Drosophilla and C. elegans and their regulation. Expression of genes during differentiation of



anterior and posterior and dorsal and ventral halves, head; thorax and abdomen. Pattern formation and positional information: Inductive interaction in the development of epithelia and body parts.

VII. Suggested Reading

- Scott F Gilbert. 2010. *Developmental Biology*, 9th edition. Sunderland (MA): Sinauer Associates.
- Scott Freeman 2014. *Biological Science*, 5th edition. Publisher: Benjamin-Cummings Publishing Co.
- Selected articles from standard journals.

Course Outline

S. No.	Title	No. of Lectures
Theory		
1.	Biochemistry of fertilization.	1
2.	Sperm-egg structure. Acrosome reaction and capacitation	3
3.	Sperm-egg interaction –receptors involved; sperm entry into egg; zygote formation.	3
4.	Formation of multicellular and multi-layered embryo: factors affecting cleavage of zygote; Types of cleavage	3
5.	Blastula formation; gastrulation; neurulation; somite formation and cell migration; factors affecting cell migration; cell-cell interactions and their expression; involvement of extracellular matrix during development(cell movement and regulation of shape); growth factors and their role;	5
6.	Organogenesis-biochemistry and molecular biology.	3
7.	Application of “OMICS” techniques in developmental biology.	3
8.	Development and differentiation: Genes involved in the development of <i>Drosophilla</i> and <i>C. elegans</i> and their regulation	4
9.	Expression of genes during differentiation of anterior and posterior and dorsal and ventral halves, head; thorax and abdomen.	4
10.	Pattern formation and positional information: Inductive interaction in the development of epithelia and body parts.	3
	Total	32

I. Course Title : Bioinformatics Tools in Biochemistry

II. Course Code : BCT 707

III. Credit Hours : 1 + 1

IV. Pre-requisite

Should have studied VBC-611: Introduction to Bioinformatics and Computational Biology or other equivalent courses with similar syllabi/ content at Master’s level.

V. Aim of the course

To impart knowledge of Bioinformatics applicable to biochemistry

VI. Theory

Unit I

Biological databases, nucleic acid and protein sequence databases; Pair wise sequence alignment; global and local alignments, matrices, gap penalties; Multiple sequence



alignment and phylogenetic analysis-methods and programs

Unit II

Genome sequencing using next generation sequencing (NGS) technologies, sequence assembly and comparison, human genome, livestock, bacterial and viral genomes, Computational gene discovery; Gene and promoter prediction; Microarray technology: basic concept and application

Unit III

Protein structure- secondary and tertiary structure prediction; Homology and ab-initio based tertiary structure prediction; Structure validation tools, Ramachandran Map; protein motifs and domain prediction; RNA folding and secondary structure predictions

Unit IV

Metabolomics: concepts and principles; Nutrigenomics: bioinformatics in nutrition and health; Pharmacogenomics: introduction, applications, current and future perspectives

VII. Practical

- Practical application of NCBI resources
- Web based tools: Expasy, SwissProt, EBI
- Perform local alignment using different BLAST variants
- Multiple sequence alignment using ClustalW, T Coffee
- Analysis packages-commercial databases and packages, GPL software for Bioinformatics
- Database searching
- Phylogenetic analysis by PHYLIP and MEGA tools
- Protein structure visualization tools: RASMOL, SWISSPDB viewer,
- Homology modelling and structure validation of protein structures
- Tools for protein secondary and tertiary structure prediction- SANJIVNI, BHAGIRATH, SWISS Model, MODELLER, ROSETTA, I-TASSER, etc.
- Biomolecule chemical structure creation and modification using ChemSketch

VIII. Suggested Reading

- *Essential bioinformatics* 2006. Xin Xiong. Cambridge University Press
- *Discovering Genomics, Proteomics and Bioinformatics* 2007. A. Malcolm Campbell and Laurie J Heyer. Benjamin Cummings.
- *Proteins: Structures and Molecular Properties* 1993. Creighton TE. W.H. Freeman.
- *Bioinformatics: Sequence and Genome Analysis* 2001. Mount DW. Cold Spring Harbor.
- *Introduction to Computational Molecular Biology* 1997. Setubal Joao and Meidanis Joao. PWS Publishing Company.
- *Bioinformatics: Concepts, Skills and Applications* 2004. Rastogi SC, Mendiratta N and Rastogi P. CBS.
- *Principles of Genome Analysis and Genomics* 2003. SB. Primrose and R.M. Twyman, Blackwell Publishing.
- *Molecular Analysis and Genome Discovery* 2004. Ralph Rapley and Stuart Harbron (Eds.), John Wiley and Sons.
- *Bioinformatics* 2001. Andreas D. Baxevanis and B. F. Francis Ouellette (Eds.).
- Online Resources available on Internet and Selected articles from standard journals.

**Course Outline**

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Biological databases: nucleic acid and protein sequence databases	1
2.	Pair wise sequence alignment, global and local alignments, matrices, gap penalties	1
3.	Multiple sequence alignment: methods and programs	1
4.	Phylogenetic analysis: methods and applications	1
5.	Genome sequencing technologies-traditional and next generation sequencing (NGS)	1
6.	Assembly and comparison of genome: Human genome, livestock and bacterial genomes	1
7.	Computational gene discovery, Gene and promoter prediction	1
8.	Microarray technology: basic concept and application	1
9.	Protein structure- secondary and tertiary structure prediction	1
10.	Homology and ab-initio based tertiary structure prediction	1
11.	Protein structure validation tools, Ramachandran Map	1
12.	Protein motifs and domain prediction	1
13.	RNA folding and secondary structure predictions	1
14.	Metabolomics: concepts and principles	1
15.	Nutrigenomics: bioinformatics in nutrition and health	1
16.	Pharmacogenomics: introduction, applications, current and future perspectives	1
	Total	16
Practical		
1.	Practical application of NCBI resources	3
2.	Web based tools: Expasy, SwissProt, EBI	1
3.	Local alignment using different BLAST variants	2
4.	Multiple sequence alignment using ClustalW, T Coffee	1
5.	Commercial bioinformatics databases and packages, GPL software for Bioinformatics	2
6.	Database searching	1
7.	Phylogenetic analysis by PHYLIP and MEGA tools	1
8.	Protein structure visualization tools: RASMOL, SWISSPDB viewer, UCSF ChimeraX	1
9.	Homology modelling and structure validation of protein structures	1
10.	Practice on tools for protein secondary and tertiary structure prediction: SANJIVNI, BHAGIRATH, SWISS Model, MODELLER, ROSETTA, I-TASSER, etc.	2
11.	Biomolecule chemical structure creation and modification using ChemSketch	1
	Total	16

- I. Course Title : Environmental and Toxicological Biochemistry**
II. Course Code : BCT 708
III. Credit Hours : 2 + 0
IV. Aim of the course



To impart awareness on

environmental pollutants and toxicants
affecting livestock



and poultry; Clinical Biochemistry in Toxicology.

V. Theory

Unit I

Introduction to environmental pollutants and toxicants, their classification, sources and impact on animal health including poultry. Effect of various pollutants on animal and microbial metabolism; their detoxification mechanism in animals and birds, Biochemical basis of pollutant tolerance. Soil enzymes, their source and role in environment, methods for measurement of pollution, Pesticide residues and its effect on animal health. environmental chemo-dynamics. Heavy metals and metalloids, industrial chemicals and biotoxins on animal health and productivity.

Unit II

Water pollution, biochemical basis for measuring water pollution, chemical properties of water-physical, chemical and biological treatment process. Biochemical oxygen demand and water quality assessment. Biochemical aspects of water quality.

Unit III

Global environmental issues in the light of biochemistry, methanogenesis and role of ruminants, global warming, green house gases, acid rain and their effects on animal health and productivity.

Unit IV

Distribution and storage of toxicants in animal body, target organ toxicity, biotransformation and elimination of toxicants, methods for measurement of toxin level in animals.

Unit V

Clinical Biochemistry in Toxicology- Hepatotoxicity and biochemical changes due to hepatotoxicity, Nephrotoxicity and its effect, Effects of toxins on lungs, respiratory tract, endocrine system, nervous system, erythrocyte and haematopoietic system. Toxins affecting haemoglobin and oxidative metabolism.

VI. Suggested Reading

- Casarett, Louis J.; Doull, John. *Casarett and Doull's Toxicology: The Basic Science of Poisons* 8th ed.: New York: McGraw-Hill, 2013. ISBN:9780071769235
- Hayes AW, Kruger CL. *Hayes' principles and methods of toxicology* 6th ed. ISBN:9781842145364
- Kaneko JJ, Harvey JW and Bruss ML. *Clinical Biochemistry of Domestic Animals*, Academic press, ISBN 13:978-0-12-370491-7.
- Selected articles from journals.

Course Outline

S. No.	Topic	No. of Lectures
Theory		
1	Introduction to environmental pollutants and toxicants, their classification	2
2	Sources and impact of pollutants and toxicants on animal health including poultry	2
3	Effect of various pollutants on animal and microbial metabolism	2



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S. No.	Topic	No. of Lectures
4	Detoxification mechanism in animals and birds	2
5	Biochemical basis of pollutant tolerance	1
6	Soil enzymes, their source and role in environment	1
7	Methods for measurement of pollution	1
8	Pesticide residues and its effect on animal health	1
9	Environmental chemo-dynamics	1
11	Heavy metals and metalloids, industrial chemicals and biotoxins on animal health and productivity.	2
12	Water pollution, biochemical basis for measuring water pollution	1
13	Chemical properties of water-physical, chemical and biological treatment process	1
14	Biochemical oxygen demand and water quality assessment	1
15	Biochemical aspects of water quality	1
16	Distribution and storage of toxicants in animal body	1
17	Target organ toxicity	1
18	Introduction to environmental pollutants and toxicology	1
19	Biotransformation and elimination of toxicants	2
20	Methods for measurement of toxin level in animals	1
21	Clinical Biochemistry in Toxicology	1
22	Hepatotoxicity and biochemical changes due to hepatotoxicity	1
23	Nephrotoxicity and its effect	1
24	Effects of toxins on lungs, respiratory tract, endocrine system, nervous system, erythrocyte and haematopoietic system	2
25	Toxins affecting haemoglobin and oxidative metabolism.	2
	Total	32

I. Course Title : Biochemistry of Diseases and Disorders

II. Course Code : BCT 709

III. Credit Hours : 2 + 0

IV. Pre-requisite

Should have studied BCT-605: Clinical Biochemistry of Animals (2+1) or other equivalent courses with similar syllabi/ content at Master's level.

V. Aim of the course

To update general biochemical concepts for an understanding of biological and chemical principles underlying health, disease and disorders of animals and poultry.

VI. Theory

Unit I

Scope of biochemistry and its applications in understanding the development of diseases and their control.

Biochemical basis of Immunological diseases: Equine immuno- deficiency, neutrophil function defects and its testing, Autoimmune Diseases, Primary Immune Deficiency Diseases, Secondary Immunodeficiency, Hypersensitivity Diseases.

Endocrine diseases arising from over or under production of hormones or from resistance to a particular hormone; Thyroid disorders; Pancreatic disorders; Cushings disease. Hemostatic diseases: Role of Vascular Endothelium, Platelets, Coagulation Proteins, Complexes, and Thrombin Activation; Fibrinolysis, Hereditary and Acquired disorders of hemostasis.



Unit II

Nutritional diseases arising from over or under-nutrition of fat and water soluble vitamins and minerals: Night blindness, pernicious anaemia, iron overload, metabolic disorders of iron metabolism, rickets, osteomalacia, milk fever, swayback, anaemia of Inflammatory disease.

Toxic diseases: Hepatotoxicity, Nephrotoxicity; Toxins affecting: Skeletal and Cardiac muscle; Lung and Respiratory tract; Gastrointestinal tract; Erythrocytes, Haematopoietic system, Hemoglobin and oxidative metabolism; Endocrine system, Nervous system and neuromuscular disorders.

Unit III

Neoplastic diseases: Biochemical changes in development of various neoplasms, Deranged glucose metabolism in cancerous tissue, oncogenesis.

Degenerative diseases: *Neurodegenerative diseases* – including amyotrophic lateral sclerosis, Parkinson's disease, Alzheimer's disease, and Huntington's disease. Molecular basis of cell injury and diseases by Free Radicals.

Unit IV

Biochemical basis of cardiomyopathies in dogs and birds, Prions disease (Scrapie), Bovine spongiform encephalopathy, Reticuloendotheliosis in poultry, Avian Influenza; Retinitis pigmentosa, retinal degeneration and Lysosomal storage diseases in animals.

Comparative medical genetics: Genome sequences, Disease Gene Mapping, Genetic diseases, Gene therapy

VII. Suggested Reading

- Charles A Janeway Jr, Paul Travers, Mark Walport and Mark J Shlomchik. 2001. *Immunobiology, The Immune System in Health and Disease*, 5th edition, New York.
- David L Nelson and Cox Michael M. 2017. *Lehninger's Principles of Biochemistry*. 7th Ed. Freeman.
- Kaneko JJ, Harvey JW and Bruss ML. *Clinical Biochemistry of Domestic Animals*, Academic press, ISBN 13:978-0-12-370491-7.
- Kenneth M Murphy and Casey Weaver 2016. *Janeway's Immunobiology*, 9th Edition ISBN: 978-0-815-34505-3.
- Thomas M. Devlin (Ed) 2011. *Textbook of Biochemistry with Clinical Correlations*, John Wiley and Sons.
- Voet D, Voet JG and Pratt CW. 2016. *Fundamentals of Biochemistry of Life at the Molecular Level*. 5th Ed. John Wiley and Sons.
- Selected articles from standard journals.

Course Outline

S. No.	Topic	No. of Lectures
Theory		
1.	Scope of biochemistry and its applications in understanding the development of diseases and their control	1
2.	Biochemical basis of Immunological diseases: Equine immunodeficiency, neutrophil function defects and its testing, Autoimmune Diseases, Primary Immune Deficiency Diseases, Secondary Immuno deficiency, Hypersensitivity Diseases	3
3.	Endocrine diseases arising from over or underproduction of hormones or from resistance to a particular hormone; Thyroid disorders;	

Pancreatic disorders; Cushings



disease.



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S. No.	Title	No. of Lectures
4.	Hemostatic diseases: Role of Vascular Endothelium, Platelets, Coagulation Proteins, Complexes, and Thrombin Activation; Fibrinolysis, Hereditary and Acquired disorders of hemostasis.	2
5.	Nutritional diseases arising from over or under-nutrition of fat and water soluble vitamins and minerals: Night blindness, pernicious anaemia, iron overload, metabolic disorders of iron metabolism, rickets, osteomalacia, milk fever, swayback, anaemia of Inflammatory disease.	4
6.	Toxic diseases: Hepatotoxicity, Nephrotoxicity; Toxins affecting: Skeletal and Cardiac muscle; Lung and Respiratory tract; Gastrointestinal tract; Erythrocytes, Haematopoietic system, Hemoglobin and oxidative metabolism; Endocrine system, Nervous system and neuromuscular disorders.	4
7.	Neoplastic diseases: Biochemical changes in development of various neoplasms, Deranged glucose metabolism in cancerous tissue, oncogenesis.	4
8.	Degenerative diseases: <i>Neurodegenerative diseases</i> – including amyotrophic lateral sclerosis, Parkinson’s <i>disease</i> , Alzheimer’s <i>disease</i> , and Huntington’s <i>disease</i> ; Molecular basis of cell injury and diseases by Free Radicals.	4
9.	Biochemical basis of cardiomyopathies in dogs and birds, Prions disease (Scrapie), Bovine spongiform encephalopathy, Reticuloendotheliosis in poultry, Avian Influenza; Retinitis pigmentosa, retinal degeneration and Lysosomal storage diseases in animals.	5
10.	Comparative medical genetics: Genome sequences, Disease Gene Mapping, Genetic diseases, Gene therapy.	3
	Total	32

I. Course Title : Immuno-biochemistry

II. Course Code : BCT 710

III. Credit Hours : 2 + 0

IV. Aim of the course

To impart knowledge about fundamental principles and applications of immunology and immunochemical research techniques.

V. Theory

Unit I

History and scope of immunology, Cellular basis of immunity-adaptive and non-adaptive immunity, Memory, Specificity and Diversity, Self and non self discrimination, Immune system, Organs, tissues and cells, Cell mediated vs Humoral immunity, Immunoglobulins, Concept of antigen, Immunogen, Adjuvant, Hapten

Unit II

Classes of antibodies, Antibody diversity, Theories of generation of antibody diversity, Monoclonal antibodies, Polyclonal antibodies, Hybridoma, Recombinant antibodies, Single chain and single domain antibodies in immunodiagnostics and immunotherapy, Phage display library, complement system- classical and alternate.

Unit III

Cellular interactions in the immune response, affinity, avidity, B-cell and T-cell



response, major histocompatibility complex, cell mediated immune response, cytokines, Vaccine. Nanoparticles in vaccine development and delivery, Nanomedicine in immunodiagnostics and immunotherapy, Immunoregulation, immunological tolerance, hypersensitivity, innate resistance and specific immunity.

Unit IV

Current immunological techniques: Raising of antisera and antibody purification, Immunodiffusion, Immunoelectrophoresis, immunofluorescence, rocket electrophoresis, Immunological markers and fluorescence-activated cell sorting, Radioimmuno assay (RIA) and different types of ELISA, Immunohistochemistry, Immunoinformatics techniques.

VI. Suggested Reading

- Abbas AK and Lichtman AH. 2003. *Cellular and Molecular Immunology*. 5th Ed. WB Saunders.
- David J Dabbs. 2018. *Diagnostic Immunohistochemistry*. 5th Ed. Elsevier.
- Goldsby RA, Kindt TJ and Osborne BA. 2003. *Immunology*. 4th Ed. WH Freeman.
- Harlow and Lane D. (Eds.). 1988. *Antibodies: A Laboratory Manual*. Cold Spring Harbor Laboratory.
- *Immunochemistry*: Edited by CJ van Oss and MHV van Reganmortel. pp 1069. Marcel Dekker, New York. 1994. ISBN 0 8247 9123 1; TR O'Brien.
- Ivan Roitt (Eds.). 1997. *Essential Immunology* Publisher -Blackwell Scientific Publication, Oxford.
- Kuby J. 1996. *Immunology*. 3rd edition WH Freeman.
- Male D, Brostoff J, Roth DB and Roitt I. 2006. *Immunology*. 7th Ed. Elsevier.
- Manson MM. (Eds.). 1992. *Immunochemical Protocols: Methods in Molecular Biology* Vol. 10- Humana Press Totowa NJ.
- Mariusz Skwarczynski, Istvan Toth. 2017. *Micro and Nanotechnology in Vaccine Development*. 1st ed. Elsevier.
- Mathew Sebastian, Neethu Ninan AK. Haghi. 2012. *Nanomedicine and Drug Delivery*. 1st Ed. Apple Academic Press.
- Selected articles from standard journals.

Course Outline

S. No.	Title	No. of Lectures
Theory		
1.	History and scope of immunology, cellular basis of immunity- adaptive and non-adaptive immunity, memory, specificity and diversity, self and non self-discrimination,	2
2.	Immune system, organs, tissues and cells, cell mediated vs humoral immunity, immunoglobulins	3
3.	Concept of antigen, immunogen, adjuvant, haptan	1
4.	Classes of antibodies, Antibody diversity, theories of generation of antibody diversity,	3
5.	Monoclonal antibodies, polyclonal antibodies, Hybridoma, Recombinant antibodies, Single chain and single domain antibodies in immunodiagnostics and immunotherapy, Phage display library	4
6.	Complement system- classical and alternate.	2
7.	Cellular interactions in the immune response, affinity, avidity, B-cell and T-cell response, major histocompatibility complex, cell mediated immune response, cytokines.	4
8.	Vaccine Nanoparticles in vaccine development and delivery, Nanomedicine in immunodiagnostics and immunotherapy,	3



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S. No.	Topics	No. of Lectures
9.	Immunoregulation, immunological tolerance, hypersensitivity, innate resistance and specific immunity.	2
10.	Current immunological techniques: Raising of antisera and antibody purification,	1
11.	Immunodiffusion, Immuno-electrophoresis, immunofluorescence, rocket electrophoresis	2
12.	Immunological markers and fluorescence-activated cell sorting.	1
13.	Radioimmuno assay (RIA) and different types of ELISA.	2
14.	Immunohistochemistry.	1
15.	Immunoinformatics techniques.	1
	Total	32

I. Course Title : Special Problem

II. Course Code : BCT 711

III. Credit Hours : 0+2

IV. Aim of the course

To provide expertise in handling practical research problem(s).

V. Practical

Short research problem(s) involving contemporary issues and research techniques.

VI. List of Journals

- *Indian Journal of Chemical Technology*
- *Indian Journal of Biochemistry and Biophysics*
- *Indian Journal of Chemistry - Section B*
- *Indian Veterinary Journal*
- *Journal of Chemical Sciences*
- *Journal of Indian Chemical Society*
- *Meat Science - An International Journal*
- *The EMBO Journal*
- *Theriogenology*
- *Trends in Biochemical Sciences*

e-Resources

- www.niscair.res.in/ScienceCommunication (Indian Journal of Biochemistry)
- www.medind.nic.in/iaf/iafm.shtml (Indian Journal of Clinical Biochemistry)
- www.ijcb.co.in (Indian Journal of Clinical Biochemistry)
- www.mcponline.org (Molecular and Cellular Proteomics)
- www.elsevier.com/vj/proteomics (Proteomics Virtual Journal)
- www.elsevier.com (Journal of Proteomics)
- www.elsevier.com (Clinical Biochemistry)
- www.sciencedirect.com/science/journal (Science Direct – Clinical Biochemistry)
- www.jbc.org (Journal of Biological Chemistry)



SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Basic Veterinary Sciences

– Veterinary Biotechnology





Preamble

Considering latest trends in Veterinary Biotechnology four new courses at Doctorate level, i.e. Recent Trends in Cell and Molecular Biology, Diagnostic Platform, Gene Manipulation and Genome Editing and Recent trends in Bioinformatics have been introduced and some courses are reorganized



Course Title with Credit Load

M.V.Sc. in Veterinary Biotechnology

Course Code	Course Title	Credit Hours
BTY 601	Basic and Applied Biotechnology	2+0
BTY 602	Fundamentals of Cell Biology	2+0
BTY 603	Molecular Biology and Genetic Engineering	2+0
BTY 604	Animal Cell Culture–Principles and Applications	2+1
BTY 605	Molecular Diagnostics	2+1
BTY 606	Immunology Applied to Biotechnology	2+1
BTY 607	Introduction to Bioinformatics	2+1
BTY 608	Animal Genomics	2+1
BTY 609	Techniques in Molecular Biology and Genetic Engineering	0+2
BTY 610	Reproductive Biotechnology	2+1
BTY 611	Masters Seminar	1+0
BTY 612	Masters Research	0+30



Course Contents

M.V.Sc. in Veterinary Biotechnology

- I. Course Title** : **Basic and Applied Biotechnology**
II. Course Code : **BTY 601**
III. Credit Hours : **2+0**

IV. Theory

Unit I

History and scope of Biotechnology, Application of Biotechnology in Agriculture, Veterinary Sciences, diagnostics and therapeutics, pharmaceutical industry, food industry, chemical industry and environment, plant tissue culture and its applications

Unit II

Biofermentation, Fermentation technology, aerobic and anaerobic fermentation, Different types of fermentations, Basic design and construction of fermenter, Media sterilization, Upstream and Downstream processing, Microbes and enzymes of industrial importance, Microbial growth kinetics, Immobilized enzymes and cells and immobilization process.

Unit III

Vaccines and their immune response, Types of vaccines: Conventional and new generation vaccine, Subunit vaccine, recombinant vaccines, Vecteded vaccines, DNA vaccine, edible vaccine, DIVA strategy and reverse vaccinology

Unit IV

Biodiversity, genetic diversity, molecular taxonomy, species and population biodiversity, quantifying biodiversity, maintenance of ecological diversity, conservation of biodiversity and conservation of animal genetic resources.

V. Suggested Readings

- Becker JM, Cold Well GA and Zachgo EA. 2007. *Biotechnology a Laboratory Course*. Academic Press.
- Brown CM, Campbell I and Priest FG. 2005. *Introduction to Biotechnology*. Panima.
- Singh BD. 2006. *Biotechnology Expanding Horiozon*. Kalyani

S No.	Topics	Lecture No.
1.	History and scope of Biotechnology, Application of Biotechnology in agriculture, veterinary sciences, diagnostics and therapeutics, pharmaceutical industry, food industry, chemical industry and environment, plant tissue culture and its applications	1-3
2.	Biofermentation	4
3.	Fermentation technology, aerobic and anaerobic fermentation	5
4.	Different types of fermentations	6
5.	Basic design and construction of fermenter	7



S No.	Topics	Lecture No.
6.	Upstream processing- Media sterilization, inoculum preparation and and Downstream processing	8
7.	Microbes and enzymes of industrial importance, Microbial growth kinetics and products.	9
8.	Immobilized enzymes and cells and immobilization process	10
9.	Vaccines and their immune response	11
10.	Types of vaccines -Conventional and new generation vaccine	12-14
11.	Subunit vaccine, recombinant vaccines	15
12.	Vectored vaccines and DNA vaccine and their immune response	16
13.	Edible vaccine, DIVA strategy and reverse vaccinology	17-20
14.	Biodiversity, genetic diversity, molecular taxonomy, species and population biodiversity	21-22
15.	Quantifying biodiversity, maintenance of ecological diversity	23-25
16.	Conservation of biodiversity and conservation of animal genetic resources	26-28

I. Course Title : Fundamentals of Cell Biology

II. Course Code : BTY602

III. Credit Hours : 2 + 0

IV. Aim of the course

Understanding the functions of cell components and cell signal pathways

V. Theory

Unit I

Origin and evolution of cells – from molecules to first cell – from prokaryotes to eukaryotes – from single to multi cellular organisms – Chemical components of a cell – catalysis and use of energy by cells – techniques used to study cells – microscopy – light microscopy – fluorescent microscopy – electron microscopy – confocal microscopy – cell and cell parts separation techniques – ultracentrifugation – flow cytometry – detection of cell parts - antibodies

Unit II

Structure of cell – Plasma membrane – cytoskeleton – Nucleus – Chromosome- Chromosomal DNA packaging and its implications - endoplasmic reticulum – ribosome - mitochondria –Mitochondrial DNA organization - golgi complex – peroxisome - lysosome

Unit III

Cell Membrane transport – transport of small molecules - macromolecules and particles- exocytosis and endocytosis – Nuclear transport –protein synthesis and sorting – endoplasmic reticulum – golgi complex – peroxisomes – lysosomes – lipid synthesis and sorting – Electron transport chain – chemiosmotic coupling - Transport of metabolites across the inner mitochondrial membrane – Mechanism of muscle contraction – cell crawling – functions of keratin and neurofilaments – organelle transport and separation of mitotic chromosome

Unit IV

Cell signaling – modes of cell-cell signaling- steroid hormones and the steroid



receptor super family – Neurotransmitters - Peptide Hormones and Growth Factors
- G Protein-Coupled Receptors - Receptor Protein-Tyrosine Kinases - Cytokine Receptors and Non receptor Protein-Tyrosine Kinases - The cAMP Pathway: Second Messengers and Protein Phosphorylation - Cyclic GMP - Phospholipids and Ca²⁺ - Ras, Raf, and the MAP Kinase Pathway - The JAK/ STAT Pathway - Integrins and Signal Transduction - Regulation of the Actin Cytoskeleton - Hedgehog and Wingless - Notch Signaling – Cell signal network - Feedback and crosstalk and networks of cellular signal transduction – cell cycle – regulators of cell cycle – events of M phase

VI. Suggested Readings

- Lewin B. 2008. *Gene IX*. Jones and Bartlett.
- Primrose SB. 2001. *Molecular Biotechnology*. Panima.
- Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific

S. No.	Topic	No. of Lectures
1.	Origin and evolution of cells from molecules to first cell from prokaryotes to eukaryotes from single to multicellular organisms	1
2.	Chemical components of a cell Catalysis and use of energy by cells	2
3.	Techniques used to study cells Principles and applications of microscopy, light microscopy, fluorescent microscopy, electron microscopy and confocal microscopy, Cell and cell parts separation techniques Principles and applications of ultracentrifugation and flow cytometry Detection of cell parts Primary and secondary antibodies used to detect cell parts	3-4
4.	Structure of cell, Plasma membrane, Cytoskeleton	5
5.	Structure of cell, Nucleus, Chromosome Chromosomal DNA packaging and its implications	6
6.	Structure of cell, Endoplasmic reticulum, Ribosome Mitochondria	7
7.	Structure of cell, Mitochondrial organization, Golgi complex Peroxisome, Lysosome	8
8.	Cell Membrane transport, Transport of small molecules, Macromolecules and particles	9
9.	Cell Membrane transport, Exocytosis and endocytosis Nuclear transport	10
10.	Cell Membrane transport, Protein synthesis and sorting into Endoplasmic reticulum Golgi complex	11
11.	Cell Membrane transport, Protein synthesis and sorting into Peroxisomes, Lysosomes Lipid synthesis and sorting	12-13
12.	Cell Membrane transport, Electron transport chain Chemiosmotic coupling	14
13.	Transport of metabolites across the inner mitochondrial membrane	15
14.	Mechanism of muscle contraction, cell crawling functions of keratin and neurofilaments	16
15.	Cell Membrane transport, organelle transport separation of mitotic chromosome	17
16.	Cell signaling, Modes of cell-cell signaling Steroid hormones and the steroid receptor super family	18
17.	Cell signaling, Neurotransmitters, Peptide Hormones and Growth Factors	19
18.	Cell signaling, G Protein-Coupled Receptors Receptor Protein-Tyrosine Kinases	20



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S. No.	Topic	No. of Lectures
19.	Cell signaling, Cytokine Receptors Non receptor Protein-Tyrosine Kinases	21
20.	Cell signaling, The cAMP Pathway Second Messengers and Protein Phosphorylation	22
21.	Cell signaling, Cyclic GMP Phospholipids and Ca ²⁺	23
22.	Cell signaling Ras, Raf, and the MAP Kinase Pathway The JAK/ STAT Pathway Integrins and Signal Transduction	24
23.	Cell signaling, Regulation of the Actin Cytoskeleton Hedgehog and Wingless Notch Signaling	25-26
24.	Cell signaling, Cell signal network, Feedback and crosstalk Networks of cellular signal transduction	27
25.	Cell cycle, Regulators of cell cycle Events of M phase	28

I. Course Title : Molecular Biology and Genetic Engineering

II. Course Code : BTY 603

III. Credit Hours : 2+0

IV. Aim of the course

Understanding the principles of molecular biology and genetic engineering.

Unit I

History and scope of molecular biology – Discovery of DNA and evidence for DNA as the genetic material - structure of DNA, RNA and proteins – Organization of prokaryotic and eukaryotic genome – Gene transfer in micro organisms like conjugation, transformation, transduction and protoplasmic fusion – DNA replication - genetic code - transcription, RNA processing and alternative splicing - Translation in prokaryotes and eukaryotes - Regulation of gene expression.

Unit II

Enzymes used in molecular biology and recombinant DNA research - Cloning vectors – plasmids, phages, phagemids, cosmids, BAC, YAC - Expression vector – bacterial, viral, baculo and yeast vectors, shuttle vectors - Polymerase chain reaction and different types of PCR - Probes – Synthesis and types, Nucleic acid hybridization and blotting - Construction of gene libraries and cDNA library - Gene mapping and DNA structure analysis.

Unit III

Cloning in bacteria, yeast, plant and animal cells – identification of gene of interest and synthesis of double stranded DNA and complementary DNA - Restriction enzyme digestion – ligation - methods for transfer of cloned DNA - identification and enrichment of recombinant clones - expression of recombinant DNA in prokaryotic and eukaryotic vectors - strategies for purification of expressed protein.

Unit IV

Molecular mechanism of mutation – DNA repair - site directed DNA alterations and gene manipulations - Gene editing techniques - Methods of DNA sequencing - Genetics of tumorigenic region of agrobacteria - Applications of genetic engineering in veterinary science- Ethics, legal issues and safety aspects of genetic manipulation.



V. Suggested Readings

- Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
- Sambrook J and Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
- Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

S. No.	Topic	No. of Lectures
1	History and scope of molecular biology – Discovery of DNA and evidence for DNA as the genetic material	1
2	Structure of DNA, RNA and proteins – Organization of prokaryotic and eukaryotic genome	2
3	Gene transfer in micro organisms like conjugation, transformation, transduction and protoplasmic fusion	3
4	DNA replication - genetic code - transcription, RNA processing and alternative splicing	4-5
5	Translation in prokaryotes and eukaryotes - Regulation of gene expression	6-7
6	Enzymes used in molecular biology and recombinant DNA research	8-9
7	Cloning vectors – plasmids, phages, phagemids, cosmids, BAC, YAC	10-11
8	Expression vector – bacterial, viral, baculo and yeast vectors, shuttle vectors	12-13
9	Polymerase chain reaction and different types of PCR	14-15
10	Probes – Synthesis and types, Nucleic acid hybridization and blotting	16-17
11	Construction of gene libraries and cDNA library - Gene mapping and DNA structure analysis	18
12	Cloning in bacteria, yeast, plant and animal cells – identification of gene of interest and synthesis of double stranded DNA and complementary DNA	19-21
13	Restriction enzyme digestion – ligation - methods for transfer of cloned DNA - identification and enrichment of recombinant clones	22-24
14	Expression of recombinant DNA in prokaryotic and eukaryotic vectors - strategies for purification of expressed protein	25
15	Molecular mechanism of mutation – DNA repair - site directed DNA alterations and gene manipulations	26
16	Gene editing techniques and Methods of DNA sequencing	27-28
17	Genetics of tumorigenic region of agrobacteria	29
18	Applications of genetic engineering in veterinary sciences	30
19	Ethics, legal issues and safety aspects of genetic manipulation	31

I. Course Title : Animal Cell Culture–Principles and Applications

II. Course Code : BTY 604

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the principles and applications of animal cell culture

V. Theory

Unit I

Introduction, History of cell culture development, Methods of sterilization, Different tissue culture techniques including primary culture, Continuous cell lines- anchorage dependent and independent cell lines, Organ culture, Cell bank.



Unit

Different types of cell culture media, Serum, growth supplements, Balanced salt solution, Serum free media, Enzymes used in cell culture, Factors that affecting the growth of cells.

Unit III

Cell culture contaminants, Cryopreservation of primary culture and cell line, Cell cloning, Types of cell culture bioreactor, Cell counting and cytotoxic assays.

Unit IV

Applications of animal cell culture, Hybridoma technology and monoclonal antibody production, Applications of monoclonal antibodies in diagnostic and cancer research, Isolation and culturing of adult and embryonic stem cells, Therapeutic applications of adult stem cells.

VII. Practicals

- Packaging and sterilization of glass and plastic ware for cell culture
- Preparation of reagents and media for cell culture
- Primary chicken embryo fibroblast
- Primary sheep/ goat kidney culture
- Cultivation of continuous cell lines
- Quantification of cells by trypan blue exclusion dye
- Isolation of lymphocytes and cultivation
- Study of effect of toxic chemicals on cultured mammalian cells
- Study of cytopathic effect of virus on mammalian cells
- Cryopreservation of primary cultures and cell lines
- Isolation and culture of stem cells from bone marrow

VIII. Suggested Readings

- Freshney: *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*, 6th Edition.
- Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction, History of cell culture development	1-2
2.	Methods of sterilization	3
3.	Tissue culture techniques- primary culture using various methods	4-5
4.	Continuous cell lines- anchorage dependent and independent cell lines	6
5.	Organ culture	7
6.	Cell bank and role of cell bank.	8
7.	Different types of cell culture media, Serum, growth supplements, balanced salt solution, Serum free media	9-12
8.	Enzymes used in cell culture, Factors that affecting the growth of cells	13
9.	Cell culture contaminants	14
10.	Cryopreservation of primary culture and cell line	15
11.	Cell cloning	16
12.	Types of cell culture bioreactor	17-18
13.	Cell counting and cytotoxic assays	19-21
14.	Applications of animal cell culture	22-24



15. Hybridoma technology and

monoclonal antibody production,



S. No.	Topic	No. of Lectures
16.	Applications of monoclonal antibodies in diagnostic and cancer research	27
17.	Isolation and culturing of adult and embryonic stem cells and therapeutic applications of adult stem cells	28
Practical		
1.	Packaging and sterilization of glass and plastic ware for cell culture	1
2.	Preparation of reagents and media for cell culture	2
3.	Primary chicken embryo fibroblast	3
4.	Primary sheep/ goat kidney culture	4
5.	Cultivation of continuous cell lines	5
6.	Quantification of cells by trypan blue exclusion dye	6
7.	Isolation of lymphocytes and cultivation	7
8.	Study of effect of toxic chemicals on cultured mammalian cells	8
9.	Study of cytopathic effect of virus on mammalian cells	9
10.	Cryopreservation of primary cultures and cell lines	10
11.	Isolation and culture of stem cells from bone marrow	11

I. Course Title : Molecular Diagnostics

II. Course Code : BTY 605

III. Credit Hours : 2+1

IV. Aim of the courses

Understanding the various diagnostics methods using molecular techniques.

V. Theory

Unit I

Introduction, Importance and historical perspective of development of molecular diagnostic technology, Development and optimisation of Nucleic acid detection assays: OIE guidelines, Concept of development of group specific and strain specific nucleic acid-based diagnostics, Basis for selection of gene/ nucleotide sequence of pathogenic organism to target for detection.

Unit II

Types and application of different molecular diagnostic assays. Restriction endonuclease analysis for identification of pathogens, Principle of development of pathogen specific DNA probes, Blotting techniques e.g. Southern and Northern hybridization.

Unit III

Signal, target and probe based amplification techniques, Transcription based amplification (TBA)/ Nucleic Acid Sequence Based Amplification (NASBA)/ Self-Sustaining Sequence Replication (SSSR/ 3SR), Strand Displacement Amplification (SDA), LAMP, Ligase Chain Reaction (LCR)-Prospects and Applications, History of PCR, principle, Cyclic and thermal parameters in PCR, Real time PCR, Variations in PCR, Applications of PCR for diagnosis of infectious diseases of animals and poultry.

Unit IV



Advancements in diagnostic technology platforms including DNA array technology, biosensors, Nanodiagnosics, Mass spectrometry, Molecular cloning, DNA sequencing



including Next generation sequencing, Bead based assays and lateral-flow device technology.

VI. Practicals

- Preparations of buffers and reagents.
- Collection of clinical and environmental samples from animal and poultry farms for molecular detection of pathogens.
- Extraction of nucleic acids from clinical specimens.
- Qualitative and quantitative analysis of extracted nucleic acid.
- Agarose gel electrophoresis of extracted nucleic acids.
- Restriction endonuclease digestion and analysis in agarose electrophoresis.
- Polymerase chain reaction for detection of pathogens in blood and other animal tissues.
- RT-PCR for detection of RNA viruses
- PCR-RFLP for detection and typing of pathogens
- Real time PCR for detection of pathogens in semen and other animal tissues
- DNA fingerprinting for identification of genetic diseases
- PCR based detection of potential pathogens in milk, eggs and meat
- Sanger sequencing using capillary electrophoresis

Suggested Readings

- Elles R and Mountford R. 2004. *Molecular Diagnosis of Genetic Disease*. Humana Press.
- Rao JR, Fleming CC and Moore JE. 2006. *Molecular Diagnostics. Horizon Bioscience in seed lot systems*.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction, importance and historical perspective of development of molecular diagnostic technology	1-2
2.	Development and optimization of nucleic acid detection assays: OIE guidelines	3-4
3.	Concept of development of group specific and strain specific nucleic acid based diagnostics, basis for selection of gene/ nucleotide sequence of pathogenic organism to target for detection	5-6
4.	Types and application of different molecular diagnostic assays	7-8
5.	Restriction endonuclease analysis for identification of pathogens	9-10
6.	Principle of development of pathogen specific DNA probes Blotting techniques e.g. Southern and Northern hybridization	11
7.	Nucleic Acid Sequence Based Amplification (NASBA)-Prospects and Applications	12-13
8.	Historical background of development of PCR and other diagnostic assays, Signal, target and probe based amplification techniques, Transcription based amplification (TBA)/ Nucleic Acid Sequence Based amplification (NASBA)/ Self-Sustaining Sequence Replication (SSSR/ 3SR), Strand Displacement Amplification (SDA), LAMP, Ligase chain reaction (LCR) - Prospects And Applications PCR principle, cyclic and thermal parameters in PCR, Real time PCR, Variations in PCR, application of PCR for diagnosis of infectious diseases of animals and poultry	14-17
9.	Real-time PCR and its application in diagnosis	18-19
10.	Advancements in diagnostic technology platforms	20
11.	DNA array technology	21



S. No.	Topic	No. of Lectures/ Practicals
12.	Nano-diagnostics	22-23
13.	Biosensors	24
14.	Mass spectrometry in disease diagnosis.	25
15.	Molecular cloning	26
16.	Bead based assays	27
17.	DNA sequencing including Next generation sequencing	28-29
18.	Lateral-flow devices and its applications in diagnosis	30
Practical		
1.	Preparation of buffers and reagents	1
2.	Extraction of nucleic acids and qualitative and quantitative analysis of Nucleic acid	2-3
3.	Agarose gel electrophoresis of Nucleic acids.	4
4.	Amplification of pathogen specific gene using PCR.	5-6
5.	Different types of PCR including RT-PCR, nested PCR, etc.	7-9
6.	Real-time PCR	10
7.	PCR-RFLP	11-12
8.	DNA fingerprinting for identification of genetic diseases	13
9.	Sanger sequencing using capillary electrophoresis	14-16

I. Course Title : Immunology Applied to Biotechnology

II. Course Code : BTY 606

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the basic immunology and various immunoassays

V. Theory

Unit I

Introduction, Principles of immunology, Immune system, Immune response, Major histocompatibility complex: Structure, Functions and gene organization and its association with disease and resistance; Immunity against infectious agents of animals; Immunological tolerance; Autoimmunity; Techniques used in biotechnology.

Unit II

Immunoglobulins: Isotype, Allotype and Idiotype; Antibody production and purification; Application of antibodies in purification, Immunoblotting; Expression of immunoglobulin genes in plants and production of antibodies; Cytokines: classification, Structure, Functions; Industrial production of cytokines and interferon.

Unit III

Application of antibodies in chemiluminescence and fluorescence assay used for identification of recombinant genes; Antibody based nucleic acid probes and their applications; Immunoinformatics; Transgenic animals and cellular chimeras; Immunodiagnostic tests: Agar gel precipitation, Agglutination reaction based tests, various types of immunoassays, immunofiltration tests, flow cytometry in disease diagnosis.

Unit IV



Chimeric and humanized
antibodies; Modern

monoclonal

antibodies,

Recombinant



uses of antibody: Biosensors, Catalysis, *in vivo* imaging, Microarrays, Proteomics; Cancer immunity and its immunotherapy.

VI. Practicals

- Agar gel immunodiffusion test; latex agglutination test
- Immunofiltration assay
- Immunodiffusion assays
- Flow cytometry
- Immuno-electrophoresis.
- Fluorescent antibody test.
- Enzyme immunoassays including various types of ELISA & Immunoblotting.
- Affinity chromatography
- Lymphocyte proliferation assay
- Cultivation of normal lymphocytes and myeloma cell line.
- Somatic cell hybridization and production of hybridoma.
- Screening of hybrids for production of monoclonal antibodies
- Bioinformatics tools for immunological research

VII. Suggested Readings

- Kindt TJ, Goldsby RA and Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.
- Male D, Brostoff J, Roth DB and Roitt I. 2006. *Immunology*. Elsevier.
- Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to principles of immunology, immune system and immune response	1
2.	Major histocompatibility complex: its structure, functions and gene organization	2
3.	MHC and its association with disease and resistance	3
4.	Immunity against infectious agents of animals	4
5.	Immunological tolerance	5
6.	Autoimmunity: mechanism and control	6
7.	Techniques used in biotechnology	7
8.	Immunoglobulins and its type: Isotype, Allotype and Idiotype	8
9.	Antibody production and purification	9
10.	Application of antibodies in purification	10
11.	Immunoblotting: principle and applications	11
12.	Expression of immunoglobulin genes in plants and production of antibodies	12
13.	Cytokines: classification, structure, functions	13
14.	Industrial production of cytokines and interferon	14
15.	Application of antibodies in chemiluminescence and fluorescence assay for identification of recombinant genes	15
16.	Antibody based nucleic acid probes and their applications	16
17.	Immunoinformatics: concept and application	17
18.	Transgenic animals and cellular chimeras	18
19.	Immunodiagnostic tests: agar gel precipitation, agglutination reaction based assays	19
20.	Various types of Immunoassays, immunofiltration tests, flow cytometry in disease diagnosis	20
21.	Chimeric and humanized monoclonal antibodies	21



S. No.	Topic	No. of Lectures/ Practicals
22.	Recombinant antibodies: production and application	22
23.	Modern uses of antibody: biosensors, catalysis, <i>in vivo</i> imaging, microarrays, proteomics	23
24.	Cancer immunity and its immunotherapy	24
Practical		
1.	Agar gel immunodiffusion test; latex agglutination	1
2.	Immunofiltration assay	2
3.	Flow cytometry	3
4.	Immuno-electrophoresis	4
5.	Fluorescent antibody test	5
6.	Enzyme immunoassays including various types of ELISA	6
7.	Immunoblotting	7
8.	Affinity chromatography	8
9.	Lymphocyte proliferation assay	9
10.	Cultivation of normal lymphocytes and myeloma cell line	10
11.	Somatic cell hybridization and production of Hybridoma	11
12.	Screening of hybrids for production of monoclonal antibodies	12
13.	Bioinformatics tools for immunological research	13

I. Course Title : Introduction to Bioinformatics

II. Course Code : BTY 607

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the various databases and packages used in Bioinformatics.

V. Theory

Unit I

Introduction, Database searching - Biological Data Acquisition, Retrieval methods for DNA sequence, protein sequence and protein structure information, General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum) Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches.

Unit II

DNA sequence analysis, Progressive and hierarchical algorithms for MSA multiple sequence alignment, Local versus global. Distance metrics. Similarity and homology. Scoring matrices. Dynamic programming algorithms, Needleman-wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA, BLAST and PSI BLAST. Multiple Sequence Alignment and software tools for pairwise and multiple sequence alignment; Genome Analysis: Whole genome analysis, Viral vector resources, cDNA libraries and EST, EST analysis, EST contigs resources, Phylogeny: Phylogenetic analysis, Definition and description of phylogenetic trees



and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method], Comparative genomics, orthologs, paralogs.

Unit III

Secondary database searching, Introduction to concept of secondary data bases and their applications, Genome databases at NCBI, SANGER, TIGR, EBI, AGD and T (Animal genome database and tool), Introduction to animal genome research, RNA databases, protein structural databases, Building search protocol, Introduction to concept chemoinformatics computer aided drug Design–basic principles, Docking, QSAR.

Unit IV

Analysis packages–commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools.

VI. Practicals

- Usage of NCBI resources
- Retrieval of sequence/ structure from databases
- Visualization of protein structures
- Protein structure modeling/ predictions
- Protein antigenicity predictions
- Docking of ligand receptors
- BLAST exercises.
- Multiple sequence alignment and construction of phylogenetic tree

VII. Suggested Readings

- Attwood TK and Parry-Smith DJ. 2003. *Introduction to Bioinformatics*. Pearson Education.
- Rastogi SC, Mendiratta N and Rastogi P. 2004. *Bioinformatics: Concepts, Skills and Applications*. CBS.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to bioinformatics, concept and history of databases, various primary databases resources	1-4
2.	Nucleic acid databases and their variants	5
3.	Protein databases and its variants	6
4.	Specialized genomic resources	7
5.	DNA sequence analysis, introduction to concept indel, identity, mutations, gaps and penalties	8-9
6.	cDNA library, its applications, EST, gene contings, EST databases, EST analysis tools, sequence assembly tools and clustering EST libraries	10-12
7.	Gene cloning vectors, their databases, tools and resources	13
8.	Similarity vs homology, local and global alignments	14
9.	Introduction to the concept of pair wise sequence alignment and multiple sequence alignment, difference between pair wise sequence alignment and multiple sequence alignment, introduction to various algorithms used in pair wise sequence alignment and multiple sequence alignments	15-16
10.	Applications of phylogenetic analysis, type of phylogenetic trees	17-18



S. No.	Topic	No. of Lectures/ Practicals
11.	Introduction to methods/ matrices used for construction of phylogenetic trees use of concept bootstrap value	19
12.	Introduction to concept secondary database, their applications	20
13.	Genome databases, animal genome databases	21
14.	RNA database and their variants with applications	22
15.	Building search protocols, use of search tools for homology/ similarity identification	23
16.	Secondary protein databases, their applications, protein sequence structure relationship and patterns protein folding	24-25
17.	Introduction to chemoinformatics and its applications, Applications of computer aided drug designing	26
18.	Basic concept of computer aided drug designing	27
19.	Structure based computer aided drug designing, ligand based computer aided drug designing, databases searching, de novo drug designing	28
20.	Commercial databases and packages	29
21.	GPL software for Bioinformatics	30
22.	Web based analysis tools	31
23.	Applications of bioinformatics in veterinary clinical research	32
Practical		
1.	Usage of NCBI resources, its variants and specialized databases	1-2
2.	Retrieval of sequence/ structure from databases, retrieval of nucleic acid sequences and retrieval of protein sequence and structure studies	3-4
3.	Proteins structure visualization, prediction using software and tools	5-6
4.	Protein modelling.	7
5.	Protein antigenicity prediction tools	8
6.	Using of ligand database tools and ligand docking	9-10
7.	RNA database searching	11
8.	BLAST searching tools generalized and specialized searches	12
9.	Pair wise sequence alignment, multiple sequence alignment, phylogenetic analysis	14-16

I. Course Title : Animal Genomics

II. Course Code : BTY 608

III. Credit Hours : 2 + 1

IV. Aim of the course

Understanding the gene mapping and DNA markers in livestock improvement

V. Theory

Unit I

Historical perspective, Genome organization in eukaryotes-Chromosome numbers in farm animals – Physical and molecular structure of chromosomes -Chromosome abnormalities– High order structures, Cohesions and condensins in chromosome structure. SMC proteins –Importance of repetitive DNA –Classical satellites, microsatellites and mini satellites- SINES and LINES- Minisatellite and microsatellite based fingerprinting techniques.

Unit II

Importance of gene mapping in livestock, Methods and techniques used for gene



mapping, Physical mapping, Linkage analysis, Cytogenetic techniques, FISH technique in gene mapping, Somatic cell hybridization, Radiation hybrid maps, *in-situ* hybridization, Comparative gene mapping.

Unit III

DNA markers – Properties of DNA markers- RFLPs – Minisatellite and Microsatellite markers –PCR based markers- RAPD, PCR-RFLPs, Allele specific – PCR, SSCP, STMS markers, DAMD-PCR, ARMS PCR, AP-PCR, RAMPO, AFLP, SNP, EST, etc. Genetic characterization based on DNA markers, Genetic distance analysis, Quantitative Trait Loci (QTL), Applications of DNA markers in livestock improvement- Marker Assisted Selection (MAS) – Marker Assisted Introgression – Parentage determination – SNP chips - Genomic selection based on SNP typing – Methods of genome editing –ZFN, TALENS, Meganucleases and CRISPR –Cas. Role of genome editing in livestock improvement.

Unit IV

Genome sequencing- Next Generation Sequencing – Metagenomics –RNASeq analysis-Exome sequencing and ddRAD sequencing for genome wide SNP detection- Current status of whole genome sequencing and gene maps of livestock, Role of MHC in disease resistance, Genes influencing production traits, Mitochondrial DNA of farm animals, Evolutionary significance, Applications of genome analysis in animal breeding.

VI. Practicals

- Chromosome preparation (normal karyotyping, different types of banding) in farm animals
- Isolation and purification of animal genomic DNA from blood lymphocytes
- Analysis of DNA by agarose or polyacrylamide gel electrophoresis
- Checking the quality and quantity of genomic DNA
- Restriction digestion and analysis
- Southern hybridization
- DNA testing by microsatellite markers
- Techniques for revealing polymorphism- RFLP, SSCP, AFLP, Microsatellites, SNP chips
- Genomic DNA cloning or cDNA cloning
- Differentiation of tissues of different species by mitochondrial genome analysis.
- NGS data analysis- metagenome, RNASeq, exome and ddRAD sequence data by bioinformatics software

VII. Suggested Readings

- Gibson G and Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.
- Primrose SB and Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.
- Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II. Wiley- CVH.

S. No.	Topic	No. of Lectures/ Practicals
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History

1. Historical perspective, Genome organization in eukaryotes- Chromosome numbers in farm animals – Physical and molecular structure of chromosomes -Chromosome abnormalities in farm animals 1-2



S. No.	Topic	No. of Lectures/ Practicals
2.	High order structures, Role of cohesions and condensins in chromosome structure- SMC proteins	3-4
3.	Importance of repetitive DNA –Classical satellites, microsatellites and mini satellites-SINES and LINES- Minisatellite and microsatellite based fingerprinting techniques	5-6
4.	Importance of gene mapping in livestock, methods and techniques used for gene mapping	7
5.	Physical mapping- cytogenetic techniques, FISH technique in gene mapping,	8
6.	Gene mapping by somatic cell hybridization.	9
7.	Radiation hybrid maps for gene mapping	10
8.	Linkage analysis -comparative gene mapping.	11
9.	DNA markers – Properties of DNA markers- RFLPs – Minisatellite and Microsatellite markers –PCR based markers- RAPD, PCR-RFLPs, Allele specific – PCR, SSCP, STMS markers, DAMD-PCR, ARMS PCR, AP-PCR, RAMPO, AFLP, SNP, EST, etc.	12-13
10.	Genetic characterization based on DNA markers, genetic distance analysis	14
11.	Quantitative Trait Loci (QTL)-Candidate gene approach-QTL mapping approach	15
12.	Applications of DNA markers in livestock improvement- Marker Assisted Selection (MAS)	16
13.	Marker Assisted Introgression –Parentage determination – SNP chips	17
14.	Genomic selection based on SNP typing	18
15.	Methods of genome editing –ZFN, TALENS, Meganucleases and CRISPR –Cas. Role of genome editing in livestock improvement.	19-20
16.	Genome sequencing-Sanger sequencing-Hierarchical shot gun approach	21
17.	Next Generation Sequencing-Pyrosequencing-Semiconductor sequencing-Illumina sequencing-Helicos and SMRT sequencing platforms	22-23
18.	Metagenomics –RNA Seq analysis	24-25
19.	EXome sequencing and ddRAD sequencing for genome wide SNP detection	26-27
20.	Current status of whole genome sequencing and gene maps of livestock	28
21.	Role of MHC in disease resistance	29
22.	Genes influencing production traits	30
23.	Mitochondrial DNA of farm animals, evolutionary significance	31
24.	Applications of genome analysis in animal breeding.	32
Practical		
1.	Chromosome preparation (normal karyotyping, different types of banding) in farm animals	1-2
2.	Isolation and purification of animal genomic DNA from blood lymphocytes	3
3.	Analysis of DNA by agarose gel electrophoresis	4
4.	Analysis of DNA by polyacrylamide gel electrophoresis	5
5.	Checking the quality and quantity of genomic DNA by Spectrophotometer	6
6.	Restriction digestion and analysis	7
7.	Southern hybridization	8
8.	DNA testing by microsatellite markers	9
9.	Techniques for revealing polymorphism- PCR-RFLP	10



S. No.	Topic	No. of Lectures/ Practicals
10.	Single Strand Conformational Polymorphism (SSCP) analysis	11
11.	AFLP, SNP chips	12
12.	Genomic DNA cloning or cDNA cloning	13
13.	Differentiation of tissues of different species by mitochondrial genome analysis	14
14.	NGS data analysis-metagenome, RNASeq, exome and ddRAD sequence data by bioinformatics software	15-16

I. Course Title : Techniques in Molecular Biology and Genetic Engineering

II. Course Code : BTY 609

III. Credit Hours : 0+2

IV. Aim of the course

To develop skill in various molecular biology and genetic engineering techniques

- Isolation of DNA from mammalian cells
- Isolation of bacterial plasmids
- Restriction endonuclease digestion of plasmid and chromosomal DNA
- Agarose gel electrophoresis of RE digested DNA
- PCR using random primers as well as specific primers
- Different types of PCR
- Isolation of mRNA/ RNA, Quantification of nucleic acids
- cDNA synthesis
- Real time polymerase chain reaction
- Synthesis of nucleic acid probes
- Nucleic acid hybridization
- Cloning of bacterial and viral genes into plasmid vectors
- DNA ligation and transformation and confirmation of recombinants
- Purification of recombinant protein
- Polyacrylamide gel electrophoresis (PAGE)
- Western blot analysis

Suggested Readings

- Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
- Sambrook J and Russel DW. 2001. *Molecular Cloning: A Laboratory Manual*. Cold Spring Harbour Lab. Press.
- Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

S. No.	Topic	No. of Lectures/ Practicals
1.	Isolation of DNA from blood and mammalian cells	1-2
2.	Isolation of bacterial plasmids	3-4
3.	Restriction endonuclease digestion of plasmid and chromosomal DNA	5-6
4.	Agarose gel electrophoresis of RE digested DNA	7
5.	Polymerase Chain Reaction using random primers as well as specific primers	8-9
6.	Different types of PCR	10-12



7. Isolation of mRNA/ RNA,

Quantization of nucleic acids



S. No.	Topic	No. of Lectures/ Practicals
8.	cDNA synthesis	15
9.	Real time polymerase chain reaction	16-17
10.	Synthesis of nucleic acid probes and hybridization	18
11.	Cloning of bacterial and viral genes into plasmid vectors	19-20
12.	DNA ligation and transformation and confirmation of recombinants	21-23
13.	Purification of recombinant proteins	24-25
14.	Polyacrylamide gel electrophoresis (PAGE)	26-27
15.	Western blot analysis	28-29

I. Course Title : Reproductive Biotechnology

II. Course Code : BTY 610

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the concept of assisted reproductive technology

V. Theory

Unit I

Assisted Reproductive Technology (ART), History, Role of biotechnology in ART, importance of assisted reproductive technology in human and animals

Unit II

Multiple Ovulation Embryo Transfer (MOET), *in-vitro* fertilization, Micro assisted fertilization, Embryo culture, Micromanipulation of gametes and embryos, preservation of embryos and oocytes

Unit III

Semen sexing technology, Embryo splitting, Different methods of embryo sexing, Transgenic animal production, Application, Limitation and regulatory issues

Unit IV

Somatic cell nuclear transfer of domestic animals and application. Isolation and characterization of embryonic stem cells. Different applications of embryonic stem cells

VI. Practicals

- MOET protocols for domestic animals
- Oocyte and embryo freezing protocol
- Oocyte collection and evaluation from live and slaughter house animals
- *In-vitro* embryo production
- Embryo quality analysis
- Embryo biopsy and embryo sexing

VII. Suggested Reading

- Ball PJH and Peter AR. 2004. *Reproduction in Cattle*. Blackwell.
- Gordon I. 2003. *Laboratory Production of Cattle Embryos*. CABI.
- Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI.



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S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	History, role of biotechnology in Assisted reproductive technology(ART)	1-2
2.	Application of ART in human and animals	3-4
3.	Multiple ovulation embryo transfer (MOET)- donor and recipient selection- synchronization-super ovulation-artificial insemination-embryo flushing- embryo evaluation- recipient management	5-6
4.	Oocyte recovery from slaughter house ovaries and live animals, oocytes evaluation and <i>in-vitro</i> maturation	7-8
5.	<i>In-vitro</i> fertilization of oocytes, <i>In-vitro</i> culture and assessment of embryonic developmental stages	9-11
6.	Micro assisted fertilization	12-13
7.	Micromanipulation of gametes and embryos	14
8.	Preservation of embryos and oocytes	15
9.	Semen sexing technology and semen analysis	16
10.	Embryo splitting	17
11.	Different methods of embryo sexing	18-19
12.	Transgenic animal production, application, limitation and regulatory issues	20-22
13.	Somatic cell nuclear transfer of domestic animals and application	23-25
14.	Isolation and characterization of embryonic stem cells	26-27
15.	Different applications of embryonic stem cells	28
Practicals		
1.	MOET protocols for domestic animals	1-2
2.	Oocyte and embryo freezing protocol	3-4
3.	Oocyte collection and evaluation from live and slaughter house animals	5-6
4.	<i>In-vitro</i> embryo production	7-8
5.	Embryo quality analysis	9
6.	Embryo biopsy and embryo sexing	10



Course Title with Credit Load Ph.D. in Veterinary Biotechnology

Course Code	Course Title	Credit
BTY 701	Genetic Engineering	1+2
BTY 702	Functional Genomics and Proteomics	3+0
BTY 703	Advances in Cell and Molecular Biology	2+0
BTY 704	Diagnostic Platform	1+1
BTY 705	Gene Manipulation and Genome Editing	2+0
BTY 706	Trends in Vaccinology	2+1
BTY 707	Advances in Bioinformatics	1+1
BTY 708	Advances in Reproductive Biotechnology	2+1
BTY 709	Advances in Animal Cell Culture	2+1
BTY710	Industrial Biotechnology	2+1
BTY 711	Rumen and Feed Biotechnology	2 +1
BTY 712	Doctorate Seminar-I	1+0
BTY 713	Doctorate Seminar-II	1+0
BTY 714	Doctorate Research	0+70



Course Contents

Ph.D. in Veterinary Biotechnology

I. Course Title : Genetic Engineering

II. Course Code : BTY 701

III. Credit Hours : 1+2

IV. Aim of the course

Understanding the concept of gene cloning and expression.

V. Theory

Unit I

Cloning vectors- plasmids, Phages, Cosmids, BAC, YAC, Expression vectors-viral, baculo and yeast vectors, Shuttle vectors.

Unit II

Restriction, ligation, Transformation and recombinant selection methods, Construction of genomic and cDNA library, Construction of full length cDNA, Preparation of probe, Nick translation, Random hexamer and nick translation.

Unit III

Linkers, Adapters and cassettes, Screening the library.

Unit IV

Expression of genes, Prokaryotic and eukaryotic expression, Identification of recombinant proteins, Purification of expressed protein.

VI. Practicals

- Preparation of vector
- Restriction enzyme digestion of vector
- Preparation of target DNA and Purification of DNA
- DNA ligation
- Preparation of electro competent cells
- Transformation
- Calculation of transformation efficiency
- Screening by colony PCR
- Selection of recombinant by insert release
- Induction of expressed protein
- Purification of expressed protein
- SDS-PAGE
- Western blotting.

VII. Suggested Readings

- Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA and Struhl K. 2002. *Short Protocols in Molecular Biology*. Wiley



S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Cloning vectors- plasmids, phages, cosmids, BAC, YAC	1-2
2.	Expression vectors- viral, baculo and yeast vectors, shuttle vectors.	3-4
3.	Restriction, ligation, transformation	5-6
4.	Recombinant selection methods	7
5.	Construction of genomic and cDNA library	8
6.	Construction of full length cDNA	9
7.	Preparation of probe	10
8.	Nick translation random hexamer and nick translation	11
9.	Linkers, adapters, Cassettes,	12
10.	Screening the library	13
11.	Expressions of genes, prokaryotic and eukaryotic expression	14-15
12.	Identification of protein, Purification of expressed protein	16
Practical		
1.	Preparation of vector	1-2
2.	Restriction enzyme digestion of vector	3
3.	Preparation of target DNA and Purification of DNA	4-5
4.	DNA ligation	6
5.	Preparation of electro competent cell	7
6.	Transformation	8
7.	Calculation of transformation efficiency	9
8.	Screening by colony PCR	10
9.	Selection of recombinant by insert release	11-12
10.	Induction of expressed protein	13
11.	Purification of expressed protein	14-15
12.	SDS-PAGE	16-17
13.	Western blotting	18-19

I. Course Title : Functional Genomics and Proteomics

II. Course Code : BTY 702

III. Credit Hours : 3+0

IV. Aim of the course

Understanding the principles of functional genomics and proteomics

V. Theory

Unit I

Overview of Mammalian Genome: Mitochondrial genome, Protein coding genes, RNA genes and repeat sequences, Variations in the mammalian genome, Expression of mammalian genome.

Unit II

Overview of Mammalian Transcriptome: Different methods to study gene expression, Single gene analysis, Northern blots, Quantitative PCR, SAGE, MPSS and SSH, Introduction to basic microarray technology, Design of experiments, Types of microarray.

Unit III

Methods to study the mammalian



Genome: Chromosome number evolution in



mammalian species, Chromosome territory, Karyotyping, FISH and Spectral karyotyping, Next Generation sequencing platforms chemistries and their applications, Mutation detection methods for single gene and genome wide scale.

Unit IV

Databases such as NCBI, EBI, Nucleotide, Genome, SNP, Gene, Unigene, Homologene, Protein, etc. under NCBI. Service databases under EBI. Genome browsers, The concept of Comparative genomics, Genome BLAST and BLAT. Proteomics technology, Identification and analysis of proteins by 2D analysis, Mass spectrophotometry, Circular Dischorism, Fluorescence Spectroscopy, NMR and X-ray crystallography, MALDI-TOF, Differential display proteomics, Protein -protein interaction, Yeast two hybrid system and phage display.

VI. Suggested Reading

- Gibson G and Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.
- Primrose SB and Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.
- Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II Wiley- CVH.

S. No.	Topic	No. of Lectures
1.	Overview of Mammalian Genome: Mitochondrial genome	1
2.	Protein coding genes	2
3.	RNA genes and repeat sequences	3
4.	Variations in the mammalian genome	4
5.	Expression of mammalian genome	5
6.	Overview of Mammalian Transcriptome	6
7.	Different methods to study gene expression	7-8
8.	Single gene analysis, Northern blots, Quantitative PCR	9-10
9.	SAGE, MPSS and SSH	11-12
10.	Introduction to basic microarray technology, Design of experiments	13-14
11.	Types of microarray	15-16
12.	Mammalian Genome- Chromosome number, evolution in mammalian species	17
13.	Chromosome territory	18
14.	Karyotyping, FISH and Spectral karyotyping	19
15.	Next Generation sequencing platforms chemistries and their applications	20-21
16.	Mutation detection methods for single gene and genome wide scale	22-23
17.	Databases such as NCBI, EBI	24
18.	Nucleotide, Genome, SNP, Gene, Unigene, Homologene, Protein, etc. under NCBI. Service databases under EBI	25
19.	Genome browsers, The concept of Comparative genomics, Genome BLAST and BLAT	26
20.	Proteomics technology, identification and analysis of proteins by 2D analysis	27-29
21.	mass spectrophotometry,	30
22.	Circular Dischorism	31
23.	Fluorescence Spectroscopy	32-34
24.	NMR and X-ray crystallography	35-37
25.	MALDI-TOF	38-39
26.	Differential display proteomics	40-42
28.	Protein -protein interaction, yeast two hybrid system	43-45
29.	Phage display	46



- I. Course Title : Advances in Cell and Molecular Biology**
II. Course Code : BTY 703
III. Credit Hours : 2 + 0

IV. Aim of the course

Understanding the latest development in cell and molecular biology

V. Theory

Unit I

Cell chemistry and Biosynthesis pathways – Molecular motors of cell biology – Cell signalling – Signal Transduction – Chemotropic Energy Metabolism – Apoptosis pathways.

Unit II

Structure and functions of Prokaryotic and Eukaryotic Operons – Recombination and Genetic variability – Regulation of Gene Expression – Strategies of nuclear Transport – Carrier Proteins and active membrane transport methodologies.

Unit III

Protein Biosynthesis and Transportation – Protein sorting - Enzymes in Molecular Biology – Post transcriptional control strategies – Plasmids in recombinant DNA technology.

Unit IV

RNA interference technology – Insights into Nanobiology – Biosensors – DNA Microarray – Peptide Synthesis – Reverse Genetics.

VI. Suggested Readings

- Lewin B. 2008. *Gene IX*. Jones and Bartlett.
- Primrose SB. 2001. *Molecular Biotechnology*. Panima.
- Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific

S. No.	Topic	No. of Lectures
1.	Cell chemistry and biosynthesis pathway	1
2.	Molecular motors of cell biology	2
3.	Cell signalling	3
4.	Signal transduction	4
5.	Chemotropic energy metabolism	5
6.	Apoptosis pathways	6
7.	Structure and functions of prokaryotic and eukaryotic operons	7-8
8.	Recombination and genetic variability	9
9.	Regulation of gene expression	10
10.	Strategies of nuclear transport	11
11.	Carrier proteins and active membrane transport methodologies	12
12.	Protein biosynthesis	13
13.	Protein transportation	14
14.	Protein sorting	15
15.	Enzymes in molecular biology	16
16.	Post transcriptional control strategies	17
17.	Plasmids in recombinant DNA technology	18
18.	RNA interference technology	19
19.	Insights into nanobiology	20



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S. No.	Topic	No. of Lectures
20.	Biosensor	21
21.	DNA microarray	22-24
22.	Peptides synthesis	25-27
23.	Reverse genetics	28

I. Course Title : Diagnostic Platform

II. Course Code : BTY 704

III. Credit Hours : 1 + 1

IV. Aim of the course

Understanding the concept of various diagnostic platforms.

V. Theory

Unit I

History and evolution of diagnostic platforms- Methods for identifying agents for infection or disease- Point-of-care assays- Point-of-care assays based on proteins- point-of-care assays based on nucleic acids, Principles for specific identification of the analytes or clinical parameters - Various assays for different platform.

Unit II

Catridges- Polymer catridges- Catridge based *in-vitro* diagnostics- Microfluidics/ nanotechnology sensors- Complexity and diversity of samples- Sample preparation- extraction of DNA/ RNA- PCR for marker DNA sequence- POC based on microfluidic chips.

Unit III

Detection principles- Colorimetric- Optical, Electrochemical, Magnetic, Mechanical protein detection methods- Sensitive sensing principles- NASBA- RPA- LAMP with QUASR- Integrated microfluidic system.

Unit IV

Instrumentation for point of care diagnostic platform- Blood protein analyses, the Afinion platform from Axis-Shield- The Verigene® System by Nanosphere- Cepheid's GeneXpert cassette- NorChip- use of smart phone apps for real time monitoring and analysis.

VI. Practicals

- DNA/ protein extraction
- RNA extraction
- Polymerase chain reaction
- NASBA
- RPA
- LAMP
- Microfluidic assay

VII. Suggested Readings

- *Diagnostic Devices with Microfluidics*. 1st Edition. Francesco Piraino, Šeila Selimoviæ. CRC Press
- *Point-of-Care Diagnostics on a Chip*. David Issadore Robert M. Westervelt



S.No.	Topic	No. of Lectures/ Practicals
Theory		
1.	History and evolution of diagnostic platforms	1
2.	Methods for identifying agents for infection or disease, point-of-care assays	2
3.	Point-of-care assays	3
4.	Principles for specific identification of the analytes or clinical parameters, various assays for different platform	4
5.	Catridges, polymer catridges- catridge based <i>in-vitro</i> diagnostics	5
6.	Microfluidics/ nanotechnology sensors, complexity and diversity of samples	6
7.	sample preparation, extraction of DNA/ RNA, PCR for marker DNA sequence	7
8.	POC based on microfluidic chips	8
9.	Detection principles- colorimetric- optical, electrochemical, magnetic	9
10.	Detection principles- colorimetric- optical, electrochemical, magnetic, mechanical protein detection methods	10
11.	Sensitive sensing principles- NASBA- RPA- LAMP with QUASR	11
12.	Integrated microfluidic system	12
13.	Instrumentation for point of care diagnostic platform	13
14.	Blood protein analyses, the Afinion platform from Axis-Shield	14
15.	The Verigene ® System by Nanosphere- Cepheid's GeneXpert cassette	15
16.	NorChip, use of smart phone apps for real time monitoring and analysis	16-17
Practical		
1.	DNA/ protein extraction	1-2
2.	RNA extraction	3
3.	Polymerase chain reaction	4-5
4.	NASBA	6
5.	RPA	7
6.	LAMP	8
7.	Microfluidic assay	9-10

I. Course Title : Gene Manipulation and Genome Editing

II. Course Code : BTY 705

III. Credit Hours : 2 + 0

IV. Aim of the course

Understanding the various method of gene manipulation and genome editing.

V. Theory

Unit I

Genome Overview: Genetic architectures of model organisms: yeast, *C. elegans*, Drosophila, Mouse, Human, Chromosomal and Genomic overviews of cattle, buffalo, sheep, goat, pigs and poultry.

Unit II

Tools to characterize transgene: Identification and characterization of suitable transgene. Vectors used to clone and expression of foreign gene in prokaryotic and

eukaryotic systems. Different expression of transgene. born.



types of promoters for tissue specific Detection of transgene in the new-

**Unit**

Methods of gene transfer: Microinjection of recombinant DNA into fertilized eggs/ stem cells, Transfection of DNA totipotent kerato-carcinoma cells, Electroporation, gene transfer into cultured cells.

Unit IV

Genome editing tools: Zinc finger, TALEN and CRISPR: Their discovery, Types and their mechanism. Applications of these tools for *in vivo* genome engineering. Mono allelic and biallelic gene editing. Screening for genome editing process in cells/ animals. Applications of these tools in animal science for genetic studies, therapeutic potential and transgenic animal as bioreactors. Recent examples of genome edited animals and their applications in animal science.

VI. Suggested reading

- *Human genome editing science, ethics and governance*

S. No.	Topic	No. of Lectures
1.	Genetic architectures of model organisms: yeast, <i>C. elegans</i> , <i>Drosophila</i> , Mouse, human	1-2
2.	Chromosomal and Genomic overviews of cattle, buffalo, yak, Mithun, sheep and goat	3-4
3.	Chromosomal and Genomic overviews of pigs and poultry genome	5
4.	Identification and characterization of suitable transgene	6
5.	Vectors used to clone and expression of foreign gene in prokaryotic systems.	7-8
6.	Vectors used to clone and expression of foreign gene in eukaryotic systems.	9-10
7.	Different types of promoters in prokaryotes and eukaryaotes for tissue specific expression of transgene	11-12
8.	Detection of transgene in the new-born	13
9.	Microinjection of recombinant DNA into fertilized eggs/ stem cells	14-16
10.	Transfection of DNA totipotent/ ES cells and kerato-carcinoma cells,	17-18
11.	Electroporation, gene transfer into cultured mammalian cells.	19-21
12.	Zinc finger and TALEN types and their mechanism	22
13.	CRISPR types and their mechanism	23-24
14.	Applications of these tools for <i>in vivo</i> genome engineering.	25
15.	Mono allelic and biallelic gene editing	26
16.	Screening for genome editing process in cells/ animals.	27
17.	Applications of these tools in animal science for genetic studies, therapeutic potential and transgenic animal as bioreactors.	28
18.	Recent examples of genome edited animals and their applications in animal science	29-30

I. Course Title : Trends in Vaccinology

II. Course Code : BTY 706

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the current trends in vaccine production technologies.



V. Theory

Unit I

Immunity against veterinary infectious agents: Bacteria, Virus, fungi and parasites; Immunoinformatics and its application to epitope mapping of pathogens, etc.; Advancement in vaccinology: Vaccinomics, Adversomics, Systems Vaccinology, reverse vaccinology, Structural Vaccinology and computational vaccinology and its applications.

Unit II

Current trends in vaccine development against animal pathogens; Molecular approaches for vaccine development including: recombinant peptide vaccines, vectored vaccines, Marker vaccines, DNA vaccines, genetically manipulated live vaccines, etc.; Plant expression system based vaccines, idiotype and synthetic peptide based vaccines.

Unit III

Vaccines and Immunotherapeutic for Treating Non-Infectious Diseases: Cancer; obesity, neurodegenerative diseases, addictions, atherosclerosis, etc.; DIVA Vaccines for animal disease; Vaccines for emerging human and animal diseases; Novel immunomodulators and vaccine delivery systems: Immunomodulators including cytokines and new adjuvants; delivery of immunogens through liposomes, microspheres, ISCOMS, nanotechnology based vaccine delivery, etc.

Unit IV

Vaccine formulation: pharmacopeia requirements; Vaccine qualities and its control; Large scale vaccine production technology: cost effectiveness of preventive immunization programmes; Stages of development of vaccine; Clinical trials of vaccine and its regulation; Commercial vaccines available against animal pathogens, its characteristics and immunization schedule; Vaccine stability, Preservation and vaccination failure; Environmental concerns with the use of recombinant vaccines.

VI. Practicals

- Purification of immunoglobulins: gel filtration and ion exchange chromatography
- Hybridoma technique for monoclonal antibody production
- Preparation of gene construct for recombinant and nucleic acid vaccine
- Expression of gene encoding immunogenic protein in prokaryotic/ yeast/ animal cell culture system
- Study of immune response against recombinant vaccine
- Use of modern adjuvants in vaccines
- Isolation and characterization of antigens from viruses, bacteria
- Immunoassays: ELISA, FAT, RIA

VII. Suggested Reading

- Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthc

S. No.	Topic	No. of Lectures/ Practicals
1	Immunity against veterinary infectious agents: bacteria, virus, fungi and parasites	1-3



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topic	No. of Lectures/ Practicals
2	Immunoinformatics and its application to epitope mapping of pathogens, etc.	4
3	Advancement in vaccinology: Vaccinomics and Adversomics	5
4	Systems Vaccinology and Reverse vaccinology	6-7
5	Structural Vaccinology, computational vaccinology and its applications	8
6	Current trends in vaccine development against animal pathogens	9
7	Molecular approaches for vaccine development including: recombinant peptide vaccines, vectored vaccines, Marker vaccines, DNA vaccines, genetically manipulated live vaccines, etc.	10-12
8	Plant expression system based vaccines	13
9.	Idiotypic and synthetic peptide based vaccines	14
10.	Vaccines and Immunotherapeutic for treating non-infectious Diseases: Cancer; obesity, neurodegenerative diseases, addictions, atherosclerosis, etc.	15-16
11.	DIVA Vaccines for animal disease	17
12.	Vaccines for emerging human and animal diseases	18
13.	Novel immunomodulators: Immunomodulators including cytokines and new adjuvants	19-20
14.	Novel vaccine delivery systems: delivery of immunogens through liposomes, microspheres, ISCOMS, nanotechnology based vaccine delivery, etc.	21-23
15.	Vaccine formulation: pharmacopeia requirements	24
16.	Vaccine qualities and its control	25
17.	Large scale vaccine production technology: cost effectiveness of preventive immunization programmes	26
18.	Stages of development of vaccine, clinical trials of vaccine and its regulation	27
19.	Commercial vaccines available against animal pathogens, its characteristics and immunization schedule	28-29
20.	Vaccine stability, preservation and vaccination failure	30-31
21.	Environmental concerns with the use of recombinant vaccines	32
Practical		
1.	Purification of immunoglobulins: gel filtration and ion exchange chromatography	1-2
2.	Hybridoma technique for monoclonal antibody production	3-4
3.	Preparation of gene construct for recombinant and nucleic acid vaccine.	5
4.	Expression of gene encoding immunogenic protein in prokaryotic/ yeast/ animal cell culture system.	6
5.	Study of immune response against recombinant vaccine.	7-8
6.	Use of modern adjuvants in vaccines	9
7.	Isolation and characterization of antigens from viruses, bacteria,	10
8.	Immunoassays: ELISA, FAT, RIA	11

I. Course Title : Advances in Bioinformatics

II. Course Code : BTY 707

III. Credit Hours : 1+1

IV. Aim of the course

To impart an introductory knowledge about the subject of Bioinformatics to the students studying any discipline of science.



V. Theory

Unit I

Introduction to Computational Gene Prediction and Genome annotation Basic concepts in Computational Phylogenetic Analysis, Super trees, consensus trees, tree compatibility. Algorithms for evaluating the tree space; Markov Chain Monte Carlo, genetic algorithms. Evaluation of results from phylogenetic analyses, phylogenetic dating Genome annotation; Gene networks (basic concepts). Completed genomes and bioinformatics approaches to analyze the genomes of Viruses, Bacteria and animals.

Unit II

DNA microarray: understanding of microarray data and correlation of gene expression data to biological processes and computational analysis tools (especially clustering approaches). Methods of Genome sequencing, EST, STS, GSS database and their generation, Whole Genome comparison, RNA folding, RNA loops, conformational study, Whole genome analysis, Whole genome regression and prediction methods, Transcriptome analysis and its applications, Animal QTL databases and SIGENAE analysis of breeding animals genome.

Unit III

Transcriptome and Proteome- General Account; Tools of proteome analysis, Motifs and Folds; Protein structure related databases, Protein Data Bank format, Concepts of B-factor and R-factor, Protein Structural Alignment and Superposition, Structure visualization of proteins. Protein Fold Classification, Protein structure comparison, CATH and SCOP Databases. Protein structure prediction methods. Homology modeling. Molecular Docking and Drug design (Basic concepts) Molecular dynamics and simulation study of protein, Force field concepts.

Unit IV

Protein identification and characterization:- AA CompIdent, TagIdent, PepIdent and MultiIdent, PROSEARCH, PepSea, PepMAPPER, FindPept, introduction to the concept of chemoinformatics, metabolomics and immunoinformatics.

VI. Practicals

- Gene annotation
- Phylogenetic tree construction
- RNA folding
- Genome database searching
- Protein folding and structure predictions
- Analysis of 3D structure of protein using RasMol through command line.
- Molecular Docking of protein and ligand by HEX.
- Analysis of 3D structure of protein and nucleic acid using Cn3D.
- QTL databases

VII. Suggested Readings

- Attwood TK and Parry-Smith DJ. 2003. *Introduction to Bioinformatics*. Pearson Education.
- Rastogi SC, Mendiratta N and Rastogi P. 2004. *Bioinformatics: Concepts, Skills and Applications*. CBS.



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S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to Computational Gene Prediction and Genome annotation	1
2.	Basic concepts in Computational Phylogenetic Analysis, phylogenetic dating genome annotation; Gene networks	2
3.	Completed genomes and bioinformatics approaches to analyze the genomes of Viruses, Bacteria and Animals	3-4
4.	Understanding of microarray data and correlation of gene expression data to biological processes and computational analysis tools	5
5.	Methods of Genome sequencing, EST, STS, GSS database Whole Genome comparison	6-7
6.	RNA folding, RNA loops, conformational study and specialized RNA databases	8
7.	Whole genome analysis, whole genome regression and prediction methods	9
8.	Transcriptome analysis and its applications, Animal QTL databases and SIGENAE analysis of breeding animals genome	10
9.	Tools of proteome analysis, Motifs and Folds; Protein structure related databases, Protein Data Bank format, Concepts of B-factor and R-factor,	11
10.	Protein Structural Alignment and Superposition, Structure visualization of proteins. Protein Fold Classification, Protein structure comparison, CATH and SCOP Databases. Protein structure prediction methods. Homology modeling	12-13
11.	Molecular Docking and Drug design (Basic concepts) Molecular dynamics and simulation study of protein, Force field concepts	14
12.	Protein identification and characterization	15
13.	Introduction to the concept of chemoinformatics, metabolomics and immunoinformatics	16
Practical		
1.	Gene annotation, sequence retrieval specialized searches	1-3
2.	Phylogenetic tree construction and phylogenetic dating	4-5
3.	RNA folding, RNA secondary structure prediction, DNA secondary structure prediction	5-6
4.	Genome database searching, contig preparation	7
5.	Protein folding and structure predictions	8
6.	Analysis of 3D structure of protein using RasMol through command line	9
7.	Molecular Docking of protein and ligand by HEX	10
8.	Analysis of 3D structure of protein and nucleic acid using Cn3D	11
9.	QTL databases	12

I. Course Title : Advances in Reproductive Biotechnology

II. Course Code : BTY 708

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the reproductive techniques in farm animals

V. Theory

Unit I



Micromanipulation of embryos
Transfer(SCNT),

and gametes, Somatic Cell Nuclear



nuclear reprogramming, Transgenic animal production, Combining Transgenic and SCNT, Gene targeting, Genome editing and disease modeling.

Unit II

In vivo Vs *in-vitro* production of embryos, Embryos quality, Transcriptomics, Metabolomic approach, Sperm sexing technologies and their application, Preimplantation genetic diagnosis and screening, Epigenetic reprogramming, Large offspring syndrome.

Unit III

Sources of stem cells, Embryonic stem cells, Spermatogonial stem cells, Induced pluripotent stem cells, Stem cells application in regenerative medicine and disease therapeutics.

Unit IV

Social, Ethical, Religious and regulatory issues related to assisted reproductive technology, Transgenic and stem cells therapy.

VI. Practicals

- Micro assisted fertilization- ICSI
- Embryo biopsy for PGD and sexing
- Sperm quality analysis by flow cytometry
- Embryo quality analysis
- SCNT protocol
- Isolation and characterization of embryonic stem cells
- Gene expression in sperm and embryos

VII. Suggested Reading

- Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Micromanipulation of embryos and gametes, Somatic cell nuclear transfer (SCNT) and Nuclear reprogramming	1-3
2.	Transgenic animal production and SCNT	4-5
3.	Gene targeting	6
4.	Gene editing and disease modelling	7-8
5.	<i>In vivo</i> vs <i>in-vitro</i> embryos	9-10
6.	Embryos quality – Transcriptomics, Metabolomic approach	11-13
7.	Sperm sexing technologies and their applications	14-15
8.	Pre implantation genetic diagnosis and screening	16-17
9.	Epigenetic reprogramming	18
10.	Large offspring syndrome	19-20
11.	Source of stem cells, embryonic stem cells, spermatogonial stem cells	21-23
12.	Induced pluripotent stem cells	24-25
13.	Stem cells application in regenerative medicine and diseases therapeutics	26
14.	Social, ethical, religious and regulatory issues related to assisted reproductive technology	27
15.	Transgenic and stems cells therapy	28



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topic	No. of Lectures/ Practicals
Practical		
1.	Micromanipulator, micro assisted fertilization, ICSI protocol	1-2
2.	Embryo biopsy- sexing	3-4
3.	Sperm preparation and sperm quality analysis by flow cytometry	5-6
4.	Embryo quality analysis- Morphological assessment and Staining technique	7-8
5.	SCNT protocol- enucleation, somatic cell injection, fusion activation and embryo culture	9-10
6.	Isolation of inner cell mass from blastocyst, culture and characterisation of embryonic stem cells	11
7.	Gene expression in sperm and embryos	12

I. Course Title : Advances in Animal Cell Culture

II. Course Code : BTY 709

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the latest development in animal cell culture

V. Theory

Unit I

Development of cell lines using various methods, Characterization of cell lines by morphology, Chromosome analysis, DNA content, Isoenzyme analysis and antigenic markers, DNA fingerprinting.

Unit II

Setting of new cell culture lab, Detection methods for cell culture contaminants, Three dimensional culture- classification of 3D culture methods and microfluidics, Tissue engineering- types of cells, Scaffold materials, Bioprinting, Bioartificial organs, Flow Cytometry and its applications in cell culture.

Unit III

DNA transfer by viral and non viral methods, Expression of recombinant proteins in mammalian and avian cell lines.

Unit IV

Monoclonal antibody production and characterization, Up-stream and downstream processing of cell culture based vaccines, Diagnostic antigens and other pharmaceutical agents, Cell culture fermentors.

VI. Practicals

- Primary and secondary mammalian cell culture
- Development of transformed cells
- Characterization of cell lines by karyotyping
- Transfection of cells with recombinant DNA
- Expression of recombinant proteins
- Scaling-up of cultures
- Flow Cytometry



- Immunization of mice
- Maintenance of myeloma cell lines
- Fusion
- Characterization of mAbs

VII. Suggested Readings

- Freshney RI. 2005. *Culture of Animal Cells*. Wiley Liss.
- Portner R. 2007. *Animal Cell Biotechnology*. Humana Press

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Development of cell lines using various methods	1
2.	Characterisation of cell lines by morphology	2
3.	Characterisation of cell lines by chromosome analysis	3
4.	Characterisation of cell lines by DNA content, isoenzyme analysis and antigenic markers	4
5.	Characterisation of cell lines DNA fingerprinting	5
6.	Setting of new culture lab	6
7.	Detection methods for cell culture contaminants	7
8.	Classification of 3D culture methods and micro fluidics	8
9.	Tissue engineering- types of cells, scaffold materials, bio printing, bio artificial organs,	9
10.	Flow Cytometry and its applications in cell culture	11
11.	DNA transfer by viral and non viral methods	11
12.	Expression of recombinant proteins in mammalian and avian cell lines	12
13.	Monoclonal antibody production and characterisation	13
14.	Upstream and downstream processing of cell culture based vaccines, diagnostic antigens and other pharmaceutical agents	14-15
15.	Cell culture fermentors	16
Practical		
1.	Primary and secondary mammalian cell culture	1
2.	Development of transformed cells	2
3.	Characterization of cell lines by karyotyping	3
4.	Transfection of cells with recombinant DNA	4
5.	Expression of recombinant proteins	5
6.	Scaling-up of cultures	6
7.	Flow Cytometry	7
8.	Immunization of mice	8
9.	Maintenance of myeloma cell lines	9
10.	Fusion	10
11.	Characterisation of Mabs	11

I. Course Title : Industrial Biotechnology

II. Course Code : BTY 710

III. Credit Hours : 2+1

IV. Aim of the course

Understanding the fermentation process and Bioenergy system.

**V. Theory****Unit I**

Introduction to fermentation process- Microbes and enzymes of industrial importance - screening and genetic improvement of industrially important microorganisms, Microbial metabolites- Microbial growth, Substrate degradation and product formation –Recombinant products.

Unit II

Fermentation systems -Batch culture, Continuous culture, Fed-batch culture, Kinetics of growth and product formation, Design of a fermenter, Basic functions of a fermenter for microbial or animal cell culture, Aseptic operation and containment, Construction and components, Types of fermenters, Fermenters for animal cell culture, Sterilization of reactor.

Unit III

Media for industrial fermentations: Typical media, Medium formulation, Precursors and metabolic regulators, Antifoams. Upstream and Downstream processing- Filtration, Centrifugation, Cell disruption, Liquid-liquid extraction, Chromatography, membrane processes, Drying, Crystallization, Whole broth processing.

Unit IV

Bioenergy- Gaseous fuels: Biohydrogen, Biomethane and Microbial fuel cell; Liquid fuels: Bioethanol, Biodiesel and Biobutanol, Aerobic and Anaerobic wastewater treatment processes—Single cell protein production -Metal leaching- Industrial chemicals- Food additives –Food supplements -Health care products.

VI. Practicals

- Isolation of Industrially important enzyme producing microorganisms
- Strain improvement
- Bioreactor operation
- Production of Industrial compounds, enzymes
- Downstream processing- Filtration, Centrifugation, Cell disruption,
- Liquid-liquid extraction, Chromatography- HPLC
- Microbial fuel cell design and operation for waste water treatment

VII. Suggested Readings

- Alberghina L. 2000. *Protein Engineering for Industrial Biotechnology*. Routledge.
- Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
- Singh, R and Ghosh SK. 2004. *Industrial Biotechnology*. Global Vision Publ. House.
- Thomson J. 2006. *Your Guide to Industrial Biotechnology*. Abhishek Publ

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to fermentation process, history of fermentation process	1
2.	Enzymes of industrial importance, Microbes producing industrially important enzymes	2
3.	Screening of microbes for enzyme production	3
4.	Genetic improvement of microorganism for improved production	4-5
5.	Microbial growth studies and their metabolites-primary and secondary	6
6.	Product formation by substrate degradation	7



S. No.	Topic	No. of Lectures/ Practicals
7.	production of recombinant products	8
8.	Batch, continuous and fed batch fermentation	9-10
9.	Kinetics of growth and product formation	11-12
10.	Design of a fermenter, basic functions, types of fermenters	13
11.	Animal cell culture by using bioreactors, Fermenters for animal cell culture	14
12.	Aseptic operation, Containment, Sterilization	15-16
13.	Medium formulation, precursors, metabolic regulators, antifoams	17-18
14.	Upstream and down stream processing	19
15.	Filtration, Centrifugation	20
16.	Extraction, Chromatography, membrane process	21-22
17.	Drying crystallization, whole broth processing	23-24
18.	Bioenergy production	25
19.	Biohydrogen, biomethane, biodiesel and biobutanol production	26
20.	Microbial fuel cells	27
21.	Aerobic treatment of waste water	28
22.	Anaerobic waste water treatment	29
22.	Singel cell protein production, Metal leaching	30
23.	Food additives	31
24.	Food supplements and health care products	32
Practical		
1.	Isolation of industrially important enzyme producing microorganism	1
2.	Screening for enzyme production	2
3.	Extraction and characterization of enzymes	3
4.	Enzyme kinetics	4
5.	Strain improvement by different methods	5
6.	Bioreactor operation	6
7.	Optimisation of enzyme and industrial compounds production using bioreactor	7
8.	Filtration	8
9.	Cell disruption	9
10.	Chromatography	10-12
11.	Microbial fuel cell design	13
12.	Optimisation of electrodes, catholyte	14
13.	Waste water treatment	15-16

I. Course Title : Rumen and Feed Biotechnology

II. Course Code : BTY 711

III. Credit Hours : 2 + 1

IV. Aim of the course

Understanding the rumen ecosystem and manipulation of rumen microbes.

V. Theory

Unit I

Rumen ecosystem – Classification of rumen microbes – Isolation – Cultural characters – Rumen fermentation – Techniques to increase production of rumen microbes – Metabolic inter-relationship between rumen microbes.



Unit

Feed processing and preservation, Microbial bioconversion of lignin and cellulose rich feeds -Factors affecting delignification, Large scale bioconversion of substrates, Pretreatment of feeds, Chemical vs microbial treatment of feeds, Anti-nutritional factors present in feeds, Microbial detoxification of aflatoxins, Mimosine and other anti-metabolites present.

Unit III

Manipulation of rumen methane production – Addition of methane inhibitors.– Non-genetic manipulation of rumen microbes – Addition of antibiotics, Selective defaunation, Addition of fats, Addition of protein degradation protectants, Addition of buffer substances – Rumen escape proteins.

Unit IV

Genetic manipulation of rumen microflora to improve feed utilization -Manipulation of rumen microbes by recombinant DNA technology – Inter species H₂ transfer and its importance –Single cell protein (SCP) as animal feed-Rumen metagenomics-Methods of studying rumen metagenome-Conventional cloning and sequencing of metagenomic DNA-NGS based shot gun sequencing – Amplicon sequencing of 16 S/ 18S rRNA hyper variable regions –Bioinformatics analysis of metagenomic sequence data Use of probiotics-Microorganisms and proteins used as probiotics, Mechanism of action of probiotics, Immune response to probiotics, Anti-mutagenic and anti-tumour activities of probiotics.

VI. Practicals

- Introduction to feeds and fodders for ruminants
- Estimation of proximate principles, Fibre fractions in concentrates and roughages
- Methods for evaluating rumen fermentation parameters
- Sampling of rumen contents – Microbial and protozoal count – Fixing and staining of rumen protozoa and bacteria
- Estimation of rumen fermentation parameters-pH, Rumen NH₃-N, Lactic acid
- *In-vitro* Gas Production Test -(IVGPT)
- Rumen liquor analysis – Total volatile fatty acids – Individual volatile fatty acids-Ammonia Nitrogen
- TCA precipitable Nitrogen-Methane production
- Rumen microbial enzyme assay
- Isolation of DNA from rumen samples
- Rumen metagenome and Bioinformatics analysis of metagenomic sequence data

VII. Suggested Readings

- Huffnagle GB and Wernick S. 2007. *The Probiotics Revolution: The Definitive Guide to Safe, Natural Health*. Bantam Books.
- Kalidas S, Paliyath G, Pometto A and Levin RE. 2004. *Functional Foods and Biotechnology*. CRC Press.
- Roger A. 1989. *Food Biotechnology*. Cambridge Univ. Press.
- Hobson PN and Stewart CS. 1997. *The Rumen Microbial Ecosystem*.



S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Rumen ecosystem – Classification of rumen microbes	1-2
2.	Isolation and Cultural characters of rumen microbes	3-4
3.	Rumen fermentation – Techniques to increase production of rumen microbes	5-6
4.	Metabolic inter-relationship between rumen microbes	7
5.	Feed processing and preservation, microbial bioconversion of lignin and cellulose rich feeds -Factors affecting delignification, large scale bioconversion of substrates	8-9
6.	Pretreatment of feeds, chemical vs microbial treatment of feeds, anti-nutritional factors present in feeds	10-11
7.	Microbial detoxification of aflatoXins, mimosine and other anti-metabolites present.	12-13
8.	Manipulation of rumen methane production – addition of methane inhibitors	14-15
9.	Non-genetic manipulation of rumen microbes – addition of antibiotics, selective defaunation, addition of fats, addition of protein degradation protectants, addition of buffer substances – Rumen escape proteins.	16-17
10.	Genetic manipulation of rumen microflora to improve feed utilization -Manipulation of rumen microbes by recombinant DNA technology	18-19
11.	Inter species H ₂ transfer and its importance –Single cell protein (SCP) as animal feed	20
12.	Rumen metagenomics-Methods of studying rumen metagenome-conventional cloning and sequencing of metagenomic DNA	21-22
13.	NGS based shot gun sequencing – amplicon sequencing of 16S/ 18S rRNA hyper variable regions	23-24
14.	Bioinformatics analysis of metagenomic sequence data	25-26
15.	Use of probiotics-Microorganisms and proteins used as probiotics	27-28
16.	Mechanism of action of probiotics, immune response to probiotics.	29-30
17.	Anti-mutagenic and anti-tumour activities of probiotics.	31-32
Practical		
1.	Introduction to feeds and fodders for ruminants	1
2.	Estimation of proximate principles in concentrates and roughages	2
3.	Estimation of fibre fractions in concentrates and roughages	3
4.	Methods for evaluating rumen fermentation parameters	4
5.	Sampling of rumen contents – Microbial and protozoal count	5
6.	Fixing and staining of rumen protozoa and bacteria	6
7.	Estimation of rumen fermentation parameters-pH, Rumen NH ₃ -N, Lactic acid	7
8.	<i>In-vitro</i> Gas Production Test (IVGPT)	8
9.	Rumen liquor analysis – Total volatile fatty acids – Individual volatile fatty acids – Ammonia Nitrogen	9
10.	TCA precipitable Nitrogen-Methane production	10
11.	Rumen microbial enzyme assay	11
12.	Collection, isolation and quality check of DNA from rumen samples	12
13.	Rumen metagenome and Bioinformatics analysis of metagenomic sequence data	13



List of Journals

- *Animal Biotechnology*
- *Animal Genetics*
- *Animal Reproduction*
- *Cellular and Molecular Probe*
- *Current Science*
- *Genome Research*
- *Indian journal of Microbiology*
- *Journal of Clinical Microbiology*
- *Journal of Dairy Science*
- *Journal of Reproduction and Fertility*
- *Methods in Virus Research*
- *Nature*
- *Nature Biotechnology*
- *Nature Genetics*
- *Nucleic Acid Research*
- *PNAS*
- *Reproduction in Domestic Animals Science*
- *Theriogenology*
- *Trends in Biotechnology*
- *Trends in Genetics*
- *Viral Research*

e-Resources

www.cls.casa.colostate.edu/TransgenicCrops/teacherlinks

www.hpc.unm.edu/~aroberts/main/top5%25.htm

www.isaaa.org

www.ciat.cgiar.org/biotechnology/cbn/gines_mera_fund.htm

www.scidev.net/en/agriculture-and-environment/agri-biotech/links/publications-andinformation-services

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SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Basic Veterinary Sciences

– Veterinary Extension Education





Preamble **(Veterinary Extension Education)**

To ensure that academic and scientific developments in all fields of veterinary sciences and Animal Husbandry get translated into adoption by the beneficiaries, framing of contemporary courses in Veterinary Extension became essential. Livestock entrepreneurship course has been introduced at masters level. New courses at doctorate level like theory constructions in social sciences, facilitation for development and Management Extension Organizations were introduced for the first time in view of the importance of the same. Farm journalism has been shifted to Masters level. SSS-600-Statistics for Social Sciences (2+1) is made core course for M.V.Sc.

The national priorities/ international developments are given due importance and are aligned accordingly in the curriculum adequately to build required competencies of the students to meet challenges of current agricultural scenarios. The curriculum development emphasized on outcome-based approach, the social process of curriculum construction (involvement of stakeholders) and matching curriculum with job requirements for employability of students. A significant emphasis on the different developmental programmes and or initiatives of the Government of India are highlighted in the syllabi of the postgraduate and doctoral programmes. The following are the specific inclusions of topics/ units focusing on the recent national priorities/ international developments.

Course	Topic/ Unit Included
EXT 601: Development Perspectives of Extension Education (2 +1)	Extension approaches followed in current livestock development programmes, viz., Rashtriya Gokul Mission, National Livestock Mission, Rashtriya Krishi Vikas Yojana, Livestock Insurance Scheme, Livestock Health and Disease Control, Pashu Sanjivini, National Programme for Dairy Development, National Programme for Bovine Breeding, Aatmanirbhar Bharat Abhiyaan and digital initiatives such as E- Pashudhan Haat, National Animal Disease Reporting System for livestock development, etc.
EXT 607: Livestock Entrepreneurship (1+2)	Role of Government and Non-Government agencies in promoting entrepreneurship in India- eg. Atal Innovation Mission, Startup India, Mudra Bank Scheme, Dairy Entrepreneurship Development Scheme, Agri-Clinics & Agri-Business Centers (ACABC), Entrepreneurship Development and Employment Generation (EDEG)
EXT 609: Gender Empowerment and Policies and programmes in empowering women	



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Course	Topic/ Unit Included
Livestock Development (1+0)	in general and livestock development in specific. eg. UJJAWALA, Pradhan Mantri Mahila Shakti Kendra, One Stop Centre Scheme, Mahila E-haat, STEP, etc.
EXT 704 Policies and Regulations in the Livestock Sector (1+0)	State, National and Global policies related to livestock sector WTO, IPR, HACCP, Sanitary and phyto-sanitary measures, Agriculture Produce and Livestock Marketing (APLM) Act, Animal Welfare, etc.
EXT 705 Educational Technology (2+1)	Digital Initiatives in Education, viz., SWAYAM (MOOCs platform) Swayam Prabha, National Digital Library, National Academic Depository, E-Shodh Sindhu, E Acharya, Evidhwaan, Agriculture Education Portal, e-KrishiShiksha, KrishiKosh, CeRA, National Educational Alliance for Technology (NEAT), etc.
EXT 707: Monitoring and Evaluation of Livestock Development Programmes (2+1)	Development of M&E plans and procedures for livestock developmental programmes using the participatory approach.



Course Title with Credit Load M.V.Sc. in Veterinary Extension Education

Course Code	Course Title	Credit	Hou rs
EXT 601*	Development Perspectives of Extension Education	2+1	
EXT 602*	Communication for Livestock Development	1+1	
EXT 603*	Diffusion and Adoption of Innovations	2+1	
EXT 604*	Programme Planning and Evaluation	1+1	
EXT 605*	Research Methodology	2+1	
EXT 606*	Social Psychology and Group Dynamics	1+1	
EXT 607	Livestock Entrepreneurship	1+2	
EXT 608*	Human Resource Management in Animal Husbandry Sector	1+1	
EXT 609	Gender Empowerment and Livestock Development	1+0	
EXT 610	Farm Journalism	1+1	
SSS 600*	Statistics for Social Sciences	2+1	
EXT 611	Masters Seminar	1+0	
EXT 612	Masters Research	0+3	
			0

*Core Courses



Course Contents

M.V.Sc. in Veterinary Extension Education

- I. Course Title** : Development Perspectives of Extension Education
II. Course Code : EXT 601
III. Credit Hours : (2 +1)

IV. Aim of the courses

- To acquaint the students with different extension approaches and their implications in animal husbandry.
- To make students realise the importance of linkages among departments and various institutions.
- To acquaint the students with the recent development in extension.

V. Theory

Unit I

Important concepts in extension science; various schools of thought; Critical review and reflections on the philosophy and principles of extension.

Unit II

Implications of earlier extension efforts. Emerging issues, problems and challenges of animal husbandry extension education.

Unit III

Changing approaches – ToT approach, Education Approach, Farmer Participatory Approaches (PRA, RRA, PLA, PTD, PCD, etc.), Demand Driven approach, Market led extension, FSA, Commodity Specific Approach, Market led Extension; Classification of PRA, Differences between PRA and RRA; Global concepts of extension (SAARC, BRICS, US, Japan, UK, Philippines and Israel) and its application to Indian context. Privatization of extension. Public Private Partnership.

Unit IV

Extension approaches of State and Central Governments, ICAR, SVUs/ SAUs, NGOs, corporate and other organizations. Extension Advisory Services - Meaning, Concept - Challenges in Animal Husbandry Extension Advisory Services. Extension approaches followed in current livestock development programmes, viz., Rashtriya Gokul Mission, National Livestock Mission, Rashtriya Krishi Vikas Yojana, Livestock Insurance Scheme, Livestock Health and Disease Control, Pashu Sanjivini, National Programme for Dairy Development, National Programme for Bovine Breeding, Aatmanirbhar Bharat Abhiyaan and digital initiatives such as E-Pashudhan Haat, National Animal Disease Reporting System for livestock development, etc. Linkages between researcher-extension agent - livestock farmer-industry in the generation, Dissemination and commercialization of animal husbandry practices/ technologies.

VI. Practical



Study of the extension
organizational

approaches, functions, roles, responsibilities,



set-up of State Animal Husbandry Department/ Livestock Development Agency/ Dairy Federation/ Rural Development agencies, Study of selected FPOs, CIGs, NGOs, SHGs, etc. Critical analysis of cases on linkage between different actors of animal husbandry sector.

VII. Suggested Reading

- Anandajayasekeram P, Puskur R, Sindu Workneh and Hoekstra D. 2008. *Concepts and practices in agricultural extension in developing countries*: A source book. IFPRI (International Food Policy Research Institute), Washington, DC, USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 275 pp.
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- Gwyn EJ and Garforth C. n.d. *The history, development, and future of agricultural extension*. FAO. Rome.
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- Rivera WM and Schram SG. (Ed). 1987. *Agricultural Extension World wide – Issues, Practices and Emerging Priorities*. Croome Helm,
- Roling N. 1988. *Extension science, information systems in agricultural development*. Cambridge University Press
- S Adolph B. 2011. *Rural Advisory Services Worldwide: A Synthesis of Actors and Issues*. GFRAS: Lindau, Switzerland.
<https://www.g-fras.org/en/knowledge/gfras-publications.html?download=6:rural-advisory-services-worldwide&start=40>
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<http://www.fao.org/docrep/pdf/011/i0261e/i0261e00.pdf>



SVVU POST-GRADUATE STUDIES REGULATIONS 2021

- Van den Ban AW and Hawkins HS. 1998. *Agricultural extension- Chapter 10*, BSL, CBS Publishers and Distributors.

Course outlines

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Important concepts in extension science	1
2.	Various schools of thought in extension	2
3.	Critical review and reflections on the philosophy of extension	2
4.	Critical review and reflections on the principles of extension	1
5.	Implications of earlier extension efforts.	1
6.	Emerging issues, problems and challenges of animal husbandry extension education	2
7.	Changing approaches – ToT approach, Education Approach, Demand Driven approach, Market led extension, FSA, Commodity Specific Approach, Market led Extension	3
8.	Farmer participatory approaches (PRA, RRA, PLA, PTD, PCD, etc Classification of PRA, Differences between PRA and RRA;	3
9.	Global concepts of extension (SAARC, BRICS, US, Japan, UK, Philippines and Israel) and its application to Indian context	3
10.	Systems Concepts - FSA, Commodity Specific Approach, Market led Extension, Privatization of extension. Public Private Partnership	3
11.	Extension approaches of State and Central Governments, ICAR, SVUs/ SAUs, NGOs, corporate and other organizations	4
12.	Extension Advisory Services - Meaning, Concept - Challenges in Animal Husbandry Extension Advisory Services	2
13.	Extension approaches followed in current livestock development programmes, viz., Rashtriya Gokul Mission, National Livestock Mission, Rashtriya Krishi Vikas Yojna, Livestock Insurance Scheme, Livestock Health and Disease Control, Pashu Sanjivini, National Programme for Dairy Development, National Programme for Bovine Breeding, Aatmanirbhar Bharat Abhiyaan and digital initiatives such as E-Pashudhan Haat, National Animal Disease Reporting System for livestock development, etc.	2
14.	Linkages between researcher-extension agent - livestock farmer-industry in the generation of animal husbandry practices/ technologies	1
15.	Linkages between researcher-extension agent - livestock farmer-industry in the dissemination and commercialization of animal husbandry practices/ technologies	1
	Total	32
Practicals		
1.	Study of the extension approaches, functions, roles, responsibilities	1
2.	Organizational set-up of State Animal Husbandry Department	1
3.	Organizational set-up dairy/ rural development agencies	2
4.	Organizational set-up of ICAR institutions	2
5.	Study on the formation of FPOs – principles, practices, requirements, procedures	2
6.	Study on the formation of CIGs - principles, practices, requirements, procedures	2
7.	Study on the formation of SHGs principles, practices, requirements, procedures	1



S. No.	Topic	No. of Lectures/ Practicals
8.	Role of NGOs in developmental perspectives	1
9.	Critical analysis of cases on linkage between different actors of animal husbandry sector.	2
10.	Critical analysis of livestock development programmes	2
	Total	16

I. Course Title : Communication for Livestock Development

II. Course Code : EXT 602

III. Credit Hours : (1+1)

IV. Aim of the course

To acquaint students with dynamics of communication and apply in development of livestock sector.

V. Theory

Unit I

Communication- meaning, concept, purpose and process of communication- Models and theories of communication: Aristotle, Berlo, Osgood Schramm, Shanon and Weaver, Johari window, New Comb, Westley and McLean, etc. Critical analysis of models and theories of communication. Recent developments in communication theories and models.

Unit II

Types of communication-intrapersonal, interpersonal, verbal and non-verbal; Criteria of effective communication, Determinants of communication- Empathy, credibility, fidelity, distortion, feedback and barriers to effective communication; Group and mass communication. Key communicators and their role in livestock development. Organizational Communication - formal- informal; downward-upward- horizontal; Problems in organizational communication.

Unit III

Business Communication: Relevance and importance in livestock business development. Features of business communication, Guidelines for business communication, formal and informal business communication, Various types of business communication (Letters, Reports, Proposals, Manuals, Outreach writing (Advertisements, Pamphlets, Signs, Press Release, etc.). Effective business communication.

Unit IV

ICT-concept, importance and types of tools and applications; Role and significance of ICT tools in Animal Husbandry Development - Use and importance of Social Media in livestock development. Overview of emerging technologies.

VI. Practical

Exercises in improving communication skills (Speaking skill – Public speaking, Persuasive speech, Informative speech, etc.) Exercises on Listening, Exercises on Reading, Exercises on Non-verbal communication, Writing of Business



Communication, Identification of

key communicators, Communication barriers,



distortion and fidelity in livestock development. Identification of different social media tools used for livestock development; Comparative study of different tools and their areas of applications in animal husbandry sector; Hands on experience in writing blogs; ICT tools in Animal Husbandry Extension delivery system; Analysis of web portals – KVK portals, Knowledge portal, ICAR, SAUs, etc.

VII. Suggested Reading

- Bhagat Amit K. *Communication as a Management Tool: Principles and Practices*. Akhand Publishing House, New Delhi. 2012
- Cragan FJ and Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.
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www.g-fras.org/en/knowledge/gfras-publications.html?download=415:social-media-policy-guidelines-for-agricultural-extension-and-advisory-services
- Saravanan R. 2010. (Ed.) *ICTs for Agricultural Extension: Global Experiments, Innovations and Experiences*, New India Publishing Agency (NIPA), New Delhi.



http://www.saravananraj.net/wp-content/uploads/2014/12/32_India ICTs-for-Agricultural-Extension_Saravanan.pdf

- World Bank. 2017. *ICT in Agriculture (Updated Edition): Connecting Smallholders to Knowledge, Networks, and Institutions*. Washington, DC: World Bank.
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Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Communication – meaning, concept, purpose of communication	1
2.	Models and theories of communication: Aristotle, Berlo, Osgood Schramm, Shanon and Weaver, Johari window, New Comb, Westley and McLean, etc.	1
3.	Critical analysis of models and theories of communication.	1
4.	Recent developments in communication theories and models	1
5.	Types of communication-intrapersonal, interpersonal, verbal and non-verbal;	1
6.	Criteria of effective communication, Determinants of communication- Empathy, credibility, fidelity, distortion, feedback	1
7.	Barriers for effective communication	1
8.	Group and mass communication. Key communicators and their role in livestock development	1
9.	Organizational Communication - formal- informal; downward-upward-horizontal; Problems in organizational communication	1
10.	Key communicators and their role in livestock development	1
11.	Business Communication: Relevance and importance in livestock business development	1
12.	Features and guidelines for business communication, Formal and informal business communication	1
13.	Various types of business communication (Letters, Reports, Proposals, Manuals, Outreach writing (Advertisements, Pamphlets, Signs, Press Release, etc.) Effective business communication	1
14.	ICT-concept, importance and types of tools and applications; Role and significance of ICT tools in Animal Husbandry Development	1
15.	Use and importance of Social Media in livestock development.	1
16.	Overview of emerging technologies	1
	Total	16
Practicals		
1.	Exercises in improving communication skills – Oral Communication	1
2.	Exercises in improving communication skills – Public speaking	1
3.	Exercises in improving communication skills – Persuasive speech	1
4.	Exercises in improving communication skills –Informative speech	1
5.	Exercises on Listening skills	1
6.	Exercise on Reading skills	1
7.	Exercise on Non-verbal communication	1
8.	Writing of Business Communications	1
9.	Identification of key communicators	1
10.	Role of key communicators	1
11.	Communication barriers	1
12.	Distortion and Fidelity of communication in livestock development.	1
13.	Importance of feedback in communication	1
14.	Identification of different social media tools used for livestock development	1
15.	Comparative study of different tools and their areas of applications in animal husbandry sector	1



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S. No.	Topic	No. of Lectures/ Practicals
16.	ICT tools in Animal Husbandry Extension delivery system- analysis of web portals – KVK portals, Knowledge portal, ICAR, SAUs, etc.	1
Total		16

I. Course Title : Diffusion and Adoption of Innovations

II. Course Code : EXT 603

III. Credit Hours : (2+1)

IV. Aim of the course

To sensitize the students to technology generation, dissemination and its adoption through effective communication

V. Theory

Unit I

Concept, meaning, importance of diffusion. Elements in diffusion process; Models and theories of diffusion.

Unit II

Concept, meaning, importance of adoption. Steps in adoption process. Adoption models; Stages in diffusion-adoption process; Innovation- Decision Process, Adopter categories and their characteristics. Factors influencing adoption. Attributes of innovations, Factors affecting the rate of adoption and sources of information. Consequences of innovations.

Unit III

Adopter categories and their characteristics. Identification and evaluation of innovations in livestock sector – Attributes, Reason for adoption, Non-adoption and Discontinuance, Consequences. Diffusion and adoption of livestock sectoral innovations.

Unit IV

Agricultural Innovation System – Origin of innovation system - Concepts and elements; Innovation vs Invention, Innovation and types of innovation; Innovations in livestock sector; Role of enabling environment; Methodologies for AIS Diagnosis; Capacity Development in AIS.

VI. Practical

Identification of adopter categories in the selected village, Study on attributes of innovation of selected dairy farming technologies/ sheep/ goat/ poultry farming technologies. Identification of sources of information at different stages of adoption on selected livestock technologies; Study of factors increasing or retarding the rate of adoption; Consequences of adoption of livestock technologies; Case studies in of Agricultural Innovation System, Presentation of reports on adoption and diffusion of innovations

VII. Suggested Reading

- Brown Lawrence A. 1981. *Innovation Diffusion: A New Perspective. Communication for Social Change.* Sage Publ.



- Cragan FJ and Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.
- Dasgupta. 1989. *Diffusion Agricultural Innovations in Village India*.
- Hall A, Sulaiman RV, Beshah T, Madzudzo E and Puskur R. 2009. *Agricultural innovation system capacity development: Tools, principles or policies?* Capacity.org (37): 16-17. http://www.capacity.org/en/journal/practice_reports/tools_principles_or_policies
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- Leeuwis C and van den Ban A W. 2004. *Communication for rural innovation: Rethinking agricultural extension*. John Wiley and Sons. Methuen.
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Course outlines

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Concept, Meaning, Importance of diffusion with special reference to Livestock Sector	1
2.	Elements in diffusion process	1
3.	Models and theories of diffusion	2
4.	Concept, meaning, importance of adoption	1
5.	Steps in adoption process. Adoption models	2
6.	Stages in diffusion-adoption process; Innovation- Decision Process	2
7.	Adopter categories and their characteristics.	1
8.	Factors influencing adoption	1
9.	Attributes of innovations	1
10.	Factors affecting the rate of adoption and sources of information.	1
11.	Consequences of innovations.	2
12.	Adopter categories and their characteristics	2
13.	Identification and evaluation of innovations in livestock sector – attributes, reason for adoption, non-adoption and discontinuance, Consequences.	3
14.	Diffusion and adoption of livestock sectoral innovations	2
15.	Agricultural Innovation System – origin of innovation system - concepts and elements	2
16.	Innovation vs Invention, Innovation and types of innovation	2
17.	Innovations in livestock sector	1
18.	Role of enabling environment; Methodologies for AIS Diagnosis	3
19.	Capacity Development in AIS	2
	Total	32



S. No.	Topic	No. of Lectures/ Practicals
Practicals		
1.	Identification of adopter categories in the selected village	2
2.	Study on the attributes of innovation of selected dairy farming technologies	2
3.	Attributes of innovation of selected sheep/ goat/ poultry farming technologies	2
4.	Identification of sources of information at different stages of adoption on a selected livestock technologies	2
5.	Study of factors increasing or retarding the rate of adoption	2
6.	Consequences of adoption of livestock technologies	2
7.	Case studies in of Agricultural Innovation System	2
8.	Presentation of reports on adoption and diffusion of innovations	2
	Total	16

I. Course Title : Programme Planning and Evaluation

II. Course Code : EXT 604

III. Credit Hours : 1+1

IV. Aim of the course

To expose the students to programme planning, Monitoring and evaluation of animal husbandry development programmes.

V. Theory

Unit I

Genesis and importance of programme planning. Objectives, principles and steps in programme planning process. Role of animal husbandry extension agencies and stakeholders in planning and implementation of Animal Husbandry Extension programmes.

Unit II

Participatory Programme planning: Meaning, Role and Benefits; Stakeholders Participation in Development - Identify Key Stakeholders, Examine Stakeholder's Interests and Impact of the Project, Assess Stakeholder Power and Interest, Outline a Stakeholder Participation Strategy.

Unit III

Meaning and Scope of Monitoring; Basic Concepts and Elements in Monitoring; Types of Monitoring; Techniques of Monitoring; What is Evaluation? Appraisal vs. Monitoring vs. Evaluation vs. Impact Assessment – Major differences; Types of Evaluation, Evaluation Designs.

Unit IV

Project Management Techniques- Gantt chart, Programme Evaluation and Review Technique (PERT). Critical Path Method (CPM). Project formulation. Project appraisal in terms of social benefit analysis, logical frame work. Various stakeholders in livestock development; stakeholder analysis, and report writing.

VI. Practical

Preparation of comprehensive



livestock development programme for a village.



Developing instruments for monitoring and evaluation of on-going development programme at village level (Logical Frame Work). Participatory techniques (RRA, PRA, Case study, etc.). SWOT analysis of a livestock development programme.

VII. Suggested Reading

- Bagno IB. 2014. *Conducting participatory monitoring and evaluation*. Pages 81-85 in FAO, Decision tools for family poultry development.
- Baker H. 1984. *The program planning process*. Pages 50-64 in D. Blackburn (ed.), Extension handbook. Guelph, Ontario, Canada: University of Guelph.
- Baum WC and Tolbert SM. 1985. *Investing in Development: Lessons of the World Bank Experience*, Oxford University Press.
- Bennett CF. 1979. *Analyzing impacts of extension programs*. Washington, D.C., USA: U.S. Department of Agriculture.
- Choudhary S. 1988. *Project Management*, New Delhi: Tata McGraw Hill.
- Dale R. 2004. *Evaluating Development Programmes and Projects*, New Delhi, India: Sage Publications
- Fear FA. 1988. *Community needs assessment: A crucial tool for adult educators*. Paper presented at the MAACE Midwinter Conference, February 1988, Lansing, Michigan, USA.
- GFRAS. 2017. *The New Extensionist Learning Kit*. 13 Learning Modules for Extension Professionals. Lausanne, Switzerland, Global Forum for Rural Advisory Services GFRAS.
- Harold Kerzner. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. Wiley
- Hoffman V, Christinck A and Lemma M. (eds.). 2009. *Rural Extension*. Margraf Publishers GmbH.
- Leagans JP. 1961. *Programme planning to meet people's needs*. In: *Extension education in community development, Directorate of Extension*, Ministry of Food and Agriculture, Government of India, New Delhi.
- Mukherjee N. 2002. *Participatory Learning and Action with 100 field Methods*. Concept Publishing Company, New Delhi.
- Rietbergen MJ and Narayan D. 1997. *Participatory tools and techniques: A resource kit for participation and social assessment*. Washington, D.C., USA: The World Bank. Accessed at: www.fao.org/ag/againfo/programmes/en/lead/toolbox/Refer/STkHold.htm
- Roling N. 1988. *Extension science: information systems in agricultural development*, Cambridge University Press.
- Scott Bercun. 2008. *Making Things Happen – Mastering Project Management*. O'Reilly Publishers
- Somesh K. 2002. *Methods for Community Participation - A Complete Guide for Practitioners*. Vistar Publications New Delhi.
- Suvedi M and Kaplowitz MD. 2016. *Process Skills and Competency Tools – What Every Extension Worker Should Know – Core Competency Handbook*. Urbana, IL, USAID-MEAS.
- Van den Ban AW and Hawkins HS. 2002. *Agricultural extension*, CBS Publishers and Distributors, New Delhi.

Course outlines

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Genesis and importance of programme planning in Animal Husbandry Sector	1
2.	Objectives, principles and steps in programme planning process	1
3.	Role of animal husbandry extension agencies and stakeholders in planning and implementation of animal husbandry extension programmes	1
4.	Participatory Programme planning – Meaning, Role and Benefits	1



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S. No.	Topic	No. of Lectures/ Practicals
5.	Stakeholders Participation in Development - Identify Key Stakeholders, Examine Stakeholder’s Interests and Impact of the Project	1
6.	Assess Stakeholder Power and Interest, Outline a Stakeholder Participation Strategy;	1
7.	Meaning and Scope of Monitoring; Basic Concepts and Elements in Monitoring; Types of Monitoring;	2
8.	Techniques of Monitoring; What is Evaluation? Appraisal vs. Monitoring vs. Evaluation vs. Impact Assessment – Major differences;	1
9.	Types of Evaluation, Evaluation Designs;	1
10.	Project Management Techniques- Gantt chart, Programme Evaluation and Review Technique (PERT). Critical Path Method (CPM)	2
11.	Project formulation, Project appraisal in terms of social benefit analysis, logical frame work	1
12.	Various stakeholders in livestock development;	2
13.	Stakeholder analysis, and report writing.	1
	Total	16
Practicals		
1.	Preparation of comprehensive livestock development programme for a village	3
2.	Developing instruments for monitoring and evaluation	2
3.	Identification of key stakeholders in the livestock development	1
4.	Application of developed instruments for monitoring and evaluation of on-going development programme at village level (Logical Frame Work)	2
5.	Data collection and analysis of on-going development programme of a village	2
6.	Simulated exercises on Project Management Techniques - Gantt chart, PERT, CPM	3
7.	SWOT analysis of a livestock development programmes	1
8.	Report preparation and presentation	2
	Total	16

I. Course Title : Research Methodology

II. Course Code : EXT 605

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and skills in formulating and conducting an independent research in the field of Animal Husbandry Extension.

V. Theory

Unit I

Concept, nature and scope of research in social sciences. Types of research- fundamental, applied and action research, experimental and non-experimental research. Identification of concepts, constructs, variables. Hypothesis– importance, selection criteria (qualities of a workable hypothesis), formulation and testing of hypothesis. Selection and formulation of research problem.

Unit II

Measurement and levels of measurement; Research designs- exploratory,



experimental, and ex-post-facto research design. Sampling -Sampling methods- probability and non-probability sampling. Sources of errors.

Unit III

Methods of data collection– survey method, observation method, interview/questionnaire method, case study, content analysis, sociometry, focus group discussion, projective techniques, Online tools of data collection, Reliability and validity of measuring instruments.

Unit IV

Social statistics – designs in data analysis, Parametric and Non-Parametric statistical methods. Data analysis and interpretation and inference, Report writing. Review of studies in social research.

VI. Practical

Construction of data collection tools, GPS-enabled data collection, Development of online tools of data collection (Google Forms, Survey Monkeys, etc.) Application of statistical software for data analysis and interpretation. Creative scientific thinking, selecting a research problem and working it out with all the steps; report writing and presentation of the reports.

VII. Suggested Reading

- Arlene Fink (Ed). 2003. *The Survey Kit* (10 booklets). Sage Publ.
- Babbie E. 2008. *The basics of social research*. 4th ed. Belmont, CA, USA; Thompson Wordsworth.
- Creswell JW. 2009. *Research design: Qualitative, quantitative, and mixed methods approaches*. Third edition. Thousand Oaks: Sage Publications.
- Creswell John W. 1994. *Research Design – Qualitative and Quantitative Approaches*. University of Nebraska, Lincoln.
- Creswell JW. 2012. *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Fourth edition. Boston, MA: Pearson.
- Edwards AL. 1969. *Techniques of Attitude Scale Construction*. Vakil, Feffer and Simons
- Garrett HE. 1966. *Statistics in Psychology and Education*. International Book Bureau, Hyderabad.
- Goode WJ and Hatt PK. 1952. *Methods in Social Research*. McGraw-Hill.
- Guilford JP. 1971. *Psychometric Methods*. TATA McGraw Hill.
- Henerson EM, Morris LL. and Gibbon CT. 1987. *How to Measure Attitudes*. Sage Publ.
- Kerlinger FN and Lee HB. 2000. *Foundations of Behavioral Research*. Orlando, FL: Harcourt College Publishers.
- Kumar R. 2014. *Research Methodology: A Step –by - Step Guide for Beginners*. Fourth Edition. Thousand Oaks, California: Sage Publications.
- Miller Delbert C. 1991. *Handbook of Research Design and Social Measurement*. Indiana University. Sage Publ.
- NeumanWL. 2006. *Social Research Methods: Qualitative and Quantitative Approaches*. Toronto: Pearson.
- Oppenheim AN. 1979. *Questionnaire Design and Attitude Measurement*. Heinemann Educational Books.
- Sekaran U and Bougie R. 2013. *Research Methods for Business A Skill-Building Approach*. 6th Edition, Wiley, New York.
- Sivakumar PS, Sontakki BS, Sulaiman RV, Saravanan R and Mittal N. (eds). 2017. *Good Practices in Agricultural Extension Research. Manual on Good Practices in Extension Research and Evaluation. Agricultural Extension in South Asia*. Centre for research on innovation and science and policy (CRISP), Hyderabad. India.

**Course Outline**

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Concept, nature and scope of research in social sciences, scientific vs nonscientific approaches,	1
2.	Research - Characteristics of research, Approaches of Research	1
3.	Types of Research (Pure/ Basic; Evaluative, Fundamental, applied and action research)	1
4.	Experimental and non-experimental research	1
5.	Identification of concepts, constructs, variables	1
6.	Hypothesis and its importance, Characteristics and sources and Classification of hypothesis	1
7.	Selection criteria (qualities of a workable hypothesis)	1
8.	Formulation and testing of hypothesis	1
9.	Selection and formulation of research problem	1
10.	Measurement and levels of measurement	1
11.	Research Designs - Exploratory research design	1
12.	Research Designs Experimental research design	1
13.	Research Designs EX-post-facto research design	1
14.	Sampling– concept, meaning importance in social sciences	1
15.	Sampling methods - Probability Sampling and Non-Probability sampling	1
16.	Sources of errors	2
17.	Methods of data collection: Over view of different tools of data collection, selection of appropriate method	1
18.	Survey method – Purpose, Types, Planning a survey, advantages and limitations	1
19.	Observation Method - Purpose, Types, Planning for observation, advantages and limitations	1
20.	Interview/ questionnaire method - Purpose, Types, Planning an Interview/ questionnaire, advantages and limitations	1
21.	Case study - Purpose, Planning a case study, advantages and limitations	1
22.	Content analysis	1
23.	Focus Group Discussion	1
24.	Sociometry and projective techniques	1
25.	Online tools of data collection – concept, meaning, importance and types in social research	1
26.	Reliability of measuring instruments – definition, importance in social sciences, Methods to test reliability	1
27.	Validity of measuring instruments - definition, importance in social sciences, Types of validity	1
28.	Social statistics – designs in data analysis – criteria for choosing a right a right design and analysis	1
29.	Parametric and Non-Parametric statistical methods – use and significance; types of tests used in social research with implications	1
30.	Data analysis and interpretation and inference	2
31.	Report writing	1
32.	Review of studies in social research	1
	Total	32
Practicals		
1.	Construction of different data collection tools relevant to livestock sector	2



2. GPS-enabled data collection

3



S. No.	Topic	No. of Lectures/ Practicals
3.	Development of online tools of data collection (Google Forms, Survey Monkeys, etc.)	2
4.	Application of statistical software for data analysis and interpretation	3
5.	Creative scientific thinking	1
6.	Selecting a research problem and working it out with all the steps	3
7.	Report writing and presentation of the report.	2
	Total	16

I. Course Title : Social Psychology and Group Dynamics

II. Course Code : EXT 606

III. Credit Hours : 1+1

IV. Aim of the course

To acquaint the students with the structure and functioning of social groups and socio psychological aspects in interacting with livestock farmers.

V. Theory

Unit I

Concepts, scope and importance of psychology and social psychology in animal husbandry extension, Perception - nature, laws and selectivity in perception, factors in perception, importance of perception in extension work, Attitude - nature, theories, measurement and change of attitude towards livestock farming, Importance of attitude scales in livestock research and development.

Unit II

Motivation- nature, characteristics, theories, types and techniques of motivating farmers, Learning- principles, theories of learning and experiential learning and adult learning (andragogy).

Unit III

Intelligence- nature, theories and measurement, Personality- nature, traits, types, biological and socio-cultural determinants of personality, Group and individual behaviour.

Unit IV

Concept and types of groups; Group behaviour and dynamics: structures - attraction, coalition, communication and power; group mobilisation – social capital, group decision making, Factors affecting group performance; Conflict management in groups; Group belongingness, Community Mobilization, Importance of coordination among livestock development organisations.

VI. Practical

Study of groups and group dynamics (eg.: Self Help Groups (SHGs), Milk Cooperative Societies, Commodity groups and Farmer producer Company/ organization (FPO), Joint Liability Group (JLG), youth clubs, etc.). Exercises on measurement of motivation, perception and personality traits.

**VII. Suggested Reading**

- Cragan FJ and Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.
- Donelson R. Forsyth, *Group Dynamics* 2018 7th Edition, Cengage Learning
- Joseph Bohac and Stan Dekoven 2013. *Group Dynamics*. Vision Publishing (Ramona, CA)
- Kagan J and Havemann E. 1980. *Psychology – An Introduction*. Harcourt Brace Javanovich Inc.
- Morgan CT, King RA and Robinson NM. 1979. *Introduction to Psychology*. Tata McGraw-Hill.
- Napier RW and Gershenfeld MK. 2006. *Groups – Theory and Experience*. AITBS Publ.
- Robert A Baron. *Social Psychology*. 2016. 13th Edition Pearson Education
- Secord PF and Backman CW. 1964. *Social Psychology*. McGraw-Hill.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Concepts, scope and importance of psychology and social psychology in animal husbandry extension	1
2.	Perception - nature, laws and selectivity in perception	1
3.	Attitude - nature, theories, measurement and change of attitude towards livestock farming. Importance of attitude scales in livestock research and development.	1
4.	Motivation- nature, characteristics, theories, types and techniques of motivating farmers.	2
5.	Learning- principles, theories of learning and experiential learning and adult learning (andragogy).	2
6.	Intelligence- nature, theories and measurement.	1
7.	Personality- nature, traits, types, biological and socio-cultural determinants of personality.	1
8.	Group and individual behaviour.	1
9.	Concept and types of groups; Group behaviour and dynamics: structures - attraction, coalition, communication and power; group mobilisation – social capital, group decision making	2
10.	Factors affecting group performance;	1
11.	Conflict management in groups;	1
12.	Group belongingness, Community Mobilization,	1
	Total	16
Practicals		
1.	Study of Self Help Groups and their group dynamics	2
2.	Study of Milk Cooperative Societies and their group dynamics	2
3.	Study of Commodity Interest groups (CIGs)	2
4.	Study of Farmer Producer Company/ organization (FPO)	2
5.	Study of Joint Liability Group (JLG) and youth clubs, etc.	2
6.	Exercises on measurement of motivation	2
7.	Exercises on measurement of perception	2
8.	Exercises on measurement of personality traits	2
	Total	16



- I. Course Title : Livestock Entrepreneurship**
II. Course Code : EXT 607
III. Credit Hours : 1+2

IV. Aim of the courses

- To orient the students on basic concepts of entrepreneurship and the initiatives in promoting livestock as an enterprise.
- To impart knowledge in the various facets of entrepreneurial management and consumer behaviour for establishment of livestock ventures.

V. Theory

Unit I

Entrepreneurship - Role of Entrepreneurship in Economic Development of the country and current scenario and future prospects; Factors influencing Entrepreneurship (Internal factors, External factors, Political factors, Socio-Cultural Environment, Legal and Technological Environment); Role of Government and Non-Government agencies in promoting entrepreneurship in India- eg: Atal Innovation Mission, Startup India, Mudra Bank Scheme, Dairy Entrepreneurship Development Scheme, Agri-Clinics and Agri-Business Centers (ACABC), Entrepreneurship Development and Employment Generation (EDEG), etc.

Unit II

Livestock -Business Plan: Business Idea Generation, Brainstorming and evaluation of ideas, Competition, Scalability of the product, Price feasibility, Distribution and logistics, Ease of technology, Opportunities and threats, Internal strengths and weaknesses (SWOT analysis) Government regulations and statutory compliances, Sources of financial assistance.

Unit III

Livestock Business Evaluation: Evaluating financial feasibility, Cost of production and marketing, Project cost determination and fund requirement, Assessing working capital requirement, Non-fund based requirements (BG, LC), Cost of capital sources and cost of finance. Technical feasibility, Patents, Make or buy decision, Plant size and location, Machinery requirement, Outsourcing requirements, Project report and appraisal techniques- Net present value, Payback period, Break even analysis, CB Ratio.

Unit IV

Consumer Behaviour: Consumer behaviour- Definition, Consumer and customers, Buyers and users, Consumer behaviour and its applications in livestock marketing; Consumer behaviour models; Consumer motivation, Consumer perception, Consumer behaviour and marketing communications, Consumer decision-making process, Organizational buying behaviour, Modern marketing information system (marketing intelligence, communicating and acting on marketing intelligence).

VI. Practical

Exposure visits to commercial livestock enterprises- Dairy, Poultry, Meat/ Dairy/ Feed Processing Units. Analysis of successful cases of livestock entrepreneurship, Development of livestock business plans, Presentation of livestock business development plans, Study of consumer behavior, Critical analysis of livestock markets/ super markets/ malls.

**VII. Suggested Reading**

- Khanka SS. 1999. *Entrepreneurial Development*. S. Chand and Co.
- Gupta CB. 2001. *Management Theory and Practice*. Sultan Chand and Sons.
- Grover I. 2008. *Handbook on Empowerment and Entrepreneurship*. Agrotech Public
- Nandan H. 2013. *Fundamentals of Entrepreneurship*, PHI publishers
- Reading material of Course AEM-202 *Agri-Business and Entrepreneurship Development*. <http://www.manage.gov.in/pgdaem/studymaterial/aem202.pdf>
- Hisrich RD, Peters MP and Shepherd A. 2007. *Entrepreneurship*, 6th Edition, Tata McGraw Hill
- Singh D. 1995. *Effective Managerial Leadership*. Deep and Deep Publ.
- Tripathi PC and Reddy PN. 1991. *Principles of Management*. Tata McGraw Hill.
- Desai V. 1997. *Small Scale Industries and Entrepreneurship*. Himalaya Publ. House.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Entrepreneurship and its role in Economic Development of the country and current scenario and future prospects	1
2.	Factors influencing Entrepreneurship (Internal factors, External factors, Political factors, Socio - Cultural Environment, Legal and Technological Environment)	1
3.	Role of Government and Non-Government agencies in promoting entrepreneurship in India- eg: Atal Innovation Mission, Startup India, Mudra Bank Scheme, Dairy Entrepreneurship Development Scheme, Agri-Clinics and Agri-Business Centers (ACABC), Entrepreneurship Development and Employment Generation (EDEG), etc.	1
4.	Livestock -Business Plan: Business Idea Generation, Brainstorming and Evaluation of ideas, Competition, scalability of the product, Price feasibility, Distribution and Logistics Ease of Technology, Opportunities and Threats, Internal Strengths and Weaknesses (SWOT analysis)	2
5.	Government Regulations and statutory compliances, Sources of Financial Assistance	1
6.	Livestock Business Evaluation: Evaluating Financial Feasibility, Cost of Production and Marketing, Project Cost Determination and Fund requirement, assessing Working Capital Requirement, Non-fund based Requirements (BG, LC), Cost of Capital Sources and Cost of Finance	2
7.	Technical Feasibility, Patents, Make or Buy Decision, Plant Size and Location, Machinery Requirement, Outsourcing Requirements,	2
8.	Project Report and Appraisal Techniques- Net Present Value, Payback period, Break even analysis, CB Ratio	2
9.	Consumer Behaviour: Consumer Behaviour- Definition, Consumer and Customers, Buyers and Users, Consumer Behaviour and its Applications in Livestock Marketing;	1
10.	Consumer behaviour models; Consumer Motivation, Consumer Perception, Consumer Behaviour and Marketing Communications, Consumer Decision-making Process, Organizational Buying Behaviour,	2
11.	Modern marketing information system (marketing intelligence, communicating and acting on marketing intelligence).	1
	Total	16



S. No.	Topic	No. of Lectures/ Practicals
Practical		
1.	Visit to commercial livestock enterprises – Dairy, Poultry, any other economically important species of the region	5
2.	Visit to Meat/ Dairy/ Feed Processing Units	5
3.	Visit to any agri/ livestock start up	3
4.	Analysis of successful cases of livestock entrepreneurship	4
5.	Development of livestock business plans	4
6.	Presentation of livestock business development plans	3
7.	Study of consumer behavior	3
8.	Visit to livestock markets/ super markets/ malls and analysis	5
	Total	32

I. Course Title : Human Resource Management in Animal Husbandry Sector

II. Course Code : EXT 608

III. Credit Hours : 1+1

IV. Aim of the course

To make students understand human resource management techniques and deal organizational challenges effectively

V. Theory

Unit I

Concept, importance and functions of human resource management in animal husbandry sector. Process of management- planning, organizing, staffing, directing, coordination, reporting and budgeting. Principles, levels and types of organizations.

Unit II

Supervision- meaning, process and techniques. Work motivation. Job efficiency and job satisfaction.

Unit III

Organizational communication. Organizational climate. Conflict management.

Unit IV

Training– models, methods, Identification of training needs, Training evaluation and developing strategies for human resource development in animal husbandry sector. Capacity need assessment and personnel management in animal husbandry organizations.

VI. Practical

Training needs assessment farmers/ extension personnel, Development of training modules, Organization and evaluation of a training programme

VII. Suggested Reading

- Khanka SS. 1999. *Entrepreneurial Development*. S. Chand and Co.
- Gupta CB. 2001. *Management Theory and Practice*. Sultan Chand and Sons.
- BJ Lathi, Parag Narkhede and Vivek Yawalkar 2015. *Human Resource Management*,

Prashant Publications.





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- Noe RA, Hollenbeck JR, Gerhart B and Wright PM. 1997. *Human Resources Management: Gaining a competitive advantage*.
- Grover I. 2008. *Handbook on Empowerment and Entrepreneurship*. Agrotech Public.
- Nandan H. 2013. *Fundamentals of Entrepreneurship*, PHI publishers.
- Reading material of Course AEM-202 *Agri-Business and Entrepreneurship Development*. <http://www.manage.gov.in/pgdaem/studymaterial/aem202.pdf>
- Hisrich RD, Peters MP and Shepherd A. 2007. *Entrepreneurship*, 6th Edition, Tata McGraw Hill.
- Singh D. 1995. *Effective Managerial Leadership*. Deep and Deep Publ.
- Tripathi PC and Reddy PN. 1991. *Principles of Management*. Tata McGraw Hill.
- Vasanta Desai. 1997. *Small Scale Industries and Entrepreneurship*. Himalaya Publ. House.

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Concept, importance and functions of human resource management in animal husbandry sector	1
2.	Process of management- planning, organizing, staffing, directing, coordination, reporting and budgeting	1
3.	Principles, levels and types of organizations	1
4.	Supervision- meaning, process and techniques	1
5.	Work motivation	1
6.	Job efficiency and job satisfaction	1
7.	Organizational communication	1
8.	Organizational climate	1
9.	Conflict management	1
10.	Training– concept, meaning, importance of training in Animal Husbandry	1
11.	Training models and methods	2
12.	Identification of training needs	1
13.	Training evaluation	1
14.	Capacity need assessment and Personnel management in animal husbandry organizations	1
15.	Developing strategies for human resource development in animal husbandry sector	1
	Total	16
Practical		
1.	Training needs assessment of livestock farmers	2
2.	Training needs assessment of poultry farmers	2
3.	Training needs assessment of extension personnel	2
4.	Development of training module	2
5.	Planning for training programme	3
6.	Organization of training programme	3
7.	Evaluation of training programme	2
	Total	16

I. Course Title : Gender Empowerment and Livestock Development

II. Course Code : EXT 609

III. Credit Hours : 1+0

IV. Aim of the course

To acquaint students with gender perspectives, empowerment and its importance



in livestock development, policies and programmes.

V. Theory

Unit I

Gender and empowerment: meaning and importance in livestock sector, Gender related concepts and importance of empowering women in livestock development; Need and focus on gender sensitization, Gender in community diversity and its implication for empowerment.

Unit II

Gender perspectives in development of women, Social characteristics, Roles, Responsibilities, Resources, Constraints, Legal issues and opportunities; Economical, educational and other parameters with special reference to livestock development.

Unit III

Gender tools and methodologies: Dimensions and methodologies for empowerment; Gender budgeting; Gender analysis framework- context, activities, Resources and programme action profile; Technologies and empowerment, Gender specific technologies, Household technology interface, Socio-cultural interface and women as consumers of technologies.

Unit IV

Policies and programmes in empowering women in general and livestock development in specific eg: UJJAWALA, Pradhan Mantri Mahila Shakti Kendra, One Stop Centre Scheme, Mahila E-haat, STEP, etc.

VI. Suggested Reading

- Grover I and Grover D. 2002. *Empowerment of Women*. Agrotech Publ. Academy.
- Porter F, Smyth I and Sweetman C. 1999. *Gender Works: Oxfarm Experience in Policy and Practice*. Oxfarm Publ.
- Raj MK. 1998. *Gender Population and Development*. Oxford Univ. Press.
- Sahoo RK and Tripathy SN. 2006. *SHG and Women Empowerment*. Anmol Publ.
- Sinha K. 2000. *Empowerment of Women in South Asia. Association of Management Development Institution in South Asia*, Hyderabad.
- Thakur Joshi S. 1999. *Women and Development*. Mittal Publ. Vishwanathan M. 1994. *Women in Agriculture and RD*. Rupa Books.
- Ramkumar S, Garforth C, Rao SVN and Waldie K. (Ed). 2001. *Landless Livestock Farming-Problems and Prospects*. RAGACOVAS, Pondicherry.
- Seth Mira 2001. *Women and Development – Indian Experience*. Sage Publ.
- Samanta RK. (Ed). *Women in Agriculture – Perspectives, Issues and Experiences*. MD Publ.
- Waldie K and Ramkumar S. 2002. *Landless Women and Dairying – Opportunities for Development within a Poverty Perspective*. RAGACOVAS, Pondicherry.
- *Gender and empowerment: Definitions, approaches, and implications for policy*
<http://genderandenvironment.org/resource/gender-and-empowerment-definitions-approaches-and-implications-for-policy/>
- Njuki, J., Waithanji, E., Bagalwa, N. and Kariuki, J. 2013. *Guidelines on integrating gender in livestock projects and programs*. Nairobi, Kenya: ILRI.
- <https://cgspace.cgiar.org/bitstream/handle/10568/33425/GenderInLivestock.pdf>
- <http://wcd.nic.in/womendevlopment/national-policy-women-empowerment>

**Course Outline**

S. No.	Topic	No. of Lectures
Theory		
1.	Gender and empowerment: meaning, importance in livestock sector	1
2.	Gender related concepts	1
3.	Importance of empowering women in livestock development	1
4.	Need and focus on gender sensitization,	1
5.	Gender in community diversity and its implication for empowerment	1
6.	Gender perspectives in development of women	1
7.	Gender- Social characteristics, roles, responsibilities, resources, constraints, legal issues and opportunities; economical, educational and other parameters with special reference to livestock development	2
8.	Gender tools and methodologies: Dimensions and methodologies for empowerment	1
9.	Gender budgeting	1
10.	Gender analysis framework- context, activities, resources and programme action profile	1
11.	Technologies and empowerment - Gender specific technologies	1
12.	Household technology interface, Socio-cultural interface	1
13.	Women as consumers of technologies	1
14.	Policies and programmes in empowering women in general and livestock development in specific - Eg: UJJAWALA, Pradhan Mantri Mahila Shakti Kendra, One Stop Centre Scheme, Mahila E-haat, STEP etc	2
	Total	16

I. Course Title : Farm Journalism

II. Course Code : EXT 610

III. Credit Hours : 1+1

IV. Aim of the course

To sensitize students about the role of print, electronic, digital and internet media for promoting animal husbandry sector.

V. Theory**Unit I**

Concept of farm journalism and communication. Journalism as a means of mass communication and its role in livestock development. Opportunities, strength and limitations. Ethics and principles of journalism for effective writing.

Unit II

Writing skills –Principles of writing - art of writing, News items, News stories, feature articles, Success stories, Magazines, bulletins, folders, etc. Fundamentals of lay-out in writing. Writing of research papers and popular articles in journals, Farm magazines and e-journals. Methods and techniques of broadcasting of farm programmes. Writing scripts for radio and televisions.

Unit III



Rapport building with different categories of clients involved in veterinary and animal husbandry extension programmes. Art of speaking. Importance of listening and reading. Writing for press news. Relations with press media. Event management,



Organization of press meet. Qualities of a good public relations manager. Role and importance of art of speaking, listening and reading skills

Unit IV

Types of internet based media- Writing for web- concepts, Writing for social media (Blogs, etc.) – Ethics and values. Development of Multimedia Modules.

VI. Practical

Designing and preparation of news stories, feature articles, success stories related to animal husbandry. Designing and preparation of Magazines, Pamphlets, folders, popular research articles, radio, T.V. scripts. Visit to Agricultural Technology Information Centre (ATIC) centre to record the activities of preparation, editing and publication of news articles and research publications.

VII. Suggested Reading

- Bhaskaran C, Prakash R and Kishore Kumar N. 2008. *Farm Journalism in Media Management*. Agro-Tech Publ. Academy.
- Chatterjee PC. 1991. *Broadcasting in India*. Sage Publ.
- Chiranjeev A. 1999. *Electronic Media Management*. Authors Press.
- D'Souza YK. 1998. *Principles and Ethics of Journalism and Mass Communication*. Commonwealth Publ.
- Defleur ML and Dennis EE. 2001. *Understanding Mass Communications*. Goyalsaab Publ.
- Jaico Publ. Malhan PN. 2004. *Communication Media: Yesterday, Today and Tomorrow*. Directorate of Publication Division, New Delhi.
- Jain SC. 2006. *International Marketing Management*. CBS Publ.
- Keval J Kumar. 2004. *Mass Communication in India*.
- Mehta DS. 1992. *Mass Communication and Journalism in India*. Allied Publ.
- Panigrahy D. 1993. *Media Management in India*. P. K. Biswasroy (Ed.). Kanishka Publ.
- Singh AK 2014. *Agricultural Extension and Farm Journalism*, Agrobios Publications

Course Outline

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Concept of farm Journalism and communication	1
2.	Journalism as a means of mass communication and its role in livestock development.	1
3.	Role journalism in livestock development	1
4.	Opportunities, Strength and limitations in farm journalism in livestock sector	1
5.	Ethics and principles of journalism for effective writing	1
6.	Writing skills –Principles of writing, art of writing, news items, news stories, feature articles, success stories, magazines, bulletins, folders, etc.	1
7.	Fundamentals of lay-out in writing	1
8.	Writing of research papers and popular articles in journals, farm magazines and e-journals	1
9.	Methods and techniques of broadcasting of farm programmes.	1
10.	Writing scripts for radio and televisions	1
11.	Writing for press news; Organization of press meet and Event management	1
12.	Relations with press media Qualities of a good public relations manager	1
13.	Types of internet based media- Writing for web- concepts, Writing for social media (Blogs, etc.) – Ethics and values.	1



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S. No.	Topic	No. of Lectures/ Practicals
14.	Development of Multimedia Modules	1
15.	Rapport building with different categories of clients involved in veterinary and animal husbandry extension programmes	1
16.	Role and importance of art of speaking, listening and reading skills	1
	Total	16
Practicals		
1.	Designing and preparation of news stories related to animal husbandry.	1
2.	Designing and preparation of feature articles related to animal husbandry	1
3.	Designing and preparation of success stories related to animal husbandry	1
4.	Designing and preparation of Magazines	1
5.	Designing and preparation of Pamphlet	1
6.	Designing and preparation of Folders	1
7.	Designing and preparation of Popular research articles	1
8.	Writing of Radio script	1
9.	Preparation of TV script	2
10.	Development of Short film and feature film;	2
11.	Visit to editor office of farm journals of State Veterinary University	1
12.	Field visit to Successful Livestock farmer and documenting success story	1
13.	Visit to ATIC to record the activities of preparation, editing and publication of news articles and research publications	2
	Total	16

I. Course Title : Statistics for Social Sciences

II. Course Code : SSS 600

III. Credit Hours : 2+1

IV. Aim of the course

To equip the students with knowledge and skills in the applications of statistics in the field of veterinary and Animal Husbandry Extension.

V. Theory

Unit 1

Descriptive statistics- measures of central tendency, Measures of dispersion, Coefficient of variance, Standard error, Skewness and kurtosis, Contingency tables, Normal distribution, Test of significance – One sample t test, Independent t test, paired t test, ANOVA and z - one tailed and two tailed tests.

Unit 2

Population versus sample, Sampling errors, Sample size determination, Survey instruments, Open ended and closed ended questions, and online survey tools.

Unit 3

Dependency among the variables, correlation- Pearson, Spearman and Kendall, point biserial correlation, Regression analysis, Assumptions, Multiple linear Regression, Regression diagnostics-outlier, Multicollinearity, Heteroscedasticity and autocorrelation, logit/ probit model.

Unit 4

Scaling Techniques: Ranking, Rating and Paired Comparison. Scaling techniques -



Likert, Thurston and Guttman Scales. Construction and standardization; Knowledge test, Test of reliability and validity. Non-parametric tests- Signed Rank, Rank sum and Kruskal-Wallis tests. Test for independence and homogeneity. Multivariate techniques – cluster analysis, discriminant analysis and Factor analysis: Different rotations and interpretation of results.

VI. Practical

Exercises on different statistical tools and their interpretations

VII. Suggested Reading

- Cunningham BJ. 2012. *Using SPSS: An Interactive Hands-on approach*
- Edwards Allen L. 1969. *Techniques of Attitude Scale construction*. Vakils, Feffer and Simons Pvt. Ltd, Bombay
- Gupta SC and VK Kapoor. 2007. *Fundamentals of Mathematical Statistics*. Sultan Chand and Sons.
- Hair Joseph F, William C Black, Barry J Babin and Rolph E. Anderson. 2010. *Multivariate Data Analysis*. Pearson Pub.
- Hogg RV, AT Craig and JW. Mckean. 2005. *Introduction to Mathematical Statistics*, Pearson Education.
- Sukhatme PV, BV Sukhatme, S Sukhatme and C Ashok. 1984. *Sampling Theory of Surveys with Applications*, Iowa State University Press, Iowa, USA.



Course Title with Credit Load Ph.D. in Veterinary Extension Education

Course Code	Course Title	Revised	Credits
EXT 701*	Organizational Leadership and Management		2+0
EXT 702	Recent Trends in Research Techniques in Social Sciences		2+1
EXT 703*	Training for Development		1+1
EXT 704	Policies and Regulations in Livestock Sector		1+0
EXT 705*	Educational Technology		2+1
EXT 706	Dynamics of Social Change		2+0
EXT 707*	Monitoring and Evaluation of Livestock Development Programmes		2+1
EXT 708	Theory Constructions in Social Sciences		1+0
EXT 709	Facilitation for Development		2+1
EXT 710	Managing Extension Organizations		2+1
EXT 711	Doctoral Seminar-I		1+0
EXT 712	Doctoral seminar-II		1+0
EXT 713	Doctoral Research		0+75

*Core Courses



Course Contents

Ph.D. in Veterinary Extension Education

- I. Course Title** : **Organizational Leadership and Management**
II. Course Code : **EXT 701**
III. Credit Hours : **2+0**

IV. Aim of the course

To orient students with leadership and management perspectives for organizational change and development.

V. Theory

Unit I

Organizational Leadership – Introduction, Definition, Importance, Distinguishing differences between leadership and management within an organization, Theories of leadership, Current trends in leadership development, Competencies needed to be an effective leader and develop strategies for improving effective leadership potential.

Unit II

Concept, Approaches and functions of management, Principles and process of organization, hierarchy of organization, departmentalisation, Authority and responsibility. Components of individual behaviour in organization, Organizational climate, Decision making by consensus and participation by subordinates, Organization development– history, nature, characteristics, assumptions and process, Organization development interventions.

Unit III

Organizational communication, Communication network, Essentials of organizational communication. Conflict – types and management, Leadership and its role in conflict resolution, Morale in organizations, organizational factors affecting morale, attitude and productivity, methods of improving moral and evaluation of morale. Performance appraisal processes.

Unit IV

Supervision– principles, techniques and functions of supervision. Qualities of supervisor, supervisor-subordinate relationship and interaction process. Changing organizational structure and system, changing organizational climate and interpersonal style, issues and choice involved in making organizational climate effective.

VI. Suggested Reading

- Bhattacharyya DK. 2011. *Organizational Change and Development*, Oxford University Press.
- Hellriegel D, Slocum JW and Woodman. 2001. *Organizational Behaviour*.
- Luthans F. 2002. *Organizational Behaviour*. Tata McGraw-Hill, New York



- Newstrom JW and Davis K.

Organizational Behaviour: Human behaviour at Work. Tata- McGraw Hill, New Delhi.



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- Peter MS. 1998. *The Fifth Discipline: The Art and Practice of Learning Organization*. Random House, London.
- Pradip NK. 1992. *Organisational Designs for Excellence*. Tata McGraw Hill, New Delhi.
- Shukla Madhukar. 1996. *Understanding Organisations*. Prentice Hall of India, New Delhi.
- Thomas GC and Christopher GW. 2013. *Organizational development and change* (10th edition), South-Western college publishing.
- Wendell LF and Cecil HB. 1999. *Organisational Development: Behavioural Science Interventions for Organization Improvement*, Pearson. 368 pp.
- Gary A Yukl. 2013. *Leadership in Organizations* (8th edition), Pearson
- Anita Satterlee. 2018. *Organizational Management and Leadership* (3rd edition, Synergistics Inc.
- Patricia D Witherspoon. 1997. *Communicating Leadership: An Organizational Perspective*, Allyn and Bacon, Inc.

Course Outline

S. No.	Topic	No. of Lectures
Theory		
1	Introduction, Definition and Importance of Organizational Leadership with special reference to Animal Husbandry Organizations	1
2	Distinguishing differences between leadership and management within an organization	1
3	Theories of leadership, Current trends in leadership development	2
4	Competencies needed to be an effective leader and develop strategies for improving effective leadership potential.	2
5	Concept, approaches and functions of management with special reference to Animal Husbandry organizations	2
6	Principles and process of organization, hierarchy of organization, departmentalisation, Authority and responsibility.	3
7	Components of individual behaviour in organization.	1
8	Organizational climate, decision making by consensus and participation by subordinates.	1
9	Organizational development – history, nature, characteristics, assumptions and process.	1
10	Organization development interventions.	2
11	Organizational communication, Communication network, Essentials of organizational communication.	2
12	Conflict – types and management.	2
13	Leadership and its role in conflict resolution.	1
14	Morale in organizations, organizational factors affecting morale, attitude and productivity, methods of improving morale and evaluation of morale.	2
15	Performance appraisal processes	2
16	Principles, techniques and functions of supervision.	1
17	Qualities of supervisor, supervisor-subordinate relationship and interaction process.	1
18	Changing organizational structure and system	2
19	Changing organizational climate and interpersonal style, issues and choice involved in making organizational climate.	3
Total		32



I. Course Title : Recent Trends in Research Techniques in Social Sciences

II. Course Code : EXT 702

III. Credit Hours : 2+1

IV. Aim of the course

To train the students on research and management techniques/ methods applicable to animal husbandry research.

V. Theory

Unit I

Importance and relevance of scales, Tests, Index, Quotient in social science research. Techniques of attitude scale construction, viz., paired comparison, equal appearing interval, successive interval, summated ratings, scalogram analysis.

Unit II

Measurement of reliability and validity of tests and scales. Sociometry. Qualitative, quantitative and mixed methods of research. Critical incidence techniques. Q-sort technique, Observation techniques, Case studies, etc.

Unit III

Experimental and quasi experimental research designs and randomized control trials. Delphi techniques, Propensity score matching, Content analysis and projective techniques.

Unit IV

Multivariate analysis, Systems analysis, Conjoint analysis, Panel data analysis, Principal component analysis, Discriminant analysis, Non-parametric tests and their application in extension research.

VI. Practical

Exercises on scaling techniques, attitude scale construction – Paired Comparison, Equal Appearing interval, Summated Rating Scale, Critical Incident Technique, Exercise on construction of Knowledge Test. Assessing the reliability and validity of measuring instruments Exercise on observation skills.

VII. Suggested Reading

- Babbie E. 2008. *The basics of social research* (4th Edition), Belmont, CA, USA; Thompson Wordsworth.
- Creswell JW. 2009. *Research design: Qualitative, quantitative, and mixed methods approaches*. Third edition. Thousand Oaks: Sage Publications.
- Creswell JW. 2012. *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th edition). Boston, MA: Pearson.
- Kerlinger FN and Lee HB. 2000. *Foundations of Behavioral Research*. Orlando, FL: Harcourt College Publishers.
- Kumar R. 2014. *Research Methodology: A Step- by- Step Guide for Beginners*. (4th Edition). Thousand Oaks, California: Sage Publications.
- Malhotra NK. 2010. *Marketing research: An applied orientation. Sixth Edition*. Upper Saddle River NJ: Prentice Hall.
- Neuman WL. 2006. *Social Research Methods: Qualitative and Quantitative Approaches*. Toronto: Pearson.
- Sekaran U and Bougie R. 2013. *Research Methods for Business A Skill-Building Approach*. (6th Edition), Wiley, New York.



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- Sivakumar PS, Sontakki BS, Sulaiman RV, Saravanan R and Mittal N. (eds). 2017. *Good Practices in Agricultural Extension Research. Manual on Good Practices in Extension Research and Evaluation. Agricultural Extension in South Asia.* Centre for research on innovation and science and policy (CRISP), Hyderabad. India.

Course outlines

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Importance and relevance of scales, tests, index, quotient in social science research.	3
2.	Techniques of attitude scale construction, viz., paired comparison, equal appearing interval, successive interval, summated ratings, scalogram analysis.	5
3.	Measurement of reliability and validity of tests and scales.	2
4.	Sociometry.	1
5.	Qualitative, quantitative and mixed methods of research.	3
6.	Critical incidence techniques, Q-sort technique, observation techniques, case studies	3
7.	Experimental and quasi experimental research designs and randomized control trials.	2
8.	Delphi techniques, propensity score matching, content analysis and projective techniques.	3
9.	Multivariate analysis	2
10.	Systems analysis	1
11.	Conjoint analysis	1
12.	Panel data analysis	1
13.	Principal component analysis	1
14.	Discriminant analysis	1
15.	Non-parametric tests and their application in extension research.	3
	Total	32
Practicals		
1.	Scaling techniques	2
2.	Attitude scale construction – Paired Comparison, Equal Appearing interval, Summated Rating Scale, Critical Incident Technique	6
3.	Construction of Knowledge Test	3
4.	Assessing the reliability and validity of measuring instruments	3
5.	Exercise on observation skills	2
	Total	16

I. Course Title : Training for Development

II. Course Code : EXT 703

III. Credit Hours : 1+1

IV. Aim of the course

To impart knowledge on planning, implementation and evaluation of various training programmes.

V. Theory

Unit I

Concept of training and education. Role of institution, Organization, Trainer and



participants in success of training programme. Training infrastructure for extension personnel and livestock farmers.

Unit II

Planning, Development and execution of training programmes. Concept of need Assessment; Approaches in need Analysis- Performance Analysis, Task Analysis, Competency Study; Needs Survey.

Unit III

Training curriculum design and development. Training models, Methods and methodologies and strategies - Evaluation of Training (Kirkpatrick model, CIPP Model, Logic Model, etc.), and follow-up of training programmes. Training Transfer- Barriers and factors effecting transfer of training (training design, trainee characteristics, Trainer capabilities, Training environment, Organization role, etc.).

Unit IV

Training, Capacity building, Capacity development and HRD-Meaning and differences; Need and principles of capacity development; Types and levels of capacities. Approaches in Capacity Development -Informative approach, Participatory approach, Experimental approach/ Experiential, Performance based approach; Capacity Development Strategies - Academic strategy, Laboratory strategy, Activity strategy, Action strategy, Personal development strategy, Organizational development strategy.

VI. Practical

Exercise on Training Need Assessment. Development of training modules. Organization of training programmes for farmers, Evaluation of training programmes. Impact assessment of training programmes. Analysis of training institutions. Studies on training transfer.

VII. Suggested Reading

- Bentaya GM and Hoffmann V (Eds). 2011. *Rural Extension Volume 3 -Training Concepts and Tools*, Margraf Publishers GmbH, Scientific books, KanalstraBe 21; D-97990, weikersheim, 191 pp.
- DFID. 2003. *Promoting Institutional and Organisational Development. A Source Book of Tools and Techniques*, Department for International Development, United Kingdom
- FAO 2010. FAO. *Capacity Assessment Approach and Supporting Tools - Discussion Draft*, Food and Agriculture Organisation of the United Nations
- FAO 2012. *Capacity Development: Learning Module 2*. FAO Approaches to Capacity Development in Programming. Processes and Tools, Food and Agriculture Organisation of the United Nation
- GFRAS. 2012. *The New Extensionist: Roles, Strategies, and Capacities to Strengthen Extension and Advisory Services*, Global Forum for Advisory Services
- GFRAS. 2015. *The New Extensionist: Core Competencies for Individuals*, GFRAS Brief 3.
- Horton D. 2002. *Planning, Implementing, and Evaluating Capacity Development*. ISNAR Briefing Paper 50.
- Maguire. 2012. *Module 2: Agricultural Education and Training to Support Agricultural Innovation Systems. Overview*. *Agricultural Innovation Systems: An Investment Sourcebook*. The World Bank.
- Mishra DC. 1990. *New Directions in Extension Training*. Directorate of Extension, Ministry of Agriculture, Govt. of India, New Delhi.
- OECD/ DAC. 2006. *The Challenge of Capacity Development: Working Towards Good Practice*, Organisation for Economic Cooperation and Development.



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- Pretty JN, Gujit I, Thompson J, and Scoones I. 1995. *A Trainer's Guide for Participatory Learning and Action*. IEED Participatory Methodology Series.
- Rolf PL and Udai P. 1990. *Training for Development*, (3rdedn) by (West Hartford, Kumarian Press, 1990, pp. 333.
- Rolf PL and Udai P. 1992. *Facilitating Development: Readings for Trainers, Consultants and Policy-makers*, New Delhi: Sage Publications, pp. 359

Course outlines

S. No.	Topic	No. of classes
Theory		
1.	Concept of training and education.	1
2.	Role of institution, organization, trainer and participants in success of training programme.	1
3.	Training infrastructure for extension personnel and livestock farmers	1
4.	Planning, development and execution of training programmes – importance, scope and relevance to animal husbandry sector	1
5.	Concept of Need Assessment – Scope and Importance in animal husbandry sector	1
6.	Approaches in Need Analysis- Performance Analysis, Task Analysis, Competency Study; Needs Survey.	2
7.	Training curriculum design and development.	1
8.	Training models, methods and methodologies and strategies	1
9.	Training Evaluation (Kirkpatrick model, CIPP Model, Logic Model, etc.) and follow-up of training programmes.	2
10.	Training Transfer– Barriers and Factors effecting transfer of training (training design, trainee characteristics, trainer capabilities, training environment, organization role, etc.)	1
11.	Training, capacity building, capacity development and HRD -Meaning and differences;	1
12.	Need and principles of capacity development; Types and levels of capacities.	1
13.	Approaches in Capacity Development -Informative approach, Participatory approach, Experimental approach/ Experiential, Performance based approach;	1
14.	Capacity Development Strategies - Academic strategy, Laboratory strategy, Activity strategy, Action strategy, Personal development strategy, Organizational development strategy.	1
	Total	16
Practicals		
1.	Training Need Assessment of farmers, entrepreneurs/ AHD functionaries	3
2.	Development of training modules – for farmers/ entrepreneurs	2
3.	Organization of training programmes for farmers/ entrepreneurs	3
4.	Evaluation of training programmes of farmers/ entrepreneurs	2
5.	Impact assessment of training programmes	3
6.	Analysis of training institutions	2
7.	Identification of Capacity Development approaches and strategies followed by Animal Husbandry Department/ other related organization	2
	Total	16



- I. Course Title : Policies and Regulations in Livestock Sector**
II. Course Code : EXT 704
III. Credit Hours : 1+0

IV. Aim of the course

To sensitize students on policies and regulations in animal husbandry sector.

V. Theory**Unit I**

Concept, importance of development of policies and its framework. State, National and Global policies related to livestock sector. World Trade Organization in relation to livestock sector. Impact of WTO on Indian international trade of food products of animal origin, Intellectual Property Rights in relation to animal husbandry.

Unit II

HACCP, Sanitary and phyto-sanitary measures to protect the animals' life and health, Food safety uses in relation to animal husbandry sector. Introduction to Agreement on Technical Barriers to Trade (ATBT).

Unit III

Indian livestock sector related policies, National Livestock Policy, Regional Trade Agreements (RTAs) and Indian Livestock sector; Case studies – Impact of global trade agreements on livestock sector. Food safety acts and institutional arrangements for implementation; Agriculture Produce and Livestock Marketing (APLM) Act. Livestock products pricing policy. Government of India Systems, viz., Sanitary Import Permit System for livestock products

Unit IV

Animal welfare - Philosophical bases of animal welfare; Evolution of basic animal welfare principles; Animal Welfare laws- legislations in veterinary and animal sciences.

VI. Suggested Reading

- Jessica Vapnek Megan Chapman. 2010. *Legislative and regulatory options for animal welfare* (FAO Legislative Study 104) <http://www.fao.org/docrep/013/i1907e/i1907e00.pdf>
- Richard A Sprenger 2018. *The HACCP Handbook* (7th Edition)
- Sara E Mortimore and Carol A. Wallace. 2015. *HACCP: A food industry briefing*, Second Edition Sara E. Mortimore and Carol A Wallace
- World Society for the Protection of Animals. 2007. *Universal Declaration on Animal Welfare* https://www.worldanimalprotection.ca/sites/default/files/ca_-_en_files/case_for_a_udaw_tcm22-8305.pdf
- <https://awbi.org/awbi-pdf/APL.pdf>
- <https://www.petaindia.com/wp-content/uploads/2017/05/Prevention-of-Cruelty-to-Animals-Dog-Breeding-and-Marketing-Rules-2017.pdf>
- <https://www.wto.org/>

Course Outlines

S. No.Topic	No. of Lectures
Theory	
1. Concept, importance of development of policies and its framework.	1
2. State, National and Global policies related to livestock sector.	1



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S. No.	Topic	No. of Lectures
3.	World Trade Organization in relation to livestock sector.	1
4.	Impact of WTO on Indian international trade of food products of animal origin.	1
5.	Intellectual Property Rights in relation to animal husbandry.	1
6.	HACCP, Sanitary and phyto-sanitary measures to protect the animals' life and health, food safety uses in relation to animal husbandry sector.	1
7.	Introduction to Agreement on Technical Barriers to Trade (ATBT).	1
8.	Indian livestock sector related policies.	2
9.	Regional Trade Agreements (RTAs) and Indian Livestock sector	1
10.	Case studies – Impact of global trade agreements on livestock sector.	1
11.	Case studies – Food safety acts and institutional arrangements for implementation;	1
12.	Agriculture Produce and Livestock Marketing (APLM) Act.	1
13.	Livestock products pricing policy.	1
14.	Animal Welfare - Philosophical bases of animal welfare; Evolution of basic animal welfare principles	1
15.	Animal Welfare laws- legislations in veterinary and animal sciences	1
	legislations in veterinary and animal sciences	1
	Total	16

I. Course Title : Educational Technology

II. Course Code : EXT 705

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint students with different concepts of education technology for the enhancement of quality of education.

V. Theory

Unit I

Educational Technology – Meaning, Nature, Scope Concepts and Components of Educational Technology- Basics of Teaching and Learning- Theories of teaching and learning. Curriculum development at macro and micro levels. Formulation of instructional objectives. Teaching Competencies –Need and Importance in teaching – competency mapping and development.

Unit II

Preparation of course outline for instructions, lesson planning. Designing instructions for theory and practical, Innovative Teaching Methods/ methodologies – Student Centric and Teacher Centric; Instructional tools and devices in class room instruction, computer aided learning. Understanding learner's behaviour, learning styles, motivating learners. Measurement of learning outcomes.

Unit III

Students' counselling, guidance and mentoring – concepts, types and importance in higher education- Student evaluation – meaning and methods, construction of measuring instrument – question banking. Performance appraisal of teachers –



meaning and methods,
Use of library for effective learning.

construction of assessment instruments.



Unit IV

Emerging Educational Technologies- Open and Distance Learning (ODL) for quality Veterinary Education; Concepts of ODL – Implications to Veterinary Education. Online Education - Synchronous and Asynchronous learning – models – eLearning, Massive Open Online Courses – SWAYAM, Open Education Resources (OERs), RLOs, Digital Initiatives in Education, viz., Swayam Prabha, National Digital Library, National Academic Depository, E-Shodh Sindhu, E Acharya, EVidhwaan, Agriculture Education Portal, e-KrishiShiksha, KrishiKosh, CeRA, National Educational Alliance for Technology (NEAT) etc.

VI. Practical

Preparation of lesson plans, Planning and preparation of instructional aids, Individual classroom instructional exercises, Micro Teaching Exercise, Development and testing of student evaluation instrument, Development of performance appraisal instrument for teachers., Critical analysis of different online education platforms.

VII. Suggested Reading

- Aggarwal JC. 2000. *Essential of Educational Technology: Teaching Learning Innovations in Education*. New Delhi: Vikas Publishing House.
- Alston, Antoine JW, Wade Millerand, David L Williams. 2003. *The future role of instructional technology in agricultural education in North Carolina and Virginia*. Journal of Agricultural Education, Volume 44, Number 2, 2003.
- Breslow L, Pritchard DE, DeBore J, Stump GS, Ho AD, Seaton DT. 2013. *Studying Learning in the Worldwide Classroom Research into edX's First MOOC*.
- Davies IK. 1971. *The Management of Learning*. New York: McGraw-Hill Publications.
- Fred Percival and Phil Race. 2005. *Handbook of Educational Technology 3rd Edition*. New Jersey: Nichols Publishing Company.
- Holz-Clause MS and Guntuku D. 2010. *Global Agricultural Knowledge Initiative: Strengthening the global competence of students, faculty and extension agents*.
- Kumar KL. 2000. *Educational Technology*. New Delhi: New Age International Publishers.
- Leith GO et al.1966. *A Hand Book of Programmed Learning and Birmingham*.
- Mangal SK. 2002. *Foundation of Educational Technology*. Ludhiana: Tondan Publication. 137.
- Mangal SK. 2006. *Essentials of Educational Technology*. New Delhi: Prentice-Hall Publications.
- Mithra, Shiv K. 1968. *Proceeding of Symposium on Educational Technology*. IPAL, NCERT. P.4.
- Purabi Jain. March 1968. *Educational Technology*. New Delhi: Dominant Publishers and Distributers.
- Sampath K, Panneerselvam A, Santhanam M. 2001. *Introduction to Educational Technology*. New Delhi: Sterling Publishers Pvt. Ltd.
- Sharma RA. 2007. *Educational Technology and Management*. Agra: Vinod Pustak Mandir.

Course Outlines

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Meaning, nature, Scope, Concepts and Components of Educational Technology	2
2.	Basics of Teaching and Learning	1
3.	Theories of teaching and learning	2



4. Curriculum development at

macro and micro levels



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S. No.	Topic	No. of Lectures/ Practicals
5.	Formulation of instructional objectives	1
6.	Teaching Competencies – Need and Importance in teaching	2
7.	Competency mapping and development	1
8.	Lesson planning – definition, importance, steps in preparation	1
9.	Preparation of course outline for instructions, Designing instructions for theory and practical	2
10.	Innovative Teaching Methods/ methodologies – Student Centric and Teacher Centric	2
11.	Instructional tools and devices in class room instruction, computer aided learning	
12.	Understanding learner’s behaviour, learning styles, motivating learners.	2
13.	Measurement of learning outcomes	1
14.	Students’ counselling, guidance and mentoring – concepts, types and importance in higher education	2
15.	Student evaluation – meaning and methods, construction of measuring instrument – question banking	1
16.	Performance appraisal of teachers –meaning and methods, construction of assessment instruments.	2
17.	Use of library for effective learning	1
18.	Emerging Educational Technologies - Open and Distance Learning (ODL) for quality Veterinary Education	2
19.	Concepts of ODL – Implications to Veterinary Education.	1
20.	Online Education - Synchronous and Asynchronous learning – models – eLearning,	2
21.	Massive Open Online Courses – SWAYAM, Open Education Resources (OERs), RLOs, Digital Education and its application in Veterinary Education	2
	Total	32
Practicals		
1.	Preparation of lesson plans	3
2.	Planning and preparation of instructional aids	3
3.	Individual classroom instructional exercises	2
4.	EXercise on Micro teaching	2
5.	Development and testing of student evaluation instrument	2
6.	Development of performance appraisal instrument for teachers.	2
7.	Critical analysis of different online education platforms	2
	Total	16

I. Course Title : Dynamics of Social Change

II. Course Code : EXT 706

III. Credit Hours : 2+0

IV. Aim of the course

To provide understanding on the dynamics of social change and its implications to livestock development.

V. Theory

Unit I



Definition of change,
Dimensions,

development, social and cultural change.



characteristics, Types, rate and directions of social change. General conditions of social change. New dynamics in social change.

Unit II

Concept, importance and problems of planned change. Role of change agents. Approaches of change agents towards planned change. Acceptance and rejection to planned change in animal husbandry. Techniques for accelerating change.

Unit III

Theories of change: Darwin, Kurt, Lewin and Ogburn: Process of change, assessment of resources, fixation of change objective, evaluating change effect. Barriers to change-psychological, Social and economic, Stimulants to change: psychological, social and economic.

Unit IV

Social Change and its implication with reference to livestock development. Temporal changes in livestock development – national and global, Climate change and its impact on livestock development.

VI. Suggested Reading

- Chandra Shekhar. 2009. *Dynamics of Social Change*. Popular Prakashan.
- Johannes Dragsbaek Schmidt, Jacques Hersh. 2000. *Globalization and Social Change*, Routledge.
- John Solomos, Les Back. 1995. *Race, Politics, and Social Change*, Routledge.

Course outlines

S. No.	Topic	No. of Lectures
Theory		
1.	Definition of change, development, social and cultural change	2
2.	Dimensions, characteristics, types, rate and directions of social change	2
3.	General conditions of social change	2
4.	New dynamics in social change	1
5.	Concept, importance and problems of planned change	2
6.	Role of change agents in social change and Approaches of change agents towards planned change	2
7.	Acceptance and rejection to planned change in animal husbandry	2
8.	Techniques for accelerating change	1
9.	Theories of change: Darwin, Kurt, Lewin and Ogburn	3
10.	Process of change	1
11.	Assessment of resources	2
12.	Fixation of change objective	1
13.	Evaluating change effect	2
14.	Barriers to change-psychological, social and economical	1
15.	Stimulants to change: psychological, social and economic	2
16.	Social Change and its implications with reference to livestock development	2
17.	Temporal changes in livestock development – national and global	2
18.	Climate change and its impact on livestock development	2
Total		32



I. Course Title : Monitoring and Evaluation of Livestock Development Programmes

II. Course Code : EXT 707

III. Credit Hours : 2+1

IV. Aim of the course

To appraise the students about the monitoring and evaluation of livestock development programmes.

V. Theory

Unit I

Monitoring, evaluation and impact assessment - Importance and scope in livestock based developmental programmes; Approaches and Types of Monitoring Indicators- Approaches to Monitoring Indicators, Types of Monitoring Indicators; Indicators of Monitoring in Development Programmes - Capability Indicators, Performance Indicators; Monitoring and Progress Reporting; Evaluation: Data Collection Methods - Conventional Methods, Participatory Methods; Evaluation Approaches; Challenges in Programme Evaluation.

Unit II

Conceptual framework, result framework and logic models; Quantitative and qualitative indicators – characteristics and their selection criteria; indicators and information systems for sustainable livestock development - Testing and improving indicators; Integration of M and E systems into development programs.

Unit III

Difference between outcome and impact; Types of impact assessment: Climate impact assessment; Demographic impact assessment; Development impact assessment; Ecological and environmental impact assessment; Economic and fiscal impact assessment; Risk assessment; Social impact assessment; Strategic impact assessment; technology assessment, Project evaluation, Public participation and consultation.

Unit IV

Impact assessment methods: Formative and summative evaluation, Types-within-without; before-after; case study; social auditing; performance audit; quantifying the impact parameters.

VI. Practical

Development of M and E plans and procedures for livestock developmental programmes using participatory approach. Developing indicators (social and economic) and information system for sustainable livestock development; analysis of different reports, conducting impact assessment exercises, case studies, data generation, report writing.

VII. Suggested Reading

- Carlson GA, Miranowski J and Zilberman D. 1998. *Agricultural and Environmental Resource Economics*. Oxford Univ. Press. 63
- Hanley N, Shogren J and White B. 2007. *Environmental Economics in Theory and Practice*. Palgrave, London.
- Kolstad C. 1999. *Environmental Economics*. Oxford Univ. Press.
- Little IMD and Mirlees JA. 1974. *Project Appraisal and Planning for Developing Countries*. Oxford and IBH Publ.



- Prato T. 1998. *Natural Resource and Environmental Economics*. Iowa State Univ. Press.
- Sterner T. 2003. *Policy Instruments for Environmental and Natural Resource Management. Resources for the Future*. The World Bank and SIDA.

Course Outlines

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Monitoring, evaluation and impact assessment - importance and scope in livestock based developmental programmes	2
2.	Approaches to Monitoring Indicators	1
3.	Types of Monitoring Indicators	1
4.	Indicators of Monitoring in Development Programmes Capability Indicators, Performance Indicators	2
5.	Monitoring and Progress Reporting	1
6.	Evaluation: Data Collection Methods - Conventional Methods, Participatory Methods	3
7.	Evaluation Approaches	1
8.	Challenges in Programme Evaluation	1
9.	Conceptual framework, result framework and logic models	2
10.	Quantitative and qualitative indicators – characteristics and their selection criteria	2
11.	Indicators and information systems for sustainable livestock development - testing and improving indicators	2
12.	Integration of M and E systems into development programs	1
13.	Difference between outcome and impact	1
14.	Types of impact assessment: climate impact assessment; demographic impact assessment; development impact; assessment; ecological and environmental impact assessment; economic and fiscal impact assessment; risk assessment; social impact assessment; strategic impact assessment; technology assessment	5
15.	Project evaluation	1
16.	Public participation and consultation	1
17.	Impact assessment methods: Formative and summative evaluation	2
18.	Types of impact assessment -within-without; before-after; case study; social auditing; performance audit	2
19.	Quantifying the impact parameters	1
	Total	32
Practicals		
1.	Development of M and E plan for livestock developmental programmes using participatory approach.	3
2.	Development of procedures for livestock developmental programmes using participatory approach	2
3.	Developing indicators (social and economic) and information system for sustainable livestock development	3
4.	Analysis of different reports	2
5.	Conducting impact assessment exercises	2
6.	Case studies	1
7.	Data generation	1
8.	Report writing	2
	Total	16



- I. Course Title : Theory Constructions in Social Sciences**
II. Course Code : EXT 708
III. Credit Hours : 1+0

IV. Aim of the course

To provide the foundation for construction of theories in social science.

V. Theory**Unit I**

Importance of theory construction in Extension. Hypothesis, Theory, Principle and Law; Meaning, elements, Ideal Criteria, Functions, Types of theories. Definitions: Meaning, types and Rules.

Unit II

Generalizations: Meaning, Classification. Relationship: Meaning Types.

Unit III

Terminologies used in theory constructions: Axiom, Postulate, Proposition, Theorem, Fact, Concept, Construct, Probability and Measurement Basic Derived.

Unit IV

Steps in theory building - Axiomatic techniques, Historical approaches and scientific application. Theoretical concept in social sciences. Test of Theory: Applying appropriate statistical tests.

VI. Suggested Reading

- Blalock HM. 1969. *Theory Construction: Form verbal to Mathematical Formulations*. Prentice Hall.
- Dubin R. 1978. *Theory Building*. The Free Press, New York.
- Hage J. 1973. *Techniques and Problems of Theory Constructions in Sociology*. John Wiley and Sons
- Jack P Gibbs. 1972. *Sociological Theory Construction*. The Dryden Press, Illionis.
- Stinchombe AL. 1968. *Construction of Sociological Theories*. Harcourt, Brace and World.
- Wionton CA. 1974. *Theory and Measurement in Sociology*. John Wiley and Sons.

Course Outlines

S. No.	Topic	No. of classes
Theory		
1.	Importance of theory construction in Extension. Hypothesis, Theory, Principle and Law	2
2.	Theory construction definitions - Meaning, types and Rules.	1
3.	Theory - Meaning, elements, Ideal Criteria, Functions, Types	1
4.	Generalizations: Meaning, Classification.	2
5.	Relationship - Meaning Types.	1
6.	Terminologies used in theory constructions: Axiom, Postulate, Proposition, Theorem, Fact, Concept, Construct, Probability and Measurement Basic Derived	3
7.	Steps in theory building - Axiomatic techniques, historical approaches and scientific application.	2
8.	Theoretical concept in social sciences.	2
9.	Test of Theory: Applying appropriate statistical tests	2
	Total	16



- I. Course Title : Facilitation for Development**
II. Course Code : EXT 709
III. Credit Hours : 2+1

IV. Aim of the courses

- To orient students on the importance facilitation.
- To inspires students to understand facilitation tools to influence change at the individual, group and organisational levels.
- To develop capacities in multi-stakeholder engagement, facilitation and networking.

V. Theory

Unit 1

Facilitation for development in the AIS; Understanding facilitation for development; Importance of facilitation as a core function of extension within the Agricultural Innovation Systems (AIS); Basic principles of facilitation for development; Desired attributes of facilitator for development- Cognitive attributes, Emotional attributes (Emotional intelligence), Social, behavioural and attitudinal attributes; Technical skills of a facilitator for development- Design processes, Facilitation techniques and tools, the art of questioning and probing, Process observation and documentation, Visualisation.

Unit 2

Facilitating Change in Individuals, Groups And Organisations - Self-discovery to realize our potentials, Tools for self-discovery, formulating a personal vision, Taking responsibility for your own development; Understanding the dynamics of human interaction, Group dynamics and power relations, Managing relationships, Shared vision and collective action, Tools for team building; Organizational change process, Organisational learning to adapt to changing environments, Enhancing performance of organisations, Leadership development, Tools for organisational change.

Unit 3

Facilitating Operational Level Multi-Stakeholder Engagements - Defining stakeholders, Development of collective and shared goals, Building trust and accountability, Tools for stakeholder identification and visioning; Visualising innovation platforms (IPs), Why are IPs important?, Different models of IPs for multi-stakeholder engagement, policy engagement platforms, Generating issues and evidence for policy action, Advocacy for responsive policy processes.

Unit 4

Brokering Strategic Partnerships, Networking And Facilitation- Brokering linkages and strategic partnerships, Identification of critical links, Knowledge brokering, Creating linkages with markets, Learning alliances and networking, Coordination of pluralistic service provision within the AIS, The concept of action learning and reflective practitioners, Networking; Facilitating Capacity Development-Facilitate participation and learning in development programs and projects. Virtual platforms-skills for strengthening dialogue, collaboration, shared commitment amongst diverse actors and stakeholders.

**Course Outlines**

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Facilitation for development in the AIS; Understanding facilitation for development;	1
2.	Importance of facilitation as a core function of extension within the Agricultural Innovation Systems (AIS);	1
3.	Basic principles of facilitation for development; Desired attributes of facilitator for development- Cognitive attributes, Emotional attributes (Emotional intelligence), Social, behavioural and attitudinal attributes;	2
4.	Technical skills of a facilitator for development- Design processes, Facilitation techniques and tools, the art of questioning and probing,	2
5.	Process observation and documentation, Visualisation	1
6.	Facilitating Change In Individuals, Groups And Organisations - Self-discovery to realize our potentials,	2
7.	Tools for self-discovery, formulating a personal vision, Taking responsibility for your own development;	1
8.	Understanding the dynamics of human interaction, Group dynamics and power relations, Managing relationships, Shared vision and collective action,	2
9.	Tools for team building;	1
10.	Organizational change process, Organisational learning to adapt to changing environments, Enhancing performance of organisations,	2
11.	Leadership development, Tools for organisational change	1
12.	Facilitating Operational Level Multi-Stakeholder Engagements - Defining stakeholders, Development of collective and shared goals, Building trust and accountability,	2
13.	Tools for stakeholder identification and visioning;	1
14.	Visualising innovation platforms (IPs), Why are IPs important?, Different models of IPs for multi-stakeholder engagement	2
15.	Policy engagement platforms, Generating issues and evidence for policy action,	2
16.	Advocacy for responsive policy processes	1
17.	Brokering Strategic Partnerships, Networking and Facilitation- Brokering linkages and strategic partnerships, Identification of critical links, Knowledge brokering, Creating linkages with markets,	2
18.	Learning alliances and networking, Coordination of pluralistic service provision within the AIS,	1
19.	The concept of action learning and reflective practitioners, Networking;	1
20.	Facilitating Capacity Development-Facilitate participation and learning in development programs and projects.	2
21.	Virtual platforms- skills for strengthening dialogue, collaboration, shared commitment amongst diverse actors and stakeholders	2
	Total	32
Practicals		
1.	Practicing facilitation techniques	1
2.	Self discovery exercises	1
3.	Working together and interaction (task based)	1
4.	Arrangement for multi-stakeholder interactions	1



5. Understanding organisational techniques

change process tools and
1



S. No.	Topic	No. of Lectures/ Practicals
6.	Case analysis on organisational change process	1
7.	Participating with innovation platforms	1
8.	Policy engagement platforms	1
9.	Stakeholder analysis mapping	2
10.	Exercise on networking skills	2
11.	Facilitating capacity building programmes	1
12.	Facilitating virtual platforms	1
13.	Filed visit to multi-stakeholder partnership projects	2
	Total	16

VI. Suggested Reading

- Account Ability 2005. AA 1000, *Stakeholder Engagement Standard Exposure draft*. http://www.empresa.org/doc/AA1000_STHEngagement.pdf
- Anonymus..n.d. *Facilitation Tools for Meetings and Workshops*. <https://seedsforchange.org.uk/tools.pdf>
- Clarke S, Blackman R and Carter I. 2004. *Facilitation skills workbook -Training material for people facilitating small group discussions and activities using PILLARS Guides*. Tearfund, England. https://www.tearfund.org/~media/files/tilz/fac_skills_english/facilitation_e.pdf
- Davis S. 2014. Using the Socratic Method as a Learning Facilitator <https://facilitatoru.com/training/using-the-socratic-method-as-a-learning-facilitator/>
- Hanson L and Hanson C. *Transforming participatory facilitation: Reflections from practice*. <http://pubs.iied.org/pdfs/G01950.pdf>
- Jost C, Alvarez S and Schuetz T. 2014. *CCAFS Theory of Change Facilitation Guide*. CGIAR Research Program on Climate Change, Agriculture and Food Security. <https://cgspace.cgiar.org/bitstream/handle/10568/41674/CCAFS%20TOC%20facilitation%202014%20FINAL.pdf>
- Kennon N, Howden P and Hartley M. 2002. *Who really matters? A stakeholder analysis tool*. Extension Farming Systems Journal volume 5 number 2. https://www.csu.edu.au/__data/assets/pdf_file/0018/109602/EFS_Journal_vol_5_no_2_02_Kennon_et_al.pdf
- Koutsouris A. 2012. *Exploring the emerging facilitation and brokerage roles for agricultural extension education*. AUA Working Paper Series No. 2012-4. Agricultural University of Athens. Department of Agricultural Economics and Rural Development. http://aoatools.aua.gr/RePEc/aua/wpaper/files/2012-4_koutsouris.pdf
- Krick T, Forstater M, Monaghan P, Sillanpaa M. 2005. *The Stakeholder Engagement Manual: Volume 2, the Practitioner's Handbook on Stakeholder Engagement*. AccountAbility, United Nations Environment Programme, Stakeholder Research Associates Canada Inc.
- Linden J. 2015. *Innovation in Layer Housing: From Drawing Board to Reality*. <http://www.thepoultrysite.com/articles/3494/innovation-in-layer-housing-from-drawing-board-to-reality/>
- Lindynorris. *How to Develop Your Personal Vision Statement: A Step-by-Step Guide to Charting Your Future With Purpose and Passion* <http://static1.squarespace.com/static/5765deb1be659449f97fcbf5/t/5770b309579fb313164a7a37/1467003657818/LINDYNORRIS.COM+-+How+to+Develop+a+Personal+Vision+Statement.pdf>
- Lundy M, Gottret MV and Ashby J. *Learning alliances: An approach for building multistakeholder innovation systems*. <http://documents.worldbank.org/curated/en/564521467995077219/pdf/103509-BRI-PUBLIC-ADD-series-ILAC-brief.pdf>
- Makini FW, Kamau GM, Makelo MN, Adekunle W, Mburathi GK, Misiko M, PaliM, and



Dixon J. 2015. *Operational Field Guide for Developing and Managing Local Innovation Platforms*. Australian Centre for International Agricultural Research <https://www.aciar.gov.au/file/103711/download?token=EPYmwXnE>

- Mind Tools. n.d. *The Role of a Facilitator-Guiding an Event through to a Successful Conclusion*. <https://www.mindtools.com/pages/article/RoleofAFacilitator.htm>
- Mittal N, Sulaiman RV and Prasad RM. 2016. *Assessing Capacity Needs of Extension and Advisory Services A Guide for Facilitators*. Agricultural Extension in South Asia. <http://www.aesanetwork.org/assessing-capacity-needs-of-extension-and-advisory-services-a-guide-for-facilitators/>
- Mulema AA. 2012. *Organisation of innovation platforms for Agricultural Research and Development in the Great Lakes Region of Africa*. Graduate Theses and Dissertations. Paper 12631. <https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=3638&context=etd>
- Nederlof S, Wongtschowski M and Van der Lee (eds.). 2011. *Putting Heads Together-Agricultural Innovation Platform in Practice*. KIT Publishers.
- Ngwenya H and Kibwika P. 2016. *NELK Module 7 Introduction to Facilitation for Development, New Extensionist Learning Kit (NELK)*, Global Forum for Rural Advisory Services (GFRAS) <http://www.g-fras.org/en/knowledge/new-extensionist-learning-kit-nelk.html#module-7-introduction-for-facilitation-for-development>
- Otim RL. 2013. *Facilitation Skills Training Manual: A facilitator’s handbook*. United States Agency for International Development (USAID). https://publiclab.org/system/images/photos/000/020/662/original/FACILITATION_SKILLS_TRAINING_Manual.pdf
- Partridge K, Charles J, Wheeler D, Zohar A. 2005. *The Stakeholder Engagement Manual: Volume 1. The Guide to Practitioners’ Perspectives on Stakeholder Engagement*. Stakeholder Research Associates Canada Inc., 355 Division Street Cobourg Ontario Canada K9A 3R5.
- Pye-Smith C. 2012. *Agricultural extension: A Time for Change. Linking knowledge to policy and action for food and livelihoods*. <https://cgspace.cgiar.org/handle/10568/75389>
- Steinlin M and Jenkins CW. *Knowledge Sharing for Change- Designing and Facilitating Learning Process with a Transformational Impact.Ingenious Peoples Knowledge*. http://www.fsnnetwork.org/sites/default/files/ipk_trainingmanual_midres.pdf
- Tallia AF, Holly J, Lanham HJ, McDaniel RR Jr., and Benjamin F Crabtree BF. 2013. *7 Characteristics of Successful Work Relationships*. <https://www.aafp.org/fpm/2006/0100/p47.pdf>
- Van Rooyen A, Swaans K, Cullen B, Lema Z and Mundy P. 2013. *Facilitating Innovation Platforms in: Innovations platforms practice* brief 10. <https://assets.publishing.service.gov.uk/media/57a08a28ed915d3cfd000602/Brief10.pdf>
- Villet VV. 2015. *Motivation Theory by David McClelland*. <https://www.mindtools.com/pages/article/human-motivation-theory.htm>

- I. Course Title : Managing Extension Organizations**
- II. Course Code : EXT 710**
- III. Credit Hours : 2+1**
- IV. Aim of the courses**

- To orient students on the importance of knowledge and skills on various management functions, as applicable to extension organizations
- Discuss ways of running extension services as managers of livestock -ventures
- To develop capacities for becoming effective managers of livestock -ventures



V. Theory

Unit 1

Management- An Over view - Management and Extension management – Meaning, concept, nature and importance; Management, administration and supervision - meaning, definition and scope; Approaches to management, Principles, functions and levels of management; Qualities and skills of a manager; Interpersonal relations in the organization; Reporting and budgeting; Extension Management in public, private sector and other sectors - Extension management (POSDCORB) in public sector, Department of Agriculture, Agricultural Technology Management Agency (ATMA), Krishi Vigyan Kendra (KVK), SAUs, ICAR Institutes, Private sector, Cooperatives, NGOs, FPOs, etc. Organisational Structure, Relations between different units- Challenges in management.

Unit 2

Concepts in Management - Decision making – Concept, Types of decisions, Styles and techniques of decision making, Steps in DM Process, Guidelines for making effective decisions; Human Resource Management: Manpower planning, Recruitment, Selection, Placement and Orientation, Training and Development; Dealing with fund and staff shortages in different extension organizations (KVK, ATMA, etc.); Leadership – Concept, Characteristics, Functions, Approaches to leadership, Leadership styles; Authority and responsibility, Delegation and decentralization, line and staff relations.

Unit 3

Challenges of co-ordination in extension organizations; Managing interdepartmental coordination and convergence between KVK, ATMA and line departments; Co-ordinating pluralism in extension services; Challenges in managing public-private partnerships (PPPs) at different levels in agricultural development in general and extension in particular; Performance appraisal – Meaning, Concept, Methods.

Unit 4

Motivation and Communication- Managing work motivation – Concept, Motivation and Performance, Approaches to motivation, team building; Organizational Communication – Concept, Process, Types, Networks, Barriers to Communication; Mentoring, Time management, Team work and team-building strategies; Modernization of information handling; Supervision and Control - Supervision – Meaning, Responsibilities, Qualities and functions of supervision, Essentials of effective supervision; Managerial Control – Nature, Process, Types, Techniques of Control, Observation, PERT and CPM, Management Information Systems (MIS): Concept, tools and techniques, MIS in extension organisations.

VI. Practicals

- Simulated exercises on techniques of decision making
- Study the structure and function of agro-enterprises, Designing organizational structure/organograms
- Group activity on leadership development skills
- Simulated exercise to understand management processes
- Field visit to extension organizations (ATARI, KVKs, NGOs), FPOs, dairy cooperatives to understand the functions of management
- Practical exercises on PERT and CPM



- Group exercise on development of short term and long term plans for agro-enterprises
- Developing model agriculture-based projects including feasibility study, financial planning and cost-benefit analysis

VII. Suggested Reading

- Bitzer V. 2016. *Incentives for enhanced performance of agricultural extension systems*, KIT Working Paper 2016-6, Royal Tropical Institute, Amsterdam
<https://www.kit.nl/wp-content/uploads/2018/08/Incentives-for-enhanced-performance-of-agricultural-extension-systems.pdf>
- Bitzer V, Wennik B and de Steenhuijsen B. 2016. *The governance of agricultural extension systems*, KIT Working Paper 2016-1 Royal Tropical Institute, Amsterdam.
<https://www.kit.nl/wp-content/uploads/2018/08/The-governance-of-agricultural-extension-systems.pdf>
- Chand S. *Modern Management Theory: Quantitative, System and Contingency Approaches to Management*.
<http://www.yourarticlelibrary.com/management/modern-management-theory-quantitative-system-and-contingency-approaches-to-management/25621>
- Daniel RG, James AFS and Freeman RE. 2003. *Management* (6th Edition). Pearson India.
- Fahimifard SM and Kehkha AA. 2009. *Application of Project Scheduling in Agriculture* (Case Study: Grape Garden Stabilization) *American-Eurasian J. Agric. and Environ. Sci.*, **5**(3): 313-321.
[https://www.idosi.org/aejaes/jaes5\(3\)/3.pdf](https://www.idosi.org/aejaes/jaes5(3)/3.pdf)
- Gabathuler E, Bachmann F and Klay A. 2011. *Reshaping Rural Extension Learning for Sustainability: An integrated and learning based advisory approach for rural extension with small scale farmers*- Chapter 4. Margraf Publishesrs, Kanalstr.
- GFRAS 2017. Module 3: *Agricultural Extension Programme Management, The New Extensionist Learning Kit, Global Forum for Rural Advisory Services* (GFRAS)
<http://www.g-fras.org/fr/component/phocadownload/category/70-new-extensionist-learning-kit-nelk.html?download=564:nelk-module-3-agricultural-extension-programme-management-textbook>
- Gupta CB. 2001. *Management Theory and Practice*. Sultan Chand and Sons, New Delhi.
- Hoffmann V, Gerster BM, Christnick A and Lemma M. 2009. *Rural Extension Volume 1*- Chapter 7. Margraf Publishesrs, Kanalstr.
- HRM. 2013. *Current Trends in Human Resource Management*
<https://corehr.wordpress.com/2013/08/21/current-trends-in-human-resource-management/>
- Koontz H and Weihrich H. 2015. *Essentials of Management: An International, Innovation and Leadership perspective*. Mcgrow Hill Education (India) Private Ltd.
- MANAGE. 2008. *Project Management in Agricultural Extension*, AEM-203, Post Graduate Diploma in Agricultural Extension Management (PGDAEM), National Institute of Agricultural Extension Management, Hyderabad
<http://www.manage.gov.in/pgdaem/studymaterial/aem203.pdf>
- Mind Tools. *Core Leadership Theories: Learning the Foundations of Leadership*
- *Why are some leaders successful, while others fail?* Available online
<https://www.mindtools.com/pages/article/leadership-theories.htm>
- Qamar KM. 2005. *Modernizing National Agricultural Extension Systems: A Practical Guide for Policy-Makers of Developing Countries*, Food and Agriculture Organization of the United Nations
<http://www.fao.org/uploads/media/modernizing%20national.pdf>
- Swanson BE, Bentz RP and Sofranko AJ. 1997. *Improving Agricultural Extension. A Reference Manual*. Food and Agriculture Organization of the United Nations, Rome.
- Van den Ban AW and Hawkins HS. 1998. *Agricultural extension*- Chapter 10, BSL, CBS Publishers and Distributors.



S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Management- An Over view - Management and Extension management – Meaning, concept, nature and importance;	1
2	Management, administration and supervision - meaning, definition and scope;	1
3	Approaches to management, Principles, functions and levels of management;	1
4	Qualities and skills of a manager; Interpersonal relations in the organization;	1
5	Reporting and budgeting; Extension Management in public, private sector and other sectors	2
6	Extension management (POSDCORB) in public sector, Department of Agriculture, Agricultural Technology Management Agency (ATMA), Krishi Vigyan Kendra (KVK), SAUs, ICAR Institutes, Private sector, Cooperatives, NGOs, FPOs, etc.	2
7	Organisational Structure, Relations between different units- Challenges in management	1
8	Concepts in Management - Decision making – Concept, Types of decisions, Styles and techniques of decision making, Steps in DM Process	2
9	Guidelines for making effective decisions; Human Resource Management: Manpower planning, Recruitment, Selection, Placement and Orientation, Training and Development	2
10	Dealing with fund and staff shortages in different extension organizations (KVK, ATMA, etc.)	1
11	Leadership – Concept, Characteristics, Functions, Approaches to leadership, Leadership styles; Authority and responsibility, Delegation and decentralization, line and staff relations	2
12	Challenges of co-ordination in extension organizations	1
13	Managing interdepartmental coordination and convergence between KVK, ATMA and line departments; Co-ordinating pluralism in extension services	2
14	Challenges in managing public-private partnerships (PPPs) at different levels in agricultural development in general and extension in particular	2
15	Performance appraisal – Meaning, Concept, Methods	2
16	Motivation and Communication- Managing work motivation – Concept, Motivation and Performance, Approaches to motivation, team building	2
17	Organizational Communication – Concept, Process, Types, Networks, Barriers to Communication; Mentoring, Time management, Team work and team-building strategies	2
18	Modernization of information handling; Supervision and Control - Supervision – Meaning, Responsibilities, Qualities and functions of supervision, Essentials of effective supervision	2
19	Managerial Control – Nature, Process, Types, Techniques of Control, Observation, PERT and CPM, Management Information Systems (MIS): Concept, tools and techniques, MIS in extension organisations	3
	Total	32
Practicals		
1	Simulated exercises on techniques of decision making	2



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S. No.	Topic	No. of Lectures/ Practicals
2	Study the structure and function of agro-enterprises, Designing organizational structure/ organograms	2
3	Group activity on leadership development skills	2
4	Simulated exercise to understand management processes	1
5	Field visit to extension organizations (ATARI, KVKs, NGOs), FPOs, dairy cooperatives to understand the functions of management	3
6	Practical exercises on PERT and CPM	2
7	Group exercise on development of short term and long term plans for agro-enterprises	2
8	Developing model agriculture-based projects including feasibility study, financial planning and cost-benefit analysis	2
	Total	16

List of Journals

- *Communicator*
- *Development communication*
- *Indian Dairyman*
- *Indian journal of Adult Education*
- *Indian Journal of Dairy Science*
- *Indian Journal of Extension Education*
- *Indian Journal of Psychology*
- *Indian Journal of Public Administration*
- *Journal of Dairy Research*
- *Journal of Extension Systems*
- *Journal of Rural Development*
- *Journal of Training and Development*
- *The Indian Journal of Animal Sciences*
- *The Indian Veterinary Journal*
- *Journal of Agriculture Extension and Education*
- *Indian Journal of Animal Research*
- *Indian Journal of Gender of Studies*
- *Kurukshetra*
- *Yojana*
- *Economic and Political weekly*
- *Indian Farming*

e-Resources

- www.informaworld.com (Journal of Agricultural Education and Extension)
- www.blackwellpublishing.co (International Journal of Training and Development)
- www.blackwellpublishing.co Educational Measurement: Issue and Practices
- www.academicjournals.net (International Journal of Dairy Science)
- www.cipav.org.co (Livestock Research for Rural Development)
- www.joe.org Journal of Extension



SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Basic Veterinary Sciences

– Veterinary Physiology





Preamble

At Masters level in Veterinary Physiology new courses, Endocrinology of domestic animals and Physiology of wild animals are introduced. Similarly at Doctorate level new courses, Recent Trends in ruminant digestion, Cellular and molecular physiology and Recent trends in reproductive physiology are introduced keeping in view of the importance of these fields.



Course Title with Credit Load

M.V.Sc. in Veterinary Physiology

Course Code	Course Title	Credit Hours
VPY 601	Physiology of Digestion*	2+1
VPY 602	Cardiovascular and Respiratory Physiology*	2+1
VPY 603	Renal Physiology and Body Fluid dynamics*	2+1
VPY 604	Haematology	2+1
VPY 605	Growth and Environmental Physiology*	2+0
VPY 606	Physiology of Animal Reproduction*	2+1
VPY 607	Clinical Physiology	1+1
VPY 608	Neuromuscular Physiology*	2+0
VPY 609	Endocrinology of Domestic Animals	2+0
VPY 610	Instrumentation and Research Techniques in Veterinary Physiology	0+2
VPY 611	Physiology of Wild Life	1+0
VPY 612	Masters Seminar	1+0
VPY 613	Masters Research	0+30

*Core courses



Course Contents

M.V.Sc. in Veterinary Physiology

I. Course Title : Physiology of Digestion

II. Course Code : VPY 601

III. Credit Hours : 2+1

IV. Aim of the course

To teach comparative physiology of digestive system of monogastric animals, ruminants and birds, and basic techniques.

V. Theory

Unit I

Basic characteristics and comparative physiology of digestive system of monogastric and polygastric animals. Appetite and control of feed intake.

Unit II

Gastro-intestinal motility, secretory functions of gastro-intestinal tract, their regulation and gastro-intestinal hormones.

Unit III

Digestion, absorption and metabolism of carbohydrate, protein and fat in simple and compound stomach. Absorption of water and electrolytes.

Unit IV

Development of ruminant stomach, rumen microbiology and rumen environment. Ruminant microbial digestion, its advantages and disadvantages. Fate of rumen fermentation products. Rumino-reticular motility, its significance and control. Digestion in birds.

VI. Suggested Reading

- *Dukes' Physiology of Domestic Animals*, 13th Edn. William O Reece, Howard H Erickson, Jesse P Goff, Etsuro E Uemura. 2015.
- *Cunningham's Textbook of Veterinary Physiology* 5th Edn. Bradley G. Klein 2012
- *Digestive Physiology and Nutrition of Ruminants* by D C Church, 1975
- *The Rumen Microbial. Ecosystem.* 2nd Edn. Ed. by. P.N. HOBSON and C.S Stewart 1997
- Hungate RE. 1966. *Rumen and its Microbes.* Acad. Press. N.Y.
- *Rumen Microbiology*, Burk A Dehority. 2003. Nottingham University Press

S. No.	Topic	No. of Lectures/ Practicals
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Theory

- | | | |
|----|---|---|
| 1. | Basic characteristics and comparative physiology of digestive system of domestic animals. Classification of animals on the basis of feeding habits, differences in the anatomy of digestive tract | 1 |
| 2. | General functions of Gastrointestinal tract and its control | 1 |
| 3. | Functional anatomy of digestive tract of monogastric animals- | |



structural differences among

the monogastric animals



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topic	No. of Lectures/ Practicals
4.	Functional anatomy of digestive tract of ruminants: Development of ruminant stomach	1
5.	Structural details of rumen, reticulum, omasum and abomasum, Rumino-reticular motility, its significance and control	1
6.	Pseudoruminants, reticular groove reflex, rumination process and its phases.	1
7.	Prehension, prehensile organs in different animals, grazing, browsing, rooting, mastication, deglutition, feed intake, water requirements and intake, drinking habits of water in different animals	1
8.	Motility of esophagus, gastro-intestinal motility, primary peristalsis and secondary peristalsis, functions and zones of stomach	1
9.	Rate of gastric emptying, interdigestive motility patterns, migrating myoelectric complex, emesis or vomiting	
10.	Motility in small intestine, nervous and hormonal control, peristaltic reflex and segmentation reflex. Motility in large intestine: caecum, colon, haustral contractions, oral and aboral peristaltic contractions, antiperistaltic contractions, Rate of passage of digesta and its estimation	1
11.	Appetite and control of feed intake, hunger contractions, thirst, constipation, defecation, diarrhea	1
12.	Regulation of GIT functions, gastro-intestinal hormones and their functions	1
13.	Salivary secretion, its composition and functions	1
14.	Secretion of gastric juice, phases of gastric secretion, composition, zymogen, autocatalysis and digestion in stomach	1
15.	Pancreatic juice, secretion, control and composition,	1
16.	Proteases, lipases, amylases and other enzymes of pancreatic juice.	1
17.	Trypsin inhibitor and end products of pancreatic digestion	1
18.	Liver, structure of liver lobule: secretion of bile and its regulation bile acids, bile salts, bile pigments: functions of bile	1
19.	Enterohepatic recirculation: gall bladder function and contractions.	1
20.	Intestinal juices, their secretions, composition and functions	1
21.	Absorption of nutrients in the digestive tract and the effect of nutrient interactions	1
22.	Bacterial fermentation in large intestine, fermentative products, absorption of end products of fermentation	1
23.	Metabolism and excretion of various nutrients,	1
24.	Development of ruminant system and rumen environment	1
25.	Rumen microbiology, Rumen microbes: classification of rumen bacteria, protozoa, fungi	2
26.	Ruminant microbial digestion, Fermentation pathways: fermentation of carbohydrates, protein and fat, microbial activities in ruminant stomach and intestine	2
27.	Rumen degradable proteins, rumen undegradable proteins and urea feeding	1
28.	Volatile fatty acids, Absorption of end products and place of absorption and mechanism of absorption	1
29.	Advantages and disadvantages of ruminant digestion, artificial rumen	1
30.	Digestion in birds: functional anatomy of avian digestive system, swallowing, crop, proventriculus, ventriculus, caeca, nitrogen metabolism	1
	Total	32



S. No.	Topic	No. of Lectures/ Practicals
Practicals		
1.	Collection of saliva and its enzymatic studies	1
2.	Gastric and intestinal motility, Rate of passage of digesta and its estimation	1
3.	Rumino-reticular movements	1
4.	Activity of pepsin and trypsin enzymes	1
5.	Estimation of digestive metabolites such as glucose and ketone bodies,	1
6.	Estimation of triglycerides, cholesterol	1
7.	Estimation of urea nitrogen and total proteins	1
8.	Liver function tests	2
9.	Pancreatic function tests	1
10.	Methods of collection of rumen liquor, merits and demerits	1
11.	Determination of pH, total volatile fatty acids in rumen liquor	1
12.	Determination of ammonia-nitrogen and total-nitrogen in strained rumen liquor	2
13.	Counting of protozoa and bacteria in rumen liquor	1
14.	Demonstration of fermentation of feed-stuff in artificial rumen	1
	Total	16

I. Course Title : Cardiovascular and Respiratory Physiology

II. Course Code : VPY 602

III. Credit Hours : 2+1

IV. Aim of the course

To teach function and regulation of heart, recording of ECG and respiration in different animals and basic techniques.

V. Theory

Unit I

Functional anatomy of heart and properties of cardiac muscle, Origin and propagation of cardiac impulses. Rhythmic excitation of heart, Electrophysiology of heart, Cardiac cycle, Cardiac sounds.

Unit II

Cardiac output and its measurements, Factors affecting cardiac output. Venous return and its regulation. Regulation of the cardiac functions.

Unit III

Normal electrocardiogram, Electrocardiographic interpretation in common cardiac disorders. Cardiac murmurs and cardiac arrhythmias. Echocardiography.

Unit IV

Circulation - coronary, systemic and pulmonary circulation and their regulation. Regional circulation. Pathophysiology of circulation. Hemodynamics. Arterial pressure. Capillary exchanges. Lymphatic circulation.

Unit V



Respiration, Mechanism of ventilation, Transport and exchange of respiratory gases at alveolar and tissue level, Respiratory adjustments at high altitude, Stress and



exercise. Pulmonary volumes and capacities. Neural and chemical control of respiration. Respiration in birds.

VI. Suggested Reading

- Guyton and Hall *Textbook of Medical Physiology* 13th Edn John E. Hall Ph.D. 2015
- *Ganong's Review of Medical Physiology*, 26th Edn Kim E. Barrett, Susan M. Barman, Scott Boitano, Heddwen Brooks, 2019
- *Dukes' Physiology of Domestic Animals*, 13th Edn. William O. Reece, Howard H. Erickson, Jesse P. Goff, Etsuro E. Uemura 2015.
- *Cunningham's Textbook of Veterinary Physiology* 5th Edn. Bradley G. Klein 2012.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Functional anatomy of heart	1
2	Electrophysiology of heart	1
3	properties of cardiac muscle	1
4	Origin and propagation of cardiac impulses	1
5	Rhythmic excitation of heart	1
6	Cardiac cycle	1
7	Cardiac sounds	1
8	Cardiac output and its measurements	1
9	Factors affecting cardiac output	1
10	Regulation of the cardiac functions	1
11	Venous return and its regulation	1
12	Normal electrocardiogram	1
13	Electrocardiographic interpretation in common cardiac disorders.	1
14	Cardiac murmurs	1
15	Cardiac arrhythmias	1
16	Echocardiography	1
17	Hemodynamics	1
18	Blood pressure - factors affecting it and measurement	1
19	Regulation of blood pressure	1
20	Systemic circulation and pulmonary circulation	1
21	Coronary circulation	1
22	Regional circulation	1
23	Introduction to respiration	1
24	mechanism of ventilation	1
25	Pulmonary volumes and capacities	1
26	Transport and exchange of respiratory oxygen at alveolar and tissue level	1
27	Transport and exchange of respiratory carbon dioxide at alveolar and tissue level	1
28	Neural and chemical control of respiration	1
29	Respiratory adjustments at high altitude	1
30	Respiratory adjustments to stress	1
31	Respiratory adjustments to exercise	1
32	Respiration in birds	1
	Total	32
Practical		
1.	Determination and recording of cardiac output	1
2.	Measurement of blood pressure by sphygmomanometer	1
3.	Recording of heart rate by physiograph	1



S. No.	Topic	No. of Lectures/ Practicals
4.	Effect of various ions and electrolytes on heart	1
5.	Effect of hormones on heart	1
6.	Effect of temperature on heart	1
7.	Recording and interpretation of normal ECG	1
8.	Recording and interpretation of cardiac disorders by ECG	1
9.	Determination of blood volume	1
10.	Effect of exercise on heart rate, pulse rate rate	1
11.	Estimation of cardiac marker enzymes	1
12.	Determination of lung volumes and capacities by spirometry	1
13.	Estimation of blood gases	1
14.	Estimation of blood pyruvate	1
15.	Estimation of blood lactate	1
16.	Effect of exercise on respiration rate	1
	Total	16

I. Course Title : Renal Physiology and Body Fluid Dynamics

II. Course Code : VPY 603

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge regarding excretory system of mammals and birds, maintenance of body fluid homeostasis

V. Theory

Unit I

An overview of nephron structure and function. Renal function in mammals.

Unit II

Renal haemodynamics. Glomerular filtration, Tubular reabsorption and secretion. Urine formation- stages and factors affecting different stages.

Unit III

Role of kidney in acid-base balance, Physiology of micturition, Endocrine control of renal function- Renin angiotensin aldosterone system. Non excretory functions of kidney.

Unit IV

Excretory system in birds.

Unit V

Body fluids – various body fluid compartments, Different types of body fluids and their functions, Composition of different body fluids and their regulation.

VI. Suggested Reading

- Guyton and Hall *Textbook of Medical Physiology* 13th Edn John E Hall Ph.D.. 2015
- *Ganong's Review of Medical Physiology*, 26th Edn Kim E Barrett, Susan M Barman, Scott Boitano, Heddwen Brooks. 2019.
- *Dukes' Physiology of Domestic Animals*, 13th Edn. William O Reece, Howard H Erickson, Jesse P Goff, Etsuro E Uemura. 2015.
- *Cunningham's Textbook of Veterinary Physiology* 5th Edn. Bradley G Klein. 2012.
- Klahar S. 1983. *The Kidney and Body Fluids in Health and Diseases*. Plenum Press.



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to physiology of mammalian kidney	1
2.	Theories of renal formation and Functional anatomy of kidney	1
3.	Renal homeostatic function	1
4.	Renal circulation and Pressures in renal function	1
5.	Glomerular filtration	1
6.	Solute reabsorption	1
7.	Tubular secretion	1
8.	Water excretion	1
9.	Absorptive capabilities of different segments of nephron	1
10.	Renal mechanism for concentration of urine	1
11.	Renal mechanism for dilution of urine	1
12.	Autoregulation of renal blood flow and GFR	1
13.	Renal function tests	1
14.	Hormonal regulation of kidney function	1
15.	Characteristics of urine in different species	1
16.	Renin-angiotensin-aldosterone system	1
17.	Micturition	1
18.	Non excretory functions of kidney	1
19.	Acids and bases in the body	1
20.	Buffers in the body	1
21.	Role of buffers in acid base balance	1
22.	Disturbances in acid base balance	1
23.	Urine formation in birds	1
24.	Characteristics of avian urine	1
25.	Body fluid compartments	1
26.	Regulation of ECF osmolality and volume	1
27.	Regulation of ECF electrolytes	1
28.	Water balance	1
29.	Measurement of body water	1
30.	Water loss from routes other than kidney	1
31.	Water conservation in domestic animals	1
32.	Diuretics	1
33.	Determining the degree of dehydration in an animal	1
34.	Fluid therapy	1
	Total	34
Practical		
1.	Collection and preservation of urine	1
2.	Qualitative analysis of physiological constituents of urine	1
3.	Qualitative analysis of pathological constituents of urine	1
4.	Quantitative analysis of BUN in blood and urine	1
5.	Quantitative analysis of creatinine in blood and urine	1
6.	Quantitative analysis of phosphate and glucose in blood and urine	1
7.	Determination of sodium, potassium in serum	1
8.	Determination of calcium and chloride in serum	1
9-16.	Demonstration of various kidney function tests- glomerular filtration rate, creatinine clearance rate, urea clearance rate and glucose tolerance test.	8
	Total	16



- I. Course Title : Hematology**
II. Course Code : VPY 604
III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students about haematology of different animals including hands-on training.

V. Theory**Unit I**

Hematopoietic stem cells, Blood cells and hematological indices, Anaemia, Different types of anaemia, Polycythemia and their effect on circulation in mammals and birds. Fate of erythrocytes. Porphyrias.

Unit II

Resistance of the body to infection, Leukocytes, tissue macrophage system and inflammatory response.

Unit III

Haemoglobin and its types, Iron binding proteins in blood, Haemoglobin disorders. Hemophilias. Immunity, Ommunoglobulins complement system.

Unit IV

Hemostasis and coagulation factors, Role of platelets, Fibrinolysis. Conditions causing bleeding disorders. Blood groups, transfusion of blood.

VI. Suggested Reading

- Jain NC. 1993. *Essentials of Veterinary Hematology*. Lea and Febiger.
- *Schalm's Veterinary Hematology* 6th Ed - D Weiss J Wardrop, Wiley-Blackwell. 2010.
- *Guyton and Hall Textbook of Medical Physiology* 13th Edn John E Hall Ph.D. 2015.
- *Cunningham's Textbook of Veterinary Physiology* 5th Edn. Bradley G Klein. 2012.
- *Dukes' Physiology of Domestic Animals*, 13th Edn. William O Reece, Howard H Erickson, Jesse P Goff, Etsuro E Uemura. 2015.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Haematology- blood - composition-solutes of blood-plasma-interstitial fluid-lymph	1
2.	Functions of blood-general characteristics of blood-haematocrit-ESR-viscosity-temperature- volume-pH- colour- lifespan	1
3.	Haematocrit-methods of determination -colour index- icterus index-blood volume- methods of determination	1
4.	Plasma proteins – fractions- electrophoretic separation- general functions	1
5.	Functions of pre albumin-albumin-globulins and its fractions-	1
6.	Haematopoiesis- multipotent stem cells-definition-organs of hematopoiesis- red and yellow marrow	1
7.	Multipotent lymphoid and myeloid stem cells- differentiation and maturation	1
8.	Bone marrow micro environment for haematopoiesis- stages of erythropoiesis	1
9.	Erythropoiesis- its regulation- vitamins and erythropoietin- haematinics	1



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S. No.	Topic	No. of Lectures/ Practicals
10.	Haemoglobin- stages of Hb synthesis- regulation	1
11.	Types of Hb	1
12.	Iron metabolism- Fe requirement- hepcidin	1
13.	Intravascular and extravascular haemolysis	1
14.	Catabolism of Hb	1
15.	Plasma bilirubin- types- hyperbilirubinemia	1
16.	Jaundice - types- etiology - differential diagnosis	1
17.	Anisocytosis- poikilocytosis- RBC membrane structure- composition of RBC membrane	1
18.	RBC metabolism-physiological and pathological conditions associated with polycythemia and oligocythemia	1
19.	Anemias- classification- defective formation-excessive destruction- abnormal heme- abnormal globin chains- causes	1
20.	Erythrocyte indices- cytometric classification of anemias- causes- Red cell distribution width	1
21.	Leucocytopoiesis- granulocytopoiesis- lymphopoiesis	1
22.	Functions of neutrophils- phagocytosis- opsonisation-eosinophils-basophils-monocytes	1
23.	Conditions associated with altered number of neutrophils, eosinophils, basophils, monocytes and lymphocytes	1
24.	Hemostasis- blood fluidity maintenance- injury leading to primary hemostatic plug formation	1
25.	Secondary hemostatic pathways- intrinsic and extrinsic pathways-regulation-stabilisation of clot	1
26.	Fibrinolysis- retraction of clot- haemostatic disorders	1
27.	Types of immunity-innate-acquired- types of acquired immunity-Passive immunity-types-antibody-mechanism of actions of Ab-	1
28.	NK cells-functions-T-cell lymphocytopoiesis- thymus- functions-thymosin-thymopoietin-maturation of T cells- T cell receptors-blood thymus barrier	1
29.	Formation of T helper, cytotoxic and regulatory cells	1
30.	Plasma cells-structure – formation and functions	1
31.	Blood group antigens- cross reactivity- transfusion immunology	1
32.	Rh blood group- erythroblastosisfoetalis-treatment	1
	Total	32
Practical		
1.	Enumeration of RBC, WBC	1
2.	Enumeration of platelets	1
3.	Enumeration of reticulocytes	1
4.	Enumeration of differential leucocytes	1
5.	Special staining techniques for leucocytes	1
6.	Haemogram by automated blood cell counter	1
7.	Anemic blood: Hb, PCV	1
8.	Icterus index calculation using plasma and standard	1
9.	Colour index calculation using plasma and standard	1
10.	Band cell count and arneth count	1
11.	Blood viscosity and RBC fragility determination	1
12.	Activated partial thromboplastin time	1
13.	Prothrombin time	1



S. No.	Topic	No. of Lectures/ Practicals
14.	Avian blood: haemogram-I (erythrocyte relates parameters using special stain)	1
15.	Avian blood-haemogram-II (leucocyte relates parameters using special stain)	1
16.	Preparation of blood cells for electron microscopic analysis	1
	Total	16

I. Course Title : Growth and Environmental Physiology

II. Course Code : VPY 605

III. Credit Hours : 2+0

IV. Aim of the course

To teach the Growth process and its regulation, effect of mineral and vitamins on body functions and influence of environmental conditions on homeothermy.

V. Theory

Unit I

Growth - Introduction and Concepts. Hormonal regulation of growth. Growth promoters.

Unit II

Minerals - Classification-functions and disorders. Chelated minerals, nanominerals.

Unit III

Vitamins - Classification-functions and disorders. Synthetic vitamins.

Unit IV

Environment - Introduction and concepts. Weather and climate. Homeothermy, Poikilothermy. Hibernation and estivation. Thermoregulation, thermal stress. Effect of environment on production and reproduction.

VI. Suggested Reading

- Samuel Brody. 1945. *Bioenergetics and growth*. Reinhold Publishing Corp., New York
- Hossner KL. 2005. *Hormonal Regulation of Farm Animal Growth*. CABI.
- McDowell LR. 1989. *Vitamins in Animal Nutrition*. Academic Press.
- Underwood EJ. 1977. *Trace Elements in Human and Animal Nutrition*. Academic Press.
- ESE Hafez. 1968. *Adaptation of Domestic Animals*. Lea and Febiger.
- *Dukes' Physiology of Domestic Animals*, 13th Edn. William O Reece, Howard H Erickson, Jesse P Goff, Etsuro E Uemura 2015.

S. No.	Topic	No. of Lectures/ Practicals
1.	Growth - Definition, concepts, terminologies used in expression of growth	1
2.	Hormonal regulation of growth	2
3.	Commercial and synthetic hormones used in growth regulation	1
4.	Growth promoters used in livestock	1
5.	Growth promoters used in poultry	1
6.	Minerals - Introduction, Classification, sources	1



7. Bioavailability of different

minerals



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S. No.	Topic	No. of Lectures/ Practicals
8.	Physiological role of minerals	1
9.	Disorders of mineral metabolism in livestock	1
10.	Disorders of mineral metabolism in poultry	1
11.	Chelated minerals	1
12.	Nanotechnology in mineral supplementation	1
13.	Vitamins - Introduction, Classification, sources	1
14.	Physiological role of fat soluble vitamins	1
15.	Physiological role of water soluble vitamins	1
16.	Disorders of fat soluble vitamins	1
17.	Disorders of water soluble vitamins	1
18.	Synthetic vitamins in animal production	1
19.	Environment - Introduction, physical components	1
20.	Physical principles of heat exchange	1
21.	Weather and climate	1
22.	Homeothermy, Poikilothermy, endothermy and ectothermy	1
23.	Hibernation and estivation	1
24.	Body temperature in different species	1
25.	Thermoregulation in livestock	1
26.	Thermoregulation in poultry	1
27.	Thermal stress	1
28.	Heat tolerance coefficient	1
29.	Effect of weather variables on production - Milk, meat, wool	2
30.	Effect of weather variables on reproduction	1
	Total	32

I. Course Title : Physiology of Animal Reproduction

II. Course Code : VPY 606

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge of male and female reproductive system of different species of animals including birds.

V. Theory

Unit I

Functional histomorphology of male and female reproductive system. Development of male and female sex organs in different domestic animals. Neuro-endocrine reflexes.

Unit II

Puberty and its endocrine control. Sexual cycles and mating behaviours in females, oogenesis, folliculogenesis and ovulation. Secretions of female reproductive tract in different species of animals. Endocrine regulation of female reproduction.

Unit III

Male mating behaviour, Spermatogenesis, Spermiogenesis, Spermatogenic cycles. Spermatozoa- structure and composition, Maturation and transportation. Secretions of male reproductive tract. Endocrine regulation of male reproduction.



Unit IV

Transport of male and female gametes, Fertilization, implantation. Early embryo development and maternal recognition of pregnancy. Hormones of pregnancy. Placentation, parturition and Uterine Involution. Avian reproduction and formation of egg.

VI. Suggested Reading

- *Reproduction in Farm Animals*, 7th Edn ESE Hafez, B Hafez. 2013.
- *McDonald's Veterinary Endocrinology*, Pineda and Doley. Iowa State University Press, Ames, 2003.
- *Physiology of Reproduction and Artificial Insemination*, Salisbury GW and Demark NL. WB Saunders, 1978.
- *Dukes' Physiology of Domestic Animals*, 13th Edn. William O Reece, Howard H Erickson, Jesse P Goff, Etsuro E Uemura. 2015.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Functional histomorphology of male reproductive system	1
2	Functional histomorphology of female reproductive system	1
3	Development of male sex organs in different domestic animals	1
4	Development of female sex organs in different domestic animals	1
5	Neuro-endocrine reflexes	1
6	Puberty and its endocrine control in male domestic animals	1
7	Puberty and its endocrine control in female domestic animals	1
8	Sexual cycles in females	1
9	Mating behaviour in females	1
10	Oogenesis	1
11	Folliculogenesis	1
12	Ovulation	1
13	Secretions of female reproductive tract in different species of animals	1
14	Endocrine regulation of female reproduction in different species of animals	1
15	Spermatogenesis	1
16	Spermiogenesis	1
17	Spermatogenic cycles	1
18	Spermatozoa- structure and composition	1
19	Spermatozoa- maturation and transportation	1
20	Secretions of male reproductive tract.	1
21	Endocrine regulation of male reproduction in different species of animals	1
22	Transport of male and female gametes	1
23	Fertilization	1
24	Implantation	1
25	Early embryo development	1
26	Maternal recognition of pregnancy	1
27	Hormones of pregnancy	1
28	Placentation	1
29	Gestation	1
30	Parturition and Uterine Involution	1
31	Post-partum recovery in different species of domestic animals	1
32	Avian reproduction and formation of egg	1
Total		32

Practical



1. Methods of heat detection in animals

different species of domestic
1



S. No.	Topic	No. of Lectures/ Practicals
2.	Palpation of reproductive organs	1
3.	EXamination of fern pattern in cervical mucus	1
4.	Semen evaluation - Gross	1
5.	Semen evaluation - Microscopical	1
6.	Semen evaluation - Biochemical	1
7.	Demonstration of preservation of semen	1
8.	Isolation of different follicles	1
9.	Collection of oocytes and their grading	1
10.	Estimation of reproductive hormones	3
11.	Demonstration of estrus behaviour	1
12.	Demonstration of mating	1
13.	Demonstration of parturition	1
14.	Demonstration of oviposition	1
	Total	16

I. Course Code : Clinical Physiology

II. Course Title : VPY 607

III. Credit Hours : 1+1

IV. Aim of the course

To teach physiological basis of clinical abnormalities in body functions.

V. Theory

Unit I

Introduction and basic concepts of understanding of alteration in system functions
Relationship of cardiovascular, renal, respiratory systems and liver in healthy domestic animals and compensatory mechanisms during failure/ disorder of one or other systems
Clinical Haematology and enzymology.

Unit II

Metabolism of carbohydrate, protein, lipid, vitamin and minerals in health and disease of various species of domestic animals and poultry.

Unit III

Evaluation of common endocrine disorders – pituitary, thyroid, parathyroid, pancreas in domestic animals (with reference to species and profile). Reproductive function alterations in male and female domestic animals during stress- productive, environmental, nutritional.

Unit IV

Clinical evaluation of Gastrointestinal tract; Clinical evaluation of Special Senses; Neuromuscular disorders and clinical correlation; Assessment of acid base and electrolyte balance.

VI. Suggested Reading

- *Clinical Biochemistry of Domestic Animals* 6th Edn, Jiro Jerry Kaneko, John W Harvey, Michael L Bruss, Academic Press. 2008.
- *Hawk's Physiological Chemistry*. Oser BL Tata McGraw-Hill. 1976.



- *Clinical Biochemistry: An Illustrated Colour Text.*
Allan Gaw; Michael Murphy; Robert Cowan; Denis O'Reilly; Michael Stewart; James Shepherd, 2004



Basic Veterinary Sciences: Veterinary Physiology

- *Clinical Physiology of Acid Base and Electrolyte Disorders*. Rose BD. McGraw-Hill. 1989.
- *Clinical Physiology: An Examination Primer*. 1st Edn, Ashis Banerjee, Cambridge University Press. 2005.
- *Textbook of Veterinary Physiological Chemistry* 3rd Edn, Larry R Engelking. 2014.
- *Practical Clinical Biochemistry: Methods and Interpretations*. 4th Edn. Chawla Ranjna. 2014.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Introduction and basic concepts of understanding of alteration in system functions	1
2	Relationship of cardiovascular, renal, respiratory systems and liver in healthy domestic animals and compensatory mechanisms during failure/ disorder of one or other systems	2
3	Clinical Haematology	1
4	Clinical enzymology	1
5	Metabolism of Carbohydrate in health and disease of various species of domestic animals and poultry	1
6	Metabolism of protein in health and disease of various species of domestic animals and poultry	1
7	Metabolism of lipid in health and disease of various species of domestic animals and poultry	1
8	Metabolism of vitamins in health and disease of various species of domestic animals and poultry	1
9	Metabolism of minerals in health and disease of various species of domestic animals and poultry	1
10	Evaluation of common endocrine disorders – pituitary, thyroid, parathyroid, pancreas in domestic animals (with reference to species and profile)	2
11	Reproductive function alterations in male and female domestic animals during stress- productive, environmental, nutritional	1
12	Clinical evaluation of Gastrointestinal tract and special senses	1
13	Neuromuscular disorders and clinical correlation	1
14	Acid base and electrolyte balance	1
15	Biological fluid analysis	1
	Total	17
Practical		
1	Hematological analysis of clinically recovered animals	2
2	Liver function tests of clinically recovered animals	2
3	Electrocardiography and interpretations of clinically recovered animals	2
4	Sphygmomanometry of clinically recovered animals	1
5	Respiratory Function tests of clinically recovered animals	1
6	Digestive function tests of clinically recovered animals	1
7	Renal function tests of clinically recovered animals	1
8	Estimation of serum enzymes related to cardiovascular functions of clinically recovered animals	1
9	Estimation of serum enzymes related to liver functions of clinically recovered animals	1
10	Estimation of serum enzymes related to kidney functions of clinically recovered animals	1
11	Clinical Examination of endocrinology disorder animals Bioassay of steroid hormones of clinically recovered animals	2
12	Physiographic study of body parameters of clinically recovered animals	1
	Total	16



I. Course Title : Neuromuscular Physiology

II. Course Code : VPY 608

III. Credit Hours : 2+0

IV. Aim of the course

To impart knowledge of coordination of body functions and regulation of brain functions and sense organs.

V. Theory

Unit I

Functional anatomy, types and classification of muscles, of muscles. Properties of skeletal muscle, Contractile elements, Membrane and action potential, Molecular mechanism of muscle contraction, Myoneuronal junction and transmission of impulse, Smooth muscle contraction.

Unit II

Length and tension relationship, Force and velocity relationship. Skeletal muscle energetics, Metabolism and lactate shuttle. Exercise, adaptation to training and performance.

Unit III

Classification of nervous system. Neuron and its classification, Properties. Development of action potential and transmission of nerve impulse in nerve and synapse. Regulatory centres in brain. Reflexes. Functions of Cerebrum, Cerebellum, Hypothalamus, Limbic system.

Unit IV

Receptors and its types. Special senses.

VI. Suggested Reading

- *Guyton and Hall Textbook of Medical Physiology* 13th Edn John E Hall Ph.D. 2015.
- *Ganong's Review of Medical Physiology*, 26th Edn Kim E Barrett , Susan M Barman, Scott Boitano, Heddwon Brooks, 2019.
- *Dukes' Physiology of Domestic Animals*, 13th Edn. William O Reece, Howard H Erickson, Jesse P Goff, Etsuro E Uemura. 2015.
- *Cunningham's Textbook of Veterinary Physiology* 5th Edn. Bradley G. Klein. 2012.
- *Fundamentals of Neurophysiology*. Smith RF Springer Verlag. 1978.

S. No.	Topic	No. of Lectures
1.	Introduction, Organisation of Nervous system	1
2.	Cellular communication- concept of membrane potential	1
3.	Synapse and its properties, Synaptic transmission	1
4.	Neurotransmitters	1
5.	Sensory systems and Receptors	1
6.	Pain Physiology	1
7.	Cerebral cortex –Anatomy and Physiology	1
8.	Interbrain, thalamus and hypothalamus	1
9.	Midbrain – Physiological capability	1
10.	Brain stem – Physiological anatomy	1
11.	Sleep and EEG	1
12.	Memory and its types	1
13.	Pons and medulla – Anatomy and Physiology	1



S. No.	Topic	No. of Lectures
14.	Cerebellum – Anatomy and Physiology	1
15.	Spinal cord - Anatomy and Physiology	1
16.	Spinal reflexes and properties	1
17.	Postural reflexes	1
18.	Peripheral nervous system	1
19.	Autonomic nervous system – Sympathetic nervous system	1
20.	Autonomic nervous system – Parasympathetic nervous system	1
21.	Enteric nervous system	1
22.	Overall motor control	1
23.	Sensory Physiology – Photoreception	1
24.	Sensory Physiology – Auditory and equilibrium maintenance	1
25.	Sensory transduction – Gustation and olfaction	1
26.	Muscle structure and types	1
27.	Physiological properties of muscle	1
28.	Mechanism of muscle contraction	1
29.	Properties of muscle contraction	1
30.	Muscle metabolism	1
31.	Anatomy of Neuromuscular junction	1
32.	Smooth muscle physiology	1
	Total	32

I. Course Title : Endocrinology of Domestic Animals

II. Course Code : VPY 609

III. Credit Hours : 2+0

IV. Aim of the course

To impart knowledge of chemical integration of body functions.

V. Theory

Unit I

Methods of study of bioregulation including methods of endocrine analysis. Manipulation and disruption of biorhythms in homeostatic and natural ecosystem.

Unit II

Hormonal relationship in animal production. Concepts in hormone function, classification and methods of study, Hormonal assay, Mechanism of hormone synthesis, Release and transport. Mechanisms of hormone action, Target cell interactions.

Unit III

Genetic and genomic approaches in endocrinology. Animal models and alternate uses of animal model. Regulation and metabolism of hypothalamic, hypophyseal, thyroid and adrenal hormones.

Unit IV

Gonadal and placental hormones, their regulation and mechanism of action. Hormonal principles of pineal gland and its role in production.

Unit V

Endocrine control of carbohydrate and calcium homeostasis. Hormones and



adaptation to environment. Hormonal regulation of gastro-intestinal activity. Prostaglandins. Hormones in fertility regulation and production augmentation. Avian endocrinology.

VI. Suggested Reading

- *McDonald's Veterinary Endocrinology*, Pineda and Doley. Iowa State University Press, Ames, 2003
- *General Endocrinology*. Turner CD and Bagnara JT, WB Saunders. 1976
- *Canine and Feline Endocrinology and Reproduction*, 3rd Edition, Edward C Feldman, Richard W Nelson. 2003.
- *Applied Animal Endocrinology* 2nd Edn. E James Squires. 2010

S. No.	Topic	No. of Lectures
1	Introduction to bioregulation <ul style="list-style-type: none"> - Scientific methods - Controlled experimental testing - Representative sampling - Dose response Relationship - Biological Rhythm - Endocrine-Nervous -Immune system interaction 	1
2	Methods of endocrine secretion analysis <ul style="list-style-type: none"> - Extirpation -observation: Replacement -observation - Imaging - Radioimmunoassay - Enzyme immunoassay - High Performance Liquid Chromatography/ spectroscopy - Immunohistochemistry - Bioassays - Techniques for determining the number and characteristics of hormone receptor 	1
3	Disruption of biorhythms in homeostatic and natural ecosystem <ul style="list-style-type: none"> - Endocrine disruptors or modulators - Assessment of endocrine disruptor activity - Sources of endocrine disruptors - Xenobiotics - Environmental pollutants altering endocrine secretions 	1
4	Concepts in hormone function <ul style="list-style-type: none"> - Morphological functions - Biological functions - Physiological functions - Molecular functions 	1
5	Mechanism of hormone synthesis of <ul style="list-style-type: none"> - Protein hormones - Steroid hormones - Eicosanoids - Thyroid hormones - Monoamines 	1
6	Release and transport in blood <ul style="list-style-type: none"> - Mechanisms for regulating release - In response to Trophic hormone - In response to Nervous stimuli (environmental cues) - In response to levels of various metabolites 	



S. No.	Topic	No. of Lectures
	Transport	
	– Carrier proteins	
	– Half life	
	– Control of hormone release	
	– Pulsatile release	
	– Sustained release	
	– Feed back mechanism	1
7	Mechanisms of hormone action	
	Extracellular receptors	
	– G protein coupled receptors	
	– Catalytic receptors	
	Intracellular receptors	
	– cytoplasmic	
	– intranuclear	
	Target cell interactions	
	– Upregulation	
	– Down regulation	2
8	Genomic approaches in endocrinology.	
	– Use of transgeneic animals	
	– Knockout animals	
	– Proteomics	
	– Two dimensional gel electrophoresis	
	– X ray crystallography	
	– Tomography	
	– MRI	2
9	Animal models to study endocrine disorder	
	– Whole animal model	
	– Isolated organs or tissues	
	– <i>In vitro</i> models	2
10	Hypothalamic, hypophyseal hormones	
	– Structure	
	– function relationship of pituitary and hypothalamus	
	Anterior pituitary hormones	
	Growth hormone	
	– structure, production, biological functions, disorders of growth hormone production	
	Prolactin	
	– structure, production, biological	
	– functions, disorders of growth hormone production	
	ACTH	
	– structure, production, biological	
	– functions	
	FSH	
	– structure, production, biological functions	
	LH	
	– structure, production, biological functions	
	Posterior pituitary hormones	
	Oxytocin	
	– structure, production, biological functions	
	Vasopressin	
	– structure, production, biological functions	



S. No.	Topic	No. of Lectures
	Hypothalamic releasing and release inhibiting hormones	
	– Growth hormone inhibiting hormone	
	– Gonadotropin releasing hormone	2
11	Thyroid hormones	
	– Transport	
	– Receptors	
	– Metabolism	
	– Metabolic effects	
	– Effect on growth, development, fertility and milk production	2
12.	Adrenal hormones	
	• Structure of adrenal and synthesis of cortical hormones	
	• Physiological roles of	
	– Glucocorticoids	
	– Mineralocorticoids	
	• Physiological role of medullary hormones	2
13.	Pineal gland and its role in production.	
	• Melatonin	
	• Photoperiodism	
	• Seasonal breeding	
	• Manipulation of breeding cycle	
	– Implants	
	– Sustained release bolus	1
14.	Endocrine control of carbohydrate homeostasis	
	– Insulin	
	– Glucagon	
	– Epinephrine	
	– Growth hormone	
	– Glucocorticoids	
	– Thyroxine	2
15.	Endocrine control of calcium homeostasis	
	– Parathyroid hormone	
	– Calcitonin	
	– Calcitriol (Vitamin D3)	
	– Estrogens/ Androgens	
	– Glucocorticoids	
	– Thyroid hormones	
	– Insulin like growth factors	2
16.	Hormonal regulation of gastro-intestinal activity	
	– Gastrin	
	– Secretin	
	– Gastrin releasing peptide	
	– Cholecystokinin	
	– Gastric inhibitory peptide	
	– others	1
17.	Prostaglandins-Synthesis, types, release and mode of action	1
18.	Hormones in fertility regulation	
	• Manipulation of reproduction	
	• Regulation and manipulation of oestrous cycle	
	• Use of hormone agonists to control fertility	
	• Detection and synchronization of oestrus	
	• Methods for detection oestrus	
	• Strategies for synchronizing oestrus	
	• Prostaglandin F _{2α} based systems	
	• Progesterin and other hormones based systems	
	• Superovulation and embryo transfer	



S. No.	Topic	No. of Lectures
	<ul style="list-style-type: none">• <i>In-vitro</i> production of embryos• Recognition and maintenance of pregnancy• Induction of abortion/ parturition• Advancing cyclicity in seasonal breeders, and puberty in animals• Immunological manipulation of reproduction	3
19.	Hormones in production augmentation <ul style="list-style-type: none">• Somatotrophin• Adipokines• Leptin• Anabolic steroids and Analogues –mechanism of action delivery systems and safety aspects• β Adrenergic Agonists –mechanism of action delivery systems and safety aspects• Dietary supplements<ul style="list-style-type: none">– chromium, PUFA and CLA• Regulation of feed intake<ul style="list-style-type: none">– Orexigenic hypothalamic neurohormones– AnoreXigenic hypothalamic neuropeptides– Hormonal regulation of mammary gland development and milk secretion	2
20	Avian endocrinology <ul style="list-style-type: none">– Reproductive hormones– Hormonal manipulation of egg production– Control of broodiness in poultry– Manipulation of moulting	2
	Total	32

I. Course Title : Instrumentation and Research Techniques in Veterinary Physiology

II. Course Code : VPY 610

III. Credit Hours : 0+2

IV. Aim of the course

Training in various techniques for application in research in Animal Physiology

V. Suggested Reading

- *Hawk's Physiological Chemistry*. Oser BL Tata McGraw-Hill. 1976.
- *Varley's Practical Clinical Biochemistry* Alan H Gowenlock
- *Handbook of Radioimmunoassay*. Abraham GE Marcel Dekker. 1977.
- *Electrocardiograms: A Systematic Method of Reading Them* Armstrong ML. 1978
- *Rumen Microbiology*, Burk A Dehority 2003 Nottingham University Press

S. No.	Topic	No. of Lectures
1.	Design and types of research laboratory	1
2.	Maintenance of research equipments	1
3.	Imparting knowledge about preparation of various solutions	1
4.	Basic principles and concepts of pH	1
5.	Determination of pH of various solutions and biological samples	1
6.	Basic principles and concepts of ECG	1



7. Recording of ECG in animals

1



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S. No.	Topic	No. of Lectures
8.	Basic principles and concepts of physiograph and its accessories for <i>in-vitro</i> live tissue experiments	1
9.	Recording of blood pressure by physiograph and sphygmomanometer	1
10.	Recording of pulse rate by physiograph	1
11.	Recording of respiratory volumes by spirometer	1
12.	Neuro muscular experimental physiology using physiograph	1
13.	Physical and chemical principles of chromatography	1
14.	Extraction of active compounds from biological samples	1
15.	Protein separation and isolation methods – basic concepts	1
16.	Methods of protein determination	1
17.	Electrophoresis	1
18.	Thin layer chromatography	1
19.	Gas liquid chromatography	1
20.	Basic concepts of mineral estimation	1
21.	Flame photometry	1
22.	Laws of colorimetry	1
23.	Spectrophotometry	1
24.	Organ bath – Applications in experimental physiology	1
25.	Experiments using organ bath	1
26.	Enumeration of ruminal microflora	1
27.	Estimation of VFA	1
28.	Estimation of ammonia nitrogen	1
29.	Estimation of body water	1
30.	<i>In-vitro</i> rumen studies	1
31.	ELISA for estimation of various hormones	1
32.	RIA for estimation of various hormones	1
	Total	32

I. Course Title : Physiology of Wild Life

II. Course Code : VPY 611

III. Credit Hours : 1+0

IV. Aim of the course

To impart the knowledge on physiology of wild animals. The course content refers to wild animals related to Indian forests restricted to small and large animals. This course does not cover insects and other species for which veterinarian are not usually called for.

V. Theory

Unit I

Overview of Indian forests – Identification of sex in wild animals and birds - Blood collection methods in wild animals – Hematology - Common clinical biochemical estimations.

Unit II

Body temperature measurement techniques – Measurement of stress - Measuring senescence.



Unit III

Reproduction management in wild animals - Understanding sound mechanics and communication methods – Ethology of wild animals - Government policies for wild life protection.

VI. Suggested Reading

Standard text books and Government policies pertaining to wild life.

S. No.	Topic	No. of Lectures
Theory		
1.	Animal Species Overview of Indian forests.	1
2.	How to identify the sex of wild animals and birds.	1
3.	Collection of Clinical materials for laboratory examination; methods	1
4.	Haematology	1
5.	Common clinical biochemical estimations.	1
6.	Methods of measuring body temperature of wild animals	1
7.	Measuring capture and immobilization stress in wildlife	1
8.	Measuring senescence in wild animal populations	1
9.	Reproduction management in wild animals	2
10.	Understanding sound mechanics and communication methods	1
11.	Wild animal ethology	2
12.	Government policies for wild life protection (respective state)	1
13.	Lecture by wildlife vet or conservationist	2
	Total	16



Course Title with Credit Load Ph.D. in Veterinary Physiology

Course Code	Course Title	Credit Hours
VPY 701	Applied physiology of body fluids and electrolytes	2+1
VPY 702	Physiology of animal behaviour	2+0
VPY 703	Recent trends in ruminant digestion	2+1
VPY 704	Recent trends in neuroendocrinology	2+1
VPY 705	Myophysiology and kinesiology	2+0
VPY 706	Avian physiology*	2+1
VPY 707	Physiology of lactation	2+1
VPY 708	Recent trends in environmental physiology and growth	2+1
VPY 709	Cellular and molecular physiology*	2+0
VPY 710	Recent trends in immuno-physiology	2+1
VPY 711	Physiology of stress	2+0
VPY 712	Recent trends in reproductive physiology	2+1
VPY 713	Doctorate Seminar-I	1+0
VPY 714	Doctorate Seminar-II	1+0
VPY 715	Doctorate Research	0+75

*Compulsory Major course for Doctorate programme. The other credits can be registered from remaining 700 Series courses listed above.



Course Contents

Ph.D. in Veterinary Physiology

- I. Course Title** : Applied Physiology of Body Fluids and Electrolytes
II. Course Code : VPY 701
III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge regarding physiology of body fluids and electrolytes in relation to homeostasis.

V. Theory

Unit I

Volume and composition of body fluids, Exchange of water and electrolytes between body compartments and transport mechanisms, Blood and external environment. Osmolarity and osmolality of body fluids.

Unit II

Regulation of volume and osmolarity of extracellular fluid. Regulation of pH and acid base balance. Formation and composition of cerebrospinal fluid and lymph.

Unit III

Clinical implications of change in electrolytes and body fluids. Functional consideration of plasma volume and its composition. Diuresis and endocrine control of renal functions.

Unit IV

Clinical feature in fluid and electrolyte imbalances, clinicopathological indicators of fluid and electrolyte imbalances. Physiological basis of fluid therapy.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Body fluid compartments-Extracellular and Intracellular fluid compartment (ECF and ICF), Volume of ECF and ICF. Composition of various body fluids	1
2.	Total Body water, Water requirement, daily intake and loss of water from the body	1
3.	Different transport mechanisms for exchange of water and electrolytes-Active and passive transport, filtration, diffusion and osmosis	1
4.	Exchange of nutrients and other substances between blood and interstitial fluid. Capillary pressure, interstitial fluid pressure, exchange of fluids through capillary membrane	1
5.	Principles of osmosis and osmotic pressure, osmotic equilibrium between ICF and ECF, Tonicity of body fluids	1
6.	Composition of synovial fluid and peritoneal fluid	1



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S. No.	Topic	No. of Lectures/ Practicals
7.	Osmolarity and Osmolality of ICF and ECF, regulation of volume and osmolarity of ECF	1
8.	Contribution of different molecules viz glucose, sodium and urea towards osmolarity of ECF	1
9.	pH of different body fluids, factors affecting pH of body fluids, Physiology of acid base balance, buffer systems of ICF and ECF	1
10.	Different types of Acidosis and Alkalosis, their etiology and compensation	1
11.	Evaluation of acid–base status- Siggaard–Andersen alignment nomogram, Anion gap, base excess and deficit	1
12.	Role of Respiratory system and Kidneys in maintenance of Acid base balance	1
13.	Formation and composition of Cerebrospinal fluid and lymph	1
14.	Clinical disorders resulting into loss of electrolytes from body fluids.	1
15.	Changes in plasma volume and its composition under different clinical conditions-vomition and diarrhoea	1
16.	hypovolemia and hypovolemia, Implications of hypovolemic and hemorrhagic shock	1
17.	Dehydration - its types and causes. Water intoXication	1
18.	Role of kidneys in regulation of water balance. Renin-angiotensin system	1
19.	Role of kidneys in formation and excretion of concentrated and diluted urine	1
20.	Hormonal regulation of important electrolytes in plasma	1
21.	Role of Hormones in renal regulation of water and electrolytes	1
22.	Diuresis and pressure natriuresis, polyuria and oligouria	1
23.	Clinical considerations in fluid and electrolyte imbalances	1
24.	Clinicopathological indicators of fluid and electrolyte imbalance	1
25.	Clinical Physiology of Dehydration – Signs, symptoms, evaluation of intensity of dehydration	1
26.	Clinical Physiology of vomition and diarrhoea- Signs and symptoms	1
27.	Clinical Physiology of edema Signs and symptoms, causes and prevention	1
28.	Role of serum sodium, hyponatremia, hypernatremia; Role of serum potassium, hypokalemia, hyperkalemia	1
29.	Role of serum chloride, hypochloremia and hyperchloremia, bicarbonate ions	1
30.	Principle and indications of fluid therapy	1
31.	Types of solution used for fluid therapy, role of their components and their use in different clinical conditions	1
32.	Effect of adding different saline, glucose solutions to ECF-isotonic, hypertonic and hypotonic solutions	1
	Total	32
Practical		
1.	Estimation of pH of different body fluids and evaluation of acid base status.	1
2.	Determination of sodium in serum sample of farm animals (by flame photometry/ colorimetric method)	1
3.	Determination of potassium in serum sample of farm animals (by flame photometry/ colorimetric method)	1
4.	Determination of chloride in serum sample of farm animals (by flame photometry/ colorimetric method)	1



S. No.	Topic	No. of Lectures/ Practicals
5.	Determination of bicarbonate in serum sample of farm animals	1
6.	Determination of Calcium in serum sample of farm animals	1
7.	Determination of Magnesium in serum sample of farm animals	1
8.	Determination of phosphate in serum sample of farm animals	1
9.	Determination of total body water (simulated demonstration)	1
10.	Determination of blood volume (simulated demonstration)	1
11.	Determination of plasma volume (simulated demonstration)	1
12.	Determination of Interstitial Fluid Volume (simulated demonstration)	1
13.	Estimation of osmolarity and osmolality of urine of farm animals	1
14.	Estimation of osmolarity and osmolality of milk	1
15.	Estimation of osmolarity and osmolality of blood of farm animals	1
16.	Evaluation of dehydration in animal and choosing the fluid type, its volume and rate for fluid therapy	1
	Total	16

I. Course Title : Physiology of Animal Behaviour

II. Course Code : VPY 702

III. Credit Hours : 2+0

IV. Aim of the course

To acquaint the students about physiology of animal behaviour in different species of domestic animals.

V. Theory

Unit I

Introduction to animal ethology. Neurophysiological basis of animal behaviour.

Unit II

Behaviour in relation to changes in the environment. Feeding, Grazing, Stall feeding and rumination behaviour.

Unit III

Sexual behaviour in female and male animals. Maternal behaviour. Milk let down.

Unit IV

Social behaviour, Communication in animals, Animal temperament. Responses of dogs and horses to training.

S. No.	Topic	No. of Lectures
Theory		
1.	Introduction to ethology and its importance in Veterinary Science.	1
2.	Ethology-definition and its importance in animal welfare	1
3.	Types of animal behaviour	2
4.	Behavioural Ecology, evolutionary basis for animal behavior	2
5.	Ecological pressures, ontogeny and phylogeny of behaviour	1
6.	Physiological concept of behaviour, neuro-endocrine integration for behavioural manifestation	2
7.	The concept of instinct, Habituation, imprinting, reinforcement,	



conditioning, reasoning and

intelligence. Temperament scoring



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S. No.	Topic	No. of Lectures
8.	Ingestive/ feeding behaviour in ruminants: Prehension, grazing behaviour in cattle, sheep and goats, rumination behaviour	2
9.	Ingestive behaviour in dogs	1
10.	Ingestive behaviour in swine	1
11.	Special feeding patterns; Abnormal feeding behaviour	2
12.	Precopulatory behavior (Searching, Courtship, Sexual arousal, Erection, Penile protrusion): Species differentiation	1
13.	Copulatory behaviour (Mounting, intromission and ejaculation): Species differentiation	2
14.	Post copulatory behaviour (Dismounting and refractory period)	1
15.	Manifestation of behavioural estrus, estrus intensity scoring	1
16.	Role of pheromon in sexual behaviour manifestation	1
17.	Abnormal sexual behavioural pattern	1
18.	Maternal behaviour: Formation of bond between mother and fetus, concept of critical period, vocalization	1
19.	Maternal behaviour in different species, abnormal maternal behaviour	1
20.	Milking behaviour: Milking temperament, milk let down reflex and the factors affecting milking behaviour	1
21.	Social behaviour: Dominance, Social hierarchy	1
22.	Agonistic (combat or aggressive) behaviour, Gregarious, Peck order in chicken	1
23.	Communicating behaviour: Attraction, Repulsion and Submission	1
24.	Mode of communication (visual, auditory, chemical) in different species.	1
25.	Responses of dogs and horses to training	1
	Total	32

I. Course Title : Advances in Ruminant Digestion

II. Course Code : VPY 703

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge about advances in digestion of ruminant animals.

V. Theory

Unit I

Introduction to rumen bacteria, protozoa and fungi. Development and natural fluctuation in rumen microbial population. Salivary secretion and its regulation.

Unit II

Microbial ecology and physiology of feed degradation within the rumen. Metabolism of nitrogen containing compounds.

Unit III

Degradation of carbohydrate, fat and protein by rumen microbes, Microbe- microbe interaction. Protected nutrients and other feed additives.

Unit IV

Genetics and biotechnology of rumen microbes, rumen anaerobic fungi, their role and interaction with other rumen microbes. Probiotics supplementation, etc. Rumen flow rate and rumen volume.



S. No.	Topic	No. of Lectures
Theory		
1.	Functional development of ruminant stomach	1
2.	Microbial ecosystem of fermentative digestion	1
3.	Fluctuation in rumen microbial population	1
4.	Substrates for fermentative digestion	1
5.	Salivary secretion and its regulation	1
6.	Role of saliva on fermentative digestion	1
7.	Rumen motility and its regulation	1
8.	Rumen bacteria	2
9.	Rumen protozoa – its importance and its interaction with other group	2
10.	Anerobic fungi	1
11.	Polysaccharide degradation by rumen microbes	2
12.	Metabolism of nitrogen containing compounds	1
13.	Lipid metabolism in rumen	1
14.	Rumen metabolites and their assimilation	1
15.	Microbe-microbe interaction	1
16.	Comparative efficiency of rumen function in different species.	2
17.	Protected nutrients	1
18.	Digestive disorders of rumen	1
19.	Nutritional toxicity and strategy to address it	1
20.	Stoichiometry of fermentative digestion	1
21.	Approaches to modification of ruminal fermentation	2
22.	Modifiers of ruminal microbial activity	1
23.	Biological models of rumen function	2
24.	Rumen simulation technique	2
25.	Rumen flow rate and rumen volume	1
	Total	32
Practical		
1.	Reticulo-ruminal motility	1
2.	Total volatile fatty acids and their fractions	2
3.	Culture of rumen bacteria	3
4.	Protozoal counting	1
5.	Culture of rumen fungi	3
6.	Demonstration of effect of defaunation	2
7.	Flow rates of ruminal contents	2
8.	Artificial rumen techniques	2
	Total	16

I. Course Title : Advances in Neuro-endocrinology

II. Course Code : VPY 704

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students about advances in neuro-endocrinology of domestic animals.

V. Theory

Unit I



Neuroendocrine integrating mechanism. Structure of hypothalamus, pituitary gland, limbic and other neural pathways and endocrine functions.

**Unit II**

Neural control of oxytocin, adrenocorticotrophic hormone, aldosterone, thyrotropic hormone, growth hormone, gonadotrophins, Hypothalamic releasing factors and the neuro-vascular link between brain and anterior pituitary.

Unit III

Role of afferent impulses from genitals and other regions in reproductive system. Influence of hormones on brain activity.

Unit IV

Effects of drugs on neuro-endocrine system. Neuro-endocrine mechanisms in birds. Interaction of nervous, endocrine and immune system in animal production and reproduction.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Evolution and theory of hormones	1
2	Development of endocrine glands	1
3	Neuroendocrine integrating mechanism	1
4	Homeostatic regulation by hormones; Feedback regulation of hormones	1
5	Biorhythms, manipulation and disruption of biorhythms in homeostatic and natural ecosystem	1
6	Hormones and adaptation to environment	1
7	Endocrine methodologies in study of bioregulation	1
8	Animal models and alternate uses of animal model in endocrine studies	1
9	Methods of hormonal assays - Radioimmunoassay, Immunoremediometric assay, Radioceptors assay, enzyme linked immunosorbent assay, chemi-luminescence assay	2
10	Hormone secretion, transport and clearance	1
11	Cellular receptors for hormone; Hormones and target cells	1
12	Genomic and non genomic effects of hormones	1
13	Second messenger system; Receptor signal transduction; Hormone receptor interaction – protein and peptide hormones; Hormone receptor interaction – steroid and other hormones	2
14	Half-life of hormones, pattern of hormone release;	1
15	Types and family of hormones	1
16	Hormones regulating growth	1
17	Hormones regulating energy metabolism	1
18	Hormones regulating digestion	1
19	Hormones regulating calcium and phosphorus	1
20	Hormones regulating electrolytes – Na and K	1
21	Hormones regulating hyper and hypoglycemia	1
22	Hormones regulating blood volume and blood pressure	1
23	Alleviation of stress by hormones	1
24	Endocrine role of pineal gland	1
25	Hormones and behavior	1
26	Endocrine pathophysiology	2
27	Avian endocrinology	1
28	Synthetic hormones	1
29	Application of nanotechnology in endocrine studies	1
Total		32



S. No.	Topic	No. of Lectures/ Practicals
Practical		
1.	Extraction of hormones	1
2.	Immunohistochemistry of hormones	2
3.	Radio-immuno assay of hormones	3
4.	Enzyme linked immunosorbent assay of hormones	2
5.	Bioassay of hormones	2
6.	Induction of atherosclerosis	1
7.	Induction of hypoglycemia in laboratory models by allaxon and streptozotocin	2
8.	Induction of hyperglycemia in laboratory models by administration of epinephrine and glucagon, etc.	1
9.	<i>In-vitro</i> effects of certain hormones such as adrenaline, histamine and acetyl choline on excised intestine	1
10.	Hormone assay in fecal samples	1
Total		16

I. Course Title : Myophysiology and Kinesiology

II. Course Code : VPY 705

III. Credit Hours : 2+0

IV. Aim of the course

To impart knowledge to the students about myophysiology and kinesiology.

V. Theory

Unit I

Morphology of muscle; Chemical composition of muscle; Electrical phenomena and iron influxes; Muscle contraction and irritability; Neuromuscular transmission; Excitation contraction coupling; Mechanical properties of skeletal muscle; Types of chemical muscle fibres; Coordination among muscles.

Unit II

Thermal properties of muscles; Chemical correlates of contraction.

Unit III

Molecular basis of muscular contraction of skeletal muscle; Energetics of Muscle Contraction; Electromyogram; Pathophysiology of muscles; Myocardium – electrical properties; Myocardium – mechanical properties; Pacemaker tissue; Endurance of muscle.

Unit IV

Lever systems of body joints; Synovial fluid formation and its physiology; Principles of Kinesiology and its application in work physiology.

S. No.	Topic	No. of Lectures
1.	Morphology of muscle	1
2.	Chemical composition of muscle	1
3.	Electrical phenomena and iron influxes	2
4.	Muscle contraction and irritability.	2



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S. No.	Topic	No. of Lectures
5.	Neuromuscular transmission	2
6.	Excitation contraction coupling	2
7.	Mechanical properties of skeletal muscle	1
8.	Types of chemical muscle fibres	1
9.	Coordination among muscles.	1
10.	Thermal properties of muscles.	1
11.	Chemical correlates of contraction.	1
12.	Molecular basis of muscular contraction of skeletal muscle	2
13.	Energetics of Muscle Contraction	2
14.	Electromyogram	1
15.	Pathophysiology of muscles	1
16.	Myocardium – electrical properties	2
17.	Myocardium – mechanical properties	2
18.	Pacemaker tissue	1
19.	Endurance of muscle	1
20.	Lever systems of body joints,	2
21.	Synovial fluid formation and its physiology.	1
22.	Principles of Kinesiology and its application in work physiology	2
	Total	32

I. Course Title : Avian Physiology

II. Course Code : VPY 706

III. Credit Hours : 2 + 1

IV. Aim of the course

To teach physiology of birds.

Unit I

Digestive and urinary system.

Unit II

Blood, cardiovascular and respiratory system.

Unit III

Reproductive and endocrine system.

Unit IV

Nervous system and musculo-skeletal system.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Digestive system Comparative Functional Anatomy of the Digestive Tract -Gastrointestinal Function	1
2.	Food Intake Regulation GI Motility, Neural and Hormonal Control of Motility	1
3.	Secretions and Digestion	1
4.	Absorption - Carbohydrates, Amino Acids and Peptides, Fatty Acids and Bile Acids, Volatile Fatty Acids	1
5.	Urinary system Functional anatomy of The Kidneys- Intake of	





S. No.	Topic	No. of Lectures/ Practicals
6.	Formation of Urine- Osmoregulation	1
7.	Postrenal Modification of Ureteral urine	1
8.	Salt Glands - Evaporative Water Loss	1
9.	Blood, Cardiovascular Blood -Components – Effects of Altitude	1
10.	Gross Structure and Function	1
11.	General Circulatory Hemodynamics	1
12.	Control of the Cardiovascular System	1
13.	Integrative Neural Control	1
14.	Respiratory system Anatomy of the Avian Respiratory System-Air Sacs	1
15.	Ventilatory Reflexes -Respiratory System Volumes	1
16.	Gas Exchange -Ventilation and Respiratory Mechanics	1
17.	Basic Principles of OXYgen Transport - Cross-Current Gas EXchange	1
18.	High-Altitude Flight -Control of Breathing	1
19.	Reproductive system Anatomy of the Female Reproductive Breeding and Ovulation-Oviposition Cycles	1
20.	Ovarian Hormones Hormonal and Physiologic Factors Affecting Ovulation	1
21.	Effect of Light on the Ovary and Ovulation PhotorefractorinessMolt	1
22.	Incubation Physiology	1
23.	Male Reproductive Tract Anatomy Hormonal Control of Testicular Function, Spermatogenesis Extragonadal Sperm Transport and Maturation	1
24.	Endocrine system. Synthesis, Release of Hormones and functions of endocrine glands	1
25.	Hypothalamus and Pituitary Hormones	1
26.	Pancreatic and Adrenal hormones	1
27.	Secretions of Thyroid gland, parathyroid gland	1
28.	Nervous system and musculo-skeletal system Sensory Physiology - Uniqueness of avian brain	1
29.	Functional Organization of the Spinal Cord	1
30.	The Autonomic Nervous System of Avian Species	1
31.	Skeletal MuscleMuscle Fiber Types, Electrical Properties of Muscle Fibers -Contractile Properties	1
32.	Neurotransmission, Smooth muscle	1
	Total	32
Practical		
1.	Collection of blood from the birds and blood processing.	1
2.	Study of blood cells RBC count	1
3.	WBC count	1
4.	DLC	1
5.	Thrombocyte count	1
6.	Haemoglobin concentration	1
7.	Packed cell volume (haematocrit)	1
8.	Erythrocyte sedimentation rate	1
9.	Determination of feed passage rate in birds	1
10.	Enzymatic profile under various physiological states of birds	1
11.	Collection of semen and its evaluation	1
12.	Demonstration of cold shock resistant of avian spermatozoa and sperm stimulatory and inhibitory agents	1
13.	Determination of glucose and calcium in blood	1
14.	Determination of uric acid and urea in blood	1
15.	Electrophoretic separation of plasma proteins and egg proteins	1
16.	Localization of different endocrine glands	1
	Total	16



I. Course Title : Physiology of Lactation
II. Course Code : VPY 707
III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge on physiology of lactation in dairy animals.

Unit I

Functional anatomy, histology and cytology of mammary gland in domestic animals.

Unit II

Development of mammary gland, Hormonal control of mammogenesis.

Unit III

Process of lactation, Initiation of milk secretion, Hormonal control of lactation. Biochemical and histological changes in mammary gland during lactation. Mechanism of galactopoiesis.

Unit IV

Neural control of lactation, Milk let down, Milk ejection and inhibition of milk ejection. Induced lactation. Composition of milk in animals.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Introduction to the mammary gland and milk production	1
2.	Mammary gland anatomy - macrostructure	1
3.	Mammary gland anatomy - microstructure	1
4.	Mammary gland anatomy – blood supply, nerve supply and lymphatic network	1
5.	Comparative anatomy and physiology of mammary gland of different domestic animals	1
6.	Basic histology of parenchyma and cellular organization of the mammary epithelial cell	1
7.	Mammary growth and development I: fetal through puberty	1
8.	Mammary growth and development II: Post-puberty through involution	2
9.	Hormonal control of mammogenesis	1
10.	Lactogenesis	1
11.	Lactation	2
12.	Biochemical changes in mammary gland during lactation	1
13.	Histological changes in mammary gland during lactation	1
14.	Galactopoiesis	1
15.	Neuro endocrine control of lactation	1
16.	Milk letdown and its inhibition	1
17.	Factors affecting milk yield	1
18.	Dry period – importance, different strategies and beliefs	1
19.	Mammary involution	1
20.	Milk properties and composition	1
21.	Colostrum	1
22.	Milk carbohydrate synthesis and secretion	1
23.	Milk protein synthesis and secretion	1
24.	Milk lipids synthesis and secretion	1
25.	Mammary gland immunology	1



S. No.	Topic	No. of Lectures/ Practicals
26.	Other important milk components	1
27.	Contaminants and pollutants in milk	2
28.	Manipulation of milk production	1
29.	Diseases associated with mammary gland	1
	Total	32
Practical		
1.	External structure of cow's udder	1
2.	Internal structure of cow's udder	2
3.	Histological examination of udder in cows	1
4.	Milk letdown response in dairy animals	2
5.	Composition of colostrum	1
6.	Composition of milk during different phases of lactation	2
7.	Artificial induction of lactation	3
8.	Estimation of lactogenic hormones	4
	Total	16

I. Course Title : Advances in Ecosystem, Environmental Physiology and Growth

II. Course Code : VPY 708

III. Credit Hours : 2+1

IV. Aim of the course

To teach physiology of growth process in animals and effect of environmental factors on homeostasis of animals.

V. Theory

Unit I

Ecology of farm animals, Biological rhythms, Mammalian circadian rhythms, their regulation. Components of physical environment, Biometeorology and principles of thermoregulation in mammals and birds.

Unit II

Physiological response of farm animals to heat and cold. Effect of various climatic components on health and production (growth and egg production), reproduction and climatic adaptation.

Unit III

Concept and definitions of cellular, prenatal and postnatal growth - Patterns in animals.

Unit IV

Factors affecting growth - Nutrition, Hormones, Vitamins, Antibiotics, Environment. Ageing and senescence. Growth anomalies.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1	Ecology and its scope in livestock productivity;	1
2	Disciplines of ecology; fundamental principles of ecology	1



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S. No.	Topic	No. of Lectures/ Practicals
3	Biosphere and biodiversity	1
4	Ecosystem and Components of Ecosystem; Types of Species Found in Ecosystems; Principal Ways Species Interact	2
5	Adaptation, Acclimation and Acclimatization	1
6	Temperature Regulation - <i>Thermoregulators and Thermoconformer</i>	1
7	Principles of Heat gains and losses in animals	1
8	Warm-blooded versus cold-blooded animals and its relevance to survival	1
9	Heat production in birds and mammals	
10	Hibernation, Estivation and Daily Torpor; Cold Habitation	1
11	Body Temperature of Homeotherms - concept of core temperature measurements -Rectal Temperature of different animal species; Diurnal Variations	1
12	Physiological responses to heat in animals and birds	1
13	Temperature regulation in birds	1
14	Bioclimatology with respect to livestock and poultry farming	1
15	Surface temperature of earth- its measurements	1
16	earth's atmosphere-Geographic Belts, Composition of the Atmosphere	1
17	Climatic elements- components – measurements	2
18	Cold stress, Heat stress- impact on animal health and production	2
19	Adaptation to atmospheric pressure differences [altitude]- physiological changes and phenotypic characters;	1
20	Physiology of growth and its measurements	1
21	Periods of growth- prenatal and postnatal	2
22	Pattern of growth	1
23	Factors affecting growth	1
24	Recent concepts in manipulation of growth	1
25	Growth promoters	2
26	Ethical issues in use of growth promoters	2
27	Growth anomalies	1
28	Ageing and senescence	1
	Total	32
Practical		
1	Atmosphere definition- understanding the globe	1
2	Temperature Recording in animal house, poultry house, and laboratory	1
3	Calculation of RH	1
4	Calculation of THI	1
5	Calculation of Heat Loading index	1
6	Measurement of sweating rate in cattle	2
7	Stress assessment- different methods and indicators	2
8	Weather forecast models followed in India	1
9	Date analysis of rain and temperature for 20 years in the respective region	2
10	Assessing impact of different shades and houses on milk production in the college farms	1
11	Measurements of growth rate and chart of crossbred calves, native breed calf, etc.	1
12	Visit to meteorology stations	1
13	Purpose and role Satellites of ISRO related to the course (invited lecture)	1
	Total	16



- I. Course Title : Cellular and Molecular Physiology**
II. Course Code : PHY 709
III. Credit Hours : 2+0

IV. Aim of the course

To impart knowledge about cellular and molecular physiology.

V. Theory

Unit I

Cell membrane, Organelles and their functions. DNA synthesis and replication.

Unit II

Physiology of cell signaling. Basic classification and characterization of membrane receptors. Intracellular/ nuclear receptors.

Unit III

Major signaling pathways: SPs associated with second messengers; Cell signaling and apoptosis.

Unit IV

Cell cycle and Checkpoints in Cell Cycle Regulation. Regulators of the Cell cycle, cyclin-dependent kinases (CDKs) Signaling defects. Modern methods to study signaling.

S. No.	Topic	No. of Lectures
Theory		
1.	Cell and its organelles – structure and function, difference between prokaryotic and eukaryotic cell	2
2.	Structural organization of bimembranes	1
3.	Transport of molecules through cell membrane	1
4.	Membrane proteins and their functions	1
5.	Cell adhesion molecules and their functions	1
6.	Transmembrane signalling pathways	2
7.	Cell signaling and apoptosis	1
8.	Modern methods to study signaling	1
9.	Cell cycle-stages, mitosis and meiosis and regulatory molecules	3
10.	Organization of eukaryotic and prokaryotic genome	3
11.	DNA replication in prokaryotes and eukaryotes	4
12.	Transcription in prokaryotes and eukaryotes	2
13.	Translation in prokaryotes and eukaryotes	2
14.	Techniques in molecular biology – PCR, DNA sequencing, DNA micro-array, DNA finger printing in situ hybridization	4
15.	Recombinant DNA technology and its applications	2
16.	Gene silencing by RNA interface technology	2
	Total	32

- I. Course Title : Advances in Immuno Physiology**
II. Course Code : VPY 710
III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge regarding physiology of immune system.

**V. Theory****Unit I**

Introduction, History, Body defense, Organs of immune system, Ontogeny and phylogeny of immune system, Vertical transmission of immunity in animals.

Unit II

Immunoglobulins – Basic structure and functions, Hematopoiesis, T-cell and B- cell-evolution, Development and their functions, Cytokines-sources and actions, MHC, genetic organization of immunoglobulin, MHC and complement system.

Unit III

Immune-endocrine interactions, Immune-reproduction, Ageing, Stress and other physiological functions, Immune modulation.

Unit IV

Hypersensitivity, diseases related to immune system, dysfunction, autoimmune disorders and their genesis, immunodeficiency.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Types of immunity	1
2.	Host cell receptors of innate immunity	1
3.	Passive immunity.	1
4.	Acute phase reactant proteins (APRs) – positive APRs and negative APRs	1
5.	Significance of CRPs	1
6.	Antigen	1
7.	Factors influencing immunogenicity of antigens	1
8.	Heterophile antigens	1
9.	Antibody	1
10.	Functions of immunoglobulin	1
11.	Isotypes	1
12.	Hybridomas	1
13.	Monoclonal antibodies (mAB)	1
14.	Antigen antibody reaction	1
15.	Neutralisation	1
16.	Western blotting technique	1
17.	Complement pathways	1
18.	Leucocytopoiesis	1
19.	Central lymphoid organs I	1
20.	Central lymphoid organs II	1
21.	Characteristics and functions of different T and B lymphocytes	1
22.	NK cells	1
23.	Major histocompatibility	1
24.	Cytokines: interleukins, interferons, TNF, CSF	1
25.	Antigen presenting cells	1
26.	Cell mediated immunity	1
27.	Humoral/ Ab mediated immunity	1
28.	Immediate type	1
29.	Hypersensitivity type III – mechanism	1
30.	Autoimmunity	1



S. No.	Topic	No. of Lectures/ Practicals
31.	Immunological tolerance	1
32.	Transplant immunology	1
	Total	32
Practical		
1.	Isolation of lymphocytes from blood by density gradient centrifugation	1
2.	Determination of live and dead lymphocytes in the separated sample	1
3.	Estimation of CRP in serum by immunoturbidimetric assay	1
4.	Hyperimmunesum production	1
5.	Haemagglutination test	1
6.	Haemagglutination inhibition assay	1
7.	Immunoprecipitation test	1
8.	Complement fixation test	1
9.	ELISA methodology	1
10.	ELISA diagnostic test	1
11.	RIA methodology	1
12.	RIA diagnostic test	1
13.	Antibody-dependent cell-mediated cytotoxicity methodology	1
14.	Immunofluorescence- Immunohistochemistry	1
15.	Western blotting methodology	1
	Total	15

I. Course Title : Physiology of Stress

II. Course Code : VPY 711

III. Credit Hours : 2+0

IV. Aim of the course

To understand impact of various stress factors on the physiology of animals.

V. Theory

Unit I

Definition of stress, Various types of stresses, Their effect on animal production and reproduction.

Unit II

Physico-chemical changes of blood composition due to exercise and work. Energy utilization and requirement of muscles during work and exercise.

Unit III

Capacity of work under field and controlled laboratory conditions, Factors that regulate it.

Unit IV

Effect of various stresses on endocrine status of animals, Endurances in animals.

Unit V

Energy partitioning in lactating animals under stress, Physiological basis of ameliorative measures to combat stress in lactating animals.



S. No. Topic No. of Lectures

Theory

1. Definition of Stress, distress and eustress - Concept of Stressors – types of stressors – Acute and chronic stress - Broad measures of stress in animals – Behavioral, Physiological and molecular measures of stress 1
2. Neuroendocrinology of stress response - sympathetic-adrenal-medullary (SAM) pathway - the hypothalamic-pituitary-adrenal (HPA) axis 1
3. Effect of stress on musculoskeletal system – Exercise and Draft associated stress - Physiological assessment and indices for evaluating work load – concept of acceptable work load. 1
4. Effects of stress on reproduction (including birds) – pregnancy, prenatal growth, lactation and Egg production 1
5. Effect of stress on lactation - Energy partitioning in lactating animals under stress - Physiological basis of strategies to combat stress in lactating animals 1
6. Effect of stress on immune system – altered cellular responses and cytokine production patterns and their consequences 1
7. Effect of Stress on learning and memory – Areas of brain associated with stress induced alterations in learning and memory 1
8. Environmental characteristics affecting animals – Role of Temperature, Humidity, wind, Rainfall and solar radiation on animals 1
9. Concept of Homeothermy and Thermal stress in animals – Thermoneutral and Thermocomfort Zone – Upper and lower critical temperatures 1
10. Thermal exchanges between animal and environment – Conduction, Convection, Radiation and Evaporation 1
11. Physical and biological measures of thermal stress – Temperature Humidity Index (THI), The Livestock Weather Safety Index (LWSI), A wind chill index (WCI), Comprehensive climate index (CCI), Tunica Dartos Index (TDI), Infra-red thermography (IRT) based measures 1
12. Effect of other environmental stressors like Solar UV radiation, high altitude, pollution related stressors 1
13. Concept of Adaptation, Acclimatization, Acclimation - Types and levels of Adaptation 1
14. Morphological, Anatomical Adaptation of Animals and Birds to various kinds of environments – Theories associated with such adaptations 1
15. Physiological adaptations to heat stress – circulatory, respiratory, endocrine adjustments – Panting and Sweating in animals – 1
16. Physiological adaptations to cold stress – circulatory, respiratory, endocrine adjustments – Thermogenesis in cold – Tissues associated with thermogenesis 1
17. Cellular and Molecular adaptations to thermal stress – Heat shock response – Chaperones and their role in thermotolerance 1
18. Behavioral adaptations to thermal stress in Animals and Birds – Individual and Group adaptation behaviors 1
19. Special adaptations to Extreme environments like Deserts, polar regions – Estivation, hibernation and torpor 1
20. Physiology of thermal reception and processing – Central and peripheral thermo receptors – Fever, Hyperthermia and Hypothermia 1
21. Overview of all thermal adaptation features in Farm animals including camel and donkeys, Yak 1
22. Special thermal adaptation features in birds – Thermal adaptation 1



during flight

1



S. No.	Topic	No. of Lectures
23.	Measures of thermotolerance in animals – Rhoads, Gaala's, Benezra's, Iberian heat tolerance indices and cooling efficiency test of Dowling	1
24.	Adaptation of animals to High Altitude Stress – Pulmonary circulation changes adjustments in blood-O ₂ affinity with change in altitude	1
25.	Concept of Global warming and climate change – Approaches to alleviate the adverse effects of climate change induced heat stress.	1
26.	Concept of redox biology, oxidative eustress and oxidative distress– History of oxidative stress concept	1
27.	Kinds and forms of Oxidative stress – Classification of oxidative stress (Basal, low intensity, intermediate intensity and high intensity)	1
28.	Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS) – Different types of ROS and RNS– Sources of ROS and RNS generation – Oxidative and Nitrosative damage	1
29.	Concept of Redox signaling – Role of redox signaling in physiological and pathological processes	1
30.	Measuring Reactive Oxygen Species – Direct and indirect assays measuring ROS including chemiluminescence and electron spin resonance	1
31.	Antioxidant defense and their mechanism of cytoprotective actions – Enzymatic and non-enzymatic antioxidants in the body	1
32.	Dietary antioxidants in livestock and poultry production including synthetic and herbal antioxidants	1
	Total	32

I. Course Title : Advances in Reproductive Physiology

II. Course Code : VPY 712

III. Credit Hours : 2+1

IV. Aim of the course

To understand recent developments in physiology of reproduction in domestic animals.

V. Theory

Unit I

Estrus synchronization, Superovulation and Embryo transfer in farm animals.

Unit II

Seminal plasma proteins; Sexing of spermatozoa; Cryopreservation of semen.

Unit III

Collection and grading of oocytes; IVM, IVF and IVC; Cryopreservation of embryos; sexing of embryos; Micromanipulation of gametes and embryos.

Unit IV

Transgenic animals; applications of stem cells and nano technology in reproduction.

S. No.	Topic	No. of Lectures/ Practicals
Theory		
1.	Estrus synchronization in farm animals (Cattle, Buffalo, Sheep and Goat)	3
2.	Superovulation and Embryo transfer in farm animals(Cattle, Buffalo, Sheep and Goat)	3



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S. No.	Topic	No. of Lectures/ Practicals
3.	Collection of Semen in farm animals	1
4.	Seminal plasma proteins and their importance in determining male fertility	2
5.	Sexing of spermatozoa	1
6.	Cryopreservation of semen in farm animals	1
7.	Collection of oocytes from live animals and slaughter house specimens	1
8.	Grading of oocytes	1
9.	<i>In-vitro</i> maturation of oocytes	2
10.	<i>In-vitro</i> fertilization of oocytes	2
11.	<i>In-vitro</i> culture of embryos	1
12.	Cryopreservation of embryos in farm animals	2
13.	Sexing of embryos	2
14.	Micromanipulation of gametes and embryos (Intracytoplasmic sperm injection and somatic cell nuclear transfer) and their applications	3
15.	Transgenic animal production and its importance	2
16.	Stem cell production and its clinical applications	3
17.	Nanotechnology and its use in farm animal breeding and reproduction	2
	Total	32
Practical		
1.	Semen analysis – Fructolytic index, zona free ovum test, Acrosomal integrity test	2
2.	Synchronization and superovulation protocols.	1
3.	Ovum pick up from superovulated animals	1
4.	Collection of oocytes from slaughter house derived ovaries, grading and evaluation	1
5.	Capacitation of spermatozoa	1
6.	<i>In-vitro</i> fertilization, <i>In-vitro</i> embryo production	1
7.	Collection of embryos using non-surgical procedures, Transferring embryos using non- surgical procedures.	2
8.	Oocyte/ Embryo/ ovarian/ testicular tissue freezing protocols.	1
9.	Demonstration on Intracytoplasmic sperm injection	1
10.	Micromanipulation of early embryos.	2
11.	Isolation and identification of embryonic stem cells	3
	Total	16

Note: The course teachers shall conduct the above practicals by utilizing facilities from semen/ IVF lab in the university/ college, if not available in the department.

List of Journals

- *Acta Endocrinologica*
- *Advances in Clinical Chemistry*
- *Advances in Reproductive Physiology*
- *Advances in Veterinary Sciences*
- *American Journal of Clinical Nutrition*
- *American Journal of Physiology*
- *American Journal of Veterinary Research*
- *Animal Nutrition and Feed Technology*
- *Animal Reproduction Science*
- *Animal Sciences*
- *Annual Review of Physiology*



- *Buffalo Journal*



- *Domestic Animal Endocrinology*
- *Indian Journal of Animal Reproduction*
- *Indian Journal of Animal Nutrition*
- *Indian Journal of Animal Physiology*
- *Indian Journal of Animal Research*
- *Indian Journal of Animal Science*
- *Indian Veterinary Journal*
- *Journal of Endocrinology*
- *Journal of Physiology*
- *Journal of Reproduction and Fertility*
- *Neuroendocrinology*

e-Resources

- <http://intl-joe>, endocrinology-journals.org (Journal of Endocrinology)
- <http://intl-ajpcon.physiology.org> (American Journal of Physiology)
- <http://arjournals.annualreviews.org> (Annual Review of Physiology)
- www.jneurosci.org (Journal of Neuroscience)
- www3.interscience.wiley.com (Journal of Physiology and Animal Nutrition)
- <http://jp.physioc.org> (Journal of Physiology)

VOLUME II B

Veterinary Clinical Subjects

Animal Reproduction Gynaecology and Obstetrics

Veterinary Surgery and Radiology

Veterinary Medicine



Suggested list of specified minor subjects (departments)

Major Subject	Minor Subjects
Veterinary Gynaecology and Obstetrics	Veterinary Surgery & Radiology, Veterinary Physiology, Veterinary Biochemistry, Veterinary Medicine, Veterinary Biotechnology, Veterinary Pharmacology & Toxicology, Animal Nutrition
Veterinary Medicine	Veterinary Surgery and Radiology, Veterinary Pharmacology & Toxicology, Veterinary Physiology, Veterinary Biochemistry, Veterinary Gynecology and Obstetrics
Veterinary Surgery and Radiology	Veterinary Anatomy, Veterinary Medicine, Veterinary Pharmacology & Toxicology, Veterinary Physiology, Veterinary Pathology, Veterinary Gynecology and Obstetrics



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Veterinary Clinical Subjects

Animal Reproduction Gynaecology and Obstetrics





Preamble

(Animal Reproduction, Gynaecology and Obstetrics)

At Masters' level, BSMA committee members thoroughly examined the existing course contents and deleted those portions which were of repetitive nature and non-pertinent. Also, the titles of many existing courses have suitably been modified. Some of the new chapters, both in theory as well as practical courses, viz., Role of pineal gland, endogenous opioids and neuropeptides in reproduction, Negative energy balance w.r.t. infertility, its prevention and amelioration, White side test, Endometrial cytology, Transition cow, Onset of postpartum ovarian activity, Caesarean section, Anaesthesia for caesarean section, Ovariohysterectomy, Seminiferous epithelial cycle, Spermatogonial wave, Mechanism of sperm motility, Influence of seminal plasma proteins in modulating fertility, Heat stress and its effect on sperm production, Screening of the breeding bulls to be selected for semen collection, Biosecurity measures in semen production and controlling microbial load, Quality assurance for quality semen production, Instrumentation in semen laboratory, MSP for semen production, Sexed semen production, sexing of embryos, *in-vitro* culture of granulosa cells, cumulus cells, luteal cells and oviductal cells, Recovery of bovine oocytes from abattoir ovaries and live animals, Principles and application of PCR technique in animal reproduction, etc., were suitably added in the different chapters of existing courses. Eight new courses, viz., Canine and feline reproduction, Caprine and ovine reproduction, Equine reproduction, Camel reproduction, Elephant reproduction, Wild and zoo animal reproduction, Porcine reproduction and Ultrasonography in animal reproduction has been introduced at masters level. These new courses will be helpful in introducing new insights to the students. This will increase the wide coverage of area specific courses essentially required with respect to regional prospective of the country. These new courses will also be helpful in enhancing the competency of students in a global prospective.

At doctoral level, different existing courses were examined thoroughly and chapters of repetitive nature were deleted from the course contents. Also, the titles of four existing courses have suitably been modified. Some of the new chapters, viz., Assessment of neonatal viability, Care of the newborn, Care of the postpartum dam, Seminiferous epithelial cycle, Theory of sperm motility and ultrastructure of sperm. Sperm passage in female reproductive tract; capacitation and acrosome reaction, Karyotyping to identify sperm defect and DNA mapping for parentage, Collection of preputial washings and semen for bacterial load and venereal pathogens, Cryopreservation of embryos, Intracytoplasmic sperm injection (ICSI), Gene expression in oocyte and embryo, identification of cellular organelles of Gamete, Semen sorting for production of sexed semen, Contribution of gonads and accessory sex glands to semen ejaculate. Factors affecting semen production. Morphology of sperm and their defects. Biochemical composition of semen, Metabolism of sperm. Role of seminal plasma proteins. Species variation in seminal characteristics, Commercial extenders used for bovine semen, Microbial contamination of semen and measures for its prevention, Quality control and quality assurance of semen, Antisperm antibodies, Flow cytometric assessment of sperm quality, Sperm vitrification, Freeze drying of sperm and sperm encapsulation, *in-vitro* tests for sperm function, i.e. BCMPT, HOST, etc., Physical and enzymatic changes in semen following cryopreservation, Tests to assess acrosomal integrity, mitochondrial activity, DNA



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damage, binding assays, etc. Fluorescent probe based assessment of sperm quality. Comet assay, Sperm chromatin structure assay, TUNEL assay, etc. were added in different units of revised courses of both in theory and practical portions. The revised courses will be helpful in introducing new insights and improve competency in the students in a global context.



Course Title with Credit Load

M.V.Sc. in Animal Reproduction Gynaecology and Obstetrics

Course Code	Course Title	Credit Hours
VGO 601	General Gynaecology*	2+1
VGO 602	Female Infertility in Farm Animals*	2+1
VGO 603	Veterinary Obstetrics*	2+1
VGO 604	Andrology and Male Infertility*	2+1
VGO 605	Semen Preservation and Artificial Insemination	2+1
VGO 606	Basics of Reproductive Biotechnology*	2+1
VGO 607	Clinical Practice-I*	0+3
VGO 608	Clinical Practice-II*	0+3
VGO 609	Canine and Feline Reproduction	2+1
VGO 610	Caprine and Ovine Reproduction	2+1
VGO 611	Equine Reproduction	2+1
VGO 612	Camel Reproduction	2+1
VGO 613	Elephant Reproduction	2+1
VGO 614	Wild and Zoo Animal Reproduction	2+1
VGO 615	Porcine Reproduction	2+1
VGO 616	Ultrasonography In Animal Reproduction	1+2
VGO 690	Special Problem	0+1
VGO 691	Master's Seminar	1+0
VGO 699	Master's Research	30

*Core Courses



Course Contents

M.V.Sc. in Animal Reproduction Gynaecology and Obstetrics

I. Course Title : General Gynaecology

II. Course Code : VGO 601

III. Credit Hours : 2+1

IV. Aim of the course

To understand the basics of physiology of female reproduction and its hormonal regulation/ manipulation/ control.

V. Theory

Unit I

Functional anatomy, puberty and sexual maturity, Role of hypothalamic-pituitary-gonadal axis in attainment of puberty and sexual maturity, Endocrine regulation of estrous cycle. Role of pineal gland, endogenous opioids and neuropeptides in reproduction.

Unit II

Folliculogenesis, Oogenesis and ovulation and associated endocrine pattern, manipulation of follicular waves, Synchronization of estrus and ovulation and induction of ovarian activity.

Unit III

Gamete transport, Fertilization, Implantation and maternal recognition of pregnancy.

Unit IV

Embryonic and fetal development, Placentation, Fetal circulation and gestation, position of fetus in the uterus, age characteristics of fetus.

Unit V

Pregnancy diagnosis: Clinical, Ultrasonographic, Endocrinological and other diagnostic laboratory tests.

Unit VI

Lactation and artificial induction of lactation.

VI. Practical

Clinical examination of female genitalia. Biometry of female genital organs. Rectal and vaginal examination to diagnose cyclic phases of estrous cycle. Fern pattern of cervical mucus and exfoliated vaginal cytology. Pregnancy diagnosis in large and small animals by various methods. Estimation of age of the fetus. Use of ultrasound/RIA/ELISA in gynaecology. Synchronization of estrus and ovulation in farm animals.

VII. Suggested Reading

- Perry T Cupps. 2009. *Reproduction in Domestic Animals*. Academic Press.
- Hafez ESE and B Hafez. 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.
- Mauricio Pineda and Michael P Dooley. 2008. *McDonald's Veterinary Endocrinology* and Wiley-Blackwell.



- David Noakes, Timothy Parkinson and Gary England 2018. *Veterinary Reproduction and Obstetrics*. Saunders Ltd.
- Roberts SJ. 2005. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.

I. Course Title : Female Infertility in Farm Animals

II. Course Code : VGO 602

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training in diagnosis and treatment of infertility in female domestic animals.

V. Theory

Unit I

Introduction to infertility, classification, economic impact. Anatomical causes of infertility, congenital and hereditary causes and acquired defects.

Unit II

Nutritional causes of infertility. Importance of body condition score. Negative energy balance, its prevention and amelioration.

Unit III

Managemental and environmental causes of infertility. Out of season breeding.

Unit IV

Infectious causes of female infertility, Specific and non-specific infections; It's diagnosis, treatment, prevention and control.

Unit V

Ovarian dysfunction; Anoestrus, Cystic ovarian degeneration, Anovulation, Delayed ovulation and luteal insufficiency; causes, diagnosis and treatment.

Unit VI

Repeat breeding; its causes, diagnosis and treatment.

Unit VII

Early embryonic death (EED); it's causes, Diagnosis and therapeutic management.

Unit VIII

Abortion; causes, diagnosis and prevention of abortion.

Unit IX

Interactions in immunological mechanisms and infertility.

VI. Practical

Record keeping, herd fertility assessment and management, diagnosis and treatment of infertility in female animals, use of uterine swabs for bacterial and fungal culture, histo-pathological evaluation of uterine biopsy, white side test, endometrial cytology and hormone assay. Use of ultrasonography in diagnosis of infertility. Immuno- diagnostic techniques.

VII. Suggested Reading

- Laing JA. 1979. *Fertility and Infertility in Domestic Animals*. English Language Book Soc. and Bailliere Tindall.



- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- David Noakes. Timothy Parkinson and Gary England 2018. *Veterinary Reproduction and Obstetrics*. Saunders Ltd.
- Roberts SJ. 2005. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.

I. Course Title : Veterinary Obstetrics

II. Course Code : VGO 603

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training on problems of pregnancy and parturition and their management in domestic animals.

V. Theory

Unit I

Parturition; stages of parturition, Mechanism of initiation of parturition, Hormonal profiles associated with parturition, Transition cow, Onset of postpartum ovarian activity.

Unit II

Principles of handling of dystocia, Obstetrical procedures: Mutations, Fetotomy, caesarean section. Obstetrical anaesthesia and analgesia, epidural anaesthesia.

Unit III

Fetal and maternal dystocia; causes, diagnosis and management.

Unit IV

Uterine torsion; causes, diagnosis and its correction. Caesarean section, anaesthesia for caesarean section, ovariohysterectomy.

Unit V

Diseases and accidents during gestation and around parturition.

Unit VI

Etiology, diagnosis and treatment of ante-partum and post-partum uterine and vaginal prolapse.

Unit VII

Induction of parturition and elective termination of pregnancy.

Unit VIII

Involution of uterus following normal and abnormal parturition.

Unit IX

Care of dam and the newborn.

VI. Practical

Pelvimetry of different species of farm animals. Diagnosis and correction of abnormal fetal presentation, position and posture in phantom box. Epidural anaesthesia, episiotomy, ovariohysterectomy and caesarean operation. Management of incomplete cervical dilation. Fetotomy operations. Detorsion of uterus. Management of cervico-vaginal and uterine prolapse. Handling of clinical cases of dystocia.



VII. Suggested Reading

- David Noakes, Timothy Parkinson and Gary England 2018. *Veterinary Reproduction and Obstetrics*. Saunders Ltd.
- Roberts SJ. 2005. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.
- Sloss V and Duffy JH. 1980. *Handbook of Bovine Obstetrics*. Williams and Wilkins.

I. Course Title : Andrology and Male Infertility

II. Course Code : VGO 604

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training about male reproduction and treatment of male infertility in domestic animals.

V. Theory

Unit I

Structure and function of reproductive tract of male.

Unit II

Sexual behavior and examination of bulls for breeding soundness.

Unit III

Spermatogenesis, Seminiferous epithelial cycle, Spermatogonial wave, Structure of spermatozoa, Semen and its composition. Mechanism of sperm motility.

Unit IV

Diseases transmitted through semen. Factors affecting semen quality, semen culture, tests for assessment of sperm motility, sperm survival and fertilizing capacity of spermatozoa.

Unit V

Causes of infertility; hereditary, congenital, infectious, nutritional and hormonal. Pathological and functional disturbances of epididymis, vas deferens and accessory sex glands.

Unit VI

Impotentia coeundi and impotentia generandi. Testicular hypoplasia and degeneration; causes and affect on semen and fertility. Coital injuries and vices of male animals.

Unit VII

Influence of seminal plasma proteins in modulating fertility. Heat stress and its effect on sperm production.

Unit VIII

Screening of the breeding bulls to be selected for semen collection.

VI. Practical

General and rectal examination for biometrics of male genitalia and accessory sex glands. Breeding soundness evaluation of male animals. Semen evaluation for sperm abnormalities, fertility and determination of other biochemical constituents of seminal plasma, Microbiological load of semen. Examination, diagnosis and treatment of infertile male animals.



VII. Suggested Reading

- Hafez ESE and B Hafez. 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.
- Mann T and Lutwak-Mann C. 1981. *Male Reproductive Function and Semen*. Springer-Verlag.
- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Roberts SJ. 2005. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.
- Salisbury GW, VanDemark NL and Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman and Co.

I. Course Title : Semen Preservation and Artificial Insemination

II. Course Code : VGO 605

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training about collection, evaluation and preservation of semen and artificial insemination in domestic animals.

V. Theory

Unit I

History of artificial insemination. Methods of semen collection.

Unit II

Semen evaluation; macroscopic, microscopic, biochemical and microbiological tests.

Unit III

Semen preservation. Extenders for preservation of semen at different temperatures. Semen additives for enhancement of motility and fertilizing capacity of spermatozoa. Dilution of semen.

Unit IV

Cryopreservation of semen. Effect of cryopreservation on spermatozoa, semen quality and fertility. Liquid Nitrogen (LN₂) cylinders; its handling, care and maintenance.

Unit V

Thawing protocols of frozen semen. Factors affecting post-thaw semen quality.

Unit VI

Ideal protocol for AI in different species of animals. Factors affecting success of AI.

Unit VII

Biosecurity and biosafety guidelines for frozen semen stations, semen processing laboratories and quarantine stations. Minimum standards and standard operating procedures for artificial insemination, Quality testing of straws and sheath for use in artificial insemination.

VI. Practical

Instrumentation in semen laboratory, Minimum standards of protocols and Standard operating procedures for semen production, Computer assisted semen analysis (CASA), Collection and evaluation of semen. Preparation of extenders. Preservation of semen; room temperature, refrigeration and cryopreservation. Handling and evaluation of processed semen. Practice of AI techniques.



VII. Suggested Reading

- Hafez ESE and B Hafez 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.
- Enos Johnson Perry 2013. *Artificial Insemination of Farm Animals*. Jodhpur: Axis Books (India).
- Salisbury GW, VanDemark NL and Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman and Co.

I. Course Title : Basics of Reproductive Biotechnology

II. Course Code : VGO 606

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training on biotechniques in animal reproduction.

V. Theory

Unit I

Embryo transfer technology: selection of donors and recipients.

Unit II

Synchronization, super-ovulation, surgical and non-surgical collection of embryos and evaluation of embryos.

Unit III

Cryopreservation of embryos, transfer of embryos to donors. Sexed semen production, sexing of embryos. Guidelines for export and import of bovine germplasm. Guidelines and standards regarding embryo production.

Unit IV

In-vitro culture of granulosa cells, cumulus cells, luteal cells and oviductal cells. Recovery of bovine oocytes; from abattoir ovaries and live animals, *in-vitro* fertilization, *in-vitro* maturation, micromanipulation of embryos.

Unit V

Immuno-neutralization of hormones. Immunomodulation of fertility.

VI. Practical

Synchronization of estrus in donors and recipients, superovulation, surgical and non-surgical collection and transfer of embryos. Collection of oocytes from slaughter house genitalia. *In-vitro* fertilization, *in-vitro* maturation and cryopreservation of embryos. Sexing of embryos.

VII. Suggested Reading

- Ian Gordon. 2017. *Reproductive Technologies in Farm Animals*. Wallingford, Oxfordshire CABI.
- Hafez ESE and B Hafez. 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.
- B Singh, SK Gautam and MS Chauhan. 2012. *Textbook of Animal Biotechnology*, Pearson Education.
- Heiner Niemann, Christine Wrenzycki. 2018. *Animal Biotechnology 1: Reproductive Biotechnologies*. Springer.
- Heiner Niemann, Christine Wrenzycki. 2018. *Animal Biotechnology 2*. Springer International Publishing AG.
- Troy L Ott, Zhihua Jiang. 2010. *Reproductive Genomics in Domestic Animals*. John Wiley.



- Marcelo Marcondes Seneda, Katia Cristina Silva-Santos LS Rafagnin Marinho. 2016. *Biotechnology of Animal Reproduction*, Nova Science Pub. Inc; UK Ed.
- Tacia Gomes Bergstein-Galan. 2018. *Reproduction Biotechnology in farm animals*. Avid Science.

- I. Course Title : Clinical Practice-I**
- II. Course Code : VGO 607**
- III. Credit Hours : 0+3**

IV. Aim of the course

Hands-on training on diagnosis and treatment of reproductive disorders in animals at VCC.

V. Practical

Clinical examination of animals affected with reproductive disorders, Use of diagnostic techniques for diagnosis and institution of required therapy. Acquaintance with different equipment used for handling reproductive disorders, Client management, Public relations, Code of conduct, Database management, Maintenance of case records.

VI. Suggested Reading

- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Zemjanis R 1970. *Diagnostic and Therapeutic Techniques in Animal Reproduction*. Williams and Wilkins; Second Edition.

- I. Course Title : Clinical Practice-II**
- II. Course Code : VGO 608**
- III. Credit Hours : 0+3**

IV. Aim of the course

Hands-on training on diagnosis and treatment of reproductive disorders in animals at VCC.

V. Practical

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Acquaintance with different equipment used for handling reproductive disorders, Client management, Public relations, Code of conduct, Database management, Maintenance of case records.

VI. Suggested Reading

- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Zemjanis R. 1970. *Diagnostic and Therapeutic Techniques in Animal Reproduction*. Williams and Wilkins; Second Edition.

- I. Course Title : Canine and Feline Reproduction**
- II. Course Code : VGO 609**
- III. Credit Hours : 2+1**

IV. Aim of the course

To impart knowledge and training about reproduction in canine and feline.



V. Theory

Unit I

Development of reproductive system. Anatomy of male and female reproductive system. Canine and feline estrous cycle, endocrinology of estrous cycle.

Unit II

Breeding management, pregnancy, pregnancy diagnosis; clinical, ultrasonographic, endocrinological and other diagnostic laboratory tests.

Unit III

Parturition, fetal and maternal dystocia; causes, diagnosis and management. Induction of parturition and caesarean section, periparturient disorders.

Unit IV

Medical termination of pregnancy in dogs and cats, management of pseudopregnancy, pyometra and its management. Infertility and its management in dogs and cats.

Unit V

Postpartum care of dam and lactation. Neonatal care.

Unit VI

Population control in dogs; surgical and non surgical methods.

Unit VII

Reproductive physiology of male dogs, semen collection techniques, semen evaluation, freezing of semen, artificial insemination techniques, male reproductive disorders and its management.

VI. Practical

Exfoliative vaginal cytology, determination of ovulation time, demonstration of semen collection and artificial insemination, predicting time of parturition using hormonal assay, management of dystocia using clinical cases, castration, ovariohysterectomy, caesarean section, surgical procedure related to reproductive disorders in both male and female dogs and cats.

VII. Suggested Reading

- Edward C Feldman, Richard William Nelson. 2003. *Canine and Feline Endocrinology and Reproduction*. Elsevier Health Sciences, Saunders.
- Shirley Dianne Johnston, Margaret V Root Kustritz, Patricia Schultz Olson. 2001. *Canine and Feline Theriogenology*. Saunders Publ.
- Margaret V, Root Kustritz. 2009. *Clinical Canine and Feline Reproduction: Evidence-Based Answers*. John Wiley and Sons.
- Phyllis A. Holst MS. 2010. *Canine Reproduction: The Breeder's Guide 3rd Edition*. DOGWISE.
- Cheryl Lopate. 2012. *Management of Pregnant and Neonatal Dogs, Cats, and Exotic Pets*. John Wiley and Sons.
- Jovi R Otite. 2015. *Reproduction in the Dog a Tropical Approach*. Xlibris Corporation.

I. Course Title : Caprine and Ovine Reproduction

II. Course Code : VGO 610

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training about reproduction in sheep and goat.



V. Theory

Unit I

Caprine and ovine estrous cycle, endocrinology of estrous cycle, Seasonal breeding activity in sheep and goat, Artificial control of oestrus in sheep and goat.

Unit II

Breeding management, methods for advancing sheep breeding season, Induction of multiple births in sheep. Artificial insemination, pregnancy and parturition, Dystocia and it's management.

Unit III

Reproductive disorders and it's management.

Unit IV

Reproductive physiology of males, semen collection techniques, semen evaluation, freezing of semen, male reproductive disorders and it's management.

VI. Practical

Demonstration of semen collection and artificial insemination, management of dystocia using clinical cases, castration, ovariohysterectomy, caesarean section, surgical procedure related to reproductive disorders in both male and females.

VII. Suggested Reading

- Mauricio Pineda and Michael P Dooley. 2008. *McDonald's Veterinary Endocrinology and Reproduction*. Wiley-Blackwell.
- Lindsay DR and Pearce DT. 2011. *Reproduction in Sheep*, Cambridge University Press, Cambridge, London.
- Selected articles from journals.

I. Course Title : Equine Reproduction

II. Course Code : VGO 611

III. Credit Hours : 2+1

IV. Aim of the course

To encompass the fundamentals of equine reproductive anatomy and physiology. This will help in understanding the care and management of the breeding stallion and the broodmare.

V. Theory

Unit I

Anatomy and physiology of the mare and stallion.

Unit II

Manipulation of estrus in the mare, estrous cycle, broodmare management, Use of ultrasound in breeding management.

Unit III

Infertility and it's management.

Unit IV

Pregnancy diagnosis and management of the pregnant mare. Fetal development, abortion, induced parturition and dystocia.



Unit V

Neonatal management and common neonatal diseases, orphan foal management, foal management during the first six months.

Unit VII

Semen collection, semen preservation, artificial insemination and embryo transfer.

VI. Practical

Visit of equine/ stud farm, overall management of an equine breeding program, handling the cases of reproductive disorders, artificial insemination, semen collection, semen preservation, breeding record keeping and analysis.

VII. Suggested Reading

- Mauricio Pineda and Michael P Dooley. 2008. *McDonald's Veterinary Endocrinology and Reproduction*. Wiley-Blackwell.
- McKinnon, Squires, Vaala and verner. 2011. *Equine Reproduction* (2nd Ed). Wiley- Blackwell.
- Juan Samper, Jonathan Pyocock and Angus McKinnon. 2007. *Current Therapy in Equine Reproduction*. Saunders.
- Steven Brinsko Terry Blanchard Dickson Varner James Schumacher Charles Love. 2010. *Manual of Equine Reproduction* (3rd Ed). CV Mosby.
- John Dascanio and Patrick McCue. 2014. *Equine Reproductive procedures*. John Wiley and Sons, Inc.
- Selected articles from journals.

I. Course Title : Camel Reproduction

II. Course Code : VGO 612

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training about reproduction in camels.

V. Theory

Unit I

Male reproductive organs, male reproductive physiology and sexual behavior, puberty and sexual maturity, seasonal changes, copulation, semen collection and its characteristics.

Unit II

Female reproductive organs, female reproductive physiology and sexual behavior, oestrous cycle, external signs of oestrus, pregnancy and foetal development, pregnancy diagnosis and parturition.

Unit III

Age of sexual maturity, breeding season, conception rate, calving interval, reproductive longevity.

Unit IV

Early embryonic mortality, reproductive problems in the female, reproductive problems in the male.

Unit V

Artificial insemination, nutrition and reproduction, embryo transfer in camel.



VI. Practical

Management of dystocia in clinical cases, castration, ovariohysterectomy, caesarean section, surgical procedure related to reproductive disorders in both male and females.

VII. Suggested Reading

- H Merkt, D Rath, B Musa, MA El-Naggar. 1990. *Reproduction in Camels*. FAO.
- Muhammad Jamshed Khan. 2011. *Equine and Camel Production: An Approach towards Better Management*. LAP LAMBERT Academic Pub.
- Selected articles from journals.

I. Course Title : Elephant Reproduction

II. Course Code : VGO 613

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training about reproduction in elephant.

V. Theory

Unit I

General introduction, *Elephas maximus*, domestic and wild elephants.

Unit II

Male genital system, Accessory sex glands, Hormonal control and semenology.

Unit III

Female reproductive system, Ovaries, fallopian tubes, Uterus, vagina and external genitalia. Oestrous cycle, Hormonal regulation of estrous cycle, Mating behaviour and act of copulation.

Unit IV

Pregnancy, Gestation length and parturition. Neonatal care of elephant calves.

Unit V

Musth in elephants, behavioral patterns, pre-musth, violent- musth and post-musth phases, controlling elephants in musth using drugs/ hormones, anti androgens. Artificial insemination and cryopreservation of gametes.

VI. Practical

Management of dystocia in clinical cases, surgical procedure related to reproductive disorders in both male and females.

VII. Suggested Reading

- Brown JL, Paris S, Prado-Oviedo NA, Meehan CL, Hogan JN, Morfeld KA and Carlstead KA. 2016. *Reproductive Health Assessment of Female Elephants in North American Zoos and Association of Husbandry Practices with Reproductive Dysfunction in African Elephants (Loxodonta africana)*. PLOS ONE | DOI:10.1371/journal.pone.014573.
- Ortolani A, Leong K, Graham L, Savage A. 2005. *Behavioral indices of estrus in a group of captive African Elephants (Loxodonta africana)*. Zoo Biol. 24:311-329.
- Rasmussen LE, Schmidt MJ, Henneous R, Groves D, Daves GD. Jr. 1982. *Asian bull elephants: flehmen-like responses to extractable components in female elephant estrous urine*. Science. 217: 159-162.
- Sukumar R. 2006. *A brief review of the status, distribution and biology of wild Asian elephants Elephas maximus*. Int. Zoo Yb. 40: 1-8.
- Thitaram C. 2009. *Elephant reproduction: Improvement of breeding efficiency and development*



of a breeding strategy. Ph.D. Thesis, Utrecht University, The Netherlands

- Vidya TNC and Sukumar R. 2005. *Social and reproductive behaviour in elephants*. *Current sci.* **89**: 1200-1207.
- Selected articles from journals.

I. Course Title : Wild and Zoo Animal Reproduction

II. Course Code : VGO 614

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge and training about reproduction in Wild and zoo animals.

V. Theory

Unit I

Introduction to reproduction, Pattern of estrous cycle, Optimal breeding time with emphasis on tiger, deer, monkey and crocodile.

Unit II

Gestational length, parturition and pregnancy diagnosis.

Unit III

Sexual behavior and major reproductive disorders in wild and zoo animals, contraception techniques for deer.

VI. Practical

Management of dystocia in clinical cases, castration, observation of estrus behavior, pregnancy diagnosis, surgical procedure related to reproductive disorders in both male and females.

VII. Suggested Reading

- GR Smith, JP Hearn and Wellcome Trust (London, England). 1988. *Reproduction and disease in captive and wild animals*, New York: Oxford University Press.
- Ian Gordon. 1997. *Controlled reproduction in horses, deer and camelids*. CAB International.
- Mauricio Pineda and Michael P Dooley. 2008. *McDonald's Veterinary Endocrinology and Reproduction*. Wiley-Blackwell.
- Paul A Rees. 2011. *An Introduction to Zoo Biology and Management*. Wiley-Blackwell.
- R Eric Miller, Murray E Fowler. 2014. *Fowler's Zoo and Wild Animal Medicine*. Saunders.
- Selected articles from journals.

I. Course Title : Porcine Reproduction

II. Course Code : VGO 615

III. Credit Hours : 2+1

IV. Aim of the course

To acquire knowledge about the fundamentals of reproductive anatomy, physiology and advances in fertility management in swine.

V. Theory

Unit I

Anatomy and physiology of boar and sow.

Unit II

Oestrus cycle in sow, manipulation of oestrus cycle, methods for detection of oestrus,



endocrinology of pregnancy and parturition.

Unit III

Infertility in sow and its management.

Unit IV

Pregnancy diagnosis and management of pregnant sow.

Unit V

Fetal development, abortion, induced parturition, dystocia, stages of parturition and mastitis-metritis complex in sow.

Unit VI

Neonatal management and common neonatal diseases, care of piglets.

Unit VII

Breeding boar selection and management, semen collection, semen preservation, natural service, artificial insemination, embryo transfer and IVF.

VI. Practical

Visit of swine farm, breeding management in sows, handling the cases of reproductive disorders, caesarean section, castration, sexual behaviour, vaginal cytology, pregnancy diagnosis, dystocia, semen collection, semen preservation, artificial insemination, embryo transfer and record keeping.

VII. Suggested Reading

- Colin T Whittemore, Ilias Kyriazakis. 2008. *Whittemore's Science and Practice of Pig Production*. John Wiley and Sons Press.
- *Control of Pig Reproduction*. Proceedings of the Eighth International Conference on Pig Reproduction, Alberta, Canada, June 2009 by Heriberto Rodríguez Martínez, Jeff L Vallet, Adam J Ziecik, Nottingham University Press. 2009.
- DJA Cole, GR Foxcroft, Butterworth-Heinemann. 2013. *Control of Pig Reproduction*. Technology and Engineering Press.
- Mauricio Pineda and Michael P Dooley. 2008. *McDonald's Veterinary Endocrinology and Reproduction*. Wiley-Blackwell.
- *Pig Reproduction: Problems, Practices and Principles*. Proceedings of a Conference Held at Christ Church, Oxford University, 16-18 December, 1998.
- Sergi Bonet, Isabel Casas, William V Holt, Marc Yeste. 2013. *Boar Reproduction: Fundamentals and New Biotechnological Trends*. Springer Science and Business Media.
- Selected articles from journals.

I. Course Title : Ultrasonography in Animal Reproduction

II. Course Code : VGO 616

III. Credit Hours : 1+2

IV. Aim of the course

To impart knowledge and training about application of ultrasonography in diagnosis of conditions associated with animal reproduction.

V. Theory

Unit I

Basic principle of ultrasonography, physics of ultrasonography, A-mode, B-mode and M-mode ultrasonography, artifacts, principle of Doppler ultrasonography.



Unit II

Trans-abdominal ultrasonography, transrectal ultrasonography, follicular dynamics and luteal characteristics in large and small ruminants, luteal blood flow studies.

Unit III

Use of ultrasonography in pregnancy diagnosis, infertility management, uterine involution, luteal cyst and follicular cyst, blood flow studies in uterine and foetal arteries. Determination of gestational age in small animals by measuring gestational sac diameter, crown rump length and body diameter. Detection of foetal resorption and mummification. Prediction of parturition time, fetal viability by detecting fetal heart rate, foetal number and sex determination.

Unit IV

Testicular and male accessory sex gland ultrasonography.

VI. Practical

Use of ultrasonography in different stages of reproductive cycle. Use of ultrasonography in diagnosis of clinical cases associated with reproductive disorders in both male and females.

VII. Suggested Reading

- MAM Taverne and AH Willemsse. 1989. *Diagnostic ultrasound and animal reproduction*. Dordrecht; Boston: Kluwer Academic.
- J Ginther. 1998. *Ultrasonic imaging and animal reproduction*. Cross Plains, Wis.: Equiservices Pub.
- Selected articles from journals.

I. Course Title : Special Problem

II. Course Code : VGO 690

III. Credit Hours : 0+1

IV. Aim of the course

To expose students to research techniques related to sub discipline of the subject and submission of written project with references.

V. Practical

Student will carry out research on allotted project and submit the project report.

VGO 691 Master's Seminar 1+0

VGO 699 Master's Research 30



Course Outline: Lecture wise

VGO 601: General Gynaecology (2+1)

Theory Lectures

1. Functional anatomy reproductive organs, puberty and sexual maturity in farm animals.
2. Endocrine regulation of estrous cycle in farm animals.
3. Role of hypothalamic-pituitary-gonadal axis in attainment of puberty.
4. Role of pineal gland, endogenous opioids and neuropeptides in reproduction.
5. Folliculogenesis, follicular waves and its manipulation, oogenesis and ovulation.
6. Synchronization of estrus and ovulation in farm animals.
7. Artificial induction of ovarian activity.
8. Transport of gametes in the reproductive tract, fertilization and implantation.
9. Maternal recognition of pregnancy in farm animals.
10. Embryonic and fetal development during gestation.
11. Placentation and fetal circulation.
12. Gestational changes in the fetus w.r.t. to position in the uterus, age, etc.
13. Pregnancy diagnosis in farm animals. Pregnancy diagnosis using clinical method.
14. Pregnancy diagnosis using endocrinological and other diagnostic laboratory methods.
15. Pregnancy diagnosis using ultrasonographic method.
16. Lactation and artificial induction of lactation in cattle and buffaloes.

Practicals

1. Clinical examination of female genitalia.
2. Biometry of female genital organs using slaughter house specimen.
3. Rectal and vaginal examination to diagnose cyclic phases of estrous cycle.
4. Fern pattern of cervical mucus and exfoliated vaginal cytology.
5. Pregnancy diagnosis in large and small animals by various methods.
6. Estimation of age of the fetus.
7. Pregnancy diagnosis using Ultrasonography method.
8. Pregnancy diagnosis using endocrinological method.
9. Synchronization of estrus and ovulation in farm animals.

VGO 602: Female Infertility In Farm Animals (2+1)

Theory Lectures

1. Infertility, its classification and economic impact.
2. Anatomical, congenital/ hereditary and acquired causes of infertility.
3. Nutritional causes of infertility.
4. Importance of body condition score. Negative energy balance, its prevention and amelioration.
5. Managerial and environmental causes of infertility.
6. Out of season breeding.
7. Infectious causes of female infertility, specific and non-specific infections; it's diagnosis, treatment, prevention and control.



8. Anoestrus; causes, diagnosis and treatment.
9. Cystic ovarian degeneration; causes, diagnosis and treatment.
10. Anovulation and delayed ovulation; causes, diagnosis and treatment.
11. Luteal insufficiency; causes, diagnosis and treatment.
12. Repeat breeding; its causes, diagnosis and treatment.
13. Early embryonic death (EED); it's causes, diagnosis and therapeutic management.
14. Abortion; Infectious and non infectious causes of abortion.
15. Diagnosis and prevention of abortion.
16. Immunological mechanisms leading to infertility.

Practicals

1. Record keeping w.r.t. herd fertility assessment and management.
2. Diagnosis and treatment of infertility in female animals.
3. Uterine swabbing for bacterial and fungal culture.
4. Histo-pathological evaluation of uterine biopsy.
5. White side test, endometrial cytology and hormone assay.
6. Use of ultrasonography in diagnosis of infertility.
7. Immuno- diagnostic techniques.

VOG 603: Veterinary Obstetrics (2+1)

Theory Lectures

1. Parturition; stages of parturition.
2. Mechanism of initiation of parturition, hormonal profiles associated with parturition.
3. Transition cow, onset of postpartum ovarian activity.
4. Dystocia and principles of handling of dystocia.
5. Obstetrical procedures: mutations, fetotomy, caesarean section.
6. Obstetrical anesthesia and analgesia, epidural anesthesia.
7. Fetal dystocia; causes, diagnosis and management.
8. Maternal dystocia; causes, diagnosis and management.
9. Uterine torsion; causes, diagnosis and its correction.
10. Caesarean section and ovariohysterectomy.
11. Diseases and accidents during gestation
12. Diseases and accidents around parturition.
13. Etiology, diagnosis and treatment of ante-partum vagino-cervical prolapse.
14. Etiology, diagnosis and treatment of post-partum uterine and vaginal prolapse.
15. Induction of parturition and elective termination of pregnancy.
16. Involution of uterus following normal and abnormal parturition.
17. Care of dam and the newborn.

Practicals

1. Pelvimetry of different species of farm animals.
2. Diagnosis and correction of abnormal fetal presentation, position and posture in phantom box.
3. Epidural anesthesia, episiotomy, ovariohysterectomy.
4. Caesarean operation.
5. Management of incomplete cervical dilation.
6. Fetotomy operations.
7. Detorsion of uterus.
8. Management of cervico-vaginal and uterine prolapse.
9. Handling of clinical cases of dystocia.



VGO 604: Andrology and Male Infertility (2+1)

Theory Lectures

1. Structure and function of reproductive tract of male.
2. Sexual behavior in males.
3. Examination of bulls for breeding soundness.
4. Spermatogenesis, seminiferous epithelial cycle and spermatogonial wave.
5. Structure of spermatozoa, semen and its composition.
6. Mechanism of sperm motility.
7. Diseases transmitted through semen.
8. Factors affecting semen quality.
9. Tests for assessment of sperm motility, sperm survival and fertilizing capacity of spermatozoa.
10. Causes of male infertility; hereditary, congenital, infectious, nutritional and hormonal.
11. Pathological and functional disturbances of epididymis, vas deferens and accessory sex glands.
12. Impotentia cocundi and impotentia generandi.
13. Testicular hypoplasia and degeneration; causes and affect on semen and fertility.
14. Coital injuries and vices of male animals.
15. Influence of seminal plasma proteins in modulating fertility.
16. Heat stress and its effect on sperm production.
17. Screening of the breeding bulls to be selected for semen collection.

Practicals

1. General and per-rectal examination for biometrics of male genitalia and accessory sex glands.
2. Breeding soundness evaluation of male animals.
3. Semen evaluation for sperm abnormalities, fertility.
4. Determination of biochemical constituents of seminal plasma.
5. Microbiological load assessment of semen.
6. Examination, diagnosis and treatment of infertile male animals.

VGO 605: Semen Preservation and Artificial Insemination (2+1)

Theory Lectures

1. History of artificial insemination.
2. Methods of semen collection.
3. Semen evaluation; macroscopic and microscopic examination.
4. Biochemical and microbiological tests of semen.
5. Semen dilution and preservation.
6. Extenders for preservation of semen at different temperatures.
7. Semen additives for enhancement of motility and fertilizing capacity of spermatozoa.
8. Cryopreservation of semen.
9. Effect of cryopreservation on spermatozoa, semen quality and fertility.
10. Liquid Nitrogen (LN₂) cylinders; its handling, care and maintenance.
11. Thawing protocols of frozen semen.
12. Factors affecting post-thaw semen quality.
13. Ideal protocol for AI in different species of animals. Factors affecting success of AI.
14. Biosecurity and biosafety guidelines for frozen semen stations, semen processing laboratories and quarantine stations.



15. Minimum standards and standard operating procedures for artificial insemination.
16. Quality testing of straws and sheath for use in artificial insemination.

Practicals

1. Instrumentation in semen laboratory.
2. Minimum standards of protocols of semen laboratory.
3. Standard operating procedures for semen production.
4. Computer assisted semen analysis.
5. Collection and evaluation of semen for its quality.
6. Preparation of semen extenders.
7. Preservation of semen; room temperature, refrigeration and cryopreservation.
8. Handling and evaluation of processed semen.
9. Practice of AI techniques.

VGO 606: Basics of Reproductive Biotechnology (2+1)

Theory Lectures

1. Embryo transfer technology: selection of donors and recipients.
2. Synchronization of estrus in donors and recipients.
3. Super-ovulation, surgical and non-surgical collection of embryos.
4. Evaluation and cryopreservation of embryos.
5. Transfer of embryos to donors.
6. Sexed semen production.
7. Sexing of embryos.
8. Guidelines for export and import of bovine germplasm.
9. Guidelines and standards regarding embryo production.
10. *In-vitro* culture of granulosa cells, cumulus cells, luteal cells and oviductal cells.
11. Recovery of bovine oocytes; from abattoir ovaries and live animals.
12. *In-vitro* maturation, *in-vitro* fertilization and micromanipulation of embryos.
13. Immuno-neutralization and immunomodulation of fertility.

Practicals

1. Synchronization of estrus in donors and recipients.
2. Superovulation, surgical and non-surgical collection and transfer of embryos.
3. Collection of oocytes from slaughter house genitalia.
4. *In-vitro* maturation and *in-vitro* fertilization of embryos.
5. Sexing of embryos.

VGO 609: Canine and Feline Reproduction (2+1)

Theory Lectures

1. Development of reproductive system. Anatomy of male and female reproductive system.
2. Canine and feline estrous cycle, endocrinology of estrous cycle.
3. Breeding management.
4. Pregnancy and pregnancy diagnosis; clinical method of pregnancy diagnosis.
5. Ultrasonographic, endocrinological and other diagnostic laboratory tests of pregnancy diagnosis.
6. Parturition and periparturient disorders in dogs and cats.
7. Dystocia; fetal and maternal causes, diagnosis and management.
8. Induction of parturition and caesarean section.
9. Medical termination of pregnancy in dogs and cats.



10. Management of pseudopregnancy and pyometra.
11. Infertility and its management in dogs and cats.
12. Postpartum care of dam and lactation. Neonatal care.
13. Population control in dogs; surgical and non surgical methods.
14. Reproductive physiology of male dogs.
15. Semen collection techniques and semen evaluation.
16. Freezing of semen and artificial insemination techniques.
17. Male reproductive disorders and its management.

Practicals

1. Exfoliative vaginal cytology.
2. Determination of ovulation time.
3. Demonstration of semen collection and artificial insemination.
4. Predicting time of parturition using hormonal assay.
5. Management of dystocia in clinical cases.
6. Castration, ovariohysterectomy and caesarean section.
7. Surgical procedure related to reproductive disorders in both male and female dogs and cats.

VGO 610: Caprine and Ovine Reproduction (2+1)

Theory Lectures

1. Caprine and ovine estrous cycle.
2. Endocrinology of estrous cycle.
3. Seasonal breeding activity in sheep and goat.
4. Artificial control of oestrus in sheep and goat.
5. Breeding management.
6. Methods for advancing sheep breeding season, induction of multiple births in sheep.
7. Artificial insemination.
8. Pregnancy and parturition.
9. Dystocia and its management.
10. Reproductive disorders and its management.
11. Reproductive physiology of males.
12. Semen collection techniques and semen evaluation.
13. Freezing of semen.
14. Male reproductive disorders and its management.

Practicals

1. Demonstration of semen collection.
2. Demonstration of artificial insemination.
3. Management of dystocia in clinical cases.
4. Castration.
5. Ovariohysterectomy and caesarean section.
6. Surgical procedure related to reproductive disorders in both male and females.

VGO 611: Equine Reproduction (2+1)

Theory Lectures

1. Reproductive anatomy and physiology of Mare.
2. Reproductive anatomy and physiology Stallion.
3. Estrous cycle, manipulation of estrus in Mare.
4. Broodmare management.



5. Use of ultrasound in breeding management.
6. Infertility in Mare and it's management.
7. Pregnancy diagnosis.
8. Management of the pregnant mare.
9. Fetal development.
10. Abortion.
11. Parturition, induced parturition.
12. Management of dystocia.
13. Neonatal management.
14. Common neonatal diseases, orphan foal management.
15. Foal management during the first six months.
16. Semen collection.
17. Semen preservation.
18. Artificial insemination.
19. Embryo transfer.

Practicals

1. Visit of equine/ stud farm.
2. Overall management of an equine breeding program.
3. Handling the cases of reproductive disorders.
4. Artificial insemination.
5. Semen collection.
6. Semen preservation.
7. Breeding record keeping and analysis.

VGO 612: Camel Reproduction (2+1)

Theory Lectures

1. Male reproductive organs, male reproductive physiology.
2. Sexual behavior, puberty and sexual maturity.
3. Seasonal changes and copulation.
4. Semen collection and it's characteristics.
5. Female reproductive organs, female reproductive physiology.
6. Sexual behavior, oestrous cycle, signs of oestrus.
7. Pregnancy and foetal development.
8. Pregnancy diagnosis.
9. Parturition.
10. Age of sexual maturity, breeding season.
11. Conception rate, calving interval, reproductive longevity.
12. Early embryonic mortality, reproductive problems in the female.
13. Reproductive problems in the male.
14. Artificial insemination.
15. Nutrition and reproduction.
16. Embryo transfer in camel.

Practicals

1. Management of dystocia in clinical cases.
2. Castration and ovariohysterectomy.
3. Caesarean section.
4. Surgical procedure related to reproductive disorders in both male and females.



VGO 613: Elephant Reproduction (2+1)

Theory Lectures

1. General introduction, *Elephas maximus*, domestic and wild elephants.
2. Male genital system, accessory sex glands.
3. Spermatogenesis and hormonal control.
4. Semen characteristics.
5. Female reproductive system, ovaries, fallopian tubes, uterus, vagina and external genitalia.
6. Oestrous cycle, hormonal regulation of estrous cycle.
7. Mating behaviour and act of copulation.
8. Pregnancy, gestation length.
9. Parturition.
10. Neonatal care of elephant calves.
11. Musth in elephants, behavioural patterns, pre-musth, violent- musth and post-musth phases.
12. Controlling elephants in musth using drugs/ hormones, anti androgens.
13. Artificial insemination.
14. Cryopreservation of gametes.

Practicals

1. Management of dystocia in clinical cases.
2. Surgical procedure related to reproductive disorders in both male and females.

VGO 614: Wild and Zoo Animal Reproduction (2+1)

Theory Lectures

1. Introduction to reproduction in wild animals.
2. Pattern of estrous cycle in tiger, deer, monkey and crocodile.
3. Optimal breeding time with emphasis on tiger, deer, monkey and crocodile.
4. Gestational length and pregnancy diagnosis in wild and zoo animals.
5. Parturition in wild and zoo animals.
6. Sexual behavior in wild and zoo animals.
7. Major reproductive disorders in wild and zoo animals.
8. Contraception techniques for deer.

Practicals

1. Management of dystocia in clinical cases.
2. Castration in wild and zoo animals.
3. Observation of estrus behavior.
4. Pregnancy diagnosis.
5. Surgical procedure related to reproductive disorders in both male and females.

VGO 615: Porcine Reproduction (2+1)

Theory Lectures

1. Anatomy and physiology of Boar
2. Anatomy and physiology of Sow.
3. Oestrus cycle, manipulation of oestrus cycle in sow.
4. Methods for detection of oestrus.
5. Endocrinology of pregnancy.
6. Endocrinology of parturition.



7. Infertility in sow and its management.
8. Pregnancy diagnosis and management of pregnant sow.
9. Fetal development.
10. Abortion and induced parturition.
11. Parturition and its stages.
12. Dystocia in Sow.
13. Mastitis-metritis complex in sow.
14. Neonatal management and common neonatal diseases, care of piglets.
15. Breeding boar selection and management.
16. Semen collection and preservation.
17. Natural service and artificial insemination.
18. Embryo transfer and IVF.

Practicals

1. Visit and record keeping of swine farm.
2. Breeding management in sows.
3. Handling the cases of reproductive disorders.
4. Caesarean section and castration.
5. Sexual behaviour and vaginal cytology.
6. Pregnancy diagnosis in Sow.
7. Semen collection, semen preservation and artificial insemination.
8. Embryo transfer in Sow.

VGO 616: Ultrasonography in Animal Reproduction (1+2)

Theory Lectures

1. Basic principle of ultrasonography, physics of ultrasonography, A-mode, B-mode and M-mode Ultrasonography. Artifacts and principle of Doppler ultrasonography.
2. Trans-abdominal and transrectal ultrasonography.
3. Follicular dynamics and luteal characteristics in large and small ruminants, luteal blood flow studies.
4. Use of ultrasonography in pregnancy diagnosis and infertility management.
5. Studies on uterine involution, luteal cyst and follicular cyst, blood flow studies in uterine and foetal arteries ultrasonography.
6. Determination of gestational age in small animals by measuring gestational sac diameter, crown rump length and body diameter. Detection of foetal resorption and mummification.
7. Prediction of parturition time, fetal viability by detecting fetal heart rate, foetal number and sex determination.
8. Testicular and male accessory sex gland ultrasonography.

Practicals

1. Practicing trans-abdominal and trans-rectal ultrasonography.
2. Use of ultrasonography in follicular dynamics study.
3. Use of ultrasonography in luteal characteristics study.
4. Use of ultrasonography in pregnancy diagnosis.
5. Prediction of parturition time using ultrasonography.
6. Use of ultrasonography in diagnosis of clinical cases associated with reproductive disorders in females.
7. Testicular studies using ultrasonography.
8. Male accessory sex gland studies using ultrasonography



9. Use of ultrasonography in diagnosis of clinical cases associated with reproductive disorders in male.

Minor Courses for M.V.Sc. Degree programme

Courses of any one department/ discipline from the list given below:

- Veterinary Pathology
- Veterinary Pharmacology
- Veterinary Physiology
- Veterinary Biochemistry
- Veterinary Bacteriology
- Veterinary Immunology

Supporting Courses

It could be any subject considered relevant for student's research work. This will be decided by Advisor/ guide concerned.

Common Courses

The following courses (one credit each) will be offered to all students undergoing Master's degree programme.

- Library and Information Services
- Technical Writing and Communications Skills
- Intellectual Property and its management in Agriculture
- Basic Concepts in Laboratory Techniques
- Agricultural Research, Research Ethics and Rural Development Programmes



Course Title with Credit Load

Ph.D. in Animal Reproduction Gynaecology and Obstetrics

Course Code	Course Title	Credit Hours
VGO 701	Advances in Gynaecology and Infertility Management*	2+1
VGO 702	Advances in Veterinary Obstetrics	1+1
VGO 703	Advances in Andrology and Male Infertility*	2+1
VGO 704	Reproductive Biotechnology	1+1
VGO 705	Semenology	1+1
VGO 706	Clinical Practice-I*	0+3
VGO 707	Clinical Practice-II*	0+3
VGO 790	Special Problem	0+2
VGO 791	Doctoral Seminar-I	1+0
VGO 792	Doctoral Seminar-II	1+0
VGO 799	Doctoral Research	75

*Core Courses



Course Contents

Ph.D. in Animal Reproduction Gynaecology and Obstetrics

I. Course Title : Advances in Gynaecology and Infertility Management

II. Course Code : VGO 701

III. Credit Hours : 2+1

IV. Aim of the course

To learn about advances in endocrine, ovarian and uterine functions and effect of nutrition, season and immunological factors on female fertility.

V. Theory

Unit I

Neuro-endocrine control of reproduction, follicular development, ovulation fertilization and implantation. Embryonic and fetal development.

Unit II

Maternal recognition of pregnancy advances in early diagnosis of pregnancy.

Unit III

Embryonic losses, abortion and their prevention.

Unit IV

Seasonal breeders, Synchronization and induction of estrus and ovulation in seasonal breeders, Assisted Reproductive Technology (ART) to increase reproductive efficiency in farm animals.

Unit V

Effect of stress, nutrition and immunological factors on fertility.

Unit VI

Onset of postpartum ovarian activity and factors affecting it.

Unit VI

Diagnostic and therapeutic approaches in infertility; principles of hormone therapy in reproductive disorders, laparoscopy, ultrasonographic diagnosis of ovarian/ uterine dysfunction, reproductive disorders, vaginal and uterine cytology.

VI. Practical

Clinical examination of female animals. Use of ultrasonography in ovarian function (follicular image pattern, follicular dynamics) and in early pregnancy diagnosis and infertility. Utility of uterine culture, uterine cytology and uterine biopsy (histopathological examination) in infertility investigation. Laparoscopy in diagnosis of ovarian and uterine dysfunction. ELISA/ RIA of hormones and interpretation of results. Use of assisted reproductive technology (ART) to enhance reproductive efficiency in farm animals.

VII. Suggested Reading

- Hafez ESE and B Hafez. 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.



- Mauricio Pineda and Michael P Dooley. 2008. *McDonald's Veterinary Endocrinology* and Wiley-Blackwell.
- David Noakes, Timothy Parkinson and Gary England. 2018. *Veterinary Reproduction and Obstetrics*. Saunders Ltd.
- Roberts SJ. 2005. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.
- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Selected articles from journals.

I. Course Title : Advances in Veterinary Obstetrics

II. Course Code : VGO 702

III. Credit Hours : 1+1

IV. Aim of the course

To learn current developments in diagnosis and management of dystocia, accidents of gestation and peri-parturient disorders in domestic animals.

V. Theory

Unit I

Conceptus and its development. Factors influencing gestation period and birth weight.

Unit II

Anomalies of conceptus, teratogens and effect of stress on conceptus development.

Unit III

Mechanism of initiation of parturition. Use of tocolytic drugs.

Unit IV

Induction of parturition and termination of abnormal pregnancies. Obstetrical analgesia and anesthesia.

Unit V

Pre-treatment evaluation of the dam suffering from dystocia. Management of maternal and fetal dystocia, hydrallantois, hydramnion, fetal mummification, fetal maceration, uterine inertia and uterine torsion.

Unit VI

Fetotomy, caesarean section and ovario-hysterectomy. Retention of fetal membranes and management.

Unit VII

Neo-natal physiology and post-natal adaptations. Assessment of neonatal viability, care of the newborn.

Unit VIII

Involution of uterus, post-partum ovarian dysfunction and their manipulation. Care of the postpartum dam.

VI. Practical

Obstetrical operations in fetal dystocia; mutations, fetotomy, cesarean section, ovario-hysterectomy; induction of parturition, obstetrical analgesia and anaesthesia.



VII. Suggested Reading

- David Noakes, Timothy Parkinson and Gary England. 2018. *Veterinary Reproduction and Obstetrics*. Saunders Ltd.
- Roberts SJ. 2005. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.
- Sloss V and Duffy JH. 1980. *Handbook of Bovine Obstetrics*. Williams and Wilkins.
- Selected articles from journals.

I. Course Title : Advances in Andrology and Male Infertility

II. Course Code : VGO 703

III. Credit Hours : 2+1

IV. Aim of the course

To learn advances in male reproduction and treatment of male infertility in domestic animals.

V. Theory

Unit I

Spermatogenesis, Spermatogenic waves, Sperm passage in male genitalia, biochemical milieu of male genitalia. Correlation between motility and fertilizing capacity of spermatozoa. Seminiferous epithelial cycle, Theory of sperm motility and ultrastructure of sperm. Sperm passage in female reproductive tract; capacitation and acrosome reaction.

Unit II

Separation of motile and immotile spermatozoa.

Unit III

Sperm plasma membrane and its permeability and binding properties: acrosome and lysosomal enzymes, sperm nucleus and nuclear proteins. Mitochondria and their role in sperm metabolism. Flagellum and the mechanochemical basis of motility and cyclic nucleotides.

Unit IV

Biochemistry of seminal plasma and accessory sex gland secretions. Electrolytes, proteins, Enzymes and amino acids in seminal plasma. Fructose and other sugars, Lipids, Cholesterol, Steroid hormones and Prostaglandins in seminal plasma.

Unit V

Fructolysis index. Aerobic and anaerobic metabolism of spermatozoa.

Unit VI

Markers of fertility in males, sperm chromatin structure assay, Anti-sperm antibodies. Karyotyping to identify sperm defect and DNA mapping for parentage.

VI. Practical

Breeding soundness evaluation of bulls, biochemical tests of semen for evaluation of fertility, semen culture for diagnosis of venereal diseases, diagnosis and treatment of genital pathological condition. Computer assisted semen analysis (CASA), Semen evaluation for assessment of fertilizing capacity of spermatozoa: cervical mucus penetration test, sperm capacitation test, hypo osmotic swelling test and zona free



hamster egg penetration test. Anti-sperm antibody assay. Collection of preputial washings and semen for bacterial load and venereal pathogens.

VII. Suggested Reading

- Hafez ESE and B Hafez. 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.
- Enos Johnson Perry. 2013. *Artificial Insemination of Farm Animals*. Jodhpur: Axis Books (India).
- Roberts SJ. 2005. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.
- Selected articles from journals.

I. Course Title : Reproductive Biotechnology

II. Course Code : VGO 704

III. Credit Hours : 1+1

IV. Aim of the course

To learn advances and recent developments in biotechnology in reproduction for the production of desired elite animals.

V. Theory

Unit I

Micromanipulation, Intracytoplasmic Sperm Injection (ICSI), Sexing of embryos.

Unit II

Stem cell biotechnology, Semen sorting for production of sexed semen.

Unit III

Cloning, Biopharming, Transgenic Animals and Chimeras.

Unit IV

Transgenic animals and chimeras. Gene expression in oocyte and embryo, Identification of cellular organelles of Gamete.

Unit V

Principle and application of PCR technique in animal reproduction.

VI. Practical

Micromanipulation of embryos, Sexing of embryos, Stem cell production.

VII. Suggested Reading

- Hafez ESE and B Hafez. 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.
- B Singh, SK Gautam and MS Chauhan. 2012. *Textbook of Animal Biotechnology*, Pearson Education.
- Heiner Niemann, Christine Wrenzycki. 2018. *Animal Biotechnology 1: Reproductive Biotechnologies*. Springer.
- Heiner Niemann, Christine Wrenzycki. 2018. *Animal Biotechnology 2*. Springer International Publishing AG.
- Ian Gordon. 2017. *Reproductive Technologies in Farm Animals*. Wallingford, Oxfordshire CABI.
- Troy L Ott, Zhihua Jiang. 2010. *Reproductive Genomics in Domestic Animals*. John Wiley.
- Marcelo Marcondes Seneda, Katia Cristina Silva-Santos, LS Rafagnin Marinho. 2016. *Biotechnology of Animal Reproduction*, Nova Science Pub. Inc; UK Ed.
- Tacia Gomes Bergstein-Galan. 2018. *Reproduction Biotechnology in farm animals*. Avid Science.
- Selected articles from journals.



I. Course Title : Semenology

II. Course Code : VGO 705

III. Credit Hours : 1+1

IV. Aim of the course

To learn advances in processing and cryopreservation of semen and insemination techniques to obtain high fertility.

V. Theory

Unit I

Contribution of gonads and accessory sex glands to semen ejaculate. Factors affecting semen production. Morphology of sperm and their defects. Biochemical composition of semen.

Unit II

Metabolism of sperm. Role of seminal plasma proteins. Species variation in seminal characteristics. Factors affecting motility and fertilizing capacity of spermatozoa.

Unit III

Use of semen additives and activators. Sperm cryodamage, Commercial extenders used for bovine semen. Microbial contamination of semen and measures for its prevention. Transmission of venereal diseases through semen and their prevention.

Unit IV

Thawing protocols for frozen semen. Post-thaw evaluation of motility and fertilizing capacity of spermatozoa. Quality control and quality assurance of semen, antisperm antibodies. Flow cytometric assessment of sperm quality.

Unit V

Sperm vitrification, freeze drying of sperm and sperm encapsulation.

Unit VI

Criteria for gradation of semen stations.

VI. Practical

Semen evaluation. Estimation of bacterial load and enzymes in semen. Morphological defects of sperm. *In-vitro* tests for sperm function i.e. BCMPT, HOST, etc. Physical and enzymatic changes in semen following cryopreservation. Tests to assess acrosomal integrity, Mitochondrial activity, DNA damage, binding assays, etc. Fluorescent probe based assessment of sperm quality. Comet assay, Sperm chromatin structure assay, TUNEL assay.

VII. Suggested Reading

- Salisbury GW, VanDemark NL and Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman and Co.
- Hafez ESE and B Hafez. 2013. *Reproduction in Farm Animals*. Wiley-Blackwell.
- Selected articles from journals.

I. Course Title : Clinical Practice-I

II. Course Code : VGO 706

III. Credit Hours : 0+3

IV. Aim of the course

Hands-on training on diagnosis and treatment of reproductive disorders in animals



V. Practical

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Acquaintance with different equipment used for handling reproductive disorders, client management, public relations, code of conduct, database management, Maintenance of case records.

VI. Suggested Reading

- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Zemjanis R. 1970. *Diagnostic and Therapeutic Techniques in Animal Reproduction*. Williams and Wilkins; Second Edition.
- Selected articles from journals.

I. Course Title : Clinical Practice-II

II. Course Code : VGO 707

III. Credit Hours : 0+3

IV. Aim of the course

Hands-on training on diagnosis and treatment of reproductive disorders in animals.

V. Practical

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Acquaintance with different equipment used for handling reproductive disorders, client management, public relations, code of conduct, database management, Maintenance of case records.

VI. Suggested Reading

- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Zemjanis R. 1970. *Diagnostic and Therapeutic Techniques in Animal Reproduction*. Williams and Wilkins; Second Edition.
- Selected articles from journals.

I. Course Code : VGO 790

II. Course Title : Special Problem

III. Credit Hours : 0+2

V. Aim of the course

To expose students to research techniques related to sub discipline of the subject and submission of written project with references.

VI. Practical

Student will carry out research on allotted project and submit the project report.

VGO 791 DOCTORAL SEMINAR-I	1+0
VGO 792 DOCTORAL SEMINAR-II	1+0
VGO 799 DOCTORAL RESEARCH	75



Course Outline: Lecture wise

VGO 701: Advances in Gynaecology and Infertility Management (2+1)

Theory Lectures

1. Neuro-endocrine control of reproduction.
2. Follicular development.
3. Ovulation, fertilization and implantation.
4. Embryonic and fetal development.
5. Maternal recognition of pregnancy.
6. Advances in early diagnosis of pregnancy.
7. Embryonic losses, abortion and their prevention.
8. Seasonal breeders, synchronization and induction of estrus and ovulation in seasonal breeders.
9. Assisted reproductive technology (ART) to increase reproductive efficiency in farm animals.
10. Effect of stress and nutritional factors on fertility.
11. Effect of immunological factors on fertility.
12. Onset of postpartum ovarian activity and factors affecting it.
13. Diagnostic and therapeutic approaches in infertility.
14. Principles of hormone therapy in reproductive disorders.
15. Laproscopy.
16. Ultrasonographic diagnosis of ovarian/ uterine dysfunction.
17. Vaginal and uterine cytology.

Practicals

1. Clinical examination of female animals for reproductive soundness.
2. Use of ultrasonography in ovarian function (follicular image pattern, follicular dynamics).
3. Use of ultrasonography in early pregnancy diagnosis.
4. Use of ultrasonography in infertility management.
5. Uterine culture, uterine cytology and uterine biopsy (histopathological examination) in infertility investigation.
6. Laparoscopy in diagnosis of ovarian and uterine dysfunction.
7. Use of ELISA/ RIA in reproductive parameters study and interpretation of results.
8. Use of Assisted reproductive technology (ART) to enhance reproductive efficiency in farm animals.

VGO 702: Advances in Veterinary Obstetrics (1+1)

Theory Lectures

1. Conceptus and its development.
2. Factors influencing gestation period and birth weight.
3. Anomalies of conceptus, teratogens and effect of stress on conceptus development.
4. Mechanism of initiation of parturition. Use of tocolytic drugs.



5. Induction of parturition and termination of abnormal pregnancies.
6. Pre-treatment evaluation of the dam suffering from dystocia. Obstetrical analgesia and anaesthesia.
7. Management of maternal and fetal dystocia, hydrallantois, hydramnion, fetal mummification, fetal maceration, uterine inertia and uterine torsion.
8. Fetotomy, caesarean section and ovaro-hysterectomy.
9. Retention of fetal membranes and management.
10. Neo-natal physiology and post-natal adaptations. Assessment of neonatal viability, care of the newborn.
11. Involution of uterus, post-partum ovarian dysfunction and their manipulation. Care of the postpartum dam.

Practicals

1. Performing obstetrical operations.
2. Performing obstetrical mutations.
3. Fetotomy.
4. Caesarean section and ovario-hysterectomy.
5. Induction of parturition.
6. Obstetrical analgesia and anaesthesia.

VGO 703: Advances in Andrology and Male Infertility (2+1)

Theory Lectures

1. Spermatogenesis and spermatogenic waves.
2. Sperm passage in male genitalia, biochemical milieu of male genitalia.
3. Correlation between motility and fertilizing capacity of spermatozoa.
4. Seminiferous epithelial cycle, theory of sperm motility and ultrastructure of sperm.
5. Sperm passage in female reproductive tract; capacitation and acrosome reaction.
6. Separation of motile and immotile spermatozoa.
7. Sperm plasma membrane and its permeability and binding properties: acrosome and lysosomal enzymes, sperm nucleus and nuclear proteins.
8. Mitochondria and their role in sperm metabolism.
9. Flagellum and the mechanochemical basis of motility and cyclic nucleotides.
10. Biochemistry of seminal plasma and accessory sex gland secretions.
11. Electrolytes, proteins, enzymes and amino acids in seminal plasma. Fructose and other sugars, lipids, cholesterol, steroid hormones and prostaglandins in seminal plasma.
12. Fructolysis index. Aerobic and anaerobic metabolism of spermatozoa.
13. Markers of fertility in males.
14. Sperm chromatin structure assay.
15. Anti-sperm antibodies.
16. Karyotyping to identify sperm defect and DNA mapping for parentage.

Practicals

1. Breeding soundness evaluation of bulls.
2. Biochemical tests of semen for evaluation of fertility.
3. Semen culture for diagnosis of venereal diseases.
4. Diagnosis and treatment of genital pathological condition.
5. Studies on sperm motility using Computer assisted semen analysis (CASA).
6. Cervical mucus penetration test, sperm capacitation test and hypo-osmotic swelling test.



7. Zona free hamster egg penetration test.
8. Anti-sperm antibody assay.
9. Collection of preputial washings and semen for bacterial load and venereal pathogens.

VGO 704: Reproductive Biotechnology (1+1)

Theory Lectures

1. Micromanipulation and Intracytoplasmic sperm injection (ICSI).
2. Sexing of embryos.
3. Stem cell biotechnology.
4. Semen sorting for production of sexed semen.
5. Cloning and biopharming.
6. Transgenic animals and chimeras.
7. Gene expression in oocyte and embryo, identification of cellular organelles of Gamete.
8. Principle and application of PCR technique in animal reproduction.

Practicals

1. Micromanipulation of embryos.
2. Sexing of embryos.
3. Stem cell production.

VGO 705: Semenology (1+1)

Theory Lectures

1. Contribution of gonads and accessory sex glands to semen ejaculate. Factors affecting semen production.
2. Morphology of sperm and their defects. Biochemical composition of semen.
3. Metabolism of sperm. Role of seminal plasma proteins. Species variation in seminal characteristics.
4. Factors affecting motility and fertilizing capacity of spermatozoa. Commercial extenders used for bovine semen.
5. Use of semen additives and activators. Sperm cryodamage.
6. Microbial contamination of semen and measures for its prevention. Transmission of venereal diseases through semen and their prevention.
7. Thawing protocols for frozen semen. Post-thaw evaluation of motility and fertilizing capacity of spermatozoa.
8. Quality control and quality assurance of semen.
9. Antisperm antibodies assay.
10. Flow cytometric assessment of sperm quality.
11. Sperm vitrification, freeze drying of sperm and sperm encapsulation.
12. Criteria for gradation of semen stations.

Practicals

1. Semen evaluation for its quality.
2. Estimation of bacterial load in semen.
3. Estimation of enzymes in the semen.
4. *In-vitro* tests for sperm function i.e. BCMPT, HOST, etc.
5. Tests to assess acrosomal integrity, mitochondrial activity and DNA damage.
6. Tests to assess binding assays.
7. Fluorescent probe based assessment of sperm quality.
8. Comet assay, Sperm chromatin structure assay, TUNEL assay.



Minor Courses for Ph.D. Degree programme

The minor courses should be taken from the other than major disciplines/department of the same group of Veterinary Clinical Subjects only limiting to credits prescribed as decided by the Chairman of Advisory Committee of the student.

Supporting Courses

It could be any subject considered relevant for student's research work. This will be decided by Advisor/ guide concerned.





SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Veterinary Clinical Subjects

– Veterinary Surgery and Radiology





Preamble

(Veterinary Surgery and Radiology)

The subjects under surgical discipline have undergone sea change, except for 'Tenets of Halstead', since the introduction of 'Key Hole' surgery and newer imaging techniques. In fact, the technological advancements demand creation of two separate disciplines - Surgery and Imaging. Further, to start with there is need of separate speciality courses involving Imaging, Orthopaedics, Anaesthesia and Ophthalmology. Scope also exists for addition of Avian Surgery, etc. However, in view of BSMA guidelines, efforts have been made to tune the Syllabus as per the existing infrastructure catering futuristic societal needs and to remain relevant and purposeful.

To encourage clinical practice in the veterinary clinics, courses on clinical practice, each at M.V.Sc. and Ph.D. level have been made mandatory. To focus on learning of research methodology, scientific thinking, planning and experimentation, a course on special problems has been introduced.

The new and restructured postgraduate curricula and syllabi in Surgery and Radiology contains several innovative and practically applicable courses. Credit hours for Clinical Practice have been increased from 0+3 to 0+4, as maximum time of the postgraduate scholars of clinical disciplines is spent in clinics. Small animal anaesthesia (2+1) and Large animal anaesthesia (2+1) courses are merged together and a new course on Veterinary Anaesthesia and Analgesia (2+1) is proposed. Small Animal Soft Tissue Surgery (2+1) and Large Animal Soft Tissue Surgery (2+1) courses are merged together and a new course Soft Tissue Surgery (2+1) is proposed. As per the advances in Ophthalmology and Dentistry, Veterinary Ophthalmology and Dentistry (1+1) is bifurcated into two separate courses, Veterinary Ophthalmology (1+1) and Veterinary Dentistry and Oral Surgery (1+1) to give more emphasis in two different distinct subjects.

New Courses were added to M.V.Sc. degree programme to gain thorough knowledge in areas like Anaesthesia of zoo, wild, exotic and laboratory animals (1+1), Urogenital Surgery (1+1), Cardiovascular Surgery (1+1). Clinical Case Conference (0+1) was added to encourage the students to do thorough case study of a single patient. In few states of India, certain species of animals are more prevalent, hence, we have developed species specific courses for those dealing with majority of cases in that particular region. Thus two new courses, viz., Camel surgery (1+1) and Elephant surgery (1+1) are added.

At Ph.D. level, courses on experimental surgical techniques in animals (1+1) is deleted in view of new CPCEA guidelines of unnecessary experimentation on animals to be discouraged and new methods be designed for teaching. Few new courses in Ph.D. degree programme were added, viz., Advances in orthopaedics (2+1), Reconstructive and regenerative surgery (1+1), Cardiovascular surgery (1+1), Special problems in diagnostic imaging (0+2), Advances in soft tissue surgery (2+1), Advances in veterinary ophthalmology (1+1), Veterinary surgical oncology (1+1), Clinical case conference (0+1), Advances in radiology (2+1) and Advances in diagnostic imaging techniques (2+1). These new courses are designed in such a way to keep pace with the development of new technologies and recent advances in these areas.



SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Under existing clinical ecosystem, the implementation of the new and restructured postgraduate course curricula is expected to build clinical knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with hands on skills and comprehensive knowledge of the entire subject after Masters degree. The doctorates should, in turn, prove as specialists, in the field of their specialization.



Course Title with Credit Load

M.V.Sc. in Veterinary Surgery and Radiology

Course Code	Course Title	Credit Hours
VSR 601	Clinical Practice-I*	0+3
VSR 602	Clinical Practice-II*	0+3
VSR 603	Principles of Surgery*	2+1
VSR 604	Anaesthesia And Analgesia*	2+1
VSR 605	Diagnostic Imaging Techniques*	2+1
VSR 606	Soft Tissue Surgery	2+1
VSR 607	Orthopaedic Surgery*	2+1
VSR 608	Anaesthesia of Zoo, Wild, Exotic and Laboratory Animals	1+1
VSR 609	Urogenital Surgery	1+1
VSR 610	Ophthalmology	1+1
VSR 611	Dentistry and Oral Surgery	1+1
VSR 612	Camel Surgery	1+1
VSR 613	Elephant Surgery	1+1
VSR 687	Clinical Case Conference	0+1
VSR 688	Special Problem in Radiology	0+2
VSR 689	Special Problem in Anaesthesia	0+2
VSR 690	Special Problem in Surgery	0+2
VSR 691	Masters Seminar	1+0
VSR 699	Masters Research	0+30

*Core Courses



Course Contents

M.V.Sc. in Veterinary Surgery and Radiology

- I. Course Title** : Clinical Practice-I
II. Course Code : VSR 601
III. Credit Hours : 0+3

IV. Aim of the course

To learn techniques and procedures in anaesthesia, diagnostic imaging techniques and surgery

V. Practical

Basic requirements and designing surgical and general veterinary hospital, Developing different proformas required in hospital facility, Assessing surgical patients and documentation, Preparation of surgical team and duties of team members, Surgical suite maintenance and sterilization, Acquaintance with different equipment like inhalant anaesthesia machine, Radiography systems, Ultrasonography, Endoscopy, Electro-surgery, Cryosurgery and physiotherapy equipment, Client management, Public relations, code of conduct, Management of surgical affections, Hospital database management, Attending surgical cases, Disaster management.

- I. Course Code** : VSR 602
II. Course Title : Clinical Practice-II
III. Credit Hours : 0+3

IV. Aim of the course

To learn techniques and procedures in anaesthesia, diagnostic imaging techniques and surgery

V. Practical

Application of different equipment like inhalant anaesthesia machine, Computerized radiography system, Ultrasonography, Electro-surgery, Cryosurgery, Physiotherapy and endoscopy and Physiotherapy equipment, Client management and Counselling, public relations, Code of conduct, Management of surgical affections, Hospital management, Database management, Attending surgical cases, Disaster management.

- I. Course Title** : Principles of Surgery
II. Course Code : VSR 603
III. Credit Hours : 2+1

IV. Aim of the course

To learn basic and advance principles and standards of practice in veterinary surgery

V. Theory

Unit I

Classification of wounds, wound healing, mechanism of wound repair, local and



systemic factors affecting wound healing, current concepts of inflammation and management, thermal, electrical and chemical injuries and their management.

Unit II

Asepsis, sterilization and disinfection and principles and practice of antimicrobial therapy in surgical patients.

Unit III

Shock, classification, pathophysiology, diagnosis, treatment and monitoring, surgical stress and its systemic effects, haemorrhage and haemostasis, acid-base balance, fluid therapy and blood transfusion, metabolism of the surgical patient.

Unit IV

Principles and clinical applications of laser surgery, cryosurgery, electrosurgery, physiotherapy.

Unit V

Minimally invasive surgical procedures which includes laparoscopy and endoscopy, principles of microscopic surgery-vessel and nerve anastomosis, application of computers in surgery.

VI. Practical

Identification and handling of surgical instruments, preparation of surgical pack, surgical team and surgical patients, surgical facilities and equipment, introduction to clinical skill laboratory, practice of different suturing patterns and repair of different wounds, using drains, bandages and bandaging techniques, monitoring of traumatized surgical patient, operation theatre conduct.

I. Course Title : Anaesthesia And Analgesia

II. Course Code : VSR 604

III. Credit Hours : 2+1

IV. Aim of the course

To gain the basic and practical knowledge of principals of companion and farm animals anaesthesia and pain management

V. Theory

Unit I

Introduction and history of anaesthesia, General consideration for anaesthesia in animals, Properties of ideal anaesthetic agent, Types of anaesthesia, Anaesthetic triad, Preanaesthetic evaluation of patient and selection of anaesthesia.

Unit II

Preanaesthetic medication (anticholinergics, sedatives, tranquilizers, alpha-2 agonist, narcotics), Muscle relaxants and neuromuscular blocking agents.

Unit III

General anaesthetics and factors affecting their uptake, Distribution and metabolism; Injectable anaesthetic agents (properties, dosage and usage); Combinations of injectable agents and neuroleptanalgesia, Inhalation anaesthetic agents (properties, methods of administration, dosage and usages), Inhalation anaesthesia equipment and breathing circuits, artificial ventilation.



Unit IV

Post-operative care of the surgical patient, operating room emergencies, cardio-pulmonary arrest and resuscitation, monitoring of anaesthetic recovery.

Unit V

Local anaesthetics, their mechanisms, local and regional nerve blocks, spinal analgesia, intravenous regional anaesthesia, peri-operative and post-operative pain and its management.

VI. Practical

Inhalation anaesthesia equipment, circuits and vaporizers, artificial ventilation, use of various pre-anaesthetic and anaesthetic agents in small and large animals, anaesthetic triad, balanced anaesthesia, total intravenous anaesthesia, regional and local nerve blocks using local anaesthetics, alpha-2 agonists and their combinations in domestic animals, monitoring of anaesthesia, reversal of sedation and analgesia induced by alpha-2 agonists, practice of anaesthesia in clinical cases; record keeping in anaesthesia and euthanasia.

I. Course Title : Diagnostic Imaging Techniques

II. Course Code : VSR 605

III. Credit Hours : 2+1

IV. Aim of the course

To learn the basic principles and gain practical knowledge of diagnostic imaging techniques and interpretation

V. Theory

Unit I

Regulations regarding establishment and handling of x-ray units. Requirements for establishment of x-ray units, conventional and digital x-ray machine, x-ray films, Cassettes, screen, x-ray production, Qualities of x-rays, Image formation and dark room procedures, Image plate, Formation of radiograph technique chart, Artifacts and their prevention, Radiographic quality Contrast, Density and details), radiographic accessories, radiographic positioning for different organs/ parts in small and large animals.

Unit II

Plain and contrast radiographic techniques of small and large animals, fluoroscopy/ C-arm, principles of radiographic interpretation,

Unit III

Principles of radiation therapy, medical radioisotope curves, radiation laws and regulations. Radiation hazards and monitoring of radiographic exposure to personnel and protection.

Unit IV

Basic physics of ultrasound waves and image formation, scanning principles of ultrasound, transducers, equipment controls, modes of display, terminology used for echotexture and USG artifacts, application of ultrasound in small and large animals.

Unit V

Doppler techniques echocardiography and its application, introduction to nuclear



imaging techniques, computerized tomography, magnetic resonance imaging, positron emission tomography technique.

VI. Practical

Acquaintance with imaging equipment, computed radiography and digital radiography systems, dark room processing techniques and x-ray film handling, formulation of technique chart with fixed kVp and variable mAs, radiographic artefacts and their prevention, basics of radiographic interpretation of diseases, PACS, radiography positioning of different regions in domestic animals, contrast radiographic techniques, interpretation of radiographs, practice of ultrasonographic imaging and report writing.

I. Course Title : Soft Tissue Surgery

II. Course Code : VSR 606

III. Credit Hours : 2+1

IV. Aim of the course

To learn about soft tissue surgical skills and various surgical affections of different body systems in companion and farm animals

V. Theory

Unit I

Skin, adnexa, integument, appendages, horn, tail, sinus affections of equine and bovine, teat affections, principles of plastic and reconstructive surgery, different types of skin grafts.

Unit II

Surgical approaches/ affections of ear, oral cavity, larynx and pharynx, salivary glands, oesophagus, abdomen, rumen, reticulum, omasum, abomasum, stomach, intestines, rectum, anus, liver and biliary system, pancreas and porto-systemic shunts.

Unit III

Abdominal hernia, diaphragmatic hernia, perineal hernia, ventral, femoral and umbilical hernia, ritcher hernia, hiatal hernia, omental hernia, pre-pubic tendon rupture, use of biological and synthetic grafts for hernia repair, laparoscopic repair of hernia.

Unit IV

Principles of thoracic surgery, Functional anatomy of respiratory system, diseases of upper and lower respiratory system, functional anatomy of cardiovascular system and common affections of heart.

Unit V

Affections of pituitary, adrenals, thyroid, parathyroid glands, Principles of neurosurgery and common surgical affections of nervous system and special sense organs.

Unit VI

Haemolymphatic system, bone marrow, spleen, tonsils, lymph nodes and lymphatics, thymus.



VII. Practical

Practice of various surgical techniques of skin and adnexa, alimentary system, hernias, respiratory system, affections of horn, tail and teat, endoscopy techniques, instrumentation, use of rigid/ flexible endoscopes in companion and farm animals.

I. Course Title : Orthopaedic Surgery

II. Course Code : VSR 607

III. Credit Hours : 2+1

IV. Aim of the course

To learn about various affections of bones, joints, tendons, ligaments and foot and their treatment in companion and farm animals.

V. Theory

Unit I

Bone structure and function, growth, Response to injury, Fractures and luxations, classification of fracture, Fracture healing.

Unit II

Biomechanics of fracture healing, Considerations for selection of fixation techniques, Treatment of fractures of different bones in companion and farm animals, Diseases of bone.

Unit III

Various affections of the joints, ligaments and tendons and their treatment.

Unit IV

Spinal affections and injury to axial skeleton.

Unit V

Conformation of the limb, anatomy of hoof, anatomical, conformational and pathological causes of lameness and allied surgical conditions of fore and hind limbs, rehabilitation of orthopaedic patient.

VI. Practical

Application of Plaster of Paris cast, fiberglass cast, Roberts Jones bandage, modified Schroeder Thomas splint, Coaptation splint, sling application, practice of IM pinning, wiring, bone plating, inter locking nailing, external skeletal fixation, arthrotomy, tenotomy, examination of limbs for lameness, desmotomy, nerve blocks, injections in joints, operations for arthritis, hoof surgery and corrective shoeing.

I. Course Title : Anaesthesia of Zoo, Wild, Exotic and Laboratory Animals

II. Course Code : VSR 608

III. Credit Hours : 1+1

IV. Aim of the course

To learn about basic and practical knowledge of chemical immobilization, sedation and anaesthesia of laboratory animals, exotic, captive and free ranging wild animals.



V. Theory

Unit I

General consideration in chemical restraint of captive and free ranging wild animals, handling of birds with minimum stress, physical examination, blood sampling, crop washes, faecal sampling.

Unit II

Methods of administration of anaesthesia in captive, free ranging animals, birds and laboratory animals.

Unit III

Local and general anaesthesia in exotic species, wild animals, birds, zoo animals and laboratory animals.

Unit IV

Anaesthetic emergencies and complications.

Unit V

Diagnostic interpretation, haematology and biochemistry analysis, avian diagnostic endoscopy

VI. Practical

Familiarization with capture and anaesthetic equipments, local anaesthetic techniques, use of various preanaesthetic and anaesthetic agents in laboratory animals, birds, monitoring of patient during general anaesthesia, familiarization of various diseases in exotic birds like tumours, foreign body, crop stasis, crop tear, crop fistula, toe necrosis, feather cyst, excision of uropygial gland, rhinolith, pharyngostomy, ingluviotomy, ventriculotomy and orthopedic injuries, visits to zoos and wild life sanctuaries for practical on wild and zoo animals.

I. Course Title : Urogenital Surgery

II. Course Code : VSR 609

III. Credit Hours : 1+1

IV. Aim of the course

To learn about various surgical affections of urinary and genital tract and their treatment in companion and farm animals.

V. Theory

Unit I

Surgical anatomy of urinary and reproductive tract in male and female animals, Congenital anomalies of organs of male and female urinary and reproductive system.

Unit II

Principals of urinary tract surgery, Pathophysiology, Diagnosis and surgical management of affections of kidney, ureter, urinary bladder and urethra, Medical dissolution and prevention of Canine uroliths, Feline urologic syndrome, Surgical management of urolithiasis in ruminants and its prevention, management of uroperitoneum and renal failure.

Unit III

Pathogenesis, Clinical symptoms, Diagnosis and surgical management of vaginal



and uterine prolapse, Rectovaginal fistula, Pneumovagina, Vaginal tumours, pyometra, Cysts of Gartner's canal and vestibular glands.

Unit IV

Surgical conditions of penis, Prepuce, Prostate and testicles, Cryptorchidism, Inguinal and scrotal hernia, Affections of teat and udder.

Unit V

Indications, Techniques and postoperative complications of episiotomy, Ovariectomy, ovari hysterectomy and caesarean section, Pyometra and its surgical treatment.

Unit VI

Castration, Vasectomy, Cauda epididymectomy and penile deviation.

VI. Practical

Hands-on-training of techniques of centesis of urinary bladder in companion and farm animals, Different types of catheters used in urogenital surgery, Retrograde catheterization of urethra and urinary bladder, Normograde catheterization of urethra on clinical cases of urinary retention, Pudendal nerve block for penis examination in ruminants, Diagnostic techniques and surgical management of the affections of kidney, Ureters, Urinary bladder, Urethra, Uro-hydropropulsion, Restraint and anaesthesia for urogenital tract surgery, Cystotomy, Tube cystostomy, Nephrotomy, Ureterocolostomy, Urethrotomy, Urethrostomy, Castration, Vasectomy, Penile deviation, Epididymectomy, Amputation of penis, Episiotomy, Ovari hysterectomy, Tubectomy, Caesarean section, Management of phimosis, Paraphimosis, Venereal granuloma, Vaginal and uterine prolapse, Rectovaginal fistula and pneumovagina, Bladder and uterine marsupialization.

I. Course Title : Ophthalmology

II. Course Code : VSR 610

III. Credit Hours : 1+1

IV. Aim of the course

To learn basic principles and gain practical knowledge of diagnosis and treatment of diseases of eye.

V. Theory

Unit I

Anatomy and physiology of eye and its adnexa, Ophthalmic examination and diagnosis, Diagnostic instrumentation, Anaesthesia and surgery.

Unit II

General consideration for eye surgery in companion and farm animals, Therapeutic agents for eye diseases and surgery of eye lids, lacrimal apparatus, naso-lacrimal duct.

Unit III

Diseases of conjunctiva, cornea, sclera, iris, orbit, lens, vitreous and aqueous humor, retina and optic nerve, eye tumours, enucleation, exenteration.

Unit IV

Ocular manifestations of systemic diseases.



Unit V

Neuro-ophthalmology and ocular emergencies

VI. Practical

Ophthalmic instrumentation, examination of the eye and its adnexa, anaesthesia, preparation of patient, suture materials for eye surgery, canthotomy, tarsorrhaphy, keratoplasty, anterior chamber paracentesis, flushing of naso-lacrimal duct, iridectomy, phacoemulsification and implantation of foldable lens, surgical treatment of entropion and ectropion, cherry eye, Schirmer tear test, use of fluorescein dye in corneal ulcer, glaucoma surgery, eye worm removal.

I. Course Title : Dentistry and Oral Surgery

II. Course Code : VSR 611

III. Credit Hours : 1+1

IV. Aim of the course

To learn the basic and practical knowledge of diagnosis and treatment of diseases of teeth and oral cavity.

V. Theory

Unit I

Anatomy, development of teeth (odontogenesis), dentition and ageing of different species.

Unit II

Clinical examination of oral cavity, Dental anesthesia and pain management, Dental radiography.

Unit III

Diseases of oral cavity and teeth, Congenital and developmental anomalies of oral cavity, Abnormal tooth eruption, Irregular wear of teeth in companion and farm animals, occlusion and malocclusion, Mandibular fracture, Malformation of mandible, maxilla (cleft palate).

Unit IV

Acquired diseases of teeth (halitosis, dental caries, fracture of teeth, dental materials and dental radiography), Oronasal fistula, Maxilla and mandibular fractures repair, Orthodontics, Tumors and Other acquired condition of oral cavity.

Unit V

Exodontics, Restorative dentistry, Periodontal disease, Tooth extraction, Gum diseases. Endodontics, Pulpectomy, Root Canal therapy (RCT), Current techniques in dentistry.

VI. Practical

Oral examination, Modified triadan system of tooth numbering in various species, Dental chart for companion and farm animals, Dentistry instrumentation, Dental radiography procedure, Periodontal probing, Scaling/ teeth cleaning, Tooth extraction, Malpractices in equine dentistry, Periodical maintenance of oral hygiene, Corrective procedures, Malocclusion, Treatment strategies congenital malformations of maxilla and mandible, oral surgery.



- I. Course Title : Camel Surgery**
II. Course Code : VSR 612
III. Credit Hours : 1+1

IV. Aim of the course

To learn the basic principles and gain practical knowledge of diagnosis and treatment of surgical diseases of camel.

V. Theory

Unit I

Introduction to special surgical anatomy of important parts, i.e. Mandible, Soft palate, Chest pad, saddle region, Male urinary system, tail, etc., Restraint and positioning for various surgical procedures and radiography of different parts.

Unit II

Use of local anaesthesia, Various nerve blocks and regional anaesthesia used to treat diverse surgical disorders, Preanaesthetics, Tranquilizers, Sedatives and general anaesthetics used for camel surgery.

Unit III

Surgical affections of head and neck region: Laceration and infected wounds of nostril skin, Infection of turbinate, Actinobacillosis, Dental affections, Removal of canines in furious camels, Torticollis, Fracture of mandible and maxilla, Soft palate injuries, Ophthalmic affections, Salivary fistula, Stenson's duct ligation, Oesophageal obstruction.

Unit IV

Surgical affections of thorax and abdominal region: Saddle gall, Hernia, Chest pad wounds and enlargements, Foreign bodies in compartment, Intestinal obstruction, Obstructive urolithiasis, Rupture of urethra, Subcutaneous infiltration of urine, Cystorrhexis.

Unit V

Surgical affections of musculo-skeletal system: diagnosis of lameness in camels, management of long bone and digital fractures, upward fixation of patella, sprains, arthritis.

Unit VI

Sheath abscess, Necrosis of penis, Phimosis, Paraphimosis, Preputial prolapse, Various types of tumours, Gangrene and tumours of udder, Necrosis of tail, Punctured foot, prolapse of digital cushion, Foot injuries, Kumri, Kapali, etc.

VI. Practical

Restraint and anaesthesia (Local, regional, sedation and general anaesthesia), Preparation of sites, Surgical anatomy of important surgical affections, Special instruments used for camel restraining and surgery, Observing and assisting in diverse surgical procedures on clinical cases in camels, Practice of interdental wiring for repair of mandibular fractures in specimen mandibles, Clinical and radiographic diagnosis of lameness, Protection of wounds of chest pad and foot using special bandages, Radiography of different part of camels and postoperative care of diverse surgical affections of camels.



- I. Course Title : Elephant Surgery**
II. Course Code : VSR 613
III. Credit Hours : 1+1
IV. Aim of the course

To learn the basic principles and gain practical knowledge of diagnosis and treatment of surgical diseases of elephant.

V. Theory

Unit I

Basic surgical anatomy of Asian elephants and comparison with other farm animals.

Unit II

Drug administration techniques in captive and wild elephants, Anaesthetic management of captive and wild elephants for various surgical and managerial conditions.

Unit III

Principles of soft tissue surgery in elephants, Cyst, Bursitis, Gall, Haematoma, Abscess, etc.

Unit IV

Management and treatment of fractures and arthritis in elephants.

Unit V

Pedicure, corrective foot care and maintenance of healthy feet of captive elephants housed in different establishments in different seasons.

Unit VI

Hoisting of recumbent elephants, Surgical methods of birth control in elephants, limitations and risks of abdominal surgery in elephants (eg. Caesarian section, Castration, Hernia, etc., Soft tissue surgery like episiotomy, vestibulotomy, etc.)

VI. Practical

Familiarity with clinical examination procedures, Body weight estimation, Signs of health and diseases, Signs of localized lesions, etc., Familiarity with physical and chemical restraint procedures, Drug administrations by various routes-IM, IV, SC, sub-conjunctival, oral, per rectal, etc., foot examination and foot care procedures, visit to elephant camps and attending clinical procedures, surgeries, etc.

- I. Course Title : Clinical Case Conference**
II. Course Code : VSR 687
III. Credit Hours : 0+1
IV. Practical

Present seminar on unusual/ interesting clinical cases done in the semester. Compile them from presentation to follow up and also submit the write up in soft or hard copy.



- I. Course Title : Special Problem in Radiology**
II. Course Code : VSR 688
III. Credit Hours : 0+2

IV. Practical

Investigative radiological problems in clinical or experimental models, didactic and interpersonal learning-teaching, problem solving self-learning strategies in problems related to radiology.

- I. Course Title : Special Problem in Anaesthesia**
II. Course Code : VSR 689
III. Credit Hours : 0+2

IV. Practical

Investigative anesthetic problems in clinical or experimental models, Didactic and interpersonal learning-teaching, Problem solving self-learning strategies in problems related to anaesthesia.

- I. Course Title : Special Problem in Surgery**
II. Course Code : VSR 690
III. Credit Hours : 0+2

IV. Practical

Investigative surgical problems in clinical or experimental models, Didactic and interpersonal learning-teaching, Problem solving self-learning strategies in problems related to surgery.

VSR 691 MASTERS SEMINAR (1+0)
VSR 699 MASTERS RESEARCH (0+30)



Course Outline: Lecture wise

VSR 603: Principles of Surgery (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Classification of wounds	1
2.	Wound healing, mechanism of wound repair	2
3.	Local and systemic factors affecting wound healing	1
4.	Current concepts of inflammation and management	1
5.	Thermal, electrical and chemical injuries and their management	3
Unit II		
6.	Asepsis, sterilization and disinfection	1
7.	Principles and practice of antimicrobial therapy in surgical patients	2
Unit III		
8.	Shock, classification, pathophysiology, diagnosis, treatment and monitoring	4
9.	Surgical stress and its systemic effects	1
10.	Haemorrhage and haemostasis	1
11.	Acid-base balance	1
12.	Fluid therapy	2
13.	Blood transfusion	1
14.	Metabolism of the surgical patient	2
Unit IV		
15.	Principles and clinical applications of laser surgery, cryosurgery, electrosurgery, physiotherapy	4
Unit V		
16.	Minimally invasive surgical procedures which includes laparoscopy and endoscopy	2
17.	Principles of microscopic surgery-vessel and nerve anastomosis	1
18.	Application of computers in surgery	1
Practical		
1.	Identification and handling of surgical instruments	3
2.	Preparation of surgical pack	1
3.	Preparation of surgical team	1
4.	Preparation of surgical patients	1
5.	Surgical facilities and equipment	2
6.	Introduction to clinical skill laboratory	1
7.	Practice of different suturing patterns	2
8.	Repair of different wounds, using drains, bandages and bandaging techniques	2
9.	Monitoring of traumatized surgical patient	2
10.	Operation theatre conduct	1

**Suggested Reading**

- Fossum TW. (Ed.). 2018. *Small Animal Surgery*. Mosby.
- Slatter DH. 2003. 3rd ed. *Textbook of Small Animal Surgery*. WB Saunders.
- Hendrickson DA and Baird AN. 2013. *Turner and McIlwraiths Techniques in Large Animal Surgery* 4th ed. Wiley Black Well.
- AK Gangwar, Naveen Kumar and Kh. Sangeeta Devi. 2010. *General Animal Surgery and Anesthesiology* (With Theory and Practicals) New India Publishing Agency, New Delhi (ISBN: 9789-38-0235-172).

VSR 604: Anaesthesia and Analgesia (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Introduction and history of anaesthesia	1
2.	General consideration for anaesthesia in animals	1
3.	Properties of ideal anaesthetic agent, types of anaesthesia	1
4.	Anaesthetic triad, preanaesthetic evaluation of patient and selection of anaesthesia	1
5.	Preanaesthetic evaluation of patient and selection of anaesthesia	2
Unit II		
6.	Preanaesthetic medication (anticholinergics, sedatives, tranquilizers, alpha-2 agonist, narcotics)	5
7.	Muscle relaxants and neuromuscular blocking agents	1
Unit III		
8.	General anaesthetics and factors affecting their uptake, distribution and metabolism	2
9.	Injectable anaesthetic agents (properties, dosage and usage)	3
10.	Combinations of injectable agents and neuroleptanalgesia	1
11.	Inhalation anaesthetic agents (properties, methods of administration, dosage and usages)	2
12.	Inhalation anaesthesia equipment and breathing circuits	1
13.	Artificial ventilation	1
Unit IV		
14.	Post-operative care of the surgical patient	1
15.	Operating room emergencies	1
16.	Cardio-pulmonary arrest and resuscitation	1
17.	Monitoring of anaesthetic recovery	1
Unit V		
18.	Local anaesthetics, their mechanisms	1
19.	Local and regional nerve blocks	1
20.	Spinal analgesia, intravenous regional anaesthesia	1
21.	Peri-operative and post-operative pain and its management	2
Practical		
1.	Inhalation anaesthesia equipment, circuits and vaporizers	2
2.	Artificial ventilation	1
3.	Use of various pre-anaesthetic and anaesthetic agents in small and large animals	3
4.	Anaesthetic triad	1
5.	Balanced anaesthesia	1



S. No.	Topics	No. of Lectures/ Practicals
6.	Total intravenous anaesthesia	1
7.	Regional and local nerve blocks using local anaesthetics	1
8.	Repair of different wounds, using drains, bandages and bandaging techniques	1
9.	Alpha-2 agonists and their combinations in domestic animals	1
10.	Monitoring of anaesthesia	1
11.	Reversal of sedation and analgesia induced by alpha-2 agonists	1
12.	Practice of anaesthesia in clinical cases	1
13.	Record keeping in anaesthesia and euthanaia	1

Suggested Reading

- AK Gangwar, Naveen Kumar and Kh. Sangeeta Devi. 2010. *General Animal Surgery and Anesthesiology (With Theory and Practicals)* New India Publishing Agency, New Delhi (ISBN: 9789-38-0235-172).
- Clarke KW, Trim CM and Hall LW. 2013. *Veterinary Anaesthesia*. 11th ed. WB Saunders.
- Grim KA, Lamont LA, Tranquilli WJ, Greene SA and Robertson SA. 2015. *Veterinary Anaesthesia and Analgesia*, The 5th ed. Lumb and Jones. Wiley Blackwell.
- Grim KA, Tranquilli WJ and Lamont LA. 2011. *Essentials of Small Animal Anesthesia and Analgesia*. 2nd ed. Wiley Blackwell.
- Paddleford RR. 1999. *Manual of Small Animal Anesthesia*. 2nd ed. WB Saunders.

VSR 605: Diagnostic Imaging Techniques (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Regulations regarding establishment and handling of X-ray units, requirements for establishment of X-ray units	1
2.	Conventional and digital X-ray machine	1
3.	X-ray films, cassettes, screen	1
4.	X-ray production, qualities of X-rays	1
5.	Image formation and dark room procedures	1
6.	Image plate, formation of radiograph technique chart, artifacts and their prevention	1
7.	Radiographic quality (Contrast, density and details)	1
8.	Radiographic accessories	1
9.	Radiographic positioning for different organs/ parts in small and large animals	1
Unit II		
10.	Plain and contrast radiographic techniques of small and large animals	3
11.	Fluoroscopy/ C-arm	1
12.	Principles of radiographic interpretation	1
Unit III		
13.	Principles of radiation therapy, medical radioisotope curves, radiation laws and regulations	2
14.	Radiation hazards and monitoring of radiographic exposure to personnel and protection	2
Unit IV		
15.	Basic physics of ultrasound waves and image formation	2



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topics	No. of Lectures/ Practicals
16.	Scanning principles of ultrasound	1
17.	Transducers, equipment controls, modes of display	1
18.	Terminology used for echotexture and USG artifacts	4
Unit V		
19.	Doppler techniques echocardiography and its application	2
20.	Introduction to nuclear imaging techniques, computerized tomography, magnetic resonance imaging, positron emission tomography techniques	3
Practical		
1.	Acquaintance with imaging equipment, computed radiography and digital radiography systems	3
2.	Dark room processing techniques and X-ray film handling	1
3.	Formulation of technique chart with fixed kVp and variable mAs	1
4.	Radiographic artefacts and their prevention	1
5.	Basics of radiographic interpretation of diseases	2
6.	Radiography positioning of different regions in domestic animals	1
7.	Contrast radiographic techniques	2
8.	Interpretation of radiographs	2
9.	PACS, Practice of ultrasonographic imaging and report writing	3

Suggested Reading

- AK Gangwar, Kh. Sangeeta Devi and Naveen Kumar. 2015. *Radiography in Veterinary Practice at a glance (Including Diagnostic Imaging techniques)* Astral International Pvt. Limited, New Delhi (ISBN: 978-93-5124-335-9).
- Barr FJ and Gaschen L. 2011. *BSAVA Manual of Canine and Feline Ultrasonography*. British Small Animal Veterinary Association
- Boon JA. 2011. *Veterinary Echocardiography*. 2nd ed. Wiley-Blackwell.
- Bushong SC. 2017. *Radiologic Science for Technologists*. 11th ed. CV Mosby.
- Gillette EL, Thrall DE and Lebel JL. (Eds.). 1977. *Carlson's Veterinary Radiology*. Lea and Febiger.
- Goddard PJ. 1995. *Veterinary Ultrasonography*. CABI.
- Kealy JK, McAllister H and Graham JP. (Eds.). 2011. *Diagnostic Radiology and Ultrasonography of the Dog and Cat*. 5th ed. WB Saunders, Philadelphia.
- Mannion P. 2006. *Diagnostic Ultrasound in Small Animal practice*. Blackwell Science.
- Kirberger RM and McEvoy FJ 2016. *BASAVA Manual of Canine and Feline Musculoskeletal Imaging*. 2nd BASAVA Gloucester.
- Morgan JP. 1972. *Radiology in Veterinary Orthopaedics*. Lea and Febiger.
- Nyland TG and Mattoon JS. 2002. *Small Animal Diagnostic Ultrasound*. WB Saunders.
- Thrall DE. 2017. *Textbook of Veterinary Diagnostic Radiology*. 7th ed. Saunders, Philadelphia.
- Bargai U, Pharr, JW and Morgan JP. 1989. *Bovine Radiology*. Iowa State University Press, Ames.

VSR 606: Soft Tissue Surgery (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Skin, adnexa, integument, appendages, horn, tail, sinus affections of equine and bovine	3



Veterinary Clinical Subjects: Veterinary Surgery and Radiology

S. No.	Topics	No. of Lectures/ Practicals
2.	Principles of plastic and reconstructive surgery, different types of skin grafts	2
Unit II		
3.	Surgical approaches/ affections of ear	1
4.	Surgical approaches/ affections of oral cavity	1
5.	Surgical approaches/ affections of larynx, pharynx, salivary glands and oesophagus	1
6.	Surgical approaches/ affections of abdomen	1
7.	Surgical approaches/ affections of rumen and reticulum	1
8.	Surgical approaches/ affections of omasum and abomasum	1
9.	Surgical approaches/ affections of stomach, intestines, rectum, anus	3
10.	Surgical approaches/ affections of liver and biliary system, pancreas and porto-systemic shunts	1
Unit III		
11.	Abdominal hernia	1
12.	Diaphragmatic hernia	1
13.	Perineal hernia, ventral, femoral and umbilical hernia	1
14.	Ritcher hernia, hiatal hernia, omental hernia, pre-pubic tendon rupture	1
15.	Use of biological and synthetic grafts for hernia repair, laparoscopic repair of hernia	1
Unit IV		
16.	Principles of thoracic surgery, functional anatomy of respiratory system	1
17.	Diseases of upper and lower respiratory system	4
18.	Functional anatomy of cardiovascular system and common affections of heart	3
Unit V		
19.	Affections of pituitary, adrenals, thyroid, parathyroid glands	1
20.	Principles of neurosurgery and common surgical affections of nervous system and special sense organs	1
Unit VI		
21.	Haemolymphatic system, bone marrow, spleen, tonsils, lymph nodes and lymphatics, thymus	2
Practical		
1.	Practice of various surgical techniques of skin and adnexa	2
2.	Practice of various surgical techniques of alimentary system	5
3.	Practice of various surgical techniques of hernias	2
4.	Practice of various surgical techniques of respiratory system	2
5.	Affections of horn, tail and teat	2
6.	Endoscopy techniques, instrumentation, use of rigid/ flexible endoscopes in companion and farm animals	1
7.	Use of rigid/ flexible endoscopes in companion animals	1
8.	Use of rigid/ flexible endoscopes in farm animals	1

Suggested Reading

- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders
- Slatter DH. 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.
- Yool DA. 2012. *Small Animal Soft Tissue Surgery*. CABI.
- Tobia KM. 2010. *Manual of Small Animal Soft Tissue Surgery*. Wiley Black Well.

**VSR 607: Orthopaedic Surgery (2+1)**

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Bone structure and function, growth, response to injury, fractures and luxations	1
2.	Classification of fracture	1
3.	Fracture healing, Biological osteosynthesis	1
Unit II		
4.	Biomechanics of fracture healing	1
5.	Considerations for selection of fixation techniques	1
6.	Current trends in treatment of fractures of different bones in companion and farm animals	4
7.	Diseases of bone	2
Unit III		
8.	Various affections of the joints and their treatment	3
9.	Various affections of the ligaments and tendons and their treatment	3
Unit IV		
10.	Spinal affections and injury to axial skeleton	3
Unit V		
11.	Conformation of the limb	3
12.	Anatomy of hoof	1
13.	Anatomical, conformational and pathological causes of lameness and allied surgical conditions of fore and hind limbs	6
Practical		
1.	Application of Plaster of Paris cast	1
2.	Application of fiberglass cast	1
3.	Application of Roberts Jones bandage	1
4.	Application of modified Schroeder Thomas splint	1
5.	Application of Coaptation splint, sling application	1
6.	Practice of IM pinning, wiring	2
8.	Practice of bone plating	1
9.	Practice of inter locking nailing	1
10.	Practice of external skeletal fixation	1
11.	Practice of arthrotomy	1
12.	Practice of tenotomy	1
13.	Examination of limbs for lameness	1
14.	Desmotomy, nerve blocks, injections in joints	1
15.	Operations for arthritis and hoof surgery	1
16.	Corrective shoeing	1

Suggested Reading

- AK Gangwar, Khangembam Sangeeta Devi, Ajit Kumar Singh and Naveen Kumar (2018) *Veterinary Orthopaedics and Lameness*, Kalyani Publishers, New Delhi (ISBN 978-93-272-8837-7).
- Auer JA. 2006. *Equine Surgery*. WB Saunders.
- Baxter GM. (Ed.). 2011. *Adams and Stashak's Lameness in Horses*. 6th ed. Wiley-Blackwell.
- Decamp CE, Johnston, SA, Dejardin LM and Schaefer SL. 2016. *Handbook of Small Animal Orthopaedics and Fracture Repair*, 5th ed., Elsevier.



- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders.
- Greenough PR. 2007. *Bovine Laminitis and Lameness*. WB Saunders.
- Millis DL and Levine D 2014. *Canine Rehabilitation and Physical Therapy*, 2nd ed., Elsevier.
- Newton CD and Nunamaker DM. (Eds.). 1985. *Textbook of Small Animal Orthopaedics*. JB Lippincott.
- Oehme FW and Prier JE. (Eds.). 1974. *Textbook of Large Animal Surgery*. Williams and Wilkins.
- Tyagi RPS and Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.
- Weaver AD, Jean GS and Steiner A. 2007. *Bovine Surgery and Lameness*. 2nd ed. Wiley-Blackwell.

VSR 608: Anaesthesia of Zoo, Wild, Exotic and Laboratory Animals (1+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	General consideration in chemical restraint of captive wild animals	1
2.	General consideration in chemical restraint of free ranging wild animals	1
3.	Handling of birds with minimum stress	1
4.	Physical examination, blood sampling, crop washes, faecal sampling	1
Unit II		
5.	Methods of administration of anaesthesia in captive animals	1
6.	Methods of administration of anaesthesia in free ranging animals	1
7.	Methods of administration of anaesthesia in birds	1
8.	Methods of administration of anaesthesia in laboratory animals	1
Unit III		
9.	Local and general anaesthesia in exotic species	1
10.	Local and general anaesthesia in wild animals	1
11.	Local and general anaesthesia in birds	1
12.	Local and general anaesthesia in zoo animals	1
13.	Local and general anaesthesia in laboratory animals	1
Unit IV		
14.	Anaesthetic emergencies and complications	1
Unit V		
15.	Diagnostic interpretation, haematology and biochemistry analysis	2
16.	Avian diagnostic endoscopy	1
Practical		
1.	Familiarization with capture and anaesthetic equipments	1
2.	Local anaesthetic techniques	1
3.	Use of various preanaesthetic and anaesthetic agents in laboratory animals	1
4.	Use of various preanaesthetic and anaesthetic agents in birds	1
5.	Monitoring of patient during general anaesthesia	1
6.	Familiarization of various diseases in exotic birds like tumours, foreign body, crop stasis, crop tear, crop fistula, toe necrosis, feather cyst	2
8.	Excision of uropygial gland	1
9.	Excision of rhinoloth	1
10.	Pharyngostomy	1
11.	Ingluviotomy	1
12.	Ventriculotomy	1



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topics	No. of Lectures/ Practicals
13.	Orthopedic injuries	2
15.	Visits to zoos for practical on zoo animals	1
16.	Visits to wild life sanctuaries for practical on wild animals	1

Suggested Reading

- Coles BH. 2007. *Essentials of Avian Medicine and Surgery*. 3rd ed. Blackwell Publishing
- Donely B. 2010. *Avian Medicine and Surgery in Practice*. Manson Publishing Ltd.
- Grim KA, Lamont LA, Tranquilli WJ, Greene SA and Robertson SA. 2015. *Veterinary Anaesthesia and Analgesia*. 5th ed. Lumb and Jones. Wiley Blackwell.
- Mader DR. 2005. *Reptile Medicine and Surgery*. 2nd ed. WB Saunders
- Miller RE and Fowler M. 2014. *Fowler's Zoo and Wild Animal Medicine*. 1st ed. Saunders
- Wobeser GA. 2007. *Disease in Wild Animals: Investigation and Management*. 2nd ed. Springer

VSR 609: Urogenital Surgery (1+1)

S. No.	Topics	No. of Lectures/ Practicals
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Theory

Unit I

1. Surgical anatomy of urinary tract in male and female animals 1
2. Surgical anatomy of reproductive tract in male and female animals 1
3. Congenital anomalies of organs of male and female urinary system 1
4. Congenital anomalies of organs of male and female reproductive system 1

Unit II

5. Principles of urinary tract surgery, pathophysiology, diagnosis and surgical management of affections of kidney 1
6. Pathophysiology, diagnosis and surgical management of affections of ureter and urinary bladder 2
7. Medical dissolution and prevention of canine uroliths 1
8. Feline urologic syndrome 1
9. Surgical management of urolithiasis in ruminants and its prevention 1
10. Management of uroperitoneum and renal failure 1

Unit III

11. Pathogenesis, clinical symptoms, diagnosis and surgical management of vaginal and uterine prolapse, rectovaginal fistula, pneumovagina 1
12. Pathogenesis, clinical symptoms, diagnosis and surgical management of vaginal tumours, pyometra, cysts of Gartner's canal and vestibular glands 1

Unit IV

13. Surgical conditions of penis, prepuce, prostate and testicles, cryptorchidism, inguinal and scrotal hernia 1
14. Affections of teat and udder 1

Unit V

15. Indications, techniques and postoperative complications of episiotomy, ovariectomy, ovariohysterectomy and caesarean section, pyometra and its surgical treatment 1

Unit VI

16. Castration, vasectomy, cauda epididymectomy and penile deviation 1



Veterinary Clinical Subjects: Veterinary Surgery and Radiology

S. No.	Topics	No. of Lectures/ Practicals
Practical		
1.	Hand-on-training of techniques of centesis of urinary bladder in companion and farm animals	1
2.	Different types of catheters used in urogenital surgery, retrograde catheterization of urethra and urinary bladder	1
3.	Normograde catheterization of urethra on clinical cases of urinary retention	1
4.	Pudendal nerve block for penis examination in ruminants	1
5.	Diagnostic techniques and surgical management of the affections of kidney and ureters	2
6.	Uro-hydropropulsion	1
7.	Restraint and anaesthesia for urogenital tract surgery	1
8.	Cystotomy, tube cystostomy	1
9.	Nephrotomy, ureterocolostomy	1
10.	Urethrotomy, urethrostomy	1
11.	Castration, vasectomy, penile deviation, epididymectomy, amputation of penis, episiotomy	1
12.	Ovariohysterectomy, tubectomy	1
13.	Caesarean section	1
14.	Management of phimosis, paraphimosis, venereal granuloma	1
15.	Vaginal and uterine prolapse, rectovaginal fistula and pneumovagina	1
16.	Bladder and uterine marsupialization	1

Suggested Reading

- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders
- Slatter DH. 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.
- Wolfe DF and Moll HD. *Large Animal Urogenital Surgery* 1999. 2nd ed., Williams and Wilkins, Tokyo.
- Yool DA. 2012. *Small Animal Soft Tissue Surgery*. CABI.

VSR 610: Ophthalmology (1+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Anatomy and physiology of eye and its adnexa	1
2.	Ophthalmic examination and diagnosis, diagnostic instrumentation	1
3.	Anaesthesia and surgery	1
Unit II		
4.	General consideration for eye surgery in companion and farm animals	1
5.	Therapeutic agents for eye diseases and surgery of eye lids, lacrimal apparatus, naso-lacrimal duct	1
Unit III		
6.	Diseases of conjunctiva	1
7.	Diseases of cornea, sclera, iris, orbit	1
8.	Diseases of lens	1
9.	Diseases of vitreous and aqueous humor	1



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S. No.	Topics	No. of Lectures/ Practicals
10.	Diseases of retina and optic nerve	1
11.	Eye tumours, enucleation, exenteration	1
	Unit IV	
12.	Ocular manifestations of systemic diseases	2
	Unit V	
13.	Neuro-ophthalmology and ocular emergencies	3
	Practical	
1.	Ophthalmic instrumentation	1
2.	Examination of the eye and its adnexa	2
3.	Anaesthesia, preparation of patient, suture materials for eye surgery	1
4.	Canthotomy, tarsorrhaphy	1
5.	Keratoplasty, anterior chamber paracentesis	1
6.	Flushing of naso-lacrimal duct	1
7.	Iridectomy	1
8.	Phacoemulsification and implantation of foldable lens	1
9.	Surgical treatment of entropion	2
10.	Surgical treatment of cherry eye	1
11.	Schirmer tear test	1
12.	Use of fluorescein dye in corneal ulcer	1
13.	Glaucoma surgery	1
14.	Eye worm removal	1

Suggested Reading

- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders
- Gelatt KN. 2014. *Essentials of Veterinary Ophthalmology*. 3rd ed. Wiley Blackwell. US.
- Gilger BC. 2017. *Equine Ophthalmology*, 3rd ed. Wiley Blackwell.
- Maggs DJ, Miller PE and Ofri R. 2017. *Slatter's Fundamentals of Veterinary Ophthalmology*. 6th ed. Saunders.
- Slatter DH 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.

VSR 611: Dentistry and Oral Surgery (1+1)

S. No.	Topics	No. of Lectures/ Practicals
	Theory	
	Unit I	
1.	Anatomy, development of teeth (odontogenesis)	1
2.	Dentition and ageing of different species	1
	Unit II	
3.	Clinical examination of oral cavity, dental anesthesia and pain management	1
4.	Dental anaesthesia and pain management	1
5.	Dental radiography	1
	Unit III	
6.	Diseases of oral cavity and teeth, congenital and developmental anomalies of oral cavity	1



Veterinary Clinical Subjects: Veterinary Surgery and Radiology

S. No.	Topics	No. of Lectures/ Practicals
7.	Abnormal tooth eruption, irregular wear of teeth in companion and farm animals, occlusion and malocclusion	1
8.	Mandibular fracture, malformation of mandible, maxilla (cleft palate)	1
Unit IV		
9.	Acquired diseases of teeth (halitosis, dental caries, fracture of teeth, dental materials and dental radiography), oronasal fistula	1
10.	Maxilla and mandibular fractures repair	1
11.	Orthodontics	1
12.	Tumors and other acquired condition of oral cavity	1
Unit V		
13.	Exodontics, restorative dentistry	1
14.	Periodontal disease, tooth extraction, gum diseases	1
15.	Endodontics, pulpectomy, root canal therapy, current techniques in dentistry	2
Practical		
1.	Oral examination	1
2.	Modified triadan system of tooth numbering in various species	1
3.	Dental chart for companion and farm animals	1
4.	Dentistry instrumentation	1
5.	Dental radiography procedure	1
6.	Periodontal probing, scaling/ teeth cleaning	1
7.	Tooth extraction	1
8.	Malpractices in equine dentistry	1
9.	Periodical maintenance of oral hygiene	1
10.	Corrective procedures, malocclusion	1
11.	Treatment strategies congenital malformations of maxilla	2
12.	Oral surgery	4

Suggested Reading

- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders
- Holmstrom SE. 2013. *Veterinary Dentistry - A Team Approach*. 2nd ed. Elsevier.
- Slatter DH. 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.
- Soto JC. 2015. *Visual Atlas of Dental Pathologies in Dogs*. SERVET, Spain.

VSR 612: Camel Surgery (1+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Introduction to special surgical anatomy of important parts, i.e. mandible, soft palate, chest pad, saddle region, male urinary system, tail, etc.	1
2.	Restraint and positioning for various surgical procedures and radiography of different parts	1



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topics	No. of Lectures/ Practicals
Unit II		
3.	Use of local anaesthesia, various nerve blocks and regional anaesthesia used to treat diverse surgical disorders	1
4.	Preanaesthetics, tranquilizers, sedatives and general anaesthetics used for camel surgery	1
Unit III		
5.	Surgical affections of head and neck region: laceration and infected wounds of nostril skin, infection of turbinate, actinobacillosis, dental affections	1
6.	Surgical affections of head and neck region: removal of canines in furious camels, torticollis, fracture of mandible and maxilla, soft palate injuries	1
7.	Surgical affections of head and neck region: ophthalmic affections, salivary fistula, Stenson's duct ligation, oesophageal obstruction	1
Unit IV		
8.	Surgical affections of thorax and abdominal region: saddle gall, hernia, chest pad wounds and enlargements	1
9.	Surgical affections of thorax and abdominal region: foreign bodies in compartment, intestinal obstruction	1
10.	Surgical affections of thorax and abdominal region: obstructive urolithiasis, rupture of urethra, subcutaneous infiltration of urine, cystorrhexis	1
Unit V		
11.	Surgical affections of musculo-skeletal system: diagnosis of lameness in camels	1
12.	Surgical affections of musculo-skeletal system: management of long bone and digital fractures	1
13.	Surgical affections of musculo-skeletal system: upward fixation of patella, sprains, arthritis	1
Unit VI		
14.	Sheath abscess, necrosis of penis, phimosis, paraphimosis, preputial prolapse	1
15.	Various types of tumours, gangrene and tumours of udder, necrosis of tail	1
16.	Punctured foot, prolapse of digital cushion, foot injuries, Kumri, Kapali etc	1
Practical		
1.	Restraint and anaesthesia (Local, regional, sedation and general anaesthesia)	2
2.	Preparation of sites	1
3.	Surgical anatomy of important surgical affections	1
4.	Special instruments used for camel restraining and surgery	1
5.	Observing and assisting in diverse surgical procedures on clinical cases in camels	5
6.	Practice of interdental wiring for repair of mandibular fractures in specimen mandibles	1
7.	Clinical and radiographic diagnosis of lameness	2
8.	Protection of wounds of chest pad and foot using special bandages	1
9.	Radiography of different part of camels	1



Suggested Reading

- *Selected Topics on Camelids*, Ed-TK Gahlot, The Camelid Publishers, Bikaner and now marketed by Camel Publishing House, Edition 2000.
- *Medicine and Surgery of Camelids*. Ed-Murray E. Fowler, Wiley-Blackwell, Edition 2010.
- *Advances in Surgery and Diagnostic Imaging of the Dromedary Camel*, Ed- RO Ramadan, King Faisal University, Edition 2016.

VSR 613: Elephant Surgery (1+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Basic surgical anatomy of Asian elephants and comparison with other farm animals	4
Unit II		
2.	Drug administration techniques in captive and wild elephants, anaesthetic management of captive and wild elephants for various surgical and managerial conditions	1
3.	Drug administration techniques in captive and wild elephants, anaesthetic management of captive and wild elephants for various surgical and managerial conditions	1
Unit III		
4.	Principles of soft tissue surgery in elephants, cyst, bursitis, gall, haematoma, abscess, etc.	2
Unit IV		
5.	Management and treatment of fractures and arthritis in elephants	2
Unit V		
6.	Pedicure, corrective foot care and maintenance of healthy feet of captive elephants housed in different establishments in different seasons	2
Unit VI		
7.	Hoisting of recumbent elephants, surgical methods of birth control in elephants	1
8.	Limitations and risks of abdominal surgery in elephants (eg. caesarian section, castration, hernia, etc., soft tissue surgery like episiotomy, vestibulotomy, etc.)	2
Practical		
1.	Familiarity with clinical examination procedures	1
2.	Body weight estimation	1
3.	Signs of health and diseases	1
4.	Signs of localized lesions, etc.	1
5.	Familiarity with physical and chemical restraint procedures	1
6.	Drug administrations by various routes-IM, IV, SC, sub-conjunctival, oral, per rectal, etc.	1
7.	Foot examination and foot care procedures	1
8.	Visit to elephant camps	1
9.	Attending clinical procedures, surgeries etc	7

Suggested Reading

- Fowler ME and Mikota SK. 2006. *Biology, Medicine, and Surgery of Elephants*. Blackwell Publishing



Minor Courses for M.V.Sc. Degree programme

Courses of any one department/ discipline from the list given below or as considered relevant by the Advisory Committee from the BSMA approved subjects:

- Veterinary Physiology
- Veterinary Biochemistry
- Veterinary Biotechnology
- Veterinary Anatomy
- Veterinary Medicine
- Veterinary Pathology
- Animal Reproduction, Gynaecology and Obstetrics

Supporting Courses

It could be any subject considered relevant for student's research work. This will be decided by Advisor/ Guide concerned.

Common Courses

The following courses (one credit each) will be offered to all students undergoing Master's degree programme.

- Library and Information Services
- Technical Writing and Communications Skills
- Intellectual Property and its management in Agriculture
- Basic Concepts in Laboratory Techniques
- Agricultural Research, Research Ethics and Rural Development Programmes



Course Title with Credit Load Ph.D. in Veterinary Surgery and Radiology

Course Code	Course Title	Credit Hours
VSR 701	Clinical Practice-I*	0+2
VSR 702	Clinical Practice-II*	0+2
VSR 703	Clinical Practice-III*	0+2
VSR 704	Cardiovascular Surgery	2+1
VSR 705	Advances in Anaesthesiology	2+1
VSR 706	Advances in Radiology	2+1
VSR 707	Advances in Diagnostic Imaging Techniques	2+1
VSR 708	Advances in Orthopaedics	2+1
VSR 709	Neurosurgery	2+1
VSR 710	Reconstructive and Regenerative Surgery	1+1
VSR 711	Advances in Soft Tissue Surgery	2+1
VSR 712	Advances in Ophthalmology	1+1
VSR 713	Surgical Oncology	1+1
VSR 787	Clinical Case Conference*	0+1
VSR 788	Special Problem in Diagnostic Imaging	0+2
VSR 789	Special Problem in Anaesthesia	0+2
VSR 790	Special Problem in Surgery	0+2
VSR 791	Doctoral Seminar-I	2+0
VSR 792	Doctoral Seminar-II	2+0
VSR 799	Doctoral Research	0+75

*Core Courses



Course Contents

Ph.D. in Veterinary Surgery and Radiology

- I. Course Title** : **Clinical Practice-I**
II. Course Code : **VSR 701**
III. Credit Hours : **0+2**

IV. Aim of the course

To learn clinical techniques and procedures in anaesthesia, diagnostic imaging and surgery

V. Practical

Application of different equipment like inhalant anaesthesia machine, Computerized or digital radiography system, Ultrasonography, Endoscopy, Electro-surgery, Cryosurgery, Operating microscope, Phacoemulsification and physiotherapy, Client management and counseling, Treating surgical cases using advances techniques, managing surgical facilities, ICU equipment and personnel, Planning and formulating clinical research projects using the clinical data and facilities, Data analysis and writing of clinical case reports and success stories about the clinical achievements.

- I. Course Title** : **Clinical Practice-II**
II. Course Code : **VSR 702**
III. Credit Hours : **0+2**

IV. Aim of the course

To learn clinical techniques and procedures in anaesthesia, Diagnostic imaging and surgery

V. Practical

Application of different equipment like inhalant anaesthesia machine, Computerized or digital Radiography system, Ultrasonography, Endoscopy, Electro-surgery, Cryosurgery, Operating microscope, Phacoemulsification and physiotherapy, Client management and counseling, Treating surgical cases using advances techniques, managing surgical facilities, ICU equipment and personnel, Planning and formulating clinical research projects using the clinical data and facilities, Data analysis and writing of clinical case reports and success stories about the clinical achievements.

- I. Course Title** : **Clinical Practice-III**
II. Course Code : **VSR 703**
III. Credit Hours : **0+2**

IV. Aim of the course

To learn clinical techniques and procedures in anaesthesia, Diagnostic imaging and surgery



V.

Application of different equipment like inhalant anaesthesia machine, Computerized or digital radiography system, Ultrasonography, Endoscopy, Electro-surgery, Cryosurgery, Operating microscope, Phacoemulsification and physiotherapy, Client management and counseling, Treating surgical cases using advances techniques, Managing surgical facilities, ICU equipment and personnel, Planning and formulating clinical research projects using the clinical data and facilities, Data analysis and writing of clinical case reports and success stories about the clinical achievements.

I. Course Title : Cardiovascular Surgery

II. Course Code : VSR 704

III. Credit Hours : 2+1

IV. Aim of the course

To learn the basic principles and and gain practical knowledge of diagnosis and treatment of diseases of cardiovascular system.

V. Theory

Unit I

Surgical anatomy, Pathophysiology, Systolic and diastolic functions, Heart failure.

Unit II

Physical examination, Electrocardiography, Cardiac catheterization.

Unit III

Special preoperative considerations for patients undergoing cardiovascular surgery, Surgical approaches to thorax, Different techniques of thoracotomy. Special instruments required in cardio-thoracic surgery, Defibrillator, Heart lung machine

Unit IV

Surgical management of congenital cardiac disorders: Malpositioning, Atrial septal defect, Endocardial cushion defect, Tricuspid valve disorder, Ventricular septal defect, Pulmonic stenosis, Teratology of fallot, Eisenmenger's complex, Anomalous pulmonary venous return, Mitral valve abnormalities, Aortic stenosis, Aortic regurgitation, transposition of the great vessels, Aortic pulmonary window, Persistent arteriosus, Patent ductus arteriosus, Coarctation of aorta, Persistent right aortic arch, Pericardial diaphragmatic hernia

Unit V

Acquired cardiac disorders: Mitral regurgitation, Tricuspid regurgitation, Dilatation, Acquired aortic regurgitation, Endocarditis, Heart block, Cardiomyopathy, Pericarditis, Heart tumours, Hypothermia, Extracorporeal circulatory support, Cardiopulmonary bypass, Artificial heart transplant, Post operative management, Basic peripheral vascular procedures arteriotomy, Venotomy, anastomosis, Portocaval shunts and anomalies

VI. Practical

Instrumentation and suture techniques for cardiovascular surgery, Vascular prostheses, Anticoagulants, Surgical approaches to thorax, Different techniques of thoracotomy, Hand-on-training of different techniques of centesis of thoracic cavity



on cadavers, Thoracic drain placement, Demonstration of basic Cardiac procedures, Pericardiocentesis, Pericardiotomy, Cardiac catheterization, and various surgical conditions, Pericardiectomy, on cadaver and clinical cases of constructive pericarditis, Biopsy techniques, Use of IPPV in thoracic surgery.

I. Course Title : Advances in Anaesthesiology

II. Course Code : VSR 705

III. Credit Hours : 2+1

IV. Aim of the course

To learn advance concepts and techniques of veterinary anaesthesia.

V. Theory

Unit I

Cellular and molecular mechanisms of anaesthesia, Effects of anaesthesia on different systems.

Unit II

Drug interactions with anaesthetics, Pharmacokinetics and pharmacodynamics of anaesthetics, CRI and TCI, Computer assisted anaesthesia.

Unit III

Opioids, alpha-2 agonists and ketamine for epidural anaesthesia, Acupuncture and electroanaesthesia.

Unit IV

Critical care in ICU, Pain transmission and processing, Methods for pain assessment in animals, Multimodal and preemptive analgesia, Techniques and drugs for pain managements.

Unit V

Anaesthesia for selected diseases (cardiovascular dysfunction, pulmonary dysfunction, Neurologic diseases, Renal diseases, Hepatic diseases, Gastrointestinal diseases, Endocrine diseases, Airway diseases).

Unit VI

Anaesthesia for special patients (ocular patients, heart patients, caesarian section patients, trauma patients, neonatal and geriatric patients).

VI. Practical

Various procedures for catheterization of heart and great vessels, Central venous line, Haemodynamic changes and pulmonary function tests during trials of anaesthetics, Electrocardiographic, Encephalographic evaluation of central nervous system activity, Cybernetics, Data acquisition and retrieval, Administration and monitoring of newer anaesthetics combinations.

I. Course Title : Advances in Radiology

II. Course Code : VSR 706

III. Credit Hours : 2+1

IV. Aim of the course

To learn advance theoretical and practical knowledge in radiology.



V. Theory

Unit I

Biological effects of radiations (alpha, beta, X-ray and gamma rays) in vivo and *in-vitro* cellular response following radiation as an immunosuppressive agent.

Unit II

Different kind of projections and positioning, Contrast material, Different contrast techniques, PACS.

Unit III

Radiography of head and neck region, Radiography of thorax, Lung patterns, Radiography of abdominal and pelvic region

Unit IV

Radiography of limbs for lameness and fracture diagnosis, Application of image intensifiers in veterinary practice, Different types of screens.

Unit V

Computerized radiography (CR), Digital radiography (DR), Contrast CT and contrast MRI, PETCT, Advances in scintigraphy.

Unit VI

Radiation therapy in cancer patients, Biological effects of radiation physics, Physics of radiation, Electromagnetic radiations, Hazards of electromagnetic Radiations and protection and bio-safety.

VI. Practical

Radiographic positioning, Radiation safety measures, Handling radioactive material, Clinical radiological diagnosis at Radiology Unit, Demonstration of advanced radiological techniques.

I. Course Title : Advances in Diagnostic Imaging Techniques

II. Course Code : VSR 707

III. Credit Hours : 2+1

IV. Aim of the course

To learn advance theoretical and practical knowledge of ultrasonography, Diagnostic imaging techniques and their interpretations.

V. Theory

Unit I

Techniques of ultrasonography for diagnosis of different affections of neck, thorax (echocardiography, Doppler techniques), Abdomen and pelvis (Urinary bladder and prostate), Synovial joints, Muscle and tendons, Eye.

Unit II

Interpretation of ultrasonogram of different body organs/ vessels (normal and abnormal), Therapeutic applications of ultrasonography for physiotherapy.

Unit III

Imaging modalities like, MRI, CT scan, Nuclear medicine, Positron emission tomography technique, Single-photon emission computed tomography, etc.



Unit IV

Nuclear Scintigraphy-isotopes (natural and man-made); Cyclotron reactor, Half-life, decay pattern, Storage and handling of radioactive material,

Unit V

Methods in the detection of isotopes, Geiger-Mullar tubes, Photo-multiplier tube, medical use of isotope, Dosimetry, Nuclear medicine and its use in diagnosis of thyroid, Kidney, bone and liver function studies, Labelling of isotope and biological uses, Detonation and fission products, Image storage and transfer, DICOM, PACS and teleinterpretation.

VI. Practical

Hands-on-practice on different visceral organs collected from slaughter house for ultrasonographic scanning in water tub, dry and wet lab training, Demonstration and practice on different clinical cases reported for ultrasonography, Visit to places with facility of other alternate imaging techniques.

I. Course Title : Advances in Orthopaedics

II. Course Code : VSR 708

III. Credit Hours : 2+1

IV. Aim of the course

To learn advance concepts and techniques of treatment of various affections of bones, joints, tendons, ligaments and foot in companion and farm animals.

V. Theory

Unit I

Biomechanics of bone, Fracture etiology, Fracture reduction and different fracture fixation techniques like IM pinning, plating, nailing (inter locking nailing) and external skeletal fixation.

Unit II

Types, Properties, Biomechanics and use of different orthopaedic Implants, Bone grafts and their collection, Preservation, Indications and limitations, Bone graft substitutes like ceramics and composites, Their usage and limitations.

Unit III

Principles of osteogenesis, Osteoinduction and Osteoconduction.

Unit IV

Advances in internal fixation and external skeletal fixation techniques in veterinary orthopaedics.

Unit V

Metabolic bone diseases like rickets, osteomalacia, osteodystrophy and secondary hyperparathyroidism, etc. Classification, diagnosis and treatment of arthritis.

Unit VI

Advances in the management of congenital and acquired disorders of joints like traumatic dislocations, luxations and dysplasia. etiopathology and management of equine lameness including Laminitis, Navicular disease, Quitter, Canker and thrush, Sand cracks, Ring bone, Hygromas, Bursitis, Spavin and Splint.



Unit VII

Affections of muscles, tendons and ligaments, joint prosthesis and transplantation.

Unit VIII

Postoperative management of orthopaedic patients including the role of movement restriction, Weight bearing, Nutritional therapy, Physiotherapy and rehabilitation, Introduction to recovery assessment using lameness score, Gait analysis using computerized software.

VI. Practical

Hands on practice for different internal fixation techniques on cadaver, Management of different types of long bone fractures in different species of domestic animals, with special reference to practice of bone plating, Interlocking nailing and external skeletal fixation, Treatment of metabolic bone diseases in growing animals, Correction of antebrachial deformities including osteotomies and limb lengthening procedures, preservation of bone grafts, practice of bone grafting and use of osteoinducers in Clinical situation, Clinical and radiographic evaluation of various joint affections, Reduction and fixation of different joint luxations like coxo-femoral, Patellar, femoro-tibial, hock, scapulo-humeral, elbow and temporomandibular, Techniques of osteotomy, arthrodesis and joint replacement, Repair of tendon and ligament injuries, Diagnosis and treatment of various conditions causing lameness in equines and bovines.

I. Course Title : Neurosurgery

II. Course Code : VSR 709

III. Credit Hours : 2+1

IV. Aim of the course

To learn principles and techniques of treatment of surgical affections of nervous system in animals

V. Theory

Unit I

Nervous system – anatomy, physiology and pathological manifestations.

Unit II

Clinical neurology, Therapeutic Neurectomy, Nerve anastomosis, Pathogenesis of disease of the central nervous system.

Unit III

Diagnostic methods – Electrodiagnostic methods, Neuro radiology.

Unit IV

Fundamentals of neurosurgery, Surgical approaches to brain, Surgical diseases of peripheral nerves, Surgical affections and approaches to the spine, Diseases of the spinal column, Intervertebral disc diseases.

Unit V

Surgical approaches to brain and intracranial surgery.

VI. Practical

Methods for clinical and neurological examination including electro-encephalography,



electromyography and electro-diagnostic testing, Collection of CSF and its evaluation, Techniques of myelography, Vertebral venography, Pneumoventriculography, Cerebral arteriography and cavernous sinus venography, Management of vertebral fractures and luxations with stabilization, Treatment of spinal cord compression, viz., Disc fenestration, Hemilaminectomy, Dorsal laminectomy and ventral slot, Techniques of peripheral nerve anastomosis and reconstruction of peripheral nerves.

I. Course Title : Reconstructive And Regenerative Surgery

II. Course Code : VSR 710

III. Credit Hours : 1+1

IV. Aim of the course

To learn principles and techniques of reconstructive and regenerative surgery.

V. Theory

Unit I

Principles of regenerative medicine, Tissue homeostasis, Tissue and organ transplantation, Histo-compatibility matching, Transplantation immunity and host graft reaction, Immunosuppression

Unit II

Classification, Isolation, Characterization, Storage and application of stem cells, Extracellular matrix, Microenvironment and growth factors for tissue repair and regeneration.

Unit III

Synthetic and biological scaffolds, Preparation of biological scaffold and its role in Tissue regeneration, Whole organ decellularization and its application, Biomimetic scaffolds.

Unit IV

Designing for 3D printing, Bio-fabrication of organ and Tissue substitutes and its applications, Ethical concerns in regenerative medicine, GMP protocols and its applications in regenerative medicine

Unit V

Current techniques in designing and clinical application of biomaterials, Mechanical and functional testing of biomaterials, Biocompatibility testing

VI. Practical

Collection of bone marrow derived stem cells from different species of animals, Growth and differentiation of stem cells in different lineages, Decellularization of different tissues and organs, cell growth on different scaffolds, Clinical application of stem cells

I. Course Title : Advances in Soft Tissue Surgery

II. Course Code : VSR 711

III. Credit Hours : 2+1

IV. Aim of the course

To learn advanced concepts and practical techniques of treatment of soft tissue surgery, laparoscopic and minimally invasive surgery



V. Theory

Unit I

Advances in surgeries of ENT affections of small and large animals, Rhinoscopy-rhinotomy, Tumors of turbinates, Cheiloplasty, Hare lip correction, Salivary duct ligation, Parotid gland ablation, Bullaosteotomy, Buccotomy procedures, Glossophagia, Self suck correction.

Unit II

Upper respiratory tract affection in small and large animals, Barchiocephalic air way syndrome, Laryngeal paralysis, Tracheal collapse, Tracheostomy (temporary/permanent), Chest trauma, Chest tube placement, Thoracocentesis, Pneumectomy, (partial/ unilateral), Heart lung transplant, Thoracic duct ligation, Trans tracheal intubation, Thoracoscopic procedure.

Unit III

Esophageal affections in small and large animals, Dilatation, Diverticulum, PRAA-Mullers surgery, Gastroesophageal intussusception, Short bowel syndrome, Colostomy, megacolon, Rectal tube placement, Rectal diverticulum, Gastroscopy techniques

Unit IV

Pyelolithotomy, Lithotripsy, Renal transplantation, Ectopic ureter, Prostatectomy, Urinary incontinence, Penile urethrotomy, Urethrosopic retrieval of urolith, Endoscopic ureter stent placement.

Unit V

Thyroidectomy in cats, Liver lobectomy, Cholelithiasis, Cholecystectomy, Cholecystoduodenostomy, Porto caval shunt, Adrenalectomy.

Unit VI

Skin grafting, Subdermal, Axial skeletal, Omocervical axial pattern flap, Thoracodorsal axial pattern flap, Superficial brachial axial pattern flap, Caudal superficial epigastric axial pattern flap, Cranial superficial epigastric axial pattern flap, Deep circumflex iliac dorsal axial pattern flap, Deep circumflex iliac ventral axial pattern flap, Genicular axial pattern flap, Reverse saphenous conduit flap, Caudal auricular axial pattern flap, Split thickness and full thickness grafts, Reconstructive surgical procedures.

VI. Practical

Endoscopic surgical procedures in small and large animals, Chest tube placement, Rhinoscopy, Thoracoscopy, Bronchoscopy, Gastroscopy, Colonoscopy, Urethroscopy, Laproscopic surgical techniques, Skin flap and grafting techniques, Tracheostomy, Renal graft cystoplasty.

I. Course Title : Advances in Ophthalmology

II. Course Code : VSR 712

III. Credit Hours : 1+1

IV. Aim of the course

To learn advanced concepts and practical techniques in ophthalmology.

V. Theory

Unit I

Embryology of the eye, study of ocular physiology and biochemistry, structure and



function of eye and adenexa, Physiology of vision, Electrophysiology of visual

Unit II

Advances in diagnosis and diseases of the eye and adnexia.

Unit III

Ocular neoplasia, advances in neuro ophthalmology, Advances in ophthalmic pharmacology, microbiology and nutrition

Unit IV

Advances in ocular imaging, Advances in ocular anaesthesia and analgesia

Unit V

Advances in ocular emergencies, Ophthalmology of exotic species and lab animals, ocular toxicology

Unit VI

Corneal grafting, application of nanotechnology and stem cell therapy in veterinary ophthalmology.

VI. Practical

Exposure to latest ophthalmic instrumentation like phaco, ultrasound, cataract surgery and lens implantation, corneal transplantation.

I. Course Title : Surgical Oncology

II. Course Code : VSR-713

III. Credit Hours : 1+1

IV. Aim of the course

To learn about tumor genesis and treatment in animals.

V. Theory

Unit I

Biology of neoplastic disease: etiology, cellular mechanism, principles of surgical oncology.

Unit II

Diagnosis, classification and clinical staging of tumors and decision making for therapy, metastasis.

Unit III

Surgical management: Surgical excision of tumors, Cytoreductive surgery, Surgery for metastatic disease, Palliative surgery, Evaluation and interpretation of surgical margins.

Unit IV

Clinical signs, Diagnosis and treatment options of tumors of skin, Soft tissues, skeletal system, Head and neck, Gastro-intestinal tract, Respiratory tract, Urinary tract, Genital tract, Mammary gland, Nervous system, Endocrine system, haematopoietic system, the eye and orbit and miscellaneous tumours.

Unit V

Radiation therapy, Chemotherapy, Electrochemotherapy, Cryotherapy and targeted



therapy. Side effects of radio and chemotherapy, Nutritional management of cancer patients, Basics of immunotherapy in cancer management.

VI. Practical

General approaches to the diagnosis of neoplasia: Fine needle aspiration biopsy, needle core biopsy, excisional and incisional biopsy, bone marrow biopsy, lymph node biopsy, percutaneous lung biopsy, bone biopsy, ultrasound/ laparoscope guided biopsy.

I. Course Title : Clinical Case Conference

II. Course Code : VSR 787

III. Credit Hours : 0+1

IV. Practical

Present seminar on unusual/ interesting clinical cases done in the semester. Compile them from presentation to follow up and also submit the write up in soft or hard copy.

I. Course Title : Special Problem in Diagnostic Imaging

II. Course Code : VSR 788

III. Credit Hours : 0+2

IV. Practical

Investigative diagnosing imaging problems in clinical models, didactic and interpersonal learning-teaching, problem solving self-learning strategies in problems related to surgery

I. Course Title : Special Problem in Anaesthesia

II. Course Code : VSR 789

III. Credit Hours : 0+2

IV. Practical

Investigative anaesthetic problems in clinical models, didactic and interpersonal learning-teaching, problem solving self-learning strategies in problems related to anaesthesia

I. Course Title : Special Problem in Surgery

II. Course Code : VSR 790

III. Credit Hours : 0+2

IV. Practical

Investigative surgical problems in clinical models, didactic and interpersonal learning-teaching, problem solving self-learning strategies in problems related to surgery

VSR 791 Doctoral Seminar-I (2+0)

VSR 792 Doctoral Seminar-II (2+0)

VSR 799 Doctoral Research (0+75)



Course Outline: Lecture wise

VSR 704: Cardiovascular Surgery (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Surgical anatomy, pathophysiology	1
2.	Systolic and diastolic functions	1
3.	Heart failure	1
Unit II		
4.	Physical examination	1
5.	Electrocardiography	1
6.	Cardiac catheterization	1
Unit III		
7.	Special preoperative considerations for patients undergoing cardiovascular surgery, surgical approaches to thorax	1
8.	Different techniques of thoracotomy	1
9.	Special instruments required in cardio-thoracic surgery, defibrillator, heart lung machine	1
Unit IV		
10.	Surgical management of congenital cardiac disorders: malpositioning, atrial septal defect, endocardial cushion defect	1
11.	Surgical management of congenital cardiac disorders: tricuspid valve disorder, ventricular septal defect	1
12.	Surgical management of congenital cardiac disorders: pulmonic stenosis, teratology of fallot	1
13.	Surgical management of congenital cardiac disorders: eisenmenger's complex, anomalous pulmonary venous return	1
14.	Surgical management of congenital cardiac disorders: mitral valve abnormalities, aortic stenosis, aortic regurgitation	1
15.	Surgical management of congenital cardiac disorders: transposition of the great vessels, aortic pulmonary window, persistent arteriosus	1
16.	Surgical management of congenital cardiac disorders: patent ductus arteriosus, coarctation of aorta, persistent right aortic arch	1
17.	Surgical management of congenital cardiac disorders: pericardial diaphragmatic hernia	1
Unit V		
18.	Acquired cardiac disorders: mitral regurgitation, tricuspid regurgitation	1
19.	Acquired cardiac disorders: dirofilariasis	1
20.	Acquired cardiac disorders: acquired aortic regurgitation, endocarditis	1
21.	Acquired cardiac disorders: heart block	1
22.	Acquired cardiac disorders: cardiomyopathy, pericarditis, heart tumours	1
23.	Acquired cardiac disorders: hypothermia, extracorporeal circulatory support	1



S. No.	Topics	No. of Lectures/ Practicals
24.	Acquired cardiac disorders: cardiopulmonary bypass	1
25.	Acquired cardiac disorders: artificial heart transplant, post operative management	1
26.	Acquired cardiac disorders: basic peripheral vascular procedures arteriotomy, venotomy, anastomosis	1
27.	Acquired cardiac disorders: portocaval shunts and anomalies	1
Practical		
1.	Instrumentation and suture techniques for cardiovascular surgery	2
2.	Vascular prostheses	1
3.	Anticoagulants	1
4.	Surgical approaches to thorax	1
5.	Different techniques of thoracotomy	1
6.	Hand-on-training of techniques of centesis of thoracic cavity on cadavers	1
7.	Hand-on-training of thoracic drain placement	1
8.	Demonstration of pericardiocentesis	1
9.	Demonstration of pericardiotomy	1
10.	Demonstration of cardiac catheterization	1
11.	Demonstration of pericardiectomy on cadaver and clinical cases of constructive pericarditis	1
12.	Demonstration of cardiac biopsy techniques	1
13.	Demonstration of use of IPPV in thoracic surgery	1

Suggested Reading

- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Slatter DH. 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.

VSR 705: Advances in Anaesthesiology (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Cellular and molecular mechanisms of anaesthesia	1
2.	Effects of anaesthesia on different systems	3
Unit II		
3.	Drug interactions with anaesthetics	1
4.	Pharmacokinetics and pharmacodynamics of anaesthetics	2
5.	CRI and TCI, computer assisted anaesthesia	1
Unit III		
6.	Opioids, alpha-2 agonists and ketamine for epidural anaesthesia	2
7.	Acupuncture and electroanaesthesia	
Unit IV		
8.	Critical care in ICU	1
9.	Pain transmission and processing, methods for pain assessment in animals	1
10.	Multimodal and preemptive analgesia	1
11.	Techniques and drugs for pain managements	1



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S. No.	Topics	No. of Lectures/ Practicals
Unit V		
12.	Anaesthesia for selected diseases (cardiovascular dysfunction)	1
13.	Anaesthesia for selected diseases (pulmonary dysfunction)	1
14.	Anaesthesia for selected diseases (neurologic diseases)	1
15.	Anaesthesia for selected diseases (renal diseases)	1
16.	Anaesthesia for selected diseases (hepatic diseases)	1
17.	Anaesthesia for selected diseases (gastrointestinal diseases)	1
18.	Anaesthesia for selected diseases (endocrine diseases, airway diseases)	1
Unit VI		
19.	Anaesthesia for special patients (ocular patients)	1
20.	Anaesthesia for special patients (heart patients)	1
21.	Anaesthesia for special patients (caesarian section patients)	1
22.	Anaesthesia for special patients (trauma patients)	1
23.	Anaesthesia for special patients (neonatal patients)	1
24.	Anaesthesia for special patients (geriatric patients)	1
Practical		
1.	Various procedures for catheterization of heart and great vessels	2
2.	Central venous line	1
3.	Haemodynamic changes during trials of anaesthetics	2
4.	Electrocardiography	1
5.	Encephalographic evaluation of central nervous system activity	1
6.	Cybernetics	1
7.	Data acquisition and retrieval	1
8.	Administration and monitoring of newer anaesthetics combinations	6

Suggested Reading

- Aronson LR. 2016. *Small Animal Surgical Emergencies*. Wiley Blackwell.
- Clarke KW, Trim CM and Hall LW. 2013. *Veterinary Anaesthesia*. 11th ed. WB Saunders.
- Grim KA, Lamont LA, Tranquilli WJ, Greene SA and Robertson SA. 2015. *Veterinary Anaesthesia and Analgesia*. 5th ed. Lumb and Jones. Wiley Blackwell.
- Grim KA, Tranquilli WJ and Lamont LA. 2011. *Essentials of Small Animal Anesthesia and Analgesia*. 2nd ed. Wiley Blackwell.
- Paddleford RR. 1999. *Manual of Small Animal Anesthesia*. 2nd ed. WB Saunders.

VSR 706: Advances in Radiology (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Biological effects of radiations (alpha, beta, X-ray and gamma rays) <i>in vivo</i> and <i>in-vitro</i> cellular response following radiation as an immunosuppressive agent	4
Unit II		
2.	Different kind of projections and positioning, contrast material, different contrast techniques, PACS	4
Unit III		
3.	Radiography of head region	1



Veterinary Clinical Subjects: Veterinary Surgery and Radiology

S. No.	Topics	No. of Lectures/ Practicals
4.	Radiography of neck region	1
5.	Radiography of thorax	1
6.	Lung patterns	1
7.	Radiography of abdominal region	1
8.	Radiography of pelvic region	1
Unit IV		
9.	Radiography of limbs for lameness and fracture diagnosis	1
10.	Application of image intensifiers in veterinary practice	1
11.	Different types of screens	1
Unit V		
12.	Computerized radiography (CR)	1
13.	Digital radiography (DR)	1
14.	Contrast CT	1
15.	Contrast MRI	1
16.	PETCT	1
17.	Advances in scintigraphy	1
18.	Radiation therapy in cancer patients	1
19.	Biological effects of radiation physics	1
20.	Physics of radiation, electromagnetic radiations	1
21.	Hazards of electromagnetic radiations and protection and bio-safety	2
Practical		
1.	Radiographic positioning	3
2.	Radiation safety measures	1
3.	Handling radioactive material	1
4.	Clinical radiological diagnosis at Radiology Unit	8
5.	Demonstration of advanced radiological techniques	2

Suggested Reading

- Bargai U, Pharr, JW and Morgan JP. 1989. *Bovine Radiology*. Iowa State University Press, Ames.
- Bushong SC. 2017. *Radiologic Science for Technologists*. 11th ed. CV Mosby.
- Gillette EL, Thrall DE and Lebel JL. (Eds.). 1977. *Carlson's Veterinary Radiology*. Lea and Febiger.
- Kealy JK, McAllister H and Graham JP. (Eds.). 2011. *Diagnostic Radiology and Ultrasonography of the Dog and Cat*. 5th ed. WB Saunders, Philadelphia.
- Morgan JP. 1972. *Radiology in Veterinary Orthopaedics*. Lea and Febiger.
- Thrall DE. 2017. *Textbook of Veterinary Diagnostic Radiology*. 7th ed. Saunders, Philadelphia.

VSR 707: Advances in Diagnostic Imaging Techniques (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Techniques of ultrasonography for diagnosis of different affections of neck	1
2.	Techniques of ultrasonography for diagnosis of different affections of thorax (echocardiography, Doppler techniques)	3



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S. No.	Topics	No. of Lectures/ Practicals
3.	Techniques of ultrasonography for diagnosis of different affections of abdomen and pelvis (Urinary bladder and prostate)	1
4.	Techniques of ultrasonography for diagnosis of different affections of synovial joints	1
5.	Techniques of ultrasonography for diagnosis of different affections of muscle and tendons.	1
6.	Techniques of ultrasonography for diagnosis of different affections of eye.	1
Unit II		
7.	Interpretation of ultrasonogram of different body organs/ vessels (normal and abnormal)	3
8.	Therapeutic applications of ultrasonography for physiotherapy	1
Unit III		
9.	Imaging modalities like, MRI, CT scan, nuclear medicine, positron emission tomography technique, single-photon emission computed tomography etc	4
10.	Nuclear Scintigraphy-isotopes (natural and man-made); cyclotron reactor, half-life, decay pattern, storage and handling of radioactive material	4
Unit IV		
11.	Methods in the detection of isotopes, Geiger-Muller tubes, photo-multiplier tube, medical use of isotope, dosimetry	2
12.	Nuclear medicine and its use in diagnosis of thyroid	1
13.	Nuclear medicine and its use in diagnosis of kidney	1
14.	Nuclear medicine and its use in diagnosis of bone	1
15.	Nuclear medicine and its use in diagnosis of liver function studies	1
16.	Labelling of isotope and biological uses, detonation and fission products, image storage and transfer, DICOM, PACKS and Tele interpretation	3
Practical		
1.	Hands-on-practice on different visceral organs collected from slaughter house for ultrasonographic scanning in water tub, dry and wet lab training	6
2.	Demonstration and practice on different clinical cases reported for ultrasonography	7
3.	Visit to places with facility of other alternate imaging techniques	2

Suggested Reading

- Bargai U, Pharr, JW and Morgan JP. 1989. *Bovine Radiology*. Iowa State University Press, Ames.
- Barr FJ and Gaschen L. 2011. *BSAVA Manual of Canine and Feline Ultrasonography*. British Small Animal Veterinary Association.
- Boon JA. 2011. *Veterinary Echocardiography*. 2nd ed. Wiley-Blackwell.
- Bushong SC. 2017. *Radiologic Science for Technologists*. 11th ed. CV Mosby.
- Butler JA, Colles CM, Dyson SJ, Kold SE and Poulos PW. 2017. *Clinical Radiology of the Horse*. 4th ed. Wiley Blackwell.
- Gillette EL, Thrall DE and Lebel JL. (Eds.). 1977. *Carlson's Veterinary Radiology*. Lea and Febiger.
- Goddard PJ. 1995. *Veterinary Ultrasonography*. CABI.



- Kealy JK, McAllister H and Graham JP. (Eds.). 2011. *Diagnostic Radiology and Ultrasonography of the Dog and Cat*. 5th ed. WB Saunders, Philadelphia.
- Mannion P. 2006. *Diagnostic Ultrasound in Small Animal Practice*. Blackwell Science.
- Mantis P. 2016. *Practical Small Animal Ultrasonography Abdomen*. SERVET, Spain.
- Morgan JP. 1972. *Radiology in Veterinary Orthopaedics*. Lea and Febiger.
- Nyland TG and Mattoon JS. 2002. *Small Animal Diagnostic Ultrasound*. WB Saunders.
- Thrall DE. 2017. *Text book of Veterinary Diagnostic Radiology*. 7th ed. Saunders, Philadelphia.
- Weisse C and Berent A (Eds.) 2015. *Veterinary Image Guided Interventions*. Wiley Blackwell.

VSR 708: Advances in Orthopaedics (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Biomechanics of bone, fracture etiology	1
2.	Fracture reduction and different fracture fixation techniques like IM pinning	1
3.	Fracture reduction and different fracture fixation techniques like plating	1
4.	Fracture reduction and different fracture fixation techniques like nailing (inter locking nailing) and external skeletal fixation	1
5.	Fracture reduction and different fracture fixation techniques like external skeletal fixation	1
Unit II		
6.	Types, properties, biomechanics and use of different orthopaedic implants	1
7.	Bone grafts and their collection, preservation, indications and limitations	1
8.	Bone graft substitutes like ceramics and composites, their usage and limitations	1
Unit III		
9.	Principles of osteogenesis, osteoinduction and osteoconduction	2
Unit IV		
10.	Advances in internal fixation techniques in veterinary orthopaedics	2
11.	Advances in internal fixation techniques in veterinary orthopaedics	2
12.	Advances in external skeletal fixation techniques in veterinary orthopaedics	2
13.	Metabolic bone diseases like rickets, osteomalacia, osteodystrophy and secondary hyperparathyroidism, etc.	2
14.	Classification, diagnosis and treatment of arthritis.	3
15.	Advances in the management of congenital and acquired disorders of joints like traumatic dislocations, luxations and dysplasia.	2
16.	Etiopathology and management of equine lameness including laminitis, navicular disease, quitter, canker and thrush, sand cracks, ring bone, hygromas, bursitis, spavin and splint.	5
17.	Affections of muscles, tendons and ligaments	1
18.	Joint prosthesis and transplantation	1
Unit V		
19.	Postoperative management of orthopaedic patients including the role of movement restriction, weight bearing, nutritional therapy, physiotherapy and rehabilitation	2
20.	Introduction to recovery assessment using lameness score, gait analysis using computerized software	2



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S. No.	Topics	No. of Lectures/ Practicals
Practical		
1.	Hands on practice for different internal fixation techniques on cadaver	4
2.	Management of different types of long bone fractures in different species of domestic animals, with special reference to practice of bone plating	1
3.	Management of different types of long bone fractures in different species of domestic animals, with special reference to practice of interlocking nailing	1
4.	Management of different types of long bone fractures in different species of domestic animals, with special reference to practice of external skeletal fixation	1
5.	Treatment of metabolic bone diseases in growing animals	1
6.	Correction of antebrachial deformities including osteotomies and limb lengthening procedures	1
7.	Preservation of bone grafts	1
8.	Practice of bone grafting and use of osteoinducers in clinical situation	1
9.	Clinical and radiographic evaluation of various joint affections	1
10.	Reduction and fixation of different joint luxations like coxo-femoral, patellar, femoro-tibial, hock, scapulo-humeral, elbow and temporomandibular	1
11.	Techniques of osteotomy, arthrodesis and joint replacement	1
12.	Repair of tendon and ligament injuries	1
13.	Diagnosis and treatment of various conditions causing lameness in equines	1
14.	Diagnosis and treatment of various conditions causing lameness in bovines	1

Suggested Reading

- Auer JA and Stick JA. 2017. *Equine Surgery*. 4th ed. Elsevier Saunders.
- Baxter GM. (Ed.). 2011. *Adams and Stashak's Lameness in Horses*. 6th ed. Wiley-Blackwell
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders.
- Greenough PR. 2007. *Bovine Laminitis and Lameness*. WB Saunders.
- Newton CD and Nunamaker DM. (Eds.). 1985. *Textbook of Small Animal Orthopaedics*. JB Lippincott.
- Oehme FW and Prier JE. (Eds.). 1974. *Textbook of Large Animal Surgery*. Williams and Wilkins.
- Ross MW and Dyson SJ. 2011. *Diagnosis and Management of Lameness in the Horse*. 2nd ed. Elsevier Saunders.
- Tyagi RPS and Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS
- Weaver AD, Jean GS and Steiner A. 2007. *Bovine Surgery and Lameness*. 2nd ed. Wiley-Blackwell.

VSR 709: Neurosurgery (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Nervous system – anatomy, physiology and pathological manifestations	5



S. No.	Topics	No. of Lectures/ Practicals
Unit II		
2.	Clinical neurology	1
3.	Therapeutic neurectomy	1
4.	Nerve anastomosis	1
5.	Pathogenesis of disease of the central nervous system	1
Unit III		
6.	Diagnostic methods – electrodiagnostic methods, neuro radiology	4
Unit IV		
7.	Fundamentals of neurosurgery	1
8.	Surgical approaches to brain	1
9.	Surgical diseases of peripheral nerves	1
10.	Surgical approaches to brain and intracranial surgery	1
11.	Surgical affections and approaches to the spine	2
12.	Diseases of the spinal column	1
13.	Intervertebral disc diseases	1
Unit V		
14.	Surgical approaches to brain and intracranial surgery	3
Practical		
1.	Methods for clinical and neurological examination	1
2.	Electro-encephalography	1
3.	Electromyography and electro-diagnostic testing	2
5.	Collection of CSF and its evaluation	2
7.	Techniques of myelography	1
8.	Vertebral venography	1
9.	Pneumoventriculography	1
10.	Cerebral arteriography	1
11.	Cavernous sinus venography	1
12.	Management of vertebral fractures and luxations with stabilization	1
13.	Treatment of spinal cord compression, viz., disc fenestration, hemilaminectomy, dorsal laminectomy and ventral slot	2
15.	Techniques of peripheral nerve anastomosis and reconstruction of peripheral nerves	2

Suggested Reading

- Dewey CW and C da Costa R. 2016. *Practical Guide to Canine and Feline Neurology*, 3rd ed. Wiley Blackwell.
- Lorenz MD, Coastes JR and Kent M. 2011. *Handbook of Veterinary Neurology*, 5th ed. Elsevier.

VSR 710: Reconstructive and Regenerative Surgery (1+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Principles of regenerative medicine, tissue homeostasis	1
2.	Tissue and organ transplantation, histo-compatibility matching	1



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S. No.	Topics	No. of Lectures/ Practicals
3.	Transplantation immunity and host graft reaction, immunosuppression	1
	Unit II	
4.	Classification, isolation, characterization, storage and application of stem cells, extracellular matrix,	3
5.	Microenvironment and growth factors for tissue repair and regeneration	1
	Unit III	
6.	Synthetic and biological scaffolds	1
7.	Preparation of biological scaffold and its role in tissue regeneration	1
8.	Whole organ decellularization and its application, biomimetic scaffolds	1
	Unit IV	
9.	Designing for 3D printing, bio-fabrication of organ and tissue substitutes and its applications	1
10.	Ethical concerns in regenerative medicine	1
11.	GMP protocols and its applications in regenerative medicine	1
	Unit V	
12.	Current techniques in designing and clinical application of biomaterials,	2
13.	Mechanical and functional testing of biomaterials	1
14.	Biocompatibility testing	1
	Practical	
1.	Collection of bone marrow derived stem cells from different species of animals	3
2.	Growth and differentiation of stem cells in different lineages	1
3.	Decellularization of different tissues and organs	6
4.	Cell growth on different scaffolds	3
5.	Clinical application of stem cells	3

Suggested Reading

- Bojrab Joseph M, Monnet Eric. 2010. *Mechanisms of Disease in Small Animal Surgery*, 3rd Teton New Media, U.S.
- Griffers D and Hamaide A. (Eds.). 2016. *Complications in Small Animal Surgery*. Wiley Blackwell.
- Theoret C and Schumacher J. 2017. *Equine Wound Management*. Griffon, D and Hamaide A 2016. *Complications in Small Animal Surgery*, Wiley Blackwell.

VSR 711: Advances in Soft Tissue Surgery (2+1)

S. No.	Topics	No. of Lectures/ Practicals
	Theory	
	Unit I	
1.	Advances in surgeries of ENT affections of small and large animals- rhinoscopy, rhinotomy, tumors of turbinates	1
2.	Advances in surgeries of ENT affections of small and large animals- cheiloplasty, hare lip correction, salivary duct ligation, parotid gland abalation	1
3.	Advances in surgeries of ENT affections of small and large animals- bullaosteotomy, buccotomy procedures, glossoplagia, self suck correction	1



S. No.	Topics	No. of Lectures/ Practicals
Unit II		
4.	Upper respiratory tract affection in small and large animals- barchiocephalic air way syndrome, laryngeal paralysis	1
5.	Upper respiratory tract affection in small and large animals- tracheal collapse, tracheostomy (temporary/ permanent)	1
6.	Upper respiratory tract affection in small and large animals- chest trauma, chest tube placement, thoracocentesis	1
7.	Upper respiratory tract affection in small and large animals- pneumectomy, (partial/ unilateral), heart lung transplant, thoracic duct ligation	1
8.	Upper respiratory tract affection in small and large animals- thoracic duct ligation, trans tracheal intubation, thoracoscopic procedure	1
Unit III		
9.	Esophageal affections in small and large animals- dilatation, diverticulum, PRAA- Mullers surgery	1
10.	Esophageal affections in small and large animals- gastroesophageal intussception, short bowel syndrome	1
11.	Esophageal affections in small and large animals- colostomy, megacolon, rectal tube placement	1
12.	Esophageal affections in small and large animals- rectal diverticulum, gastroscopy techniques	1
Unit IV		
13.	Pyelolithotomy, lithotripsy	1
14.	Renal transplantation	1
15.	Ectopic ureter, prostatectomy, urinary incontinence	1
16.	Penile urethrotomy, urethroscopic retrieval of urolith, endoscopic ureter stent placement	1
Unit V		
17.	Thyroidectomy in cats, liver lobectomy	1
18.	Cholelithiasis, cholecystectomy, cholecystoduodenostomy	1
19.	Porto caval shunt, adrenalectomy	1
Unit VI		
20.	Skin grafting, subdermal, axial skeletal, omocervical axial pattern flap	1
21.	Thoracodorsal axial pattern flap, superficial brachial axial pattern flap, caudal superficial epigastric axial pattern flap	1
22.	Cranial superficial epigastric axial pattern flap, deep circumflex iliac dorsal axial pattern flap	1
23.	Deep circumflex iliac ventral axial pattern flap, genicular axial pattern flap	1
24.	Reverse saphenous conduit flap, caudal auricular axial pattern flap,	1
25.	Split thickness and full thickness grafts	1
26.	Reconstructive surgical procedures	1
Practical		
1.	Endoscopic surgical procedures in small and large animals	1
2.	Chest tube placement	1
3.	Rhinoscopy	1
4.	Thoracoscopy	1
5.	Bronchoscopy	1
6.	Gastroscopy	1
7.	Colonoscopy	1



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S. No.	Topics	No. of Lectures/ Practicals
8.	Urethrocytoscopy	1
9.	Laparoscopic surgical techniques	2
10.	Skin flap and grafting techniques	3
11.	Tracheostomy	1
12.	Renal graft cystoplasty	1

Suggested Reading

- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders
- Slatter DH. 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.
- Yool DA. 2012. *Small Animal Soft Tissue Surgery*. CABI

VSR 712: Advances in Ophthalmology (1+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Embryology of the eye, study of ocular physiology and biochemistry	1
2.	Structure and function of eye and adnexa, physiology of vision, electrophysiology of visual system	1
Unit II		
3.	Advances in diagnosis and diseases of the eye and adnexa	2
Unit III		
4.	Ocular neoplasia, advances in neuro ophthalmology	1
5.	Advances in ophthalmic pharmacology, microbiology and nutrition	1
Unit IV		
6.	Advances in ocular imaging	1
7.	Advances in ocular anaesthesia and analgesia	1
Unit V		
8.	Advances in ocular emergencies	1
9.	Ophthalmology of exotic species	1
10.	Ophthalmology of lab animals	1
11.	Ocular toxicology	1
Unit VI		
12.	Corneal grafting	1
13.	Application of nanotechnology in veterinary ophthalmology	1
14.	Application of stem cell therapy in veterinary ophthalmology	1
Practical		
1.	Exposure to latest ophthalmic instrumentation like phaco	1
2.	Exposure to latest ophthalmic instrumentation like ultrasound	1
3.	Exposure to cataract surgery and lens implantation	10
4.	Corneal transplantation	3

**Suggested Reading**

- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders
- Gelatt KN. 2014. *Essentials of Veterinary Ophthalmology*. 3rd ed. Wiley Blackwell. US.
- Gilger BC. 2017. *Equine Ophthalmology*, 3rd ed. Wiley Blackwell.
- Maggs DJ, Miller PE and Ofri R. 2017. *Slatter's Fundamentals of Veterinary Ophthalmology*. 6th ed. Saunders.
- Slatter DH. 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.

VSR 713: Surgical Oncology (1+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
Unit I		
1.	Biology of neoplastic disease: etiology, cellular mechanism	1
2.	Principles of surgical oncology	1
Unit II		
3.	Diagnosis, classification and clinical staging of tumors and decision making for therapy, metastasis	2
Unit III		
4.	Surgical management: surgical excision of tumors, cytoreductive surgery	1
5.	Surgical management: surgery for metastatic disease, palliative surgery, evaluation and interpretation of surgical margins	1
Unit IV		
6.	Clinical signs, diagnosis and treatment options of tumors of skin, soft tissues	1
7.	Clinical signs, diagnosis and treatment options of tumors of skeletal system, head and neck	1
8.	Clinical signs, diagnosis and treatment options of tumors of gastro-intestinal tract, respiratory tract	1
9.	Clinical signs, diagnosis and treatment options of tumors of urinary tract, genital tract, mammary gland	1
10.	Clinical signs, diagnosis and treatment options of tumors of nervous system, endocrine system, haematopoietic system	1
11.	Clinical signs, diagnosis and treatment options of tumors of the eye and orbit and miscellaneous tumours	1
Unit V		
12.	Radiation therapy, chemotherapy	1
13.	Electrochemotherapy, cryotherapy and targeted therapy	1
14.	Side effects of radio and chemotherapy	1
15.	Nutritional management of cancer patients, basics of immunotherapy in cancer management	1
Practical		
1.	Fine needle aspiration biopsy	1
2.	Needle core biopsy	1
3.	Excisional biopsy	1
4.	Incisional biopsy	1
5.	Bone marrow biopsy	1
6.	Lymph node biopsy	1



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S. No.	Topics	No. of Lectures/ Practicals
7.	Percutaneous lung biopsy	1
8.	Bone biopsy	1
9.	Ultrasound guided biopsy	1
10.	Laparoscope guided biopsy	1

Suggested Reading

- Kudnig ST and Sequin B. 2012. *Veterinary Surgical Oncology*, Wiley Blackwell.
- Fossum TW. 2018. *Small Animal Surgery*. 5th ed. Mosby.
- Fubini SL and Ducharme NG. 2016. *Farm Animal Surgery*. 2nd ed. Saunders.
- Maggs DJ, Miller PE and Ofri R. 2017. *Slatter's Fundamentals of Veterinary Ophthalmology*. 6th ed. Saunders.
- Slatter DH. 2003. *Textbook of Small Animal Surgery*. 3rd ed. WB Saunders.

Minor Courses for Ph.D. Degree programme

Courses of any one department/ discipline from the list given below:

- Veterinary Physiology
- Veterinary Biochemistry
- Veterinary Biotechnology
- Veterinary Anatomy
- Veterinary Medicine
- Veterinary Pathology
- Animal Reproduction, Gynaecology and Obstetrics
- Animal Biotechnology

Supporting Courses

It could be any subject considered relevant for student's research work. This will be decided by Advisor/ Guide concerned.



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Veterinary Clinical Subjects

– Veterinary Medicine





Preamble

(Veterinary Medicine)

Presently, the veterinary education at undergraduate level is regulated by Veterinary Council of India. Two separate departments of Veterinary Clinical Medicine, Ethics and Jurisprudence and Veterinary Epidemiology and Preventive Medicine were merged in 2008 following implementation of VCI norms as per Minimum Standards of Veterinary Education-2008 (MSVE-2008) and also being followed and strictly implemented as per revised VCI norms (MSVE-2016) issued by The Gazette of India Notification. Single department of Veterinary Medicine is functional in most of the colleges and universities of Veterinary Sciences including Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly. Therefore, the courses in clinical and preventive medicine have been redesigned under the subject of veterinary medicine. The national eligibility test (NET), being conducted by ICAR, New Delhi, in the subject of veterinary medicine includes syllabus for both clinical and infectious diseases. Course curriculum related to Epidemiology will be covered by the Department of Veterinary Public Health and Epidemiology as per the mandate of the BSMA Committee constituted by ICAR on the recommendation by National Core Group.

The Master's and Doctoral courses and the contents were critically examined for revisions in the light of advances transpired in the discipline of veterinary medicine during the last ten years. Precedence has been given to important species, viz., cattle, buffalo, sheep, goat, pig, canine, feline and equine in the course curriculum for M.V.Sc. programme. The courses have been reorganized with respect to species, viz., ruminant, canine and feline and equine, etc. and attempt has been made to cover all the systemic diseases in a comprehensive manner. Contents of the courses have been revised by including newer trends in diagnosis, treatment, management and prevention of various diseases. Different disease conditions have been listed precisely in ruminant and equine medicine courses so as to remove ambiguity in covering of the various topics.

Small animal practice has grown exponentially in last decade. Accordingly, courses in small animal have been recasted by giving emphasis on diseases of gastro-intestinal, respiratory, cardiovascular system. Endocrine disorders, coagulopathies, immune mediated diseases and neoplastic diseases have been given special emphasis. Problem oriented approach to common disease manifestations for better understanding and applications has been added in canine and feline courses for improving diagnostic skills of the students. In recent times, small animals are also frequently presented for behavior disorders. Therefore, topics on pet psychology, pet behavior, adaptation needs and behavioral medicine have been incorporated.

Two separate courses on clinical diagnostic techniques and emergency medicine have been designed to provide hands on training on diagnostic procedures and practical training. Topics have been included to train the students for special examination of different body systems. Emerging diseases have been added to the course curriculum. Two new courses, viz., Geriatrics and Paediatrics, Oncology and Ethno-Veterinary Medicine have been added. To provide practical approach to the diagnosis and investigation of infectious diseases, a special course on investigation of disease outbreaks has been included in the revised curriculum.



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Ph.D. courses have been designed according to body systems. This approach will help students in better comprehension of the diseases as already being followed in all veterinary colleges of countries with very high standards of veterinary education and research (USA, Canada and Europe). The doctorates, following new restructured Ph.D. curricula should, in future, manifest as specialists in the field of their specialization.

Management of emergency cases and critically ill patients is an upcoming challenge for practicing veterinarians. Special training is required for monitoring and resuscitation of critically ill patients as well as diagnosis, management and emergency care procedures for common emergencies. Therefore, a special course on 'Veterinary Emergency and Critical Care Medicine, has been designed for Ph.D. programme. Similarly, a new course on 'Advances in Veterinary Diagnostics' has been added to enhance the diagnosis skills and hands on training on the use of ophthalmoscopy, ultrasonography, endoscopy, pulse-oximetry electrocardiography, echocardiography and their interpretations.

The revision of courses has been given due importance in consonance with the national initiatives and key Central Government policies to improve productivity and livestock health. The course contents have been revised comprehensively to cover syllabi, which will be immensely helpful in introducing and exploring new insights and improving clinical knowledge and skill competency of the students, keeping in view the global trends and developments in veterinary clinical diagnosis, education and research.



Course Title with Credit Load M.V.Sc. in Veterinary Medicine

Course Code	Course Title	Credit Hours
VMD 601*	Ruminant Medicine-internal	3+0
VMD 602*	Ruminant Medicine-infectious	3+0
VMD 603	Equine Medicine	2+0
VMD 604*	Canine and Feline Medicine-I	2+0
VMD 605*	Canine and Feline Medicine-II	2+0
VMD 606	Metabolic and Endocrine Diseases, Nutritional Deficiencies and Diseases of Mammary Gland	2+0
VMD 607	Paediatrics and Geriatrics	2+0
VMD 608	Avian and Swine Medicine	2+0
VMD 609	Zoo, Wild and Laboratory Animal Medicine	1+0
VMD 610	Toxicology and Forensic Medicine	1+0
VMD 611*	Clinical Diagnostic Techniques	0+2
VMD 612	Emergency Medicine	0+2
VMD 613*	Diagnosis of Veterinary Infectious Diseases	0+1
VMD 614	Oncology and Ethno-veterinary Medicine	1+0
VMD 615	Animal Disease Investigation and Biosecurity	1+1
VMD 616*	Clinical Practice-I	0+3
VMD 617*	Clinical Practice-II	0+3
VMD 691	Master's Seminar	1+0
VMD 699	Master's Research	0+30

*Core Courses



Course Contents

M.V.Sc. in Veterinary Medicine

- I. Course Title : Ruminant Medicine - Internal**
II. Course Code : VMD 601
III. Credit Hours : 3+0
IV. Aim of the course

Internal diseases of Digestive, Respiratory, Urinary, Cardiovascular, Blood and blood forming organs, Nervous, Musculoskeletal system, Skin, eye and ear of bovine, Sheep, and goat.

V. Theory

Unit I

Examination of alimentary tract and abdomen; Diseases of the buccal cavity and related organs including pharynx, Oesophagus. Reticulo-ruminal fermentative disorders (simple indigestion, impaction, ruminal lactic acidosis), Primary and secondary bloat, Diaphragmatic hernia, Traumatic reticulo-peritonitis and Omasal impaction.

Unit II

Diseases of abomasum (impaction, displacements, ulcers, bloat), Acute and chronic diarrhoea, Intestinal obstructive disorders (intussusception, volvulus), Peritonitis, caecal dilatation and hemorrhagic bowel syndrome.

Unit III

Manifestations of liver and biliary diseases, Focal and diffuse diseases of liver. Disease of nasal cavity, sinuses, disease of larynx and trachea, pneumonias, pleuritis, manifestations Principles of treatment in uro-genital system; Rupture, Paralysis and infections of urinary bladder, Urolithiasis, Nephritis and renal failure, Nephrosis, renal ischemia, Hemolytic uremic like syndrome, Uremia and neoplasms of urinary tract.

Unit IV

Examination of cardiac system and Special examination of heart (ECG, echocardiography, Markers for diagnosis of cardiac disorders. Principal manifestations of cardiovascular diseases, congenital cardiac diseases, myocarditis, cardiomyopathy, endocarditis, pericarditis, phlebitis, thrombosis, anemia, lymphangitis, lymphadenopathies and thrombocytopenia.

Unit V

Principles of nervous dysfunction, Clinical manifestation and special examination, Localization of lesion in brain and spinal cord, Cortical diseases, Brain abscess, Meningitis, Diseases of brainstem, Cerebellar diseases, Spinal cord compression and peripheral nerve paralysis. Principal manifestations and special examination of musculoskeletal system, Myositis, Myopathies, Foot lameness, Arthritis, Osteodystrophies, Degenerative joint disease and nutritional deficiency diseases affecting musculoskeletal system; conjunctivitis, Keratitis, uveitis, Horner syndrome,



neoplasms of eye, otitis media, otitis externa; Skin diseases: folliculitis, furunculosis and skin neoplasms.

- I. Course Title : Ruminant Medicine-infectious**
II. Course Code : VMD 602
III. Credit Hours : 3+0
IV. Aim of the course

Bacterial, fungal, chlamydial, viral, parasitic, mycoplasmal, prions and rickettsial diseases of bovine, sheep, and goat.

V. Theory

Unit I

Clostridial diseases-black quarter, Botulism, Bacillary hemoglobinuria, Braxy, Enterotoxemia, Malignant edema, Pulpy kidney disease, Tetanus, Collibacillosis, Salmonellosis, Compylobacteriosis, Listeriosis, Actinobacillosis, Actinomycosis, Anthrax, Tuberculosis, Johne's disease, Leptospirosis, Pasteurellosis, Ulcerative lymphangitis, Infectious bovine keratoconjunctivitis, Chlamydiosis infections, Dermatophytosis, Cutaneous streptothricosis, Candidiasis and Rhinosporidiosis.

Unit II

Foot and mouth disease, Vesicular stomatitis, Vesicular exanthema, Rinderpest, PPR, Bovine viral diarrhea, Mucosal disease, Ephemeral fever, Bovine herpes viral diseases, Leucosis, Viral pneumonia, Pox diseases, Infectious gastroenteritis of viral etiology. Malignant catarrh fever, Rabies, Bluetongue, Louping ill, Papillomatosis, Contagious ecthyma (orf), Caprine arthritis and Encephalopathy(CAE), Contagious bovine pleuropneumonia and Contagious caprine pleuropneumonia.

Unit III

Bovine spongiform Encephalopathy, Scarpie, Bovine Anaplasmosis, Theileriasis, Babesiosis, Fasciolosis, Amphistomiosis, Gastrointestinal nematodiosis, Schistosomiosis, Lung worm infection, Echinococcosis, Coenurosis and Tapeworm infections, Coccidiosis, Thelaziasis, parasitic dermatitis (scabies, psoroptes).

- I. Course Title : Equine Medicine**
II. Course Code : VMD 603
III. Credit Hours : 2+0
IV. Aim of the course

Internal and infectious diseases of Equines

V. Theory

Unit I

Diseases of buccal cavity (dental diseases, stomatitis), Oesophagus, Gastric dilatation, gastro-duodenal ulceration, Acute and chronic diarrhea, Colic, Acute and chronic hepatitis.

Unit II

Diseases of cardio-vascular system and blood forming organs; Manifestations and principles of treatment in respiratory disorders, Epistaxis, Ethmoidal hematoma,



pharyngitis, sinusitis, Guttural pouch diseases, Tracheal collapse, Adult pneumonia, foal pneumonia, Recurrent air way obstruction, Inflammatory airway disease, Pleura-pneumonia, Pulmonary congestion and edema; Manifestations and principles of treatment of urinary system diseases, Rupture of urinary bladder, Paralysis, urolithiasis, Urinary tract infections, Acute and chronic renal failure and Neoplasms of urinary tract.

Unit III

Principal manifestations of musculoskeletal diseases, Laminitis, Inflammatory Myopathy, Exertional Myopathies, Myotonia, Hyperkalemic periodic paralysis and Nutritional deficiency diseases affecting musculoskeletal system.

Nervous diseases, Viral encephalitis, Intracarotid drug injection, Trauma to brain and cranial nerves, Brain abscess, Peripheral vestibular disease, Temporo-hyoid osteoarthropathy, Ataxia (sorghum toxicity, spinal abscesses), Peripheral facial nerve paralysis, Peripheral nerve disorders; Skin diseases, bacterial, fungal, parasitic and allergic dermatitis (culicoides hypersensitivity), Cutaneous eczema, Cutaneous acne, Cutaneous pustular dermatitis, Candidiasis, Histoplasmosis, Coccidioidomycosis and dermatophytosis.

Unit IV

Bacterial, fungal and viral keratitis, Equine recurrent uveitis, Uveitis, Ocular neoplasia. Trypanosomiasis/ dourine, Babesiosis, Parasitic pneumonia, Strangles, equine influenza, Equine herpes virus infection, Potomac horse fever, Equine infectious anaemia and setariasis.

I. Course Title : Canine and Feline Medicine-I

II. Course Code : VMD 604

III. Credit Hours : 2+0

IV. Aim of the course

Internal (digestive, liver, pancreas, cardiovascular, blood and blood forming organs) and infectious (bacterial, parasitic and protozoal) diseases of dogs and cats.

V. Theory

Unit I

Diagnostic approach to common manifestations of disease: Vomiting, acute diarrhea, Chronic diarrhea, Syncope, Anemia, Jaundice, Fever, Weight loss, Edema, Dyspnoea, coughing and nasal discharge.

Unit II

Etiology, pathogenesis, clinical signs, clinical pathology, diagnosis, Differential diagnosis and treatment of diseases of the oral cavity, oesophagus, acute gastritis, chronic gastritis, Gastric dilatation, Volvulus, Tumors of the stomach, Intussusception, Acute enteritis, Chronic enteritis, Inflammatory bowel disease, Colitis, Gastric and Intestinal foreign bodies, Diseases of rectum and anal sac, Peritonitis, Acute hepatitis, Chronic hepatitis, Diseases of gall bladder, Cholangitis, Vascular liver diseases, Extra hepatic biliary system, Acute pancreatitis and Exocrine pancreatic insufficiency.

Unit III

Anemia, Lymphangitis, Lymphadenopathies, Coagulopathies, Immune mediated



diseases, Neoplastic diseases of hemo-lymphatic system; Examination of cardiac system and special examination of heart (ECG, Echocardiography, Holter and markers for diagnosis of cardiac disorders), Congenital heart diseases, Dilated cardiomyopathy, Endocardiosis, Cardiac arrhythmias, Pericardial disorders. Pet psychology, Pet behaviour, Adaptation needs and Behavioural medicine

Unit IV

Leptospirosis, Tetanus, Brucellosis, Lyme disease, Rocky mountain spotted fever, Kennel cough, Trypanosomiasis, Ehrlichiosis, Ancylostomiasis, Dirofilariasis, Giardiasis, Coccidiosis/ Isosporosis, Toxoplasmosis, Babesiosis, Neosporosis, Hepatozoonosis and Tape worm infections.

- I. Course Title : Canine and Feline Medicine-II**
- II. Course Code : VMD 605**
- III. Credit Hours : 2+0**
- IV. Aim of the course**

Internal (respiratory, nervous, urogenital, musculoskeletal, eye, ear and skin) and infectious (viral and fungal) diseases of dogs and cats.

V. Theory

Unit I

Principles of treatment in respiratory disorders, Diseases of nasal cavity, Tracheo-bronchitis, Chronic bronchitis, Pulmonary congestion and edema, Acute pneumonia, Chronic pneumonia, Feline asthma, Pleural effusions and Neoplasms of respiratory tract.

Diagnostic approach to common manifestations of disease: Seizures, Coma, Monoparesis, Pelvic limb paralysis, Pruritis, alopecia, Obesity, Urinary incontinence, Hematuria; Focal, diffuse and multifocal diseases of brain. Diseases of spinal cord and Peripheral nervous system, Vestibular diseases and toxins affecting nervous system.

Unit II

Diseases of muscles- congenital and inherited diseases of muscles, bone and joints, Myasthenia, Myopathy; Nutritional deficiency diseases- Rickets, Primary and Secondary Hyperparathyroidism, Osteodystrophy and Osteomyelitis.

Diseases of eyelids, Epiphora, Keratitis, Conjunctivitis, Uveitis, Glaucoma, Acute blindness and Neoplasms of eye.

Unit III

Skin diseases, Common pyodermas, Atopy, Dermatophytosis and Dermatocytosis, Demodicosis, Scabies, Myiasis, and Nutritional disorders related to skin and its therapeutic management, Flea allergy and its treatment and control measures, Alopecia. Cutaneous manifestations of hormonal imbalances and systemic disorders, Auto immune diseases of skin, Diseases of the pinna, Otitis and principles of treatment in otic infections.

Manifestations and principles of treatment of urinary system diseases, Urinary tract infections, Urolithiasis, Nephritis, Nephrosis, Pyelonephritis, Renal failure and neoplasms of urinary tract.



Unit

Viral diseases: Canine parvovirus, Canine distemper, Corona viral gastroenteritis, Infectious hepatitis, Infectious tracheobronchitis, Canine herpes virus, Rabies, Feline Panleukopenia, Infectious peritonitis (FIP), Feline leukemia virus infection, Feline immunodeficiency virus, Vaccination schedule for canine and feline diseases, Dermatophytosis, Blastomycosis, Histoplasmosis, Sporotrichosis, and coccidioidomycosis.

I. Course Title : Metabolic and Endocrine Diseases, Nutritional Deficiencies and Diseases of Mammary Gland

II. Course Code : VMD 606

III. Credit Hours : 2+0

IV. Aim of the course

Study of diagnosis, management and control of metabolic, endocrine, nutritional and mammary gland diseases.

V. Theory

Unit I

Metabolic profile test parturient paresis, Downer cow syndrome, Acute hypokalemia in cattle, Transit recumbency, Lactation tetany of mares, Hypomagnesemia, Tetany of calves, Ketosis, sub-clinical ketosis, Pregnancy toxemia, Fatty liver syndrome, Equine hyperlipidemia, Steatitis, Neonatal hypoglycemia, low milk fat syndrome, Periparturient hemoglobinuria and Eclampsia in bitches.

Unit II

Deficiency of energy and protein, Deficiency of fat and water soluble vitamins and deficiency of macro- micro minerals.

Unit III

Mastitis, Diseases of teats and udder in ruminants, "mastitis-metritis-agalactia" in sow and congenital abnormalities of udder and teats.

Unit IV

Diabetes mellitus, Diabetes insipidus, Hypothyroidism, Obesity, Hypo- and hyperadrenocorticism.

I. Course Title : Paediatrics and Geriatrics

II. Course Code : VMD 607

III. Credit Hours : 2+0

IV. Aim of the course

Study of non-infectious and infectious diseases of neonates and geriatric animals.

V. Theory

Unit I

Perinatal management, Perinatal adaptation, Neonatal health, Asphyxia and Resuscitation; Physical examination of the neonate, perinatal and neonatal mortality, Colostrum and its substitutes, Manifestations of disease.



Unit II

Immunization of neonates, Fluid replacement therapy, Nutritional support, Blood and Serum transfusion, Antimicrobial therapy and neonatal diarrhoea.

Unit III

Non-infectious and infectious diseases of viral, bacterial, mycoplasma and parasitic origin of neonates, Young and aged farm and companion animals; Diseases acquired from dam, Congenital disorders, Metabolic disorders, Nutritional deficiencies, Miscellaneous conditions (hypothermia, hyperthermia, starvation, arthritis), Management of shock and other emergencies, Detection and correction of failure of passive transfer of immunity.

Unit IV

Geriatric diseases: Senility, Dental diseases, Glaucoma, Cataract, Keratitis sicca, Urinary incontinence, Renal insufficiency, Cardiac diseases, Pulmonary diseases, Neoplasia, Bone and joint diseases, Neurologic disorders, Otologic disorders, Endocrine diseases (diabetes mellitus, cushing's disease, hypothyroidism), Liver diseases, Psychological and behaviour disorders.

I. Course Title : Avian and Swine Medicine

II. Course Code : VMD 608

III. Credit Hours : 2+0

IV. Aim of the course

Recent concepts in non-infectious and infectious diseases of avian species and pigs.

V. Theory

Unit I

Specific needs of avian species; Diseases due to deficiency of vitamins (vitamins A, B complex, C, D, E, K); minerals (calcium, phosphorus, manganese, zinc, etc.) and sodium chloride.

Unit II

Miscellaneous diseases/ conditions/ vices (cage layer fatigue, beak necrosis, blue comb disease, round heart disease, kerato-conjunctivitis, ascites, urolithiasis, fatty liver, kidney hemorrhagic syndrome, heat stroke, cannibalism, vent picking), egg bound peritonitis, diseases of feather, skin, beak and foot, bumble foot, gout, infectious diseases of poultry (marek's disease, lymphoid leukosis, new castle disease, infectious coryza, fowl typhoid, CRD, pullorum disease, coccidiosis, chlamydiosis, avian pox, infectious bursal disease, infectious bronchitis, infectious laryngo-tracheitis, etc.)

Unit III

Nutritional deficiency diseases of pigs, swine influenza, hog cholera, african swine fever, swine pox, vesicular exanthema, vesicular stomatitis, rabies. porcine enteroviruses, pseudorabies, listeriosis, leptospirosis, brucellosis, anthrax, salmonellosis, swine erysipelas, pasteurellosis, tuberculosis, mange, etc.

Unit IV

Handling, physical examination, sampling, diagnostic techniques and medication.



- I. Course Title : Zoo, Wild and Laboratory Animal Medicine**
II. Course Code : VMD 609
III. Credit Hours : 1+0

IV. Aim of the course

Study of diagnosis, management and control of Zoo, wild and laboratory animals.

V. Theory

Unit I

Study of diseases and health management of zoo, Wild and laboratory animals; Etiology, Clinical signs, Diagnosis and management of various diseases of zoo, wild and laboratory animals. Restraint, Feeding, Diseases and health management of exotic animals kept as pets.

Unit II

Specific diseases of laboratory animals caused by bacteria, viruses, fungi and parasites.

Specific diseases of zoo (captive) animals caused by bacteria, viruses, fungi and parasites.

- I. Course Title : Toxicology and Forensic Medicine**
II. Course Code : VMD 610
III. Credit Hours : 1+0

IV. Aim of the course

Study of diseases caused by physical, chemical, other toxicants in domestic animals and animal welfare issues.

V. Theory

Unit I

Diseases caused by physical agents and poisoning of organic and inorganic compounds. Diseases caused by farm chemicals and phytotoxins. Diseases caused by mycotoxins and zootoxins.

Unit II

Collection, Dispatch and Examination of vetro-legal samples. Examination of wounds, blood, offenses and frauds in animal sales. Animal cruelty and welfare related issues. Study of common laws related to vetro-legal aspects.

- I. Course Title : Clinical Diagnostic Techniques**
II. Course Code : VMD 611
III. Credit Hours : 0+2

IV. Aim of the course

To impart training on diagnostic procedures for various diseases of farm and companion animals and their interpretations.

V. Theory

Unit I

Peritoneal fluid analysis, Gastrointestinal endoscopy, Colonoscopy, Proctoscopy,



Ultrasonography, Liver biopsy, Interventional imaging, Rhinoscopy, Bronchoscopy, Transtracheal lavage, Endotracheal lavage, Broncho-alveolar lavage, Thoracocentesis, Pericardiocentesis, Interpretation of hemogram, Renal and Hepatic function tests. Neurological examination.

Unit II

Electrocardiography, Echocardiography, Pulse oximetry, Blood and blood component therapy, Bone marrow biopsy, Arterial blood gas analysis, Cerebrospinal fluid analysis, Cystocentesis, Urinary catheterization, Renal function tests, Specific gravity of urine by refractometer, Skin-biopsy, Cytology- scrapings, Otoscopy, Direct and indirect ophthalmoscopy, Shirmer tear test, Tonometry. Diagnosis tests in mastitis. Assay for T₃, T₄, lipase, Amylase, Radio immunoassay and indications of CT, MRI, nuclear medicine.

I. Course Title : Emergency Medicine

II. Course Code : VMD 612

III. Credit Hours : 0+2

IV. Aim of the course

Diagnosis and management of common emergencies in animals.

V. Practical

- Diagnosis and therapeutic management of various emergencies of cardiovascular, respiratory, gastrointestinal, urinary and nervous systems.
- Diagnosis and therapeutic management of various emergencies of toxicities, sting bites, snake bite and burns in farm and companion animals.
- Monitoring critical ill patient, application of emergency care procedures for resuscitation of critically ill patients.
- Placement of central venous catheters, introsseous fluid administration, endotracheal intubation, gastric lavage, decompression of guttural pouch, stomach, cecum, ventilation, nebulization, fluid therapy, CPR, oxygen therapy, enteral nutrition, nasogastric intubation, Blood transfusion

I. Course Title : Diagnosis of Veterinary Infectious Diseases

II. Course Code : VMD 613

III. Credit Hours : 0+1

IV. Aim of the course

Concepts and diagnostic tests in veterinary infectious diseases.

V. Practical

- Sampling techniques for collection of samples during research;
- Sensitivity and specificity of diagnostic tests including false positive and false negative tests. Mastitis diagnostic tests;
- Culture and staining techniques;
- Diagnosis of fungal diseases, protozoan and rickettsial diseases, fecal examination for endoparasites, skin scrapping examination for mites, fleas and lice;
- ELISA, PCR, culture sensitivity tests on milk and other body fluids, molecular techniques and types of PCR, Molecular epidemiology tools including RFLP, etc.



- I. Course Title : Oncology and Ethno-veterinary Medicine**
II. Course Code : VMD 614
III. Credit Hours : 1+0

IV. Aim of the course

Study of diagnosis and management of tumors, natural remedies and alternative systems of medicine.

V. Theory

Unit I

Tumors related to different systems - biology and pathogenesis of cancer, diagnostic procedures, oncology medicine, chemotherapy, radiation therapy, immuno-therapy and miscellaneous therapeutic measures, including advancements of therapeutic approaches, supportive care for the cancer patient.

Unit II

Natural remedies and products for use towards therapy in animal ailments.

Unit III

Acupuncture, physiotherapy, laser therapy, nutraceuticals and dietary supplements.

- I. Course Title : Animal Disease Investigation and Biosecurity**
II. Course Code : VMD 615
III. Credit Hours : 1+1

IV. Aim of the course

Concepts in investigation of infectious diseases and their prevention.

V. Theory

Unit I

Investigation and diagnosis on dead and live diseased animal (s) and poultry. Point source epidemics and propagating epidemics, Collection, Preservation and transport of material in the face of disease outbreak, and processing of material in the laboratory for diagnosis; Recording and analysis of epidemiological data. Establishing working hypothesis and formulating and advising and/ or implementing treatment, control and prevention measures.

Unit II

Biosecurity definition, Related concepts, Principles and basic components of biosecurity, Physical and operational elements of biosecurity. Routes of entry and transmission dynamics of pathogens. Shedding pattern of pathogens by infected animals and their survival in the environment. Protection of susceptible animals, interruption of pathways of transmission, role of disinfection to break cycle of infection. Sterilization, fumigation and disinfection methods, disinfectants and its classification, Microbial resistance to disinfectants, Risk assessment and its management. Principles of biosecurity in laboratory animal house, Biosecurity measures for collection of specimen from wild animals. Biosecurity in research laboratories. Vaccines-success stories of disease eradication through vaccination.

VI. Practical

- Isolation and identification of field isolates and vaccine strains by conventional,



immunoassays and molecular techniques.

- To perform an outbreak investigation of infectious diseases and toxicological conditions in livestock and poultry in the field/ organised livestock farms.
- Practical use of disinfectants in destruction of microbes in laboratory and under field conditions. Determination of efficacy/ phenol coefficient of commonly used disinfectants.
- Approaches in animal disease control and eradication. Preliminary steps to control animal disease outbreaks.
- Types of vaccines, vaccination schedule in livestock, pets and poultry

I. Course Title : Clinical Practice-I

II. Course Code : VMD 616

III. Credit Hours : 0+3

IV. Aim of the course

Application of the theoretical concepts in practice.

V. Practical

- Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals, use of diagnostic techniques for diagnosis of medicinal cases, acquaintance with different equipment, client management, public relations, code of conduct, hospital management, database management and maintenance of case records, disaster management
- Note: This course shall be conducted in Veterinary Clinical Complex (VCC), where students shall participate in diagnosis and treatment of diseased animals.

I. Course Title : Clinical Practice-II

II. Course Code : VMD 617

III. Credit Hours : 0+3

IV. Aim of the course

Application of the theoretical concepts in practice.

V. Practical

- Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals, use of diagnostic techniques for diagnosis of medicinal cases, acquaintance with different equipment, client management, public relations, code of conduct, hospital management, database management and maintenance of case records, disaster management.
- **Note:** This course shall be conducted in Veterinary Clinical Complex (VCC), where students shall participate in diagnosis and treatment of diseased animals.



Course Outline: Lecture wise

VMD 601: Ruminant Medicine-internal 3+0

S. No.	Topics	No. of Lectures
1.	Examination of alimentary tract and abdomen	1
2.	Diseases of the buccal cavity and related organs including pharynx, oesophagus	2
3.	Reticulo-ruminal fermentative disorders (simple indigestion, impaction, ruminal lactic acidosis, alkalosis)	2
4.	Primary and secondary bloat, diaphragmatic hernia	1
5.	Traumatic reticulo-peritonitis, vagal indigestion syndrome, generalised peritonitis vagal indigestion syndrome, generalised peritonitis and omasal impaction	1
6.	Diseases of abomasum (impaction, displacements)	2
7.	(Acute and chronic diarrhoea), hemorrhagic diarrhea	2
8.	Intestinal obstructive disorders (intussusception, volvulus), strangulation	2
9.	Caecal dilatation and volvulus	1
10.	Manifestations of liver and biliary diseases	1
11.	Focal and diffuse diseases of liver, fatty liver syndrome	1
12.	Principle of treatment of respiratory diseases, respiratory insufficiency, anoxias, diseases of nasal cavity, sinuses, diseases of larynx and trachea	2
13.	Epistaxis, hemoptysis, congestion and edema of lungs, hydro and hemothorax	1
14.	Pneumonias and pleuritis	2
15.	Manifestations and principles of treatment in uro-genital system; rupture, paralysis	1
16.	Infections of urinary bladder	1
17.	Urolithiasis, nephritis and renal failure, nephrosis	2
18.	Hemolytic uremic like syndrome, uremia and neoplasms of urinary tract	1
19.	Examination of cardiac system and special examination of heart (ECG, echocardiography disorders)	1
20.	Principal manifestations of cardiovascular diseases	1
21.	Congenital cardiac diseases, Myocarditis	1
22.	Cardiomyopathy, endocarditis, pericarditis	1
23.	Phlebitis, thrombosis, anemia, lymphangitis, lymphadenopathies and thrombocytopenia, lymphosarcoma	2
24.	Principles of nervous dysfunctions, clinical manifestation SOL special examination	1
25.	Localization of lesion in brain and spinal cord	2
26.	Cortical diseases, brain abscess, SOL, meningitis, diseases of brainstem, cerebellar diseases	2
27.	Spinal cord compression, peripheral nerve paralysis, Horner Syndrome, facial nerve paralysis	2
28.	Principle manifestations and special examination of musculoskeletal system	1



S. No.	Topics	No. of Lectures
29.	Foot lameness, arthritis, osteodystrophies, degenerative joint disease and nutritional deficiency diseases affecting musculoskeletal system	3
30.	Diseases of eyes, neoplasms of eyes	1
31.	Conjunctivitis, keratitis, uveitis	1
32.	Diseases of pinna, otitis media, otitis externa	2
33.	Skin diseases: folliculitis, furunculosis, and skin neoplasms, skin tumors	1

Suggested Books

- Bradford Smith, David Van Metre, Nicola Pusterla. 2019. *Large Animal Internal Medicine*. 6th Edition, Mosby.
- Neil V Anderson, 1992. *Veterinary Gastroenterology*. 2nd Revised edition, Lea and Febiger, USA.
- Simon F Peek, Thomas J Divers. 2018. *Rebhun's Diseases of Dairy Cattle*. 3rd Edition, Elseviers.
- Research and Review Papers in Current Journals.

VMD 602: Ruminant Medicine-infectious 3+0

S. No.	Topics	No. of Lectures
1.	Principles of prevention and control of infectious diseases	1
2.	Anthrax	1
3.	Brucellosis	1
4.	Mastitis	1
5.	Foot rot/ Joint ill	1
6.	Black quarter/ Braxy	1
7.	Tetanus	1
8.	EnterotoXemia	1
9.	Bacillary haemoglobinuria	1
10.	Botulism	1
11.	Colibacillosis	1
12.	Pasteurellosis/ Hemorrhagic septicemia	1
13.	Tuberculosis	1
14.	Paratuberculosis	1
15.	Listeriosis	1
16.	Leptospirosis	1
17.	Acitnomycosis/ Actinobacillosis	1
18.	Ringworm	1
19.	Systemic mycotic infections (Aspergillosis, candidiasis, histoplasmosis, sporotrichosis, coccidiomycosis, mycotoXicosis)	1
20.	Dermatophilosis	1
21.	Campylobacteriosis	1
22.	Salmonellosis	1
23.	Contagious bovine pleuropneumonia	1
24.	Contagious agalactia	1
25.	Anaplasmosis	1
26.	Chlamydiosis, Q fever, ehrlichiosis	1
27.	Blue tongue	1
28.	Sheep and goat poX	1
29.	Peste des petits ruminants	1
30.	Scrapie, louping ill	1



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S. No.	Topics	No. of Lectures
31.	Maedi, visna, jagaskiae disease	1
32.	Rift valley fever	1
33.	Rinderpest	1
34.	Bovine viral diarrhea	1
35.	Malignant catarrhal fever	1
36.	Infectious bovine rhinotracheitis	1
37.	Enzootic bovine leucosis	1
38.	Ephemeral fever	1
39.	Foot and mouth disease	1
40.	Rabies	1
41.	Principles of control of parasitic diseases	1
42.	Amphistomosis	1
43.	Fascioliosis	1
44.	Gastrointestinal nematodiasis, schistosomosis	1
45.	Echinococcosis, tapeworm (cysticercosis)	1
46.	Verminous bronchitis, coenurosis,	1
47.	Trypanosomosis, babesiosis	1
48.	Theileriosis, hepatozoonosis	1

Suggested Books

- *Dairy Herd Health*. 2012. MJ Green, Andrew J. Bradley. CABI Publishing.
- *Merck's Veterinary Manual* K. 2016. Susan E Aiello, Michael A Moses. (11th Edition). Merck Sharp and Dohme
- *Veterinary Medicine* 2016. Peter Constable, Kenneth W Hinchcliff, Stanley Done, Walter Gruenberg. 11th Edition. Saunders Ltd.
- Research and Review Papers in Current Journals.

VMD 603: Equine Medicine (2+0)

S. No.	Topics	No. of Lectures
1.	Manifestations and principles of treatment of gastrointestinal diseases	1
2.	Diseases of the buccal cavity and oesophagus	2
3.	Gastric dilation and rupture, gastro-duodenal ulceration	1
4.	Diseases of the intestine (colic, duodenitis-proximal jejunitis, acute and chronic diarrhea	3
5.	Diseases of liver	1
6.	Diseases of the pericardium, myocardium and endocardium	2
7.	Cardiac arrhythmias, thrombosis	1
8.	Purpura haemorrhagica, immune-mediated thrombocytopenia of the neonates, neonatal isoerythrolysis	1
9.	Sinusitis, ethmoidal hematoma, guttural pouch tympany/ empyema/ mycosis, pharyngitis, recurrent laryngeal neuropathy	2
10.	Pneumonia and pleuropneumonia,	2
11.	Inflammatory airway disease	1
12.	Recurrent airway obstruction	1
13.	Acute renal failure and chronic renal failure	1
14.	Urinary tract infections	1
15.	Exertional myopathy/ Tying up syndrome, myositis	1
16.	Hyperkalemic periodic paralysis, narcolepsy, myotonia	1
17.	Osteodystrophies	1



S. No.	Topics	No. of Lectures
18.	Encephalitis, meningo-encephalitis	2
19.	Facial nerve paralysis, radial nerve paralysis, sciatic nerve paralysis, femoral nerve paralysis, polyneuritis equi (cauda equine neuritis)	1
20.	Bacterial dermatitis (Dermatophilosis, furunculosis, cellulitis, ulcerative lymphangitis, fistulous withers, bacterial psuedomycosis (botryomycosis)	1
21.	Viral skin diseases	1
22.	Allergic dermatitis: Culicoides hypersensitivity, eosinophilic granuloma, anhidrosis, equine sarcoidosis	2
23.	Fungal skin diseases	1
24.	Parasitic skin diseases- habronemiasis, onchocerciasis	1

Suggested Books

- *Equine Internal Medicine*. 2017. Stephen Reed, Warwick Bayly, Debra Sellon, 4th Edition, Elsevier, Saunders.
- *Large Animal Internal Medicine*. 2019. Bradford Smith, David Van Metre, Nicola Pusterla, 6th Edition, Mosby
- Research and Review Papers in Current Journals.

VMD 604: Canine and Feline Medicine-I (2+0)

S. No.	Topics	No. of Lectures
1.	Diagnostic approach to manifestations of gastrointestinal disorders	2
2.	Disorders of oral cavity, pharynx and oesophagus	1
3.	Common disorders of stomach	1
4.	Disorders of small intestine	1
5.	Disorders of large intestine, rectum and anus	1
6.	Diagnostic approach to manifestations of hepato-biliary diseases	2
7.	Hepato-biliary diseases of dogs and cats	1
8.	Exocrine pancreatic disorders of dogs and cats	1
9.	Diagnostic approach to manifestations of hemo-lymphatic disorders	2
10.	Disorders of hematopoietic system	1
11.	Disorders of lymphatic system	1
12.	Diagnostic approach to manifestations of cardiac diseases	1
13.	Congenital heart diseases	1
14.	Acquired valvular diseases, myocardial and pericardial diseases	1
15.	Behaviour disorders of canine and feline	1
16.	Polysystemic protozoal infection of dogs and cats (Hepatozoonosis, babesiosis, trypanosomiasis, neosporosis, toxoplasmosis)	2
17.	Polysystemic rickettsial diseases of dogs and cats (Ehrlichiosis, Lyme disease and rocky mountain spotted fever)	2
18.	Important bacterial diseases of canine and feline (Leptospirosis, tetanus, brucellosis and kennel cough)	2
19.	Endoparasitic infestation of dogs and cats	1
20.	Viral diseases of dogs (Canine parvo viral gastroenteritis, canine distemper, corona virus infection, Infectious hepatitis, Infectious tracheobronchitis, canine herpes virus and rabies)	3
21.	Viral diseases of cats (Feline panleukopenia, feline infectious peritonitis, feline leukemia virus, feline immunodeficiency virus)	2
22.	Fungal diseases of dogs and cats	1
23.	Vaccination schedule of dogs and cats	1

**Suggested Books**

- *Small Animal Internal Medicine* 2013. Nelson and Couto, 5th edition, Elsevier Mosby, St. Louis, Missouri
- *Text book of Veterinary Internal Medicine* 2001. Part I and II, Ettinger and Feldman, 7th Edition, *Publisher:* Saunders
- *Small Animal Medical Diagnosis* 2009. MD Lorenz, TM Neer and PL Demars, 3rd Edition, Willey Blackwell, Iowa, USA.
- Research and Review Papers in Current Journals.

VMD 605: Canine and Feline Medicine-II (2+0)

S. No.	Topics	No. of Lectures
1.	Clinical manifestations of upper and lower respiratory tract disorders	1
2.	Canine infectious tracheobronchitis, chronic bronchitis in dogs. feline bronchitis.	1
3.	Pneumonia (viral, bacterial, fungal), pulmonary neoplasia, pulmonary edema	1
4.	Diagnostic approach to pleural effusions	1
5.	Diagnostic approach to diseases of nasal cavity	1
6.	Principles of therapeutic management of respiratory tract disorders	1
7.	Clinical manifestations of urinary tract disorders	1
8.	Acute and chronic renal failure	1
9.	Canine and feline urinary tract infections	1
10.	Disorders of micturition	1
11.	Neoplasms of urinary tract	1
12.	Neurological manifestations of systemic diseases	1
13.	Diagnostic approach to seizures, ataxia, paresis and paralysis	1
14.	Inflammatory brain disorders (bacterial, viral, protozoal, mycotic, parasitic)	2
15.	Diseases of spinal cord (osteomyelitis, intervertebral disc disease)	1
16.	Disorder of peripheral nerves (developmental and congenital disorders, metabolic and toxic disorders, inflammatory and immune mediated neuropathies)	2
17.	Joint diseases of dogs and cats (Non inflammatory and inflammatory)	1
18.	Disorders of muscles (inflammatory myopathies, bacterial, parasitic, immunemediated, degenerative and inherited myopathies)	1
19.	Nutritional secondary hyperparathyroidism, rickets	1
20.	Diseases of ears (otitis externa, interna, media), neoplasms, principles of treatment of otitic infections	1
21.	Skin (endocrinopathies, bacterial, parasitic, fungal skin disorders, nutritional disorders related to skin)	2
22.	Alopecia, atopy, flea allergy dermatitis	1
23.	Diagnostic cytology of skin lesions, treatment and control measures.	1
24.	Eyes (diseases of eye lids, keratitis, conjunctivitis, uveitis, glaucoma, acute blindness, neoplasms of eye.	1
25.	Viral diseases of dogs and cats	2
26.	Vaccination for canine and feline diseases	1
27.	Fungal diseases of dogs and cats	2

Suggested books

- *Small Animal Internal Medicine* 2013. by Nelson RW and Couto, CG 5th edition, Elsevier Mosby, St. Louis Missouri



- *Text book of Veterinary Internal Medicine* 2010. by Ettinger and Feldman, 7th Edition, Publisher: Saunders
- Research and Review Papers in Current Journals.

VMD 606: Metabolic and Endocrine Diseases, Nutritional Deficiencies and Diseases of Mammary Gland (2+0)

S. No.	Topics	No. of lectures
1.	General aspects of production diseases and metabolic profile test	1
2.	Parturient paresis in dairy animals - etiology, pathogenesis, diagnosis, prevention and therapeutic management	1
3.	Downers cow syndrome and lactation tetany of mares	1
4.	Ketosis, sub clinical ketosis and fatty liver syndrome	1
5.	Nutritional haemoglobinuria in dairy animals	1
6.	Hypomagnesemic tetany in cattle	1
7.	Pregnancy toxemia in sheep	1
8.	Eclampsia in bitches-etiology, pathogenesis, diagnosis, prevention and therapeutic management	1
9.	Acute hypokalemia and transit recumbency of ruminants	1
10.	Equine hyperlipemia, steatitis and neonatal hypoglycaemia	1
11.	Deficiencies of energy and protein	1
12.	Iodine deficiency disorders of ruminants	1
13.	Copper deficiency diseases of ruminants	1
14.	Diseases associated with deficiency of zinc and manganese	1
15.	Diseases associated with deficiency of iron and cobalt	1
16.	Vitamin E and selenium deficiency	1
17.	Diseases associated with deficiency of vitamin B-complex	1
18.	Diseases associated with deficiencies of vitamin A and K	1
19.	Rickets, osteoporosis and osteodystrophic fibrosa	1
20.	Diabetes mellitus in dogs	1
21.	Diabetes insipidus in dogs	1
22.	Hypo- and hyperthyroidism in dogs	1
23.	Hypo- and hyperadrenocorticism in dogs	1
24.	Anatomy of the mammary glands, physiology of lactation and congenital abnormalities of udder and teats	1
25.	Physical and chemical tests for detection of mastitis	1
26.	Detection and identification of pathogenic bacteria in milk	1
27.	Epidemiology, treatment and control of mastitis caused by contagious, environment and opportunistic pathogens	2
28.	Specific and non-specific viral lesions of teats and udder	1
29.	Teat stenosis; udder oedema; galactorrhagia, galactagogue;agalactia	1
30.	Heifer and goat mastitis, mastitis-metritis-agalactia in sows	1
31.	Public health importance of mastitis	1

Suggested books

- *Veterinary Medicine* 2007. *A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats* by Otto M Radostits, Clive C Gay, Kenneth W Hinchcliff and Peter D Constable. 10th Edition. Saunders.
- *Clinical Endocrinology of Companion Animals* (2013). Ed. J Rand 1st Edition ed.by Jacquie Rand (Editor), Ellen Behrend (Editor), Danielle Gunn-Moore (Editor), Michelle Campbell-Ward (Editor). Wiley-Blackwell.
- Research and Review Papers in Current Journals.

**VMD 607: Paediatrics and Geriatrics (2+0)**

S. No.	Topics	No. of Lectures
Unit I		
1.	Perinatal adaptation, neonatal health, asphyxia and resuscitation	1
2.	Physical examination of the neonate, disease manifestation, supportive care of the abnormal newborn	1
3.	Failure of passive transfer of immunity and its management.	1
Unit II		
4.	Pediatric pharmacology	1
5.	Fluid replacement therapy	1
6.	Immunization of neonates, nutritional support, blood and serum transfusion	1
Unit III		
7.	Distended and painful abdomen, bloat	1
8.	Respiratory distress in the neonates	1
9.	Viral diseases of pups, foals and calves	2
10.	Bacterial diseases of pups, foals and calves	2
11.	Neonatal isoerythrolysis in foals, pups and kittens	1
12.	Congenital abnormalities of pups, foals and calves	1
13.	Peri-natal care and diseases of the newborn	1
14.	Non infectious diseases of pups	1
15.	Metabolic disorders, nutritional deficiencies, miscellaneous conditions (hypothermia, hyperthermia, starvation)	2
16.	Care, management and treatment of sick puppies	1
Unit IV		
17.	Guidelines for care of geriatric dogs	1
18.	Neuromuscular dysfunctions in geriatric dogs	1
19.	Common eye and ear affections in older canine and feline patients	1
20.	Hepatic and pancreatic disorders in older dogs and cats	1
21.	Paresis and/ or depressed mentation	1
22.	Urinary system diseases in geriatric dogs and cats	1
23.	Endocrine and metabolic disorders in geriatric patients	1
24.	Respiratory diseases in older dogs and cats	2
25.	Cardiac disorders in geriatric dogs and cats	1
26.	Cancer therapy in geriatric patients	1
27.	Skeletal disorders in geriatric patients	1
28.	Behaviour disorders in geriatric dogs	1

Suggested Readings

- *Equine Pediatric Medicine*. 2018. WV Bernard, BS Barr, 2nd edition, CRC Press.
- *Treatment and Care of the Geriatric Veterinary Patients* 2017. Mary Gardne and Dani McVety, Wiley-Blackwell.
- *Small Animal Pediatrics* 2011. Michael E. Peterson and Michelle Anne Kutzler, Elsevier.
- Research and Review Papers in Current Journals.

VMD 608: Avian and Swine Medicine (2+0)

S. No.	Topics	No. of Lectures
1.	General handling, sample collection and medication in various Avian Spps.	1



S. No.	Topics	No. of Lectures
2.	Etio-pathogenesis, symptomatology, diagnosis and treatment of diseases due to riboflavin deficiency in poultry	1
3.	Encephalomalacia (Crazy chick disease)	1
4.	Rickets and calcium deficiency in poultry	1
5.	Fatty liver and kidney syndrome	1
6.	Manganese and zinc deficiency in poultry	1
7.	Colibacillosis (including peritonitis in layers and salpingitis)	1
8.	Fowl cholera	1
9.	Yolk sac infection and omphalitis	1
10.	Salmonellosis and mycoplasmosis in poultry	1
11.	Infectious bursal disease (Gumboro disease) and Inclusion body hepatitis	1
12.	Infectious laryngotracheitis and infectious bronchitis	1
13.	New castle disease and marek's disease (including transient paralysis)	1
14.	Egg drop syndrome 76 (127 adenovirus/ BC14 infection)	1
15.	Lymphoid leukosis and other leukoses	1
16.	Parasitic diseases (Ascariasis and coccidiosis)	1
17.	Miscellaneous poultry diseases (cage layer fatigue, cannibalism, moult and prolapse of oviduct)	1
18.	General handling, physical examination and sample collection in pigs	1
19.	Mineral deficiency diseases in pigs (Calcium, phosphorus, iron, copper and zinc)	1
20.	Vitamin deficiency diseases in pigs (vitamin A, D, E, K, riboflavin and niacin)	1
21.	Swine influenza	1
22.	Swine fever (African and classical)	1
23.	Swine Pox	1
24.	Vesicular exanthema and vesicular stomatitis	1
25.	Swine dysentery (scours) and transmissible gastro-enteritis (TGE)	1
26.	Streptococcal meningitis	1
27.	Porcine reproductive and respiratory syndrome (PRRS)	1
28.	Pneumonia in pigs	1
29.	Glassers disease and greasy pig disease	1
30.	Swine erysipelas and mange	1
31.	FMD and brucellosis	1
32.	New and emerging diseases (Nipah virus)	1

Suggested Poultry Books

- *Diseases of Poultry*. 2013. DE Swayne, JR Glisson, LR McDougald, LK Nolan, DL Suarwz, and VL Nair. 13th Edition, Wiley-Blackwell.
- *Diseases of poultry and their control*. 2001. R. Chandra, VDP Rao, JC Gomez-Villamandos, SK Shukla and PS Banerjee. 1st edition, International book distributing Co., Lucknow, India. 2001.
- Research and Review Papers in Current Journals.

Suggested Swine Books

- *Diseases of Swine*. 2012. JJ Zimmerman, LA Karkiker, A Ramirez, KJ Schwartz and GW. Stevenson. 12th edition, Wiley-Blackwell.
- *Diseases of Swine* 2006. BE Straw, JJ Zimmerman, SD' Allaire and DJ Taylor. 9th edition, Blackwell Publishing.
- Research and Review Papers in Current Journals.

**VMD 609: Zoo, Wild and Laboratory Animal Medicine (1+0)**

S. No.	Topics	No. of Lectures
1.	Taxonomy of various genera of wild/ zoo animals of India along with their descriptions.	1
2.	Basic principles of habitat and housing of various classes of wild and zoo animals.	1
3.	Nutrient requirements, feeding habits and feeds of zoo, wild and laboratory animals.	2
4.	Diet formulation and feeding of various age groups, sick and geriatric animals.	1
5.	Post mortem examination, handling, processing and interpretation of pathological materials from zoo and wild animals.	1
6.	Breeding for conservation of wild animals.	1
7.	Population dynamics of wild animals, effective population size of wild animals in captivity/ zoo/ natural habitats.	1
8.	Restrain, capture, handling, physical examination and transport of wild and zoo animals.	1
9.	Principles of anesthesia, anesthetics, chemicals of restraining, common surgical Interventions; Capture myopathy.	2
10.	Acts and Rules related to zoo and wild animals.	1
11.	Principles of zoo hygiene, public health problems arising from zoos.	1
12.	Prevention, control and treatment of infectious, parasitic, nutritional and metabolic diseases in zoo and wild animals.	2
13.	Prevention, control and treatment of infectious, parasitic, nutritional and metabolic diseases of laboratory animals.	1

Suggested Books

- *Wild Mammals in Captivity: Principles and Techniques for Zoo Management* (2010). 2nd ed. - Kleiman, DG, University of Chicago Press
- *Zoo and Wild Animal Medicine Current Therapy* (2007). 6th ed. -C Fowler, ME
- *Zoo Animal and Wildlife Immobilization and Anesthesia* (2014). 2nd Ed.-C West, D Heard. N Caulkett, Wiley Blackwell
- Research and Review Papers in Current Journals.

VMD 610: Toxicology and Forensic Medicine (1+0)

S. No.	Topics	No. of Lectures
1.	Lead poisoning	1
2.	Arsenic and selenium poisoning	1
3.	Fluoride and copper toxicity	1
4.	Diseases associated with physical agents	1
5.	Chlorinated hydrocarbons, organophosphorous compounds and carbamates poisoning	1
6.	Nitrate nitrite poisoning, cyanide and urea poisoning	1
7.	Poisoning by mycotoxins and important phytotoxins	1
8.	Snakebite poisoning; Bee stings	1
9.	Examination of blood stains	1
10.	The vetero-legal wounds, causes of death from wounds	1
11.	Post-mortem examination of veterolegal case, submission of specimens in suspected cases of poisoning,	1



S. No.	Topics	No. of Lectures
12.	Collection and submission of specimens for histo-pathological examination, and various modern techniques for diagnosis of veterolegal cases	1
13.	Common frauds in the sale of livestock and livestock products	1
14.	Common offenses against animals in India	1
15.	Laws related to animal welfare in India	1
16.	Functioning of Animal welfare board	1

Suggested Books

- *Veterinary Toxicology*. 2014. SK Garg, CBS Publishers.
- *Veterinary Medicine- A textbook of the diseases of cattle, horses, sheep, pigs and goats* by Constable *et al.* 11th Ed., Saunders Ltd.
- *Animal Welfare Ethics and Jurisprudence* 2014. Kirti Dua, 1st Ed., Kalyani Publishers.
- *Veterinary Jurisprudence*. 2015. SN Sharma AK Gahlot and RK Tanwar. 7th Ed., NBS Publisher and Distributor.
- Research and Review Papers in Current Journals.

VMD 611: Clinical Diagnostic Techniques (0+2)

S. No.	Topics	No. of Practicals
1.	Endoscopy in small animals	1
2.	Endoscopic examination of URT in ruminants and equines	1
3.	Tracheo-broncheal lavage in ruminants, horses and dogs	2
4.	Thoracocentesis in dogs, cattle/ buffalo and horses	2
5.	Peritoneal fluid collection and examination in dogs, cattle, buffalo and horse	1
6.	Cystocentesis in dogs and urine examination	1
7.	Electrocardiography in dogs and its interpretation	1
8.	Electrocardiography in large animals and its interpretation	1
9.	Techniques in ocular examination	1
10.	Cerebrospinal fluid collection and examination	1
11.	Dermatological examination	1
12.	Collection of biopsy samples (Skin and liver)	2
13.	Diagnosis tests in mastitis	1
14.	Nasogastric/ orogastric intubation in large animals	1
15.	Echocardiography in large and small animals	2
16.	Liver function tests and their interpretation	1
17.	Pericardiocentesis in large and small animals	1
18.	Urinary Catheterization in male and female dogs	1
19.	Urinary Catheterization in a cattle/ buffalo and a mare	1
20.	Renal function tests and their interpretation	1
21.	Arterial blood collection and interpretation of acid base and blood gas analysis	1
22.	Diagnostic tests in ear affections	1
23.	Physical and special examination of musculoskeletal system	1
24.	Neurological examination in small and large animals	2
25.	Bone marrow collection in small and large animals	2
26.	Ultrasonography of chest and abdomen in large animal disease diagnosis	1
27.	CT, MRI, Pulse Oximetry, Radioimmuno assay, Nuclear Medicine	2

**Suggested Books**

- *Large Animal Internal Medicine*. 2015. Bradford P. Smith, 5th Edition, Mosby Elsevier.
- *Small Animal Clinical Techniques*. 2010. Susan M. Taylor, Saunders Elsevier.
- *Handbook of Veterinary Neurology*. 2010. Michael D. Lorenz, Joan R. Coates and Marc Kent, 5th Edition, Saunders Elsevier.
- *Handbook of Equine Respiratory Endoscopy*. 2007. Safia Barakzai, First Edition, Saunders Elsevier.
- *Manual of Canine and Feline Cardiology*. 2008. Larry P. Tilley, Francis W.K. Smith Jr., M.A. Oyama and M.M. Sleeper, 4th Edition, Saunders Elsevier.
- *Diagnostic Techniques in Equine Medicine: A Textbook for Students and Practitioners Describing Diagnostic Techniques Applicable to the Adult Horse (2009)*, Frank GR Taylor, Tim J Brazil and Mark H Hillyer, 2nd Edition, Saunders Elsevier.
- Research and Review Papers in Current Journals.

VMD 612: Emergency Medicine (0+2)

S. No.	Topics	No. of Practicals
1.	Triage and stabilization of critical ill patient	1
2.	Cardiopulmonary resuscitation (CPR) in dogs	1
3.	Oxygen therapy in dogs	1
3.	Gastrointestinal decompression in large and small animals	2
4.	Management of Acute respiratory distress syndrome in small animals	1
5.	Trans-thoracic drainage of pleural effusions in large and small animals	2
6.	Trans-thoracic drainage of pericardial effusions in large and small animals	2
8.	Intra-osseous fluid administration in pups	1
9.	Management of gastrointestinal emergencies; gastric lavage, pain management	1
10.	Endotracheal intubation in dogs	1
11.	Clinical examination and therapeutic management of status epilepticus in small animals	1
12.	Management of the shock patient	1
13.	Blood transfusion in small and large animals	2
14.	Enteral nutrition in horse and dog	2
15.	Management of metabolic emergencies (Addison's disease, Diabetic ketoacidosis, Eclampsia, etc.)	2
16.	Management of acute renal failure	1
17.	Diagnosis and management of cardiac arrhythmias	1
18.	Acute obstructive colic and its management	1
19.	Poisons and toxins	2
20.	Urinary tract emergencies	2
21.	Ocular emergencies	2
22.	Neurological emergencies	2

Suggested Books

- *Kirk and Bistner's Handbook of Veterinary Procedures and Emergency Treatment*. 2012. Richard B. Ford and Elisa Mazaferro, 9th Edition, Saunders Elsevier.
- *Blackwell's Five Minute Veterinary Consult Clinical Companion, Small Animal Emergency and Critical Care*. 2010. Mazzaferro, M. E. 1st Edition, (Wiley Blackwell)
- *Equine Emergencies Treatment and Procedures*. 2008. Orsini J.A. and Divers T.J., 3rd Edition, Saunders Elsevier.
- Research and Review Papers in Current Journals.

**VMD 613: Diagnosis of Veterinary Infectious Diseases (0+1)**

S. No.	Topics	No. of Practicals
Practical		
1.	Techniques of random/ probability sampling and using survey tool box software for random selection of villages/ animals from a state population	1
2.	Sources of data and collection of animal health information using passive data and active surveillance	1
3.	Significance of sensitivity and specificity of a diagnostic test and false positive/ negative reactions of a particular test	1
4.	Diagnosis of mastitis by BTB card, SLS paddle test, electrical conductivity meter and somatic cell count.	1
5.	Inoculation of sample on culture media, and isolation/ identification of the organism	1
6.	Culture sensitivity tests on milk and other body fluids	1
7.	Collection and examination of samples for fungal infections	1
8.	Preparation of blood smear for protozoan and rickettsial disease examination	1
9.	Examination of parasitic eggs and along with their identification points including McMaster egg counting technique	1
10.	Collection and/ or examination of skin scrapings for mites, ticks, lice or fleas	1
11.	Screening tests for animal infectious diseases, including TB, JD, glanders and brucellosis	2
12.	Enzyme linked immunosorbant assay (ELISA): direct, indirect and competitive	1
13.	Use of Polymerase chain reaction (PCR) in animal disease diagnosis and its types	2
14.	Molecular epidemiology tools to study strain variation including RFLP, PCR-RFLP, etc.	1

Suggested Books

- *Veterinary Epidemiology* (2018). Michael Thrusfield, Robert Christley. Wiley-Blackwell
- *Veterinary Epidemiologic Research*. (2003). Ian Dohoo, Wayne Martin and Henryk Stryhn, AVC Inc., Charlottetown.
- *Diseases of Animals: Diagnosis and Management* (2013). Singh, Bhoj and Somvanshi, R. Indian Veterinary Research Institute
- *Veterinarian's Guide to the Laboratory Diagnosis of Infectious Diseases* (1986). Gordon R. Carter. Veterinary Medicine Publishing Company
- Research and Review Papers in Current Journals.

VMD 614: Oncology and Ethno-veterinary Medicine (1+0)

S. No.	Topics	No. of Lectures
1.	Introduction to tumors	1
2.	Conventional and advanced diagnostic techniques for diagnosis of tumors	1
3.	Basic and advancements in chemotherapy and radiation therapy for tumors	1
4.	Immune-therapy and other miscellaneous therapy for cancer patients	1
5.	Principles of nutrition and management of chronic pain in cancer patients	1



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S. No.	Topics	No. of Lectures
6.	Tumors associated with gastrointestinal tracts	1
7.	Tumors associated with liver and spleen	1
8.	Tumors associated with endocrine system and urinary system	1
9.	Tumors associated with skin, subcutaneous tissues, eye and ear	1
10.	Tumors associated with hemopoietic and respiratory systems	1
11.	Principles of herbal medicines and their use in treating animal diseases	1
12.	Principles of homeopathic medicines and their use in treating animal diseases	1
13.	Application of acupuncture in the management of animal diseases	1
14.	Physiotherapy and laser therapy in animal diseases	1
15.	Common nutraceutical ingredients (prebiotics, probiotics, synbiotics, enzymes and antibacterial alternatives)	1
16.	Use of nutraceuticals in prevention and treatment of various animal diseases	1

Suggested Books

- *BSAVA Manual of Canine and Feline Oncology* by Dobson, Jane M. and Lascelles, B Duncan X. 3rd Ed., BSAVA.
- *Veterinary Herbal Medicine* by SG Wynn and BJ Fougere. 1st Ed., Mosby Elsevier.
- *Textbook of Veterinary Homeopathy*, by J Saxton and P Gregory. Beaconsfield Publishers, Beaconsfield
- *Complementary and Alternative Veterinary Medicine* by Narda G Robinson In: Merck Veterinary Manual. 11th Ed., Wiley.
- *Nutraceuticals in Veterinary Medicine* by, Ramesh C Gupta, Ajay Srivastava and Rajiv Lall. 1st Ed., 2019 Springer.
- Research and Review Papers in Current Journals.

VMD 615: Animal Disease Investigation and Biosecurity (1+1)

S. No.	Topics	No. of lectures/ Practicals
Theory		
1.	Investigation and diagnosis on dead animals and poultry	1
2.	Investigation and diagnosis on live animals and poultry	1
3.	Point source epidemics and propagating epidemics	1
4.	Collection, preservation and transport of material in the face of disease outbreak	1
5.	Processing of material in the laboratory for diagnosis	1
6.	Recording and analysis of epidemiological data	1
7.	Establishing working hypothesis	1
8.	Formulating and advising and/ or implementing treatment, control and prevention strategies	1
9.	Definition and related concepts of biosecurity, principles and basic components of biosecurity, physical operational elements of biosecurity	1
10.	Routes of entry and transmission dynamics of pathogens	1
11.	Shedding pattern of pathogens by infected animals and their survival in the environment	1
12.	Protection of susceptible animals, interruption of pathways of transmission	1
13.	Role of disinfection to break cycle of infection, sterilization, fumigation and disinfection methods	1



S. No.	Topics	No. of Lectures/ Practicals
14.	Disinfectants and its classification; microbial resistance to disinfectants, risk assessment and its management	1
15.	Principles of biosecurity for laboratory animal house, biosecurity in research laboratories, biosecurity measures for collection of specimen from wild animals	1
16.	Vaccines- success stories of disease eradication through vaccination	1
Practical		
1.	Isolation and identification of field isolates and vaccine strains by conventional, immunoassays and molecular techniques	3
2.	Outbreak investigation of infectious diseases in livestock and poultry in the field/ organized livestock farms	2
3.	Outbreak investigation of toxicological conditions in livestock and poultry in the field/ organized livestock farms	1
4.	Practical use of disinfectants in destruction of microbes in the laboratory and under field conditions	1
5.	Determination of efficacy/ phenol coefficient of commonly used disinfectants	1
6.	Approaches in animal disease control and eradication	1
7.	Preliminary steps to control animal disease outbreaks	1
8.	Types of vaccines- conventional and recombinants	1
9.	Vaccination schedule in cattle, sheep and, goats	2
10.	Vaccination schedule in horses and pigs	1
11.	Vaccination schedule of pets including dogs and cats	1
12.	Vaccination schedule of poultry including layers and broilers	1

Suggested Books

- *History of the Surveillance and Control of Transmissible Animal Diseases.* (2003). Jean Blancou. Office International des Epizooties
- *Veterinary Epidemiology* (2018). Michael Thrusfield, Robert Christley. Wiley-Blackwell
- *Biosecurity in Animal Production and Veterinary Medicine* (2018). Jeroen Dewulf, Filip Van Immerseel. *From Principles to Practice.* AMSTERDAM University Press
- Research and Review Papers in Current Journals.

Minor Courses for M.V.Sc. Degree programme

Courses of any one department/ discipline from the list given below:

- Veterinary Physiology
- Veterinary Microbiology
- Veterinary Parasitology
- Veterinary Pharmacology and Toxicology
- Veterinary Surgery and Radiology
- Veterinary Public Health and Epidemiology

Supporting Courses

It could be any subject considered relevant for student's research work. This will be decided by Advisor/ guide concerned.

Common Courses

The following courses (one credit each) will be offered to all students undergoing Master's degree programme.



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- Library and Information Services
- Technical Writing and Communications Skills
- Intellectual Property and its management in Agriculture
- Basic Concepts in Laboratory Techniques
- Agricultural Research, Research Ethics and Rural Development Programmes



Course Contents

Ph.D. in Veterinary Medicine

Course Code	Course Title	Credit Hours
VMD 701	Farm Animal Gastroenterology	2+0
VMD 702	Farm Animal Cardiopulmonary and Urinary System Diseases	2+0
VMD 703	Farm Animal Neurological and Musculo-skeletal System Diseases	1+0
VMD 704	Farm Animal Neonatology	1+0
VMD 705	Herd Health Management	2+1
VMD 706	Canine and Feline Gastroenterology	2+0
VMD 707	Advances in Neurological and Musculoskeletal System Diseases of Canine and Feline	1+0
VMD 708	Canine and Feline Cardiopulmonary and Urinary System Diseases	1+0
VMD 709	Dermatology and Endocrinology	1+0
VMD 710	Canine and Feline Eye and Ear Diseases	1+0
VMD 711	Veterinary Diagnostics	0+2
VMD 712	Metabolic and Nutritional Deficiency Diseases	2+0
VMD 713	Emergency and Critical Care Medicine	1+1
VMD 714	Emerging and Re-emerging Animal Diseases	2+0
VMD 715	Prevention and Control of Infectious Diseases of Ruminants	2+0
VMD 716*	Clinical Practice-I	0+2
VMD 717*	Clinical Practice-II	0+2
VMD 718*	Clinical Practice-III	0+2
VMD 791	Doctoral Seminar-I	1+0
VMD 792	Doctoral Seminar-II	1+0

*Core Courses



Course Contents

Ph.D. in Veterinary Medicine

I. Course Title : Farm Animal Gastroenterology

II. Course Code : VMD 701

III. Credit Hours : 2+0

IV. Aim of the course

Study of contemporary advancements in farm animal gastroenterology.

V. Theory

Unit I

Advances in diagnosis, Therapy and control of diseases of gastrointestinal system and associated organs of farm animals.

Unit II

Advances in diagnosis, Therapy, Control and prevention of infectious diseases of gastrointestinal system and associated organs of farm animals.

I. Course Title : Farm Animal Cardiopulmonary and Urinary System Diseases

II. Course Code : VMD 702

III. Credit Hours : 2+0

IV. Aim of the course

Advances in diseases of cardio-pulmonary and urinary systems.

V. Theory

Unit I

Advances in diagnosis and therapeutic management of internal diseases of circulatory system and urinary systems.

Unit II

Advances in diagnosis and therapeutic management of internal diseases of respiratory system.

Unit III

Advances in diagnosis, control, prevention and therapeutic management of infectious diseases of cardiopulmonary and urinary systems.

I. Course Title : Farm Animal Neurological and Musculo-skeletal System Diseases

II. Course Code : VMD 703

III. Credit Hours : 1+0

IV. Aim of the course

Study of recent advances in diseases of neurological and musculoskeletal systems.



V. Theory

Unit I

Advances in diagnosis, Therapy and control of internal diseases of nervous and musculoskeletal system.

Unit II

Advances in diagnosis, Therapy, Control and prevention of infectious diseases of nervous and musculo-skeletal systems.

I. Course Title : Farm Animal Neonatology

II. Course Code : VMD 704

III. Credit Hours : 1+0

IV. Aim of the course

Study of recent advances in care and disease management of equine and ruminant neonates.

V. Theory

Unit I

Advances in diagnosis, Therapy, Prevention and control of internal and infectious diseases of equine neonate.

Unit II

Advances in diagnosis, Therapy, Prevention and control of internal and infectious diseases of ruminant neonate.

I. Course Title : Herd Health Management

II. Course Code : VMD 705

III. Credit Hours : 2+1

IV. Aim of the course

Recent concepts in herd health medicine.

V. Theory

Unit I

General principles, Interactions between health and production, Herd medicine and population health.

Unit II

Herd health management programme for enzootic herds/ flocks.

Unit III

Recent concepts on herd management of chronic Bacterial, parasitic and fungal and rickettsial diseases.

Unit IV

Biosecurity and infection control, Herd and flock immunity, Quality management of herd health, Control of infectious diseases in the herd, Herd health economics.

VI. Practical

Visit to farms, Assessment of their problems, Estimating the presence and prevalence



of a disease and new proposals for prevention and control strategies of a specific disease and its impact.

- I. Course Title : Canine and Feline Gastroenterology**
- II. Course Code : VMD 706**
- III. Credit Hours : 2+0**
- IV. Aim of the course**

Study of advancements in canine and feline gastroenterology.

V. Theory

Unit I

Advances in diagnosis, Therapy and control of internal diseases of gastrointestinal system and associated organs of canine and feline.

Unit II

Advances in diagnosis, Therapy, Control and prevention of infectious diseases of gastrointestinal system and associated organs in canine and feline.

- I. Course Title : Advances in Neurological and Musculoskeletal System Diseases of Canine and Feline**
- II. Course Code : VMD 707**
- III. Credit Hours : 1+0**
- IV. Aim of the course**

Study of recent advances in the field of neurological and musculoskeletal diseases.

V. Theory

Unit I

Advances in diagnosis, Therapy and control of internal diseases of nervous and musculoskeletal systems.

Unit II

Advances in diagnosis, Therapy and control of infectious diseases of nervous and musculoskeletal systems.

- I. Course Title : Canine and Feline Cardiopulmonary and Urinary System Diseases**
- II. Course Code : VMD 708**
- III. Credit Hours : 1+0**
- IV. Aim of the course**

Advances in cardiopulmonary and urinary systems.

V. Theory

Unit I

Advances in diagnosis and therapeutic management of internal diseases of circulatory and urinary systems.

Unit II

Advances in diagnosis, therapeutic management of internal diseases of respiratory system.



Unit

Advances in diagnosis, therapeutic management, prevention and control of infectious diseases of cardiopulmonary and urinary systems.

- I. Course Title : Dermatology and Endocrinology**
- II. Course Code : VMD 709**
- III. Credit Hours : 1+0**
- IV. Aim of the course**

Recent concepts in diagnosis, management and control of diseases of skin and endocrine organs.

V. Theory

Unit I

Advances in diagnosis, therapy, prevention and control of infectious and non-infectious diseases of skin and integumentary systems.

Unit II

Advances in diagnosis, therapy and control of diseases of endocrine system.

- I. Course Title : Canine and Feline Eye and Ear Diseases**
- II. Course Code : VMD 710**
- III. Credit Hours : 1+0**
- IV. Aim of the course**

Study of recent advances in eye and ear diseases of canine and feline.

V. Theory

Unit I

Advances in examination, diagnosis and therapy of diseases of eye.

Unit II

Advances in diagnosis and therapy of diseases of ear.

- I. Course Title : Veterinary Diagnostics**
- II. Course Code : VMD 711**
- III. Credit Hours : 0+2**
- IV. Aim of the course**

Study of recent advances in diagnostics.

V. Practical

Unit I

Analysis and interpretation of hemogram, serum and blood biochemicals.

Unit II

Imaging techniques for the diagnosis of animal diseases (electrocardiography, echocardiography, etc.)



Unit III

Ophthalmoscopy, Ultrasonography, Pulse-oximetry. Assignments on advanced diagnostic techniques for various diseases of domestic animals. Use of above mentioned advanced diagnostic techniques where ever possible. Collection and examination of CSF, gastric/ rumen/ abomasal, peritoneal fluid, absorption and digestion tests, low and high dose dexamethasone test, ACTH stimulation test, hormone profile and enzyme profile.

- I. Course Title : Metabolic and Nutritional Deficiency Diseases**
- II. Course Code : VMD 712**
- III. Credit Hours : 2+0**
- IV. Aim of the course**

Recent trends in diagnosis, management and control of metabolic and nutritional diseases.

V. Theory

Unit I

Metabolic profile tests, Parturient paresis, Downer’s cow syndrome, Acute hypokalemia in cattle, Transit recumbency and lactation tetany of mares, Hypomagnesemic tetany of calves, Ketosis, Subclinical ketosis, Pregnancy toxemia, Fatty liver syndrome, Equine hyperlipidemia, Steatitis, Neonatal hypoglycemia, Low milk fat syndrome, Postparturient hemoglobinuria and eclampsia in bitches.

Unit II

Deficiency of energy and protein, Deficiency of fat. Deficiency of fat and water soluble vitamins, Deficiency of macro and micro minerals.

Unit III

Diabetes mellitus, diabetes insipidus, hypothyroidism, obesity, hypo- and hyperadrenocorticism, hormone deficiency syndromes.

- I. Course Title : Emergency and Critical Care Medicine**
- II. Course Code : VMD 713**
- III. Credit Hours : 1+1**
- IV. Aim of the course**

Recent advancement in emergency medicine and critical care.

V. Theory

Unit I

Diagnosis and therapeutic management of various emergencies of cardiovascular, respiratory, gastrointestinal, urinary and nervous systems.

Unit II

Diagnosis and therapeutic management of various emergencies of toxicities, sting bites and burns in farm and companion animals.

Unit III

Monitoring critical ill patient, application of emergency care procedures for resuscitation of critically ill patients.



VI. Practical

- Placement of central venous catheters, Intra-osseous fluid administration, Endotracheal intubation, Gastric lavage, Decompression of guttural pouch, Stomach, Cecum, Ventilation, Nebulisation, Fluid therapy, CPR, oxygen therapy, Enteral nutrition, Nasogastric intubation.
- Continuous rate infusion, Defibrillation– Demonstration, Peritoneal dialysis, Peritoneal diagnostic lavage, Management of hypo/ hyper thermia, Trocarization.

I. Course Title : Emerging and Re-emerging Animal Diseases

II. Course Code : VMD 714

III. Credit Hours : 2+0

IV. Aim of the course

Study on emerging and re-emerging diseases of animals.

Unit I

General concepts for emergence of new diseases and re-emergence of old diseases. Factors and determinants of emerging diseases. The role of wildlife in emerging and re-emerging diseases.

Unit II

Microbial adaptation and change; Epidemiological processes involved in the emergence of vector-borne diseases. Epidemiology of globally and nationally important emerging/ re-emerging diseases and designing of strategies for their prevention and control.

I. Course Title : Prevention and Control of Infectious Diseases of Ruminants

II. Course Code : VMD 715

III. Credit Hours : 2+0

IV. Aim of the course

Recent concepts in prevention and control of infectious diseases of ruminants.

V. Theory

Unit I

Bacterial and viral diseases of economic importance in bovines, sheep and goats.

Unit II

Fungal and parasitic diseases of economic importance in bovines, sheep and goats.

Unit III

Blood protozoan and rickettsial diseases of economic importance in bovines, sheep and goats.

I. Course Title : Clinical Practice-I

II. Course Code : VMD 716

III. Credit Hours : 0+2

IV. Aim of the course

Application of the theoretical concepts in practice.



V. Practical

Diagnostic and therapeutic protocol application, Specimen collection, Examination and management of sick farm and companion animals, Use of diagnostic techniques for diagnosis of medicinal cases, Acquaintance with different equipment, Client management, public relations, Code of conduct, hospital management, Database management and maintenance of case records, Disaster management.

Note: This course shall be conducted in Veterinary Clinical Complex (VCC) where students shall participate in diagnosis and treatment of diseased animals.

I. Course Title : Clinical Practice-II

II. Course Code : VMD 717

III. Credit Hours : 0+2

IV. Aim of the course

Application of the theoretical concepts in practice.

V. Practical

Diagnostic and therapeutic protocol application, Specimen collection, Examination and management of sick farm and companion animals, Use of diagnostic techniques for diagnosis of medicinal cases, Acquaintance with different equipment, Client management, Public relations, Code of conduct, Hospital management, Database management and maintenance of case records, Disaster management.

Note: This course shall be conducted in Veterinary Clinical Complex (VCC) where students shall participate in diagnosis and treatment of diseased animals.

I. Course Title : Clinical Practice-III

II. Course Code : VMD 718

III. Credit Hours : 0+2

IV. Aim of the course

Application of the theoretical concepts in practice.

V. Practical

Diagnostic and therapeutic protocol application, Specimen collection, Examination and management of sick farm and companion animals, Use of diagnostic techniques for diagnosis of medicinal cases, Acquaintance with different equipment, Client management, Public relations, Code of conduct, Hospital management, Database management and maintenance of case records, Disaster management.



Course Outline: Lecture wise

VMD 701: Farm Animal Gastroenterology (2+0)

S. No.	Topics	No. of Lectures
1.	Physical examination in gastrointestinal disease diagnostic strategies and initial plan in assessment of gastrointestinal function	1
2.	Imaging techniques for the gastrointestinal system radiography of the gastrointestinal system veterinary nuclear medicine	1
3.	Clinical pharmacology of the gastrointestinal tract	1
4.	Principles of fluid therapy in cattle, horse, pig, sheep and goat	1
5.	Diseases of the buccal cavity and related organs including pharynx, oesophagus	1
6.	Reticulo-ruminal disorders – recent concepts in fermentative disorders-simple indigestion, impaction, ruminal lactic acidosis, alkalosis	2
7.	Primary and secondary bloat- diagnosis	1
8.	Traumatic reticulo-peritonitis, vagal indigestion syndrome, generalised peritonitis, omasal impaction and abdominal distension	2
9.	Diseases of abomasum (impaction, displacements, ulcers)	1
10.	Intestinal disorders (intussusception, volvulus), strangulation, caecal dilatation and volvulus in ruminants.	1
11.	Diseases of bovine liver	1
12.	Diarrhea in cattle and small ruminants	1
13.	Bacterial and viral diseases: Campylobacteriosis, intestinal chlamydial infectionssalmonellosis, tyzzer's diseaseinfectious disease involving gut such as RP, BVD. FMD, actinomycosis, actinobacillosis	3
14.	Protozoal diseases: Coccidiosis, cryptosporidiosis	1
15.	Gastrointestinal parasites of pigsAscaris sp, oesophagostomum, stomach worms, strongyloides sp, trichuris sp	1
16.	Gastrointestinal parasites of horsesGastrophilus, habronema, oxyuris, parascaris, large strongyles, small strongyles, strongyloides, tapeworms, trichostrongylus	2
17.	Gastrointestinal Parasites of cattleCooperia, bunostomum, strongyloidees, nematodirus, toxocara, oesophgostomum, chabertia, trichuris, tapeworms	2
18.	Gastrointestinal parasites of sheep and goatsHaemonchus, ostertagia, and trichostrongylus, intestinal trichostrongylosis, nematodirus, oesophagostomum, chabertia, storngyloides, trichuris, tapeworms	2
19.	Gastrointestinal diseases – Horse and Pigs	1
20.	Dysphagia in horses	1
21.	Diseases of stomach: GIT ulceration, gastric dilation, impaction, gastric parasitism in horses and pigs	1
22.	Diseases causing equine colic such as anterior enteritis, small intestine strangulation, intestine impaction. Protocol and management of equine colic	1
23.	Obstructive intestinal diseases in horse	1
26.	Chronic weight loss without diarrhea, pain or icterus in horse	1
27.	Swine dysentery, hog cholera	1

**Suggested Books**

- *Equine Internal Medicine*. 2017. Stephen Reed, Warwick Bayly and Debra Sellon, 4th Edition, Elsevier, Saunders.
- *Large Animal Internal Medicine*. 2019. Bradford Smith, David Van Metre and Nicola Pusterla, 6th Edition, Mosby
- *Rebhun's Diseases of Dairy Cattle*. 2018. Simon F Peek and Thomas J Divers, 3rd Edition, Elseviers
- *Veterinary Gastroenterology*. 1992. Neil V. Anderson, 2nd Revised edition, Lea and Febiger, USA.
- Research and Review Papers in Current Journals.

VMD 702: Farm Animal Cardiopulmonary and Urinary System Diseases (2+0)

S. No	Topics	No. of Lectures
1.	Evaluation of patient with respiratory signs	1
2.	Diagnostic aids in evaluation of respiratory line	1
3.	Retropharyngeal lymph node abscessation in horses	1
4.	Pharyngeal affections in horses and Pharyngeal trauma in ruminants	1
5.	Diseases of guttural pouch in horses	1
6.	Laryngeal granuloma, abscess, edema	1
7.	Tracheal collapse and stenosis in farm animals	1
8.	Ethmoid hematoma in horses, diseases of paranasal sinuses in farm animals	1
9.	Disorders of equine soft palate	1
10.	Bacterial pneumonia and pleuropneumonia in adult horses	1
11.	Pneumonia in foals	1
12.	Pulmonary edema and smoke inhalation	1
13.	Recurrent airway obstruction in horses	1
14.	Inflammatory airway disease in horses	1
15.	Epistaxis and Exercise induced pulmonary hemorrhage in horses	1
16.	Bronchopneumonia and interstitial pneumonia in ruminants	1
17.	Hypersensitivity and metastatic pneumonia	1
18.	Progressive viral pneumonia of sheep and goats	1
19.	Pleuritis and pleural effusions, pneumothorax and lung tumors	1
20.	Viral pneumonia of sheep	1
21.	Congenital cardiac diseases	1
22.	Pericardial diseases	1
23.	Myocardial diseases	1
24.	Endocardial diseases	1
25.	Cardiac arrhythmias	1
26.	Anaemia	1
27.	Bleeding disorders	1
28.	Renal failure in horses	1
29.	Urinary incontinence and urethral obstruction in equine and bovine	1
30.	Polyuria and polydypsia in horses, urinary system disorders in the foal	1
31.	Ulcerative posthitis and vulvitis in small ruminants	1
32.	Bacterial pyelonephritis and urinary tract infection, leptospirosis	1

Suggested Books

- *Large Animal Internal Medicine*. 2019. Bradford Smith, David Van Metre and Nicola Pusterla, 6th Edition, Mosby
- *Veterinary Medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats* by Otto M Radostits, Clive C Gay, Kenneth W Hinchcliff and Peter D Constable. 10th Edition. Saunders



- *Rebhun's Diseases of Dairy Cattle*. 2018. Simon F Peek, Thomas and J Divers, 3rd Edition, Elseviers
- Research and Review Papers in Current Journals.

VMD 703: Farm Animal Neurological and Musculo-skeletal System Diseases (1+0)

S. No.	Topic	No. of Lectures
1.	Neurological examination in bovine and equine patients; Localization of lesions in nervous system	1
2.	Disease of brain stem in equines and bovines	1
3.	Diseases producing cortical signs in equines and bovines	1
4.	Diseases of spinal cord and Peripheral neuropathies	1
5.	Viral/ Prions encephalopathies: Equine herpes virus, Eastern/ Western equine encephalopathies, Bovine Spongiform Encephalopathy, etc.	2
6.	Parasitic thromboembolism and Equine Protozoal encephalomyelitis	1
7.	Encephalomalacia, Narcolepsy and Hyperkalemic periodic paralysis	1
8.	Diagnostic approach to musculoskeletal abnormalities	1
9.	Diseases of Muscle tone; Muscle Cramping	1
10.	Non-exertional Rhabdomyolysis in Horses: Inflammatory myopathies, nutritional, toxic and traumatic rhabdomyolysis	1
11.	Exertional Myopathies in Horses: Congenital, acquired and metabolic disorders	1
12.	Osteochondrosis, Septic (Infectious) arthritis osteomyelitis, osteoarthritis, laminitis in horse	1
13.	Bovine foot lameness: Characteristics of lameness, metabolic and infectious causes and conformation defects	2
14.	Nutrition and Lameness, Claw trimming and foot baths	1

Suggested Books

- *Bovine Laminitis and Lameness*. 2007. Paul R Greenough, First Edition, Saunders Elsevier.
- *Large Animal Internal Medicine*. 2019. Bradford Smith, David Van Metre, Nicola Pusterla, 6th Edition, Mosby
- *Handbook of Veterinary Neurology*. 2010. Michael D Lorenz, Joan R Coates and Marc Kent, 5th Edition, Saunders Elsevier.
- *Equine Internal Medicine*. 2004. Stephen M Reed, Warwick M Bayly and Debra C Sellon, 2nd Edition, Saunders Elsevier.
- Research and Review Papers in Current Journals.

VMD 704: Farm Animal Neonatology (1+0)

S. No.	Topics	No. of Lectures
1.	Advances in management during perinatal adaptation period	1
2.	Manifestations of neonatal diseases in calves	2
3.	Manifestations of neonatal diseases in foals	2
4.	Manifestations of neonatal diseases in lambs and kids	2
5.	Neonatal infection and sepsis	1
6.	Advances in diagnostic procedures in neonates	2
7.	Advances in intensive care of management of critically ill neonates	2
8.	Advances in chemotherapeutic management of neonatal diseases	2
9.	Vaccination and maternal antibody interference	1
10.	Advances in management of orphan neonates	1

**Suggested Books**

- *Equine Pediatric Medicine*. 2018. W V Bernard, BS Barr, 2nd edition, CRC Press
- *Practical Lambing and Lamb Care*. 2018. N Sargison, JP Crilly and A Hopker, 4th edition, Wiley Blackwell
- *Equine Neonatal Medicine*. 2006. MR Paradis, 1st edition, Saunders
- *Bovine Neonatology*. 2009. *Veterinary Clinics of North America: Food Animal Practice*. 1st Edition, Saunders
- Research and Review Papers in Current Journals.

VMD 705: Herd Health Management (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theory		
1.	General principles of herd health management	2
2.	Factors to be considered for successful implementation of herd health program	1
3.	Interaction between health and production	2
4.	Monitoring young stock health	1
5.	Targets for young stock rearing and dairy cow culling	1
6.	Disease control in rearing period	1
7.	Herd Medicine and population health	2
8.	Herd nutrition for optimum health	2
9.	Recent concepts on herd management of bacterial diseases	2
10.	Recent concepts on herd management of viral diseases	2
11.	Recent concepts on herd management of parasitic diseases	1
12.	Recent concepts on herd management of fungal diseases	1
13.	Recent concepts on herd management of rickettsial diseases	1
14.	Herd management of metabolic diseases	1
15.	Herd management of deficiency diseases	1
16.	Biosecurity and infection control	1
17.	Herd and flock immunity	1
18.	Quality management of herd health	1
19.	Control of infectious diseases in the herd	1
20.	Herd health economics	1
21.	Importance and steps of record keeping	2
22.	Control of lameness	1
23.	Diagnosis and control of mastitis and enhancement of milk quality	2
Practicals		
1.	Recent advances in calf management and diseases	1
2.	Appropriate animal housing	1
3.	Epidemiological investigations for problem identification at farm	1
4.	Farm biosecurity	1
5.	Recent advances in disinfection of farm sheds and other equipments	1
6.	Stress control of farm animals with respect to environmental and production stress	1
7.	Record keeping	1
8.	Recent advances in disease testing (TB, JD, Brucellosis, Mastitis)	1
9.	Routine farm procedures	2
10.	Herd vaccination	1
11.	Ecto and endo parasitism: principles and latest control trends	1
12.	Recent advances in mastitis control	1



S. No.	Topics	No. of Lectures/ Practicals
13.	Recent advances in lameness control	1
14.	Establishment of farm laboratory	1
15.	Use of medicines and food safety	1

Suggested Books

- *Dairy Herd Health*. 2012. MJ Green and Andrew J Bradley. CABI Publishing
- *Herd Health: Food, Animal, Production, Medicine*. 1994. OM Radostits, KE Leslie, J Fetrow and WB. Saunders,
- *Veterinary Epidemiology*. 2018. Michael Thrusfield, Robert Christley. Wiley-Blackwell
- *The Keys to Herd Health*. 2006. Jerry Brunetti. Acres U.S.A.
- *Herd Health and Production Management in Dairy Practice*. 2003. Arie Brand. International Book Distributing Company
- Research and Review Papers in Current Journals.

VMD 706: Canine and Feline Gastroenterology (2+0)

S. No.	Topics	No. of Lectures
1.	Introduction to gastrointestinal function and microbiota	02
2.	Diagnostic approach to anorexia, abdominal pain and vomiting	02
3.	Approach to clinical signs of diarrhea, constipation and tenesmus	02
4.	Diagnostic and therapeutic approach to hematochezia and melena	02
5.	Diagnostic approach to hepato-biliary diseases and pancreatic diseases, coagulopathy, icterus, ascites and hepatoencephalopathy	02
6.	Approach to clinical signs of weight loss and cachexia	01
7.	Nutritional approach to gastrointestinal disease management	02
8.	Pharmacological approach to gastrointestinal disease: antiemetic, anti-diarrhoeal and cytoprotective agents	01
9.	Pharmacological approach to gastrointestinal disease: antimicrobial and anthelmintic agents	01
10.	Pharmacological approach to gastrointestinal disease: prokinetics, probiotics and laxatives	01
11.	Chemotherapy and immunosuppressive drugs in gastrointestinal disease	01
12.	Dentistry and diseases of oropharynx	01
13.	Diagnostic evaluation and diseases of esophagus	01
14.	Gastric diseases: Gastritis, ulceration, neoplasia and dysmotility	02
15.	Advances in treatment and management of Small intestinal diseases	01
16.	Diagnostic approach and management of inflammatory bowel disease (IBD), Ulcerative colitis, bacterial, parasitic and fungal infections of large intestine	02
17.	Diagnostic evaluation and treatment of diseases of anorectum	01
18.	Diagnostic evaluation and common affections of pancreas	01
19.	Liver: Parenchymal, neoplastic, metabolic and biliary disorders	03
20.	Breed related gastrointestinal disorders	01
21.	Behaviour and gastrointestinal disease	01

Suggested books

- *Canine and Feline Gastroenterology*. 2013. RJ Washabau and MJ Day, Elsevier Mosby, St. Louis Missouri
- *Text Book of Veterinary Internal Medicine*. 2001. Part I and II, Ettinger and Feldman, 7th Edition, Saunders



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- *Small Animal Medical Diagnosis*. 2009. MD Lorenz, TM. Neer and PL Demars, 3rd Edition, Willey Blackwell, Iowa, USA.
- Research and Review Papers in Current Journals.

VMD-707 Advances in Neurological and Musculoskeletal System Diseases of Canine and Feline (1+0)

S. No	Topics	No. of Lectures
1.	Classification and general diagnostic features of acquired myopathies in dogs and cats	1
2.	Developmental and genetic bone disorders	1
3.	Idiopathic bone disorders	1
4.	Metabolic, nutritional and endocrine bone disorders	1
5.	Neoplasms of bones	1
6.	Focal brain diseases of rapid onset- idiopathic epilepsy, idiopathic vestibular disease, trigeminal neuropathy, idiopathic facial nerve paralysis	1
7.	Brain diseases of intermediate onset- brain abscesses	1
8.	Focal brain diseases of slow onset- Thiamine deficiency, hypoglycemia, poisons	1
9.	Inflammatory brain disorders- viral, bacterial, protozoal and mycotic encephalitis	1
10.	Inflammatory meningitis-granulomatous meningo-encephalitis, Pug encephalitis, rickettsial diseases	1
11.	Metabolic diseases with neurological signs	1
12.	Diseases affecting cervical spinal cord and brachial plexus	1
13.	Diseases affecting thoraco-lumbar and lumbo-sacral segments of spinal cord	2
14.	Inflammatory and immune mediated neuropathies	1
15.	Metabolic and toxic causes affecting peripheral nerves dysfunctions	1

Suggested Books

- *Handbook of Veterinary Neurology*. 2011. MD Lorenz, JR Coates and Marc Kent 5th Edition. Elsevier Saunders
- *Textbook of Veterinary Internal Medicine: Diseases of the Dog and Cat*. 2010. Stephen J. Ettinger and Edward C. Feldman, Elsevier Saunders 7th Edition.
- *Veterinary Clinics of North America: Small Animal Practice*, Elsevier, Monthly
- Research and Review Papers in Current Journals.

VMD 708: Canine and Feline Cardiopulmonary and Urinary System Diseases (1+0)

S. No	Topic	No. of Lectures
1.	Pathophysiology of heart failure, Clinical manifestations of cardiac diseases	1
2.	Diagnostic tests for cardiovascular system (radiography, electrocardiography and echocardiography)	1
3.	Therapeutic management of heart failure	1
4.	Cardiac arrhythmias and anti-arrhythmic therapy	1
5.	Acquired valvular heart diseases (Degenerative atrioventricular valve diseases and infectious endocarditis)	1
6.	Myocardial diseases of dogs and cats (Canine dilated cardiomyopathy, canine hypertrophic cardiomyopathy and feline cardiomyopathies)	1



S. No.	Topics	No. of Lectures
7.	Pericardial diseases and cardiac tumors, systemic arterial hypertension	1
8.	Clinical evaluation of patient with respiratory diseases	1
9.	Feline upper respiratory tract infections	1
10.	Bacterial rhinitis, allergic rhinitis, nasal mycosis, nasal tumors, polyps in dogs and cats	1
11.	Diseases of trachea (infectious tracheobronchitis, lungworms, tracheal hypoplasia and tracheal collapse), Canine and feline bronchitis	1
12.	Pulmonary parenchymal diseases (infectious- viral, bacterial, protozoal, fungal and parasitic)	1
13.	Pulmonary neoplasia, pulmonary edema, pleural effusions, pneumothorax	1
14.	Clinical approach and laboratory evaluation of renal diseases, Glomerulonephritis, Urolithiasis	1
15.	Acute and chronic renal failure	1
16.	Canine and feline lower urinary tract disorders, Disorders of micturition, Neoplasms of urinary tract	1

Suggested Books

- *Small Animal Internal Medicine*. 2013. Nelson RW and Couto, CG 5th edition, Elsevier Mosby, St. Louis Missouri
- *Text book of Veterinary Internal Medicine*. 2010. Ettinger and Feldman, 7th Edition, Saunders
- Research and Review Papers in Current Journals.

VMD 709: Dermatology and Endocrinology (1+0)

S. No.	Topics	No. of Lectures
1.	New trends in management of adrenal gland diseases in dogs and cats	1
2.	Hyperadrenocorticism (Pituitary pars intermedia dysfunction) in horses	1
3.	Primary hyperaldosteronism and pheochromocytoma in dogs and cats	1
4.	Advances in management of diabetes mellitus and diabetic ketoacidosis	1
5.	Equine metabolic syndrome/ Insulin resistance syndrome in horses	1
6.	Hypo and hyperthyroidism in dogs and cats	1
7.	Hypo and hypercalcemia in dogs and cats	1
8.	Hyposomatotropism and acromegaly in dogs	1
9.	Advances in management of diabetes Insipidus and polyuria/ polydipsia in Dogs and cats	1
10.	Advances in management of autoimmune disorders (different forms of pemphigus)	1
11.	Diagnosis, therapy and prevention of hypersensitivity disorders –Atopy, urticaria, milk allergy, vasculitis, contact dermatitis, culicoides hypersensitivity	1
12.	Diagnosis, therapy and prevention of bacterial skin dermatitis-dermatophillus, folliculitis, staphylococcal cellulitis, equine corynebacterial dermatitis	1
13.	Diagnosis, therapy and prevention of fungal skin dermatitis-dermatophytosis, malassezian dermatitis	1
14.	Diagnosis, therapy and prevention of parasitic skin dermatitis-mange, culicoides hypersensitivity, onchocerciasis, stephanofilaria, cutaneous leishmaniasis	1
15.	Diagnosis, therapy and prevention of viral diseases-warts, pox diseases	1
16.	Advanced diagnosis of skin tumors	1

**Suggested Books**

- *Clinical Endocrinology of companion animals*. 2013. Ed. J Rand 1st Edition ed. by Jacquie Rand (Editor), Ellen Behrend (Editor), Danielle Gunn-Moore (Editor) and Michelle Campbell-Ward (Editor). Wiley-Blackwell.
- *Muller and Kirk's Small Animal Dermatology*. 2013. 8th Edition. Edited by WH Miller, CE Griffin and KL Campbell. Elsevier, St Louis, MO, USA,
- *Equine dermatology*. 2011. 2nd Edition edited by Danny W Scott and William H. Miller, Jr 2nd edition. Elsevier, St Louis, MO, USA.
- Research and Review Papers in Current Journals.

VMD 710: Canine and Feline Eye and Ear Diseases (1+0)

S. No.	Topics	No. of Lectures
Advances in Examination, Diagnosis and Therapy of diseases of eye		
1.	Diseases of the eyelid and Conjunctiva	2
2.	Diseases of the cornea and sclera	1
3.	Disease of the lens, uvea: Glaucoma	2
4.	Disease of the retina, choroid, and optic nerve	2
5.	Disease of the Lacrimal apparatus	1
6.	Diseases of the the Orbit	1
7.	Neuro-ophthalmology	1
8.	Tumors of eye	1
Advances in Diagnosis and Therapy of diseases of ear		
1.	Otitis Externa	1
2.	Diseases of the external ear canal and pinna	1
3.	Otitis media and Otitis interna	2
4.	Tumors of ear	1

Suggested Books

- *Veterinary Ophthalmology*. 2013. Kirk N Gellat, Brian C Gilger and Thomas J Kern, 5th edition. Wiley Blackwell,
- *Saunders Manual of Small Animal Practice*. 2016. SJ Birchard and RG Sherding, WB Saunders Company
- Research and Review Papers in Current Journals.

VMD 711: Veterinary Diagnostics (0+2)

S. No.	Topics	No. of Practicals
Practical		
1.	(i) Endoscopic procedures in small animals (ii) Diagnostic aids and ancillary diagnostic tests in diseases of gastrointestinal system	2
2.	Endoscopic examination of URT in ruminants	1
3.	Endoscopic examination of URT in equines	1
4.	Tracheo-bronchial lavage in ruminants, horses and dogs	2
5.	Thoracocentesis in dogs, cattle/ buffalo and horses	2
6.	Electrocardiography in dogs and its interpretation/ Electrocardiographic diagnosis of arrhythmia in dogs	2
7.	Electrocardiography in diagnosis of arrhythmias in horses and dairy animals	1



S. No.	Topics	No. of Practicals
8.	Cerebrospinal fluid collection, examination and diagnosis and clinical case study (5 animals)	1
9.	Dermatological examination and case workup	1
10.	Biopsy collection techniques and its application on clinical cases	1
11.	Pericardiocentesis and drainage of effusions in large and small animals	1
12.	Neurological examination in small and large animals	2
13.	Techniques in ocular examination-cytology, ophthalmoscopy, measurement of intraocular pressure	2
14.	Bone marrow collection and its application in diagnosis in small and large animals	1
15.	Ultrasonography in various thoracic and abdominal affections in large animals	1
16.	Echocardiography in valvular and myocardial diseases in small animals	1
17.	Echocardiography in valvular and myocardial diseases in large animals	1
18.	Liver function tests and their interpretation with case studies	1
19.	Arterial blood collection and interpretation of acid base and blood gas analysis	1
20.	Concepts and diagnostic tests in veterinary infectious diseases Sampling techniques for collection of samples during research	2
21.	ELISA and its types, molecular techniques and types of PCR	1
22.	Molecular epidemiology tools including RFLP, etc.	2
23.	Molecular diagnostic techniques of fungal diseases, protozoan and rickettsial diseases	2

Suggested Books

- *Large Animal Internal Medicine*. 2019. Bradford Smith, David Van Metre and Nicola Pusterla, 6th Edition, Mosby
- *Small Animal Clinical Techniques*. 2010. Susan M Taylor, Saunders Elsevier
- *Handbook of Veterinary Neurology*. 2010. Michael D. Lorenz, Joan R. Coates and Marc Kent, 5th Edition, Saunders Elsevier.
- *Handbook of Equine Respiratory Endoscopy*. 2007. Safia Barakzai, 5th Edition, Saunders Elsevier.
- *Manual of Canine and Feline Cardiology*. 2008. Larry P Tilley, Francis WK Smith Jr., MA Oyama and MM Sleeper, 4th Edition, Saunders Elsevier.
- *Diagnostic Techniques in Equine Medicine: A Textbook for Students and Practitioners Describing Diagnostic Techniques Applicable to the Adult Horse*. 2009. Frank GR Taylor, Tim J Brazil and Mark H Hillyer, 2nd Edition, Saunders Elsevier.
- Research and Review Papers in Current Journals.

VMD 712: Metabolic and Nutritional Deficiency Diseases (2+0)

S. No.	Topics	No. of Lectures
1.	Strategies for transition cow health management	1
2.	Latest trends in prevention and management of parturient paresis with special reference to calcium cyclers and DCAD	1
3.	Current approach to diagnosis and management of downer's cow syndrome and acute hypokalemia in cow	1
4.	Lactation tetany and transit recumbency in mares	1
5.	Update on diagnosis and management of hypomagnesemic tetany in calves	1



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S. No.	Topics	No. of Lectures
6.	Recent trends in diagnosis and management of ketosis in dairy animals with special reference towards blood metabolites and genomic tools	1
7.	Pregnancy toxemia in sheep and goats: current diagnosis and treatment strategies	1
8.	Biomarkers of fatty liver syndrome in dairy cattle: Latest diagnosis and treatment protocols	1
9.	Update on equine hyperlipidemia and steatitis	1
10.	Neonatal hypoglycemia: Recent trends in diagnosis and management	1
11.	Sub-acute ruminal acidosis (SARA) and low milk fat syndrome	1
12.	Nutritional/ parturient/ puerperal hemoglobinuria	1
13.	Recent trends in diagnosis and management of eclampsia in bitches	1
14.	Exertional myopathies in horse	1
15.	Nutritional secondary hyperparathyroidism (bighead; bran disease)	1
16.	Recent trends in mineral supplementation in livestock with special reference to chelated and non-chelated supplements	1
17.	Diseases due to trace elements deficiency in dairy cattle	1
18.	Oxidative stress during transition period: Role of various vitamins and minerals	1
19.	Recent trends in feeding strategies during transition period for prevention of vitamin and mineral deficiencies	1
20.	Update on importance of vitamin E and selenium in transition cows	1
21.	Disorders due to sodium and potassium deficiency	1
22.	Canine diabetes mellitus: Update on diagnosis and management	1
23.	Canine diabetes insipidus: Update on diagnosis and management	1
24.	Hypothyroidism in canine: Recent trends in diagnosis and management	1
25.	Obesity in pet animals: etio-pathogenesis, diagnosis and lifestyle management	1
26.	Diagnostic tools and treatment protocols for hypo and hyper adrenocorticism in dogs	1
27.	Recent trends in diagnosis, treatment and prevention of vitamin A deficiency diseases	1
28.	Diseases due to thiamine deficiency (PEM)	1
29.	Disorders due to vit K deficiency	1
30.	Approaches towards diagnosis, treatment and prevention of riboflavin (vit B2) deficiency in swine and poultry	1
31.	Update on diagnosis, treatment and prevention strategies for niacin deficiency in swine and poultry	1
32.	Diagnosis, management and prevention of Pantothenic acid deficiency in swine and poultry	1

Suggested Books

- *Veterinary Medicine*. 2006. OM Radostits, CC Gay, KW Hinchcliff and PC Constable, 10th Edition, Saunders.
- *Large Animal Internal Medicine*. 2019. Bradford Smith, David Van Metre and Nicola Pusterla, 6th Edition, Mosby
- *Textbook of Preventive Veterinary Medicine and Epidemiology*. 2010. RD Sharma, M Kumar and MC Sharma, ICAR- New Delhi.
- *Textbook of Veterinary Internal Medicine Expert Consult*. 2016. SJ Ettinger, EC Feldman and E Cote, 8th Edition, Saunders-Elsevier
- Research and Review Papers in Current Journals.

**VMD 713: Emergency and Critical Care Medicine (1+1)**

S. No.	Topics	No. of Lectures/ Practicals
Theory		
1.	Triage and stabilization of critical ill patient	1
2.	Newer therapeutic approach in management of a shock patient	2
3.	Advances in management of respiratory emergencies	2
4.	Gastrointestinal emergencies in small and large animals	2
5.	Management of metabolic emergencies (Addison's disease, Diabetic ketoacidosis, Eclampsia, etc.) in small animals	1
6.	Diagnosis and management of Cardiac arrhythmias	1
7.	Acute obstructive colic and its management	1
8.	Poisoning and toxocosis in animals and its management	2
9.	Urinary system emergencies	1
10.	Ocular emergencies	1
11.	Neurological emergencies	1
12.	Pain, assessment and its management	1
Practicals		
1.	Cardiopulmonary resuscitation (CPR) in dogs and monitoring of critical ill patient and oxygen therapy in dogs	1
2.	Gastrointestinal decompression in large and small animals	1
3.	Clinical approach to acute respiratory distress syndrome in small animals	1
4.	Trans-thoracic drainage of pleural effusions in large animals	1
5.	Trans-thoracic drainage of pericardial effusions in large and small animals	1
6.	Intra-osseous fluid administration in pups	1
7.	Procedures for gastrointestinal emergencies in small animals	1
8.	Procedures for gastrointestinal emergencies in large animals	1
9.	Blood component therapy in critical patients	1
10.	Endotracheal intubation in dogs	1
11.	Clinical examination and therapeutic management of status epilepticus in small animals	1
12.	Case Studies on GIT emergencies	1
13.	Case Studies on Respiratory emergencies	1
14.	Case Studies on Cardiac emergencies	1
15.	Case Studies on hematological emergencies	1
16.	Case Studies on metabolic emergencies	1

Suggested Books

- *Kirk and Bistner's Handbook of Veterinary Procedures and Emergency Treatment*. 2012. Richard B Ford and Elisa Mazaferro, 9th Edition, Saunders Elsevier.
- *Blackwell's Five Minute Veterinary Consult Clinical Companion, Small Animal Emergency and Critical Care*. 2010. Mazaferro ME. 1st Edition, (Wiley Blackwell)
- *Equine Emergencies Treatment and Procedures*. 2008. Orsini JA and Divers TJ, 3rd Edition, Saunders Elsevier.
- Research and Review Papers in Current Journals.

VMD 714: Emerging and Re-emerging Animal Diseases (2+0)

S. No.	Topics	No. of lectures
1.	Definitions and concepts of emerging, re-emerging, exotic, exzootic and endemic diseases	2



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Topics	No. of lectures
2.	General concepts of new animal diseases	1
3.	Conditions for emergence of new animal diseases	2
4.	General concepts for re-emergence of old animal diseases	1
5.	Conditions for re-emergence of old animal diseases	2
6.	Factors and determinants of emerging diseases	3
7.	Effect of climate change on emergence of diseases	2
8.	The role of wildlife in the emergence and re-emergence of animal diseases	2
9.	Microbial adaptation and change	2
10.	Epidemiological processes involved in the emergence of vector-borne diseases	2
Epidemiology of globally and nationally important emerging/ re-emerging diseases and designing of strategies for prevention and control of nationally important emerging/ re-emerging diseases		
11.	Tuberculosis	1
12.	Foot and mouth disease	1
13.	Hemorrhagic septicemia	1
14.	Bovine viral diarrhea	1
15.	Anthrax	1
16.	PPR	1
17.	Blue tongue	1
18.	Swine flu	1
19.	Swine fever	1
20.	Paratuberculosis	1
21.	Glanders	1
22.	Equine diseases manifested by nervous signs	1
23.	Equine infectious anemia and African horse sickness	1

Suggested Books

- *Veterinary Epidemiology*. 2018. Michael Thrusfield, Robert Christley. Wiley-Blackwell
- *Emerging Diseases of Animals*. 2000. Corrie Brown and Carole Bolin. ASM Press
- *Emerging and Re-emerging Infectious Diseases of Livestock*. 2017. Jagadeesh Bayry. Springer
- *Transboundary and Emerging Diseases of Animals*. 2016. Anna Rovid Spickler, James A Roth, Gayle Brown and Jane Galyon. Center for Food Security and Public Health
- Research and Review Papers in Current Journals.

VMD 715: Prevention and Control of Infectious Diseases of Ruminants (2+0)

S. No.	Topics	No. of Lectures
1.	Advances in principles of prevention and control of infectious diseases	1
2.	Anthrax as a biological weapon: strategies for its control in animals	1
3.	Screening and control of Brucellosis in organized dairy herds	1
4.	Diagnosis and management of Mastitis	1
5.	Pathogenesis and symptomatology of Clostridial diseases	2
6.	Pathogenesis and control of Colibacillosis	1
7.	Recent advances in diagnosis and control of Hemorrhagic septicemia	1
8.	Approaches in diagnosis of Tuberculosis	1
9.	Paratuberculosis: differential diagnosis and control	1
10.	Epidemiology, pathogenesis and diagnosis of Listeriosis	1
11.	Pathogenesis and control of Leptospirosis in animals	1



S. No.	Topics	No. of lectures
12.	Clinical presentation, differential diagnosis and treatment of Actinomycosis and Actinobacillosis	1
13.	Advancement in diagnosis and treatment of dermatophytosis and other fungal infections	1
14.	Differential diagnosis and control of campylobacteriosis	1
15.	Latest advancements in Salmonellosis	1
16.	Advancement in diagnosis and control of Mycoplasma infections	1
17.	Latest trends in diagnosis and treatment of anaplasmosis	1
18.	Latest trends in diagnosis and control of Blue tongue	1
19.	Recent advancement in management of sheep and goat pox	1
20.	Recent literature on diagnosis and control of Peste des petits ruminants	1
21.	Lessons to be learnt from eradication of Rinderpest	1
22.	Recent advances in Bovine viral diarrhoea and malignant catarrhal fever	1
23.	Recent literature on Infectious bovine rhinotracheitis	1
24.	Recent studies on clinical symptomatology and diagnosis of ephemeral fever	1
25.	Advancements in diagnosis and control of Foot and mouth disease	1
26.	Recent approaches in diagnosis and control of Rabies	1
27.	Principles of control of parasitic diseases	1
28.	Recent trends in Clinical symptomatology, diagnosis and control of Amphistomosis and fasciolosis	1
29.	Recent approaches in control of major endoparasitic infestations	1
30.	Recent advancements in diagnosis and control of trypanosomosis	1
31.	Recent advancements in diagnosis and control of babesiosis and theileriosis	1

Suggested Books

- *Merck's Veterinary Manual K.* 2016. Susan E Aiello and Michael A Moses, 11th Edition, Merck Sharp and Dohme
- *Veterinary Medicine.* 2016. Peter Constable, Kenneth W Hinchcliff, Stanley Done and Walter Gruenberg, 11th Edition. Saunders Ltd.
- *Dairy Herd Health.* 2012. MJ Green and Andrew J Bradley. CABI Publishing
- Research and Review Papers in Current Journals.

Minor Courses for Ph.D. Degree programme

Courses of any one department/ discipline from the list given below:

- Veterinary Physiology
- Veterinary Microbiology
- Veterinary Parasitology
- Veterinary Pharmacology and Toxicology
- Veterinary Surgery and Radiology
- Veterinary Public Health and Epidemiology

Supporting Courses

It could be any subject considered relevant for student's research work. This will be decided by Advisor/ guide concerned.





VOLUME II C

Veterinary Para-Clinical Subjects

Veterinary Microbiology

Veterinary Pathology

Veterinary Parasitology

Veterinary Public Health and Epidemiology

Veterinary Pharmacology and Toxicology



Suggested list of specified minor subjects (Departments)

Veterinary Microbiology (VMC): Animal/ Veterinary Biotechnology, Veterinary Biochemistry, Veterinary Pathology, Veterinary Public Health and Epidemiology, Animal Genetics or any other discipline as per the requirement of the research problem of the student.

Veterinary Pathology (VPL): Veterinary Microbiology, Animal/ Veterinary Biotechnology, Veterinary Biochemistry, Veterinary Medicine, Veterinary Parasitology, Veterinary Public Health and Epidemiology, Veterinary Pharmacology and Toxicology or any other discipline as per the requirement of the research problem of the student.

Veterinary Parasitology (VPA): Veterinary Microbiology, Animal/ Veterinary Biotechnology, Veterinary Biochemistry, Veterinary Medicine, Veterinary Pathology, Veterinary Public Health and Epidemiology, Veterinary Pharmacology and Toxicology or any other discipline as per the requirement of the research problem of the student.

Veterinary Public Health and Epidemiology (VPE): Veterinary Microbiology, Animal/ Veterinary Biotechnology, Veterinary Medicine, Veterinary Parasitology, Veterinary Pathology, Veterinary Pharmacology and Toxicology, Statistics or any other discipline as per the requirement of the research problem of the student.

Veterinary Pharmacology and Toxicology (VPT): Veterinary Biochemistry; Animal/ Veterinary Biotechnology; Veterinary Physiology; Veterinary Microbiology; Veterinary Pathology; Veterinary Medicine; Veterinary Public Health and Epidemiology





Preamble

During the recent years, there has been appreciable advancement in Veterinary Sciences and livestock sector. In order to reduce animal sufferings, ensuring food security and human health, livestock rearing have been gradually changed from subsistence to commercial and organized system. Moreover, the futuristic requirement of the society for better animal health care, public health, food safety, environment, etc. have posed greater challenge for veterinary academicians, scientific community and service providers. Therefore, in tune with the change of development in science and technology, industrial and economic order, etc. needs to be considered for exposing the post graduate students while producing the skilled veterinarians with higher qualification and experiential training. The course curricula and syllabi of all the Veterinary Para-clinical disciplines have been reviewed and revised looking into the contemporary developments in the field of veterinary sciences and other related fields. Several new courses have been introduced as per need of the day along with revision of the contents of earlier courses. The implementations of the new and restructured course curricula is expected to build and improve knowledge, skill and competence of the students so as to enhance their employability and render efficient service to the society, farming community and the Livestock Industry.

Academicians and Researchers are being involved in devising means and methods of developing diagnostics against prevalent and emerging pathogens, prevention and control of animal diseases and zoonosis, monitoring and surveillance of disease of livestock and poultry, combating bio-terrorism, genetic engineering to optimize production and develop disease resistance breeds of animals. Bio-medical research, being heavily dependent upon animal experimentation, demands deeper scientific knowledge of veterinary science. The dominant forces shaping the Veterinary-business and Veterinary-education are global and virtual with a large number of specialists offering tele-veterinary services from off-shore locations like India. The ever changing and demanding public service sector has necessitated re-look into the veterinary higher education. At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance. Detailed study of the course curricula and syllabi, being implemented by veterinary colleges in India, revealed that there was enormous heterogeneity in the course structure, nomenclature and contents. In view of the above, the task of formulating need based contemporary post graduate courses and syllabi for implementation of post graduate education uniformly at national level was essential.

Five BSMA committees, constituted by ICAR vide Office order No. F.No.7/ 6/2017-EQR Dated 4th April, 2018 for restructuring of Master's and Doctorate course curricula and syllabi, worked in unison to formulate common basic format. The BSMA committee for Veterinary Para-clinical Subjects (Microbiology, Pathology, Parasitology, Public Health and Epidemiology and Pharmacology and Toxicology) was constituted for developing uniform course curricula, syllabi and academic regulations in line with changing global scenario.



The new and restructured Post-Graduate curricula and syllabi in respect of Veterinary Para-Clinical subjects contain several innovative and practically applicable courses and extensively revamped course contents, viz., ultra-structural studies, molecular techniques in understanding the disease pathogenesis, diagnosis and monitoring surveillance. Veterinary Para-clinical subjects provide essential support by employing disease diagnostic technologies for prevention and control of animal diseases, maintenance of biodiversity, etc. New courses in Veterinary Microbiology, on Cytokines and Chemokines, Immunoregulations and Techniques in Molecular Microbiology, in Veterinary Pathology, courses on Molecular and Ultra structural bases of cell injury, molecular bases of inflammation and pathology of laboratory animal diseases, in Veterinary Parasitology, courses on Biology and Ecology of Parasites, Molecular Veterinary Parasitology and Immunology of Parasitic Diseases, in Veterinary Public Health and Epidemiology, courses on Ecology and Animal/ Human Health, Surveys, Surveillance and Data Management, risk analysis and predictive modeling, Food Safety Standards and Regulations have been included, in Veterinary Pharmacology and Toxicology, courses on Bio-transformation of Xenobiotics, Molecular Pharmacology, Fundamentals of Pharmacokinetics. The contents of most of the courses have been revised and updated to include the latest developments. The learning of research methodology, scientific thinking, planning and experimentation and special problems has been introduced in all the subjects.

The implementations of the new and restructured post graduate course curricula is expected to build knowledge and skill of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after Masters. The Doctorates should in turn prove as specialists, in their respective disciplines. The valuable inputs received from the stake holders', viz., eminent academicians, scientists, extension workers, leading veterinary practitioners, state animal husbandry department, etc. have immensely helped in preparation of this document.



SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Veterinary Para-Clinical Subjects

– Veterinary Microbiology





Course Title with Credit Load M.V.Sc. in Veterinary Microbiology

Course Code	Course Title	Credit Hours
VMC 601	General Bacteriology*	2+1
VMC 602	Systematic Veterinary Bacteriology	2+1
VMC 603	General Virology*	2+1
VMC 604	Systematic Veterinary Virology	2+1
VMC 605	Principles of Veterinary Immunology*	2+1
VMC 606	Veterinary Mycology*	1+1
VMC 607	Vaccinology	2+0
VMC 608	Techniques in Microbiology	0+2
VMC 609	Techniques in Molecular Microbiology	1+2
VMC 610	Molecular Immunology	1+1
VMC 611	Mucosal Immunology	1+0
VMC 612	Introduction to Microbial Bio-informatics	1+0
VMC 691	Master's Seminar*	1+0
VMC 699	Master's Research	0+30

*Core Courses



Course Contents

M.V.Sc. in Veterinary Microbiology

- I. Course Title** : **General Bacteriology**
II. Course Code : **VMC 601**
III. Credit Hours : **2+1**

IV. Aim of the course

To impart knowledge of general bacteriology.

V. Theory

Unit I

Historical events of microbiology, Taxonomy and nomenclature of bacteria. Basic principles of microscopy and micrometry, Classical, Confocal, Nomarski and electron microscopy. Staining of bacteria, Structure and function of bacterial cell. Growth, Nutrition, Metabolism, Secretion and excretion systems of bacteria. General principles of bacterial disease diagnosis.

Unit II

Bacterial genetics, Bacterial variation, Horizontal genetic transfer mechanisms (transformation, transduction and conjugation), Plasmids, Transposons and drug resistance.

Unit III

Determinants of pathogenicity and its molecular basis, Markers and PAMPs, exotoxin and endotoxin.

Bacteriophages: temperate and virulent phages; lysogeny and lysogenic conversion. Antimicrobial agents and disinfectants: Mechanism of action, Resistance and susceptibility testing. Bacterial immunity.

VI. Practical

Orientation to a bacteriology laboratory, Sterilization and disinfection techniques, Laboratory biosafety and biosecurity. Cultivation of aerobic, Microaerophilic and anaerobic bacteria, Isolation of bacteria in pure culture, Microscopy, Morphological characterization of bacteria, Different staining methods and biochemical tests for identification of bacteria, Determination of bacterial number and biomass and standard protocols for antibiotic sensitivity test and detection of MIC.

- I. Course Title** : **Systematic Veterinary Bacteriology**
II. Course Code : **VMC 602**
III. Credit Hours : **2+1**

IV. Aim of the course

To learn different aspects with regards to the virulence factors, Antigenic and structural components, Epidemiology, Pathogenesis, Diagnosis and control of important aerobic, Microaerophilic and anaerobic pathogenic bacteria causing



diseases in animals and disease status in India.

V. Theory

Unit I

Systematic study of following groups of bacteria:

Spirochetes: *Leptospira*, *Brachyspira* and *Borrelia*.

Gram-negative

- Aerobic/ Microaerophilic, motile helical/ vibrioid: *Campylobacter*;
- Aerobic/ Microaerophilic rods/ cocci: *Bordetella*, *Brucella*, *Moraxella*, *Pseudomonas* and *Burkholderia*;
- Facultative anaerobic Gram-negative rods: members of *Enterobacteriaceae*, *Pasteurella*, *Mannheimia* and *Haemophilus*;
- Anaerobic, straight, curved and helical rods: *Dichelobacter* and *Fusobacterium*

Unit II

Rickettsia and Chlamydia: *Rickettsia*, *Chlamydia* (*Chlamydophila*) and *Coxiella*.

Gram-positive

- Gram-positive cocci: *Staphylococcus* and *Streptococcus* including *Enterococcus*.
- Endospore-forming rods: *Bacillus* and *Clostridium*.
- Regular non-spore forming rods: *Erysipelothrix* and *Listeria*
- Irregular non-spore forming rods: *Actinomyces*, *Corynebacterium* and *Trueperella*.

Unit III

- Mycobacteria: *Mycobacterium*; *Actinomycetes*: *Nocardia* and *Rhodococcus*, *Dermatophilus*.
- Mollicutes: *Mycoplasma*.

Unit IV

- Emerging and transboundary bacterial pathogens.

VI. Practical

Collection, transport and dispatch of clinical samples from various disease conditions. Isolation of bacteria in pure cultures from different clinical samples. Identification of the bacteria using staining, biochemical tests and other molecular techniques. Preservation and storage of bacterial cultures.

I. Course Title : General Virology

II. Course Code : VMC 603

III. Credit Hours : 2+1

IV. Aim of the course

To study general aspects of viral structure, classification, replication, interactions and immunity against viruses.

V. Theory

Unit I

History of virology, Origin and nature of viruses, Morphological structure and chemical composition of viruses, Nomenclature and classification of viruses, Cultivation and purification of viruses, Laboratory diagnosis of viral infections, Viroid and Prions.



Unit II

Replication of DNA and RNA viruses, genetic and non-genetic interactions between viruses.

Unit III

Virus-cell interactions, viral pathogenesis, viral persistence, oncogenic, oncolytic viruses and epidemiology of viral infections.

Unit IV

Immune response to viruses, viral vaccines, viral chemotherapy.

VI. Practical

Orientation to a virology laboratory, Preparation of glassware, Plasticware, Media and reagents for cell culture and other items required for virus cultivation. Protocols for primary and secondary cell cultures, Maintenance of cell lines, Cryopreservation of cells and their revival. Staining of virus infected cultured cells and demonstration of inclusion bodies. Viable cell counting. Cultivation of viruses in embryonated chicken eggs and cell cultures.

I. Course Title : Systematic Veterinary Virology

II. Course Code : VMC 604

III. Credit Hours : 2+1

IV. Aim of the course

To study viral properties, epidemiology, pathogenesis and disease status in India, diagnosis, immunity and control of diseases caused by viruses belonging to different families of animal viruses.

V. Theory

Unit I: Double and Single stranded DNA virus families

Poxviridae, Asfarviridae, Herpesviridae, Adenoviridae, Papillomaviridae, Polyomaviridae, Parvoviridae, Circoviridae and Hepdnaviridae.

Unit II: Single stranded Negative sense and Double stranded RNA viruses

Orthomyxoviridae, Paramyxoviridae, Rhabdoviridae, Bornaviridae, Reoviridae and Birnaviridae.

Unit III: Single stranded Positive sense RNA viruses

Picornaviridae, Caliciviridae, Togaviridae, Flaviviridae, Coronaviridae, Arteriviridae, Astroviridae and Retroviridae.

Unit IV: Prions

BSE, Scrapie and introduction to virioids.

Unit V

Emerging, re-emerging and transboundary viral pathogens

VI. Practical

Collection, Preservation, Transportation of clinical samples and their processing for virus isolation and identification. Isolation and cultivation of viruses from clinical samples, using different methods and its plaque purification. Titration of viruses for 50% end points using different methods, Serum neutralization test.



Electropherotyping. Concentration and purification of viruses by chemical agents, differential centrifugation, density gradient centrifugation and ultra-filtration. Methods for preservation of animal viruses.

- I. Course Title : Principles of Veterinary Immunology**
II. Course Code : VMC 605
III. Credit Hours : 2+1
IV. Aim of the course

To understand the fundamental principles of veterinary immunology and its applications.

V. Theory

Unit I

Introduction to livestock and poultry immune system: ontogeny and phylogeny of vertebrate immune system, cells and organs of immune system. Types of immunity: Innate and adaptive immune system.

Unit II: Antigen and its characteristics

Characteristic of ideal antigen; Classification of antigens, Factors affecting immunogenicity, Concept of hapten and carrier. Antigenic determinant/ epitope and cross reactivity. B-cell epitope and T cell epitope. Immunoglobulins: Basic structure and function of immunoglobulins, Immunoglobulin diversity and immunoglobulin classes.

Antigen recognition by B cell and T cell: B cell receptor, T cell receptor, receptor diversity, B cell and T cell activation.

Unit III: Major Histocompatibility Complex

General feature, structure, function, gene organization, MHC and immune response. Immune-response development: Phases of humoral and cell mediated immune response. Immunoregulation with B and T cells: Antigen recognition, antigen presentation and processing, antigen recognition by TCR, MHC restriction, Cytokines and chemokines. Cell mediated immune response: General properties of effector T cells, cytotoxic T cells, NK-cells and ADCC. Role of integrin and selectin.

Unit IV: Complement System

Basic concept of complement, mechanism of complement activation, complement pathways and Complement deficiencies. Autoimmunity and autoimmune diseases, immunological tolerance and hypersensitivity: classification, mechanism of induction with examples.

Immunodeficiency: Types with examples. Immune response in foetus and new born.

Unit V: Antigen antibody interaction

Antibody affinity, avidity, cross reactivity, precipitation and agglutination test, radio-immunoprecipitation assay (RIPA), ELISA, Western blotting, Immunodiagnostics and Immunotherapy. Monoclonal antibodies and methods for production and characterization of monoclonal antibodies.

VI. Practical

Preparation of antigens, raising of antisera against soluble and insoluble antigens.



Detection of antibody by gel diffusion, radial immunodiffusion, immune-electrophoresis techniques. Haemagglutination and haemagglutination inhibition test, ELISA and its modifications. Immunoblotting. Agglutination tests. Separation and purification of Immunoglobulin from serum. Separation of mononuclear cells from blood by density gradient centrifugation, viable count of lymphocyte by dye exclusion method. Measurement of T cell response (DTH, lymphoproliferative assay).

- I. Course Title : Veterinary Mycology**
- II. Course Code : VMC 606**
- III. Credit Hours : 1+1**
- IV. Aim of the course**

To learn detailed morphological, cultural features, virulence factors, antigenic and structural components, epidemiology, pathogenesis, diagnosis and control of fungal infections.

V. Theory

Unit I

History of mycology, Glossary of mycological terms; Morphology of fungi: structure and ultra-structure, differentiation, nutrition, physiology, reproduction, spores, cultural characters and classification of fungi of veterinary importance. Fungal immunity. Antifungal agents and important techniques in diagnosis of fungal infections.

Unit II: Systematic study of animal mycoses:

Aspergillosis, Candidiasis, Cryptococcosis, Epizootic lymphangitis, Rhinosporodiosis, Zygomycosis, Blastomycosis, Sporotrichosis, Histoplasmosis, Coccidioidomycosis, Mycetomas, Dermatophytoses, Dermatomycosis, Mycotoxycosis, Malassezia infections, Mycotic abortion, Mycotic mastitis, and Emerging mycoses.

VI. Practical

Collection and processing of clinical material for isolation of fungi. Microscopy of fungi: Lactophenol cotton blue and India ink preparations. Preparation of basal and special fungal media of veterinary importance. Slide culture and cellophane tape technique for fungi. Diagnosis of dermatophytes. Biosafety precautions in handling yeast and dimorphic fungi. Study of gross and microscopic characters of pathogenic fungi, antifungal sensitivity testing, detection of mycotoxin. Serological and molecular diagnosis in fungi.

- I. Course Title : Vaccinology**
- II. Course Code : VMC 607**
- III. Credit Hours : 2+0**
- IV. Aim of the course**

To understand different aspects of vaccines, their production, standardization and quality control of various vaccine used in animals.

Unit I

Types of vaccines and vaccine components, factors influencing choice of vaccines. **New generation vaccines:** subunit vaccines, peptide vaccines, recombinant



vaccines, reverse genetics vaccines, Marker and DIVA enabled vaccines and transmission blocking vaccines.

Unit II: Preparation of vaccines

Identification of candidate strain, identification of epitopes, seed and challenge strain maintenance. Classical methods of exaltation and attenuation of pathogens and their molecular basis. Technology of production of different types of vaccines. Multicomponent vaccines. Recent advances in vaccine delivery systems. Advances in vaccines adjuvants with their classification and mode of action.

Unit III

Standardization of veterinary vaccines as per National and Global standards. Laws and regulatory requirements about veterinary biological and Indian pharmacopoeia.

Unit IV

Vaccine failure and post vaccinal reactions. Factors affecting response to vaccines: maintenance of vaccines and cold chain. Quality control. Principles of development of vaccination schedule, methods of conducting vaccine trials (lab to field use) and pharmaco-vigilance. Scaling up methods of vaccine production.

I. Course Title : Techniques in Microbiology

II. Course Code : VMC 608

III. Credit Hours : 0+2

(Course to be offered to the students not majoring in Veterinary Microbiology)

IV. Aim of the course

To give overview of the techniques used in microbiology.

V. Practical

Unit I

Orientation to a microbiology laboratory. Different sterilization and disinfection techniques. Laboratory biosafety and biosecurity. Microscopy, media preparation, isolation, cultivation and purification of bacteria and fungi and their morphological and biochemical characterization. Antibacterial sensitivity test by Disc diffusion, broth dilution and MIC determination technique.

Unit II

Cultivation of viruses in embryonated eggs and cell culture. Virus Neutralization test.

Unit III

Different immunological techniques: Agglutination, precipitation, ELISA, Haemagglutination and Haemagglutination Inhibition and other immunological assays.

I. Course Title : Techniques in Molecular Microbiology

II. Course Code : VMC 609

III. Credit Hours : 1+2

IV. Aim of the course

To provide training in molecular biology and other diagnostic techniques used in microbiology.



V. Theory

Unit I

Basic requirements for establishing molecular diagnostics Laboratory. Principles of molecular diagnostic tests. Methods of nucleic acid extraction from pathogenic microorganisms.

Unit II

PCR, and variants of PCR. Principles of primer designing. Gel electrophoresis methods and blotting techniques: Southern blotting, northern blotting, western blotting, dot-blot. Microarrays, nucleic acid sequencing methods. Sequence analysis- sequence editing, sequence alignment, sequence comparison and phylogenetic analysis. Gene cloning and expression. Molecular diagnosis as epidemiological tool. Development and validation of diagnostic tests.

VI. Practical

Unit I

Orientation of molecular diagnosis laboratory: especially RNA and diagnostic PCR laboratory (handling RNA and DNA). Extraction of nucleic acid from different microbes: Gram positive bacteria, Gram negative bacteria, DNA viruses, RNA Viruses and fungi, DNA and RNA isolation from cell culture and blood and isolation of plasmids. Quality and quantity check of nucleic acids.

Unit II

Principles for Primer designing. Procedure for molecular diagnostic tests like PCR, RT-PCR and LAMP. Absolute and relative quantitation of DNA/ RNA using Q-PCR. SDS PAGE of proteins and RNA, study of nucleic acid and proteins by blotting techniques. Restriction Enzyme digestion Techniques and RFLP; PCR product concentration and purification for sequencing. Nucleic acid sequence analysis. Gene Cloning, expression and purification of expression products. An introduction to high throughput sequencing and MALDI-TOF.

I. Course Title : Molecular Immunology

II. Course Code : VMC 610

III. Credit Hours : 1+1

IV. Aim of the course

To learn about molecular aspects of immunology.

V. Theory

Unit I

Molecular Structure and function of PRRs. Ligands of PRRs, signal transduction through PRRs and inflammasome. Cytokines, Lymphocyte markers and CD nomenclature.

Unit II

Molecular structure of Immunoglobulin and class, Isotypes, Synthesis and expression of immunoglobulin, Rearrangement and its organization, Immunoglobulin gene diversity and mechanism of recombination of B cell gene. Theory of antibody



generation. Signature molecules of T cell and T regulatory cell. T cell receptor and T cell gene diversity.

Unit III

MHC structure, Genomic organization of the MHC gene haplotype. Concept of congenic and syngeneic, concept of polymorphism of MHC gene, pathway of signal transduction, role of co-stimulators in B cell and T cell activation and recruitment of adaptor proteins. Molecular mechanisms (events) of cell cytotoxicity.

VI. Practical

Isolation and purification of mammalian and avian immunoglobulin by precipitation technique: Caprylic acid, PEG, Ammonium Sulphate, Sodium Sulphate. Separation of immunoglobulins by size, charge and ligand affinity: size exclusion chromatography (gel filtration on Sephadex G200), ion exchange chromatography, affinity chromatography (Protein-A-Sepharose). Immuno-electrophoresis Technique: polyacrylamide gel electrophoresis innative and reducing conditions, fixed and gradient gel, Western blot, Crossed immune-electrophoresis. Chemiluminescence assay and Cell cytotoxicity assays; Non-radioactive methods like LDH release assay. Antigen detection by Immuno PCR. Haplotype matching between individuals, Flow cytometry for CD4 and CD8 ratio determination and other applications. ELISpot test for cytokine assay.

I. Course Title : Mucosal Immunology

II. Course Code : VMC 611

III. Credit Hours : 1+0

IV. Aim of the course

To learn about mucosal immunity.

V. Theory

Unit I: Innate Mechanisms

Mucosal barrier: Development and physiology of mucosal defense. Cells and lymphoid tissues of mucosal immune system: MALT, GALT, NALT and BALT. Innate immune response at mucosal surfaces: mucus, antimicrobial peptides, role of PPRs, intestinal Dendritic cell, intestinal macrophage, mucosal inductive and effector sites. Antigen uptake and presentation at mucosal sites, transepithelial transport of antigen.

Unit II: Acquired response

Mucosal Immunoglobulin, IgA synthesis and transport to intestinal lumen. Description and role of Paneth cell and crypto patches. M-cells and their functions. Mucosal immune effector mechanisms including secretory IgA response.

Extrathymic T cell development in mucosal tissues and their phenotypes and functions.

Unit III: Applications

Importance and limitations of mucosal immunization. Mucosal adjuvants and delivery systems. Oral tolerance mechanistic approach. Immunopathology at mucosal surfaces: Celiac disease, Inflammatory bowel disease, Jhone's disease; Assessment of mucosal immune response and potency testing.



I. Course Title : Introduction to Microbial Bioinformatics

II. Course Code : VMC 612

III. Credit Hours : 1+0

(Relevant practical demonstrations be given along with theory topic)

IV. Aim of the courses

To learn about key bioinformatics techniques, tools and databases.

V. Theory

Unit I

Introduction to Bioinformatics; History, Scope and Application, Internet and world wide web. Bioinformatics resources and information retrieval system. Nucleic acid sequence databases, Genome databases, Protein sequence databases, Metabolic pathways databases, NCBI, EXPASy and Ensembl Genome browser.

Unit II

Sequence comparison and alignment methods; Introduction to sequence alignment, principal methods of pairwise sequence alignment and Dot plot analysis. Significance of BLAST and FASTA programs in DNA and protein sequence analysis, variants of BLAST and FASTA programs. Introduction to multiple sequence alignment and Phylogenetic analysis to retrieve evolutionary information, Global multiple sequence alignment tool- CLUSTAL-W.

Unit III

Overview of protein structure and databases, Structure based protein classification, Protein structure database (CASP), Protein structure alignment tools (VAST, DALI), Protein 3-D structure visualization and modeling using SWISS PROT.



Course Outline-cum-Lecture Schedule for Master degree Programme

VMC 601: General Bacteriology (2+1)

S.No.	Topic of Syllabus	Lecture/ Practical
Theory		
1.	Historical events of Microbiology	2
2.	Taxonomy and nomenclature of bacteria	1
3.	Basic principle of microscopy and micrometry	1
4.	Classical, Confocal, Nomarski and Electron Microscopy	2
5.	Staining of bacteria	1
6.	Structure and function of bacterial cell	3
7.	Bacterial growth, nutrition and metabolism	3
8.	Secretion and excretion systems of bacteria	2
9.	General Principles of bacterial disease diagnosis	2
10.	Bacterial genetics and Bacterial variation	1
11.	Horizontal genetic transfer mechanisms- transformation, transduction and conjugation	1
12.	Plasmids, transposons and drug resistance	1
13.	Determinants of pathogenicity and its molecular basis	2
14.	Markers and PAMPs, exotoxin and endotoxin	1
15.	Bacteriophages- temperate and virulent phages, lysogeny and lysogenic conversion	2
16.	Antimicrobial agents	2
17.	Disinfectants -Mechanism of action	2
18.	Disinfectants -resistance and susceptibility testing	1
19.	Bacterial immunity	2
	Total	32
Practical		
1.	Orientation to a bacteriology laboratory	1
2.	Different sterilization and disinfection techniques	2
3.	Laboratory biosafety and biosecurity	1
4.	Cultivation of aerobic, microaerophilic and anaerobic Bacteria using bacteriological media	2
5.	Isolation of bacteria in pure culture	2
6.	Microscopy	1
7.	Morphological characterization of bacteria by different staining methods	2
8.	Important biochemical tests for identification of bacteria	2
9.	Determination of bacterial number and biomass by different methods	1
10.	Standard protocols for antibiotic sensitivity test	2
11.	Detection of MIC	1
	Total	16

**VMC 602: Systematic Veterinary Bacteriology (2+1)**

S.No.	Topic of Syllabus	Lecture/ Practical
Theory		
1.	Spirochetes: <i>Leptospira</i> , <i>Brachyspira</i> and <i>Borrelia</i>	2
2.	<i>Campylobacter</i>	1
3.	<i>Bordetella</i> and <i>Moraxella</i>	1
4.	<i>Brucella</i>	2
5.	<i>Pseudomonas</i> and <i>Burkholderia</i>	1
6.	<i>Enterobacteriaceae</i>	3
7.	<i>Pasteurella</i> and <i>Mannheimia</i>	2
8.	<i>Haemophilus</i>	1
9.	<i>Dichelobacter</i> and <i>Fusobacterium</i>	1
10.	Rickettsia and Chlamydia- <i>Rickettsia</i>	1
11.	Rickettsia and Chlamydia- <i>Chlamydia (Chlamydophila)</i> and <i>Coxiella</i>	1
12.	<i>Staphylococcus</i>	1
13.	<i>Streptococcus</i> and <i>Enterococcus</i>	2
14.	<i>Bacillus</i>	1
15.	<i>Clostridium</i>	3
16.	<i>Erysipelothrix</i> and <i>Listeria</i>	2
17.	<i>Actinomyces</i> , <i>Corynebacterium</i> and <i>Trueperella</i> .	1
18.	<i>Mycobacterium</i>	2
19.	Actinomycetes: <i>Nocardia</i> and <i>Rhodococcus</i> and <i>Dermatophilus</i>	2
20.	Mollicutes (<i>Mycoplasma</i>)	1
21.	Emerging and transboundary bacterial pathogens	2
	Total	32
Practical		
1.	Collection, transport and dispatch of clinical samples from various disease conditions	2
2.	Isolation of bacteria in pure cultures from different clinical samples	12
3.	Identification of the bacteria using staining, biochemical tests and other molecular techniques	
4.	Preservation and storage of bacterial cultures	2
	Total	16

VMC 603: General Virology (2+1)

S.No.	Topic of Syllabus	Lecture/ Practical
Theory		
1.	History of virology	1
2.	Origin and nature of viruses	1
3.	Morphological structure and chemical composition of viruses	2
4.	Nomenclature and classification of viruses	2
5.	Cultivation and purifications of viruses	2
6.	Laboratory diagnosis of viral infections	2
7.	Viroid and Prions	1
8.	Replication of DNA viruses	2
9.	Replication of RNA viruses	3
10.	Genetic and non-genetic interactions between viruses	2
11.	Virus-cell interactions	1
12.	Viral pathogenesis	2



Veterinary Para-Clinical Subjects: Veterinary Microbiology



S.No.	Topic of Syllabus	Lectures/ Practicals
13.	Viral persistence	1
14.	Oncogenic and oncolytic viruses	2
15.	Epidemiology of viral infections	2
16.	Immune response to viruses	2
17.	Viral vaccines	2
18.	Viral chemotherapy	2
	Total	32
Practical		
1.	Orientation to a virology laboratory	1
2.	Preparation of glassware, plasticware, media and reagents for cell culture	2
3.	Other items required for virus cultivation	1
4.	Protocols for primary and secondary cell cultures	2
5.	Maintenance of cell lines	1
6.	Cryopreservation of cells and their revival	2
7.	Staining of virus infected cultured cells	1
8.	Demonstration of inclusion bodies	1
9.	Viable cell counting	1
10.	Cultivation of viruses in embryonated chicken eggs	2
11.	Virus cultivation in primary cell cultures and cell lines	2
	Total	16

VMC 604: Systematic Veterinary Virology (2+1)

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	<i>Poxviridae</i>	2
2.	<i>Asfarviridae</i>	1
3.	<i>Herpesviridae</i>	3
4.	<i>Adenoviridae</i>	2
5.	<i>Papillomaviridae</i> and <i>Polyomaviridae</i>	1
6.	<i>Parvoviridae</i>	1
7.	<i>Circoviridae</i> and <i>Hepadnaviridae</i>	1
8.	<i>Orthomyxoviridae</i>	2
9.	<i>Paramyxoviridae</i>	2
10.	<i>Rhabdoviridae</i>	2
11.	<i>Bornaviridae</i>	1
12.	<i>Reoviridae</i>	2
13.	<i>Birnaviridae</i>	1
14.	<i>Picornae</i> and <i>Caliciviridae</i>	2
15.	<i>Togaviridae</i> and <i>Flaviviridae</i>	2
16.	<i>Coronaviridae</i>	1
17.	<i>Arteriviridae</i> and <i>Astroviridae</i>	1
18.	<i>Retroviridae</i>	2
19.	Prions: BSE, Scrapie and introduction to viroids	2
20.	Emerging, re-emerging and transboundary viral pathogens	1
	Total	32
Practical		
1.	Collection, preservation, transportation of clinical samples	1



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S.No.	Topic of Syllabus	Lectures/ Practicals
2.	Processing clinical samples for virus isolation and identification	6
3.	Isolation and cultivation of viruses from clinical samples, using different methods and its plaque purification	
4.	Titration of viruses for 50% end points using different methods	2
5.	Detection of viral antibodies by serum neutralization test	2
6.	Electropherotyping	2
7.	Concentration and purification of animal viruses by chemical agents, differential centrifugation, density gradient centrifugation and ultra-filtration	2
8.	Methods for preservation of animal viruses	1
	Total	16

VMC 605: Principles of Veterinary Immunology (2+1)

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	Introduction to livestock and poultry immune system	1
2.	Ontogeny and phylogeny of vertebrate immune system	1
3.	Cells and organs of immune system	1
4.	Types of immunity- Innate and adaptive immune system	1
5.	Antigen and its characteristics- Characteristic of ideal antigen, classification of antigens, Factors affecting immunogenicity, Concept of hapten and carrier, Antigenic determinant/ epitope and cross reactivity, B-cell epitope and T cell epitope	2
6.	Immunoglobulins- Basic structure and function of immunoglobulins	1
7.	Immunoglobulin diversity and Immunoglobulin classes	1
8.	Antigen recognition by B cell and T cell	1
9.	B cell receptor/ immunoglobulins and T cell receptor	1
10.	Receptor diversity- B cell and T cell activation	1
11.	Major Histocompatibility Complex (General feature, structure, function, gene organization, MHC and immune response and Cytokines and chemokines)	2
12.	Immune response development- Phases of humoral and cell mediated immune response	2
13.	Immunoregulation with B and T cells (Antigen recognition, Antigen presentation and processing, Antigen recognition by TCR and MHC restriction)	1
14.	Cell mediated immune response- General properties of effector T cells, cytotoxic T cells, NK-cells and ADCC, Role of integrin and selectin	2
15.	Complement System- Basic concept of complement, Mechanism of complement activation, complement pathways and Complement deficiencies	2
16.	Autoimmunity, autoimmune diseases and Immunological tolerance	1
17.	Hypersensitivity- Classification and mechanism of induction with examples	2
18.	Immunodeficiency- Types with examples	1
19.	Immune response in foetus and new born	1
20.	Antigen antibody interaction- Antibody affinity, avidity, cross reactivity, precipitation and agglutination test	2
21.	ELISA and Western blotting	1



S.No.	Topic of Syllabus	Lectures/ Practicals
22.	Immunodiagnostics and Immunotherapy	1
23.	Monoclonal antibodies and methods for production of monoclonal antibodies	1
	Total	32
Practical		
1.	Preparation of antigens	1
2.	Raising of antisera against soluble and insoluble antigens	1
3.	Detection of antibody by gel diffusion, radial immune-diffusion and immune-electrophoresis techniques	2
4.	Haemagglutination and haemagglutination inhibition test	2
5.	ELISA and its modifications	2
6.	Immunoblotting	1
7.	Different agglutination tests	2
8.	Separation and purification of Immunoglobulin from serum	1
9.	Separation of mononuclear cells from blood by density gradient centrifugation	1
10.	Viable count of lymphocyte by dye exclusion method	1
11.	Measurement of T cell response- DTH and lymphoproliferative assay	2
	Total	16

VMC 606: Veterinary Mycology (1+1)

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	History of mycology and Morphology of fungi	1
2.	Structure and Ultra structure	1
3.	Differentiation, nutrition, physiology, reproduction, spores and cultural characters	2
4.	Classification of fungi of veterinary importance	1
5.	Glossary of mycological terms and antifungal agents	1
6.	Important techniques in diagnosis of fungal infections	1
7.	Aspergillosis	1
8.	Candidiasis, Cryptococcosis and Pachydermatitis	1
9.	Epizootic lymphangitis and Rhinosporodiosis	1
10.	Zygomycosis and Blastomycosis	1
11.	Sporotrichosis and Histoplasmosis	1
12.	Coccidioidomycosis and Mycetomas	1
13.	Mycotic abortion and mycotic mastitis	1
14.	Dermatophytoses and dermatomycosis	2
15.	Mycotoxins and Emerging mycoses	1
	Total	16
Practical		
1.	Collection and processing of clinical material for isolation of fungi	1
2.	Microscopy of fungi-Lactophenol cotton blue and india ink preparations	2
3.	Preparation of basal and special fungal media of veterinary importance	1
4.	Slide culture and cellophane tape technique for fungi	2
5.	Biosafety precautions in handling yeast and dimorphic fungi	1
6.	Study of gross and microscopic characters of pathogenic fungi	5
7.	Diagnosis of dermatophytes	1



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S.No.	Topic of Syllabus	Lectures/ Practicals
8.	Antifungal sensitivity testing	1
9.	Detection of mycotoxin	1
10.	Serological and molecular diagnosis in fungi	1
	Total	16

VMC 607: Vaccinology (2+0)

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Types of vaccines	1
2.	Vaccine components, Immunogens and factors influencing choice of vaccines	1
3.	New generation vaccines- subunit vaccines, peptide vaccines and recombinant vaccines	2
4.	Reverse genetics vaccines, Marker and DIVA vaccines and transmission blocking vaccines	2
5.	Preparation of vaccines- Identification of candidate strain, identification of epitopes	2
6.	Seed and challenge strain maintenance	1
7.	Classical methods of exaltation and attenuation of pathogens and their molecular basis	2
8.	Technology of production of different types of vaccines	1
9.	Recent advances in vaccine delivery systems and multicomponent vaccines	2
10.	Advances in vaccines, adjuvants with their classification and mode of action	2
11.	Standardization of veterinary vaccines as per National and Global standards	2
12.	Laws and regulatory requirements concerning veterinary biologicals	2
13.	Indian pharmacopoeia	2
14.	Vaccine failure and Post vaccinal reactions	1
15.	Factors affecting response to vaccines and Quality control	2
16.	Principles of development of vaccination schedule	1
17.	Principles of development of vaccination schedule	1
18.	Methods of conducting vaccine trials (lab to field use)	1
19.	Pharmaco-vigilance	1
20.	Scaling up methods of vaccine production	1
	Total	32

VMC 608: Techniques in Microbiology (0+2)

S.No.	Topic of Syllabus	Practicals
Practical		
1.	Orientation to a microbiology laboratory	1
2.	Different sterilization and disinfection techniques	2
3.	Laboratory biosafety and biosecurity	1
4.	Microscopy	2



Veterinary Para-Clinical Subjects: Veterinary Microbiology

S.No.	Topic of Syllabus	Practicals
5.	Media preparation	2
6.	Isolation, cultivation and purification of bacteria and fungi	2
7.	Morphological and biochemical characterization	3
8.	Antibacterial sensitivity test by Disc diffusion, broth dilution and MIC determination technique	3
9.	Cultivation of viruses in embryonated eggs	2
10.	Cultivation of viruses in cell culture	3
11.	VNT	1
12.	Different immunological techniques- Agglutination	2
13.	Precipitation	2
14.	HA and HI	2
15.	ELISA	2
16.	Other immunological assays	2
	Total	32

VMC 609: Techniques in Molecular Microbiology (1+2)

S.No.	Topic of Syllabus	Lectures/ Practical
Theory		
1.	Basic requirements for establishing molecular diagnostics Laboratory	1
2.	Principles of molecular diagnostic tests	2
3.	Methods of nucleic acid extraction from pathogenic microorganisms	2
4.	PCR and variants of PCR	3
5.	Principles of primer designing	1
6.	Gel electrophoresis methods	1
7.	Blotting Techniques- Southern blotting, northern blotting, western blotting and dot-blot	1
8.	Nucleic acid sequencing methods	1
9.	Sequence analysis-sequence editing, sequence alignment, sequence comparison and phylogenetic analysis	1
10.	Gene cloning and expression	1
11.	Molecular diagnosis as epidemiological tool	1
12.	Development and validation of diagnostic tests	1
	Total	16
Practical		
1.	Orientation of molecular diagnosis laboratory	1
2.	RNA and Diagnostic PCR lab (Handling RNA and DNA)	2
3.	Extraction of nucleic acid from different microbes(Gram Positive bacteria, Gram Negative bacteria, DNA viruses and RNA Viruses and fungi)	4
4.	DNA and RNA isolation from cell culture and blood	2
5.	Quality and quantity check of nucleic acid-Microlitre spectrophotometry and gel electrophoresis	2
6.	Principles for Primer designing	1
7.	Procedure for molecular diagnostic tests like PCR, RT-PCR and LAMP	3
8.	Absolute and relative quantitation of DNA/ RNA using Real time PCR.	2
9.	SDS PAGE of proteins and RNA	2
10.	Study of nucleic acid and proteins by blotting techniques	2
11.	Restriction Enzyme Techniques (REA and RFLP)	2
12.	PCR product concentration and purification for sequencing	2



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S.No.	Topic of Syllabus	Lectures/ Practicals
13.	Nucleic acid sequence analysis	2
14.	Gene Cloning, expression and purification of expression products	3
15.	Idea of high throughput sequencing and MALDI-TOF	2
	Total	32

VMC 610: Molecular Immunology (1+1)

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	Molecular Structure and function of PRRs	1
2.	Ligands of PRRs and signal transduction through TLR,	1
3.	Inflammosome	1
4.	Cytokines	1
5.	Lymphocyte markers and CD nomenclature	1
6.	Molecular structure of Immunoglobulin and class, isotypes, synthesis and expression of immunoglobulin,	1
7.	Rearrangement and its organization, immunoglobulin gene diversity and mechanism of recombination of B cell gene	2
8.	Theory of antibody generation	1
9.	Signature molecules of T cell and T reg cell, T cell receptor and T cell gene diversity	2
10.	MHC structure, Genomic organization of the MHC gene haplotype and pathway of signal transduction	1
11.	Concept of congenic and syngeneic and Concept of polymorphism of MHC gene	1
12.	Role co-stimulators in B cell and T cell activation and recruitment of adaptor proteins	1
13.	Molecular mechanisms (events) of cell cytotoxicity	2
	Total	16
Practical		
1.	Isolation and purification of mammalian and avian immunoglobulin by precipitation technique: - Caprylic acid, PEG, Ammonium Sulphate and Sodium Sulphate	2
2.	Separation of immunoglobulins by size, charge and ligand affinity size exclusion chromatography (Sephadex 200), Ion exchange chromatography (DEAE), affinity chromatography (Protein-A, Sepharose) Immuno-electrophoresis Technique	2
3.	Polyacrylamide gel electrophoresis innative and reducing conditions; fixed and gradient gel	2
4.	Western blot and Crossed immune-electrophoresis	2
5.	Solid Phase ELISA and Chemiluminescence assay	1
6.	Cell cytotoxicity assaya - Non radioactive methods like LDH release assay	2
7.	Antigen detection by Immuno PCR	1
8.	Haplotype matching between individuals	2
9.	Flow cytometry for CD4 and CD8 ratio determination and other applications	1
10.	ELISPOT test for cytokine assay	1
	Total	16

**VMC 611: Mucosal Immunology (1+0)**

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Mucosal barrier- Development and physiology of mucosal defence. Mucosal inductive and effector sites	1
2.	Cells and lymphoid tissues of mucosal immune system	1
3.	MALT, GALT, NALT and BALT	1
4.	Innate immune response at mucosal surfaces: Mucus, Antimicrobial peptides and Role of PPRs	1
5.	Intestinal Dendritic cell and intestinal macrophage	1
6.	Antigen uptake and presentation at mucosal sites and transepithelial transport of antigen	1
7.	Mucosal Immunoglobulin, IgA synthesis and transport to intestinal lumen	1
8.	Extrathymic Description and role of Paneth cell and crypt patches	1
9.	M-cells and their functions	1
10.	Mucosal immune effector mechanisms including secretory IgA response	1
11.	T cell development in mucosal tissues and their phenotypes and functions	1
12.	Importance and limitations of mucosal immunization.	1
13.	Mucosal adjuvants and delivery systems	1
14.	Oral tolerance mechanistic approach.	1
15.	Immunopathology at mucosal surfaces: Celiac disease, Inflammatory bowel disease, Jhone's disease	1
16.	Assessment of mucosal immune response and potency testing	1
	Total	16

VMC 612: Introduction to Microbial Bio-informatics (1+0)

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Introduction to Bioinformatics; History, Scope and Application	1
2.	Bioinformatics Resources and databases	1
3.	Introduction to NCBI, EXPASy and Ensembl Genome browser	1
4.	Sequence comparison and alignment methods	1
5.	Principal and methods of Pairwise sequence alignment	1
6.	Dotplot analysis	1
7.	BLAST and FASTA programs and their variants	1
8.	DNA and protein sequence analysis	1
9.	Introduction to Multiple sequence alignment	1
10.	Introduction to Phylogenetic analysis	1
11.	Global multiple sequence alignment (CLUSTAL-W)	1
12.	Introduction to protein structure and databases	1
13.	Structure based protein classification	1
14.	Protein structure database -CASP	1
15.	Protein structure alignment tools (VAST, DALI)	1
16.	Protein 3-D structure visualization and modeling	1
	Total	16



Course Title with Credit Load Ph.D. in Veterinary Microbiology

Course Code	Course Title	Credit	Hou rs
VMC 701	Advances in Veterinary Bacteriology*	2+1	
VMC 702	Advances in Veterinary Mycology	2+1	
VMC 703	Bacterial Genetics	2+0	
VMC 704	Microbial Toxins	2+1	
VMC 705	Bacterial Pathogenesis	2+0	
VMC 706	Advances in Veterinary Virology*	2+1	
VMC 707	Molecular Viral Pathogenesis	2+1	
VMC 708	Structure Function Relationship of DNA and RNA Viruses	2+0	
VMC 709	Oncogenic Viruses	2+0	
VMC 710	Slow Viral Infections and Prions	1+0	
VMC 711	Advances in Veterinary Immunology*	2+1	
VMC 712	Cytokines and Chemokines	2+	0
VMC 713	Immunoregulation	1+0	
VMC 714	Advances in Vaccinology	2+0	
VMC 715	Current topics in Infection and Immunity	2+0	
VMC 716	Veterinary Microbial Biotechnology	2+1	
VMC 790	Special Problem	0+1	
VMC 791	Doctoral Seminar-I*	1+0	
VMC 792	Doctoral Seminar-II*	1+0	
VMC 799	Doctoral Research	0+7	
			5

* Core courses



Course Contents

Ph.D. in Veterinary Microbiology

- I. Course Title** : **Advances in Veterinary Bacteriology**
II. Course Code : **VMC 701**
III. Credit Hours : **2+1**

IV. Aim of the course

To learn about the latest development in field of bacteriology.

V. Theory

Unit I

Recent advances in bacterial taxonomy and phylogeny, advanced studies on cytology, molecular structure and function of bacterial cell surface, peptidoglycans, walls of Gram-positive and Gram-negative bacteria, Cell surface appendages: Flagella and Fimbriae. Role of bacteria cell envelope in pathogenicity and immunogenicity, Biochemical activities, Antigenic structure. Bacterial secretory and excretory system.

Unit II

Bacterial whole genome sequence analysis and its application.

VI. Practical

Isolation of bacterial LPS, OMP, Peptidoglycans, Capsule, Flagellar antigen, genotyping, phage typing, serotyping of bacteria, studies on host pathogen interactions.

- I. Course Title** : **Advances in Veterinary Mycology**
II. Course Code : **VMC 702**
III. Credit Hours : **2+1**

IV. Aim of the course

To learn about the latest development in the field of mycology.

V. Theory

Unit I

Advanced studies on taxonomy, Genetics, Physiology and Antigenic characterization of pathogenic fungi.

Unit II

Advanced studies on molecular approaches for identification of fungi; immunology and serology of mycoses, antifungal therapy, fungal vaccines, fungal viruses.

VI. Practical

Morphological, Biochemical and Physiological studies of various fungi. *In vivo* pathogenicity study. Molecular detection and characterization of fungi.



- I. Course Title : Bacterial Genetic**
II. Course Code : VMC 703
III. Credit Hours : 2+0

IV. Aim of the course

To learn the various aspects of bacterial genetics.

V. Theory

Unit I

Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.

Unit II

Bacterial variations: Phenotypic and genotypic variations, Mutations and mutagenesis, Types of bacterial mutants, Detection of mutants and genemapping. Mechanism of gene transfer: Transduction, Transformation and conjugation. Types and mechanism of recombination: Reciprocal, Non-reciprocal and illegitimate recombination's.

Unit III

Mobile genetic elements, molecular mechanism of antibiotic resistance, regulation of gene expression.

- I. Course Title : Microbial Toxins**
II. Course Code : VMC 704
III. Credit Hours : 2+1

IV. Aim of the course

To learn about the structure, Mechanism of action, Methods of detection of various bacterial and fungal toxins.

V. Theory

Unit I

Classification of bacterial and fungal toxin on the basis of their structure and functions. The role of microbial toxins in the pathogenesis of diseases; biochemical and biological characteristics of toxins. Toxin producing Grams-positive and Grams-negative bacteria. Properties and clinical conditions produced by different bacterial and fungal toxins. Analytical methods for detection of bacterial and fungal toxins: Biological assays, Immunological assays, Nucleic acid-based methods.

Unit II

Application of microbial toxins and immunobiological studies of toxins.

VI. Practical

Detection and identification of Mycotoxigenic fungi and mycotoxins. Method of detection of bacterial endotoxin, Production of toxins in suitable media, Purification and characterization of toxins, Biological characterization in animal and in tissue culture. Toxin neutralization test.



- I. Course Title : Bacterial Pathogenesis**
II. Course Code : VMC 705
III. Credit Hours : 2+0
IV. Aim of the course

To learn the molecular mechanisms of bacterial pathogenesis.

V. Theory

Unit I

Molecular structure, Production and mode of action of bacterial virulence factors, Bacterial biofilms and advance studies on pathogenesis of bacterial diseases of various systems.

Unit II

Host-pathogen interaction, Animal models for bacterial pathogens.

- I. Course Title : Advances in Veterinary Virology**
II. Course Code : VMC 706
III. Credit Hours : 2+1
IV. Aim of the course

Advanced study of virus structure, Their nucleic acids and proteins; Latest trends in animal virus research.

V. Theory

Unit I

Biology of RNA and DNA virus replication. An introduction to bacteriophages and phage replication.

Unit II

Current concepts in animal virus research with respect to viral structure and architecture, viral virulence, viral pathogenesis, persistence and oncogenesis. Viruses as bio-terror agents and viruses for pest management (Bio-control).

Unit III

Antiviral drugs: Scope, Use and limitations, Existing antiviral drugs and their mechanism of action, Latest trends in antiviral drug development.

Unit IV

Preparation of plasmid backbone, Preparation of viral genes for cloning and cloning in viral genome backbone, Confirmation of cloned genes, Development of positive marker and negative markers, DIVA vaccine, Different types of viral vectors (vaccinia, adenoviral, retroviral vectors).

VI. Practical

Characterization of viral proteins and genome. Problem oriented practical assignments aimed at development of bioagents and relevant diagnostic tests.

- I. Course Title : Molecular Viral Pathogenesis**
II. Course Code : VMC 707
III. Credit Hours : 2+1
IV. Aim of the course

To study molecular and genetic determinants of viral virulence and pathogenesis;



animal models for studying viral pathogenesis.

V. Theory

Unit I

Study of virus host interactions: Host specificity, Tissue tropism, Mechanism of virus spread in the body.

Unit II

Host immune responses to viral infections; Viral strategies to evade host immune responses. Viral interference and interferons.

Unit III

Pathogenesis of viral diseases of various systems, animal models for studying viral pathogenesis, molecular and genetic determinants of viral virulence, mechanisms of viral virulence.

Unit IV

Molecular and genetic determinants of viral persistence, viral oncogenesis, viral immunosuppression, and immunopathology.

VI. Practical

Pathotyping of animal viruses using Newcastle disease virus as model, Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus, Characterization of molecular determinants of viral virulence using variants, Recombinants and reassortants.

I. Course Title : Structure Function Relationship of DNA and RNA Viruses

II. Course Code : VMC 708

III. Credit Hours : 2+0

IV. Aim of the course

To understand the relationship between structure and function of DNA and RNA viruses of animals for the development of next generation viral vaccine and antivirals.

V. Theory

Unit I

Methods of studying virus structure and architecture, Methods of amplification of viral nucleicacids, Molecular characterization of viral protein and nucleic acids, Nucleotide sequencing and its analysis by software programmes.

Unit II

Detailed study of virus replication in various groups of animal viruses.

Unit III

Understanding the relationship between structure and function of animal DNA and RNA viruses, Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses.



- I. Course Title : Oncogenic Viruses**
II. Course Code : VMC 709
III. Credit Hours : 2+0

IV. Aim of the course

To study mechanisms of viral oncogenesis.

V. Theory

Unit I

General features of cell transformation and characterization of transformed cells. Oncogenic RNA and DNA viruses. Oncolytic viruses, viral and cellular oncogenes.

Unit II

Mechanisms of viral oncogenesis and diagnosis of viral oncogenesis.

- I. Course Title : Slow Viral Infections and Prions**
II. Course Code : VMC 710
III. Credit Hours : 1+0

IV. Aim of the course

To study slow viral infections, properties and replication of prions and diseases caused by them.

V. Theory

Unit I

Epidemiology, Pathogenesis, Diagnosis and control of slow viral infections.

Unit II

Properties, Replication and epidemiology of prions. Pathogenesis, immunity, Diagnosis and control of Scrapies, Bovine spongiform encephalopathy, Chronic wasting disease of deer, Transmissible mink encephalopathy. Recent trends in prion research.

- I. Course Title : Advances in Veterinary Immunology**
II. Course Code : VMC 711
III. Credit Hours : 2+1

IV. Aim of the course

To study recent advances in immunology.

V. Theory

Unit I

Cells and tissues of immune system: Significance of HSC I, Origin of myeloid cells; Lymphoid cells (T and B cells), NK cells, NKT cell, Apoptosis and its role in homeostatic mechanism. Ontogeny of the lymphoid tissue in mammals and birds. Cell adhesion molecules, Recirculation and trafficking, Cell homing receptor. Antigen presenting cells and their functions at cellular level.

Unit II

Cytokines, chemokines and cytokine receptors.



Unit

Developmental biology of Immune cells: Early development of T and B cells and its differentiation, Maturation in primary lymphoid organ. B cell development and T cell development. Lineage commitment, Memory generation. Organization of expression of lymphocyte receptors gene, Multigenic organization of immunoglobulin gene and thymic selection of T cell repertoire. Concept of extrathymic origin of T cells. Effector and memory T and B cells.

Unit IV

Recombination events in T and B cell: Mechanism of recombination of immunoglobulin genes and T cell receptor genes.

Unit V

Activation of T and B cells: Clonal expansion. Role of T cell help in B cell response, affinity maturation of B cells and class switching and T cell activation.

Unit VI

MHC: MHC class-I and II structure and gene arrangement, polymorphism, antigen processing and presentation mechanism.

Unit VII

Antibody mediated and cell mediated effector functions. Cellular immune response: Effector mechanisms of CTL, NK cells and NK T cell activation. Regulation of immune response. Role of T reg-cells, immunological tolerance and graft rejection.

VI. Practical

Purification of immunoglobulin classes, Subclasses, Fragmentation of antibody by enzyme digestion to F (ab)₂ and Fc fragments, Affinity chromatography techniques. Separation of protein by SDS PAGE under reducing condition. Western blot experiment to detect the immunogenic protein, ELISPOT, cytotoxic T cell assay, morphological and functional assays of blood monocytes. FACS and MACS.

I. Course Title : Cytokines and Chemokines

II. Course Code : VMC 712

III. Credit Hours : 2+0

IV. Aim of the course

To study recent advances in cytokines and chemokines.

V. Theory

Unit I

Properties of cytokines. General structure and function of classification of cytokines family's, Cytokine secretion by Th1 and Th2 subsets. Cytokines cross regulation. Cytokine receptors: general structure of cytokine receptors, Immunoglobulin superfamily receptors, class 1 and class 2 cytokine receptor families. TNF receptor families and cytokine antagonists.

Unit II

Cytokine related diseases. Therapeutic uses of cytokines and their receptors. Chemokines: subgroups of chemokines and their structures and functions, chemokine receptor families.



Unit III

Immunomodulators: Types of immunomodulators and their mechanism of action. Adjuvants: classification, Mode of action, Adjuvants combination and safety. Cytokine as adjuvant, PLG and microparticle as adjuvant, TLR agonist as adjuvant. Antigen delivery system and mode of action. Immunostimulants: Bacterial product and synthetic Compound, Complex carbohydrates, Immune enhancing drugs, Vitamins and cytokines.

Unit IV

Immunosuppression, Neuroendocrine control of immunoregulation, Immunosuppressive agents and drugs, Corticosteroids, Cyclosporin's, Cyclophosphamide and other agents, Like irradiation and the mode of action.

I. Course Title : Immunoregulation

II. Course Code : VMC 713

III. Credit Hours : 1+0

IV. Aim of the course

To study recent advances in immunoregulation mechanisms.

V. Theory

Unit I

Molecular mediators of immune response: Lymphokines and monokines. Idiotypic networks. Epitope specific regulation. Th, Tc and Treg cells. MHC in immunoregulation, Immune response genes. Antigen specific suppressor molecules produced by T cells. Immunosuppressive agents and immune-stimulation. Immunoregulatory pathways.

I. Course Title : Advances in Vaccinology

II. Course Code : VMC 714

III. Credit Hours : 2+0

IV. Aim of the course

To learn about advances in vaccine research and modern approaches for the vaccine development.

V. Theory

Unit I

Different phases in vaccine development. Direct and indirect correlates of protection. Antigen identification and characterization employing emerging technologies such as microarrays, *in vivo* expression technology, Signature-tagged mutagenesis and phage display technology.

Unit II

Immuno-informatics applied to epitope mapping, T cell epitopes and identification of pathogenic epitopes. Novel vaccines: nucleic acids, Marker vaccines, Mucosal vaccines, Bacterial ghosts as vaccines and virus-like particles. Futuristic vaccines: anti-allergic, Anti-autoimmune diseases, De-addiction vaccines and transplant survival/ prolonging vaccines.



- I. Course Title : Current Topics in Infection and Immunity**
II. Course Code : VMC 715
III. Credit Hours : 2+0

IV. Aim of the course

Discussions on recent developments in the immunobiology of major viral, bacterial and fungal diseases of animals.

V. Theory

Unit I

Introduction and historical developments. Host-pathogen relationship.

Unit II

Effector mechanisms of specific and non-specific immunity to different groups of microbes.

Unit III

Immunobiology of major viral, Bacterial and fungal diseases of animals. Types of vaccines for infectious diseases; Current trends in vaccine development.

- I. Course Title : Veterinary Microbial Biotechnology**
II. Course Code : VMC 716
III. Credit Hours : 2+1

IV. Aim of the course

To understand as to how microbial processes and activities can be used for development of medically and industrially important products and processes.

V. Theory

Unit I

History of microbial biotechnology. Microbes in nature. Microbes as infectious agents of human and animals. Host-microbe relationships. Microbial metabolism and growth characteristics. Microbial genetics.

Unit II

Introduction to molecular biology of microorganisms: DNA, RNA and proteins structure and functions. DNA replication, RNA transcription, reverse transcription, protein translation and regulatory mechanisms. Bacterial extrachromosomal DNA elements.

Unit III

Genetic engineering: Restriction enzymes, DNA ligases, DNA polymerases, RNases and DNases and other enzymes. DNA sequencing. Plasmids and phage-derived vectors, Bacterial hosts for cloning and expression of transgenes. Genomic libraries and sequencing. Blotting of DNA, RNA and proteins. Polymerase chain reaction. An introduction to Microarrays and Metagenomics.

Unit IV

Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. PCR and blotting techniques in infectious disease diagnosis. Nucleic acid vaccines. Vected viral and bacterial vaccines. Construction of defined mutants



and marker vaccines using genetic manipulation techniques. Manipulation of microbial processes for production of industrially useful substances.

VI. Practical

Extraction of nucleic acids from viruses and bacteria. Restriction endonuclease digestion of DNA and resolution in agarose gel electrophoresis. PCR amplification of DNA. RT-PCR of RNA. Insertion of DNA fragments into plasmid/ phagemid/ phage vectors. Construction of competent *E. coli* host cells. Transformation and transfection of competent *E. coli* cells. Screening of transformants and isolation of clones. Sequence analysis of clones/ PCR amplicons. Expression of genes of bacterial/ viral antigens. Use of PCR for infectious disease diagnosis.

I. Course Title : Special Problem

II. Course Code : VMC 790

III. Credit Hours : 1+0

IV. Aim of the course

To provide expertise in handling practical research problem(s).

V. Practical

Short research problem(s) involving contemporary issues and research techniques.



Course Outline-cum-Lecture Schedule for Doctoral Degree Programme

VMC 701: Advances in Veterinary Bacteriology 2+1

S.No.	Topic of Syllabus	Lecture/ Practical
Theory		
1.	Recent advances in bacterial taxonomy and phylogeny	3
2.	Advanced studies on bacterial cytology	2
3.	Molecular structure and function of bacterial cell surface Peptidoglycans	2
4.	Walls of Gram-positive and Gram-negative bacteria	2
5.	Cell surface appendages: Flagella and Fimbriae	3
6.	Role of bacteria cell envelope in pathogenicity and immunogenicity	4
7.	Biochemical activities	4
8.	Antigenic structure	4
9.	Bacterial secretory and excretory system	4
10.	Bacterial whole genome sequence analysis and its application	4
	Total	32
Practical		
1.	Isolation of bacterial LPS	1
2.	Isolation of bacterial OMP	1
3.	Isolation of bacterial Peptidoglycans	1
4.	Isolation of bacterial Capsule	1
5.	Isolation of bacterial Flagellar antigen	1
6.	Genotyping of bacteria	2
7.	Phage typing of bacteria	2
8.	Serotyping of bacteria	3
9.	Studies on host pathogen interactions	4
	Total	16

VMC 702: Advances in Veterinary Mycology 2+1

S.No.	Topic of Syllabus	Lecture/ Practical
Theory		
1.	Advanced studies on taxonomy of pathogenic fungi	2
2.	Advanced studies on genetics of pathogenic fungi	4
3.	Advanced studies on physiology of pathogenic fungi	4
4.	Advanced studies on antigenic characterization of pathogenic fungi	6
5.	Advanced studies on molecular approaches for identification of fungi	4
6.	Immunology and serology of mycoses	4
7.	Antifungal therapy	4
8.	Fungal vaccines	2
9.	Fungal viruses	2
	Total	32



S.No.	Topic of Syllabus	Lecture/ Practical
Practical		
1.	Morphological, biochemical and physiological studies of various fungi	6
2.	<i>In vivo</i> pathogenicity study	5
3.	Molecular detection and characterization of fungi	5
	Total	16

VMC 703: Bacterial Genetics 2+0

S.No.	Topic of Syllabus	Lecture
Theory		
1.	Comparative studies of prokaryotic and eukaryotic genome and their replication	3
2.	Structure, classification and replication of plasmids	3
3.	Bacterial variations: Phenotypic and genotypic variations	3
4.	Mutations and mutagenesis, types of bacterial mutants and detection of mutants	4
5.	Gene mapping	3
6.	Mechanism of gene transfer: transduction, transformation and conjugation	4
7.	Types and mechanism of recombination: Reciprocal, non-reciprocal and illegitimate recombination's	4
8.	Mobile genetic elements	3
9.	Molecular mechanism of antibiotic resistance	3
10.	Regulation of gene expression	2
	Total	32

VMC 704: Microbial Toxins 2+1

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	Classification of bacterial and fungal toxin on the basis of their structure and functions	4
2.	The role of microbial toxins in the pathogenesis of diseases	3
3.	Biochemical and biological characteristics of toxins	5
4.	Toxin producing Grams-positive and Grams-negative bacteria	2
5.	Properties and clinical conditions produced by different bacterial and fungal toxins	4
6.	Analytical methods for detection of bacterial and fungal toxins: Biological assays, immunological assays, Nucleic acid-based methods	8
7.	Application of microbial toxins	3
8.	Immuno-biological studies of toxins	3
	Total	32
Practical		
1.	Detection and identification of Mycotoxigenic fungi and mycotoxins	2
2.	Method of detection of bacterial endotoxin	3
3.	Production of toxins in suitable media	3
4.	Purification and characterization of toxins	3



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S.No.	Topic of Syllabus	Lectures/ Practicals
5.	Biological characterization in animal and in tissue culture	3
6.	Toxin neutralization test	2
	Total	16

VMC 705: Bacterial Pathogenesis 2+0

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Molecular structure, production and mode of action of bacterial virulence factors	8
2.	Bacterial biofilms	4
3.	Advanced studies on pathogenesis of bacterial diseases of various systems	8
4.	Host-pathogen interaction	8
5.	Animal models for bacterial pathogens	4
	Total	32

VMC 706: Advances in Veterinary Virology 2+1

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	Biology of RNA and DNA virus replication	2
2.	An introduction to bacteriophages and phage replication	2
3.	Current concepts in animal virus research with respect to viral structure and architecture	3
4.	viral virulence, viral pathogenesis, persistence and oncogenesis	4
5.	Viruses as bio-terror agents and viruses for pest management (Bio-control)	2
6.	Antiviral drugs: Scope, use and limitations	3
7.	Existing antiviral drugs and their mechanism of action	2
8.	Latest trends in antiviral drug development	2
9.	Preparation of plasmid backbone, preparation of viral genes for cloning and cloning in viral genome backbone	3
10.	Confirmation of cloned genes	2
11.	Development of positive marker and negative markers	2
12.	DIVA vaccine	2
13.	Different types of viral vectors (vaccinia, adenoviral, retroviral vectors)	3
	Total	32
Practical		
1.	Characterization of viral proteins and genome	8
2.	Problem oriented practical assignments aimed at development of bioagents and relevant diagnostic tests	8
	Total	16

**VMC 707: Molecular Viral Pathogenesis 2+1**

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	Study of virus host interactions: host specificity, tissue tropism and mechanism of virus spread in the body	3
2.	Host immune responses to viral infections	2
3.	Viral strategies to evade host immune responses	2
4.	Viral interference and interferons	2
5.	Pathogenesis of viral diseases of various systems	3
6.	Animal models for studying viral pathogenesis	3
7.	Molecular and genetic determinants of viral virulence	3
8.	Mechanisms of viral virulence	3
9.	Molecular and genetic determinants of viral persistence	3
10.	Viral oncogenesis	4
11.	Viral immunosuppression and immunopathology	4
	Total	32
Practical		
1.	Pathotyping of animal viruses using Newcastle disease virus as model	4
2.	Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus	8
3.	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants	4
	Total	16

VMC 708: Structure Function Relationship of DNA and RNA Viruses 2+0

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Methods of studying virus structure and architecture	3
2.	Methods of amplification of viral nucleicacids	2
3.	Molecular characterization of viral protein and nucleic acids	3
4.	Nucleotide sequencing and its analysis by software programmes	6
5.	Detailed study of virus replication in various groups of animal viruses	6
6.	Understanding the relationship between structure and function of animal DNA and RNA viruses	6
7.	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses	6
	Total	32

VMC 709: Oncogenic Viruses 2+0

S.No.	Topic of Syllabus	Practical
Theory		
1.	General features of cell transformation and characterization of transformed cells	4
2.	Oncogenic RNA and DNA viruses	4



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S.No.	Topic of Syllabus	Practical
3.	Oncolytic viruses	5
4.	Viral and cellular oncogenes	5
5.	Mechanisms of viral oncogenesis	8
6.	Diagnosis of viral oncogenesis	6
	Total	32

VMC 710: Slow Viral Infections and Prions 1+0

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Epidemiology of slow viral infections	1
2.	Pathogenesis of slow viral infections	1
3.	Diagnosis and control of slow viral infections	2
4.	Properties, replication and epidemiology of prions	2
5.	Scrapies	2
6.	Bovine spongiform encephalopathy	2
7.	Chronic wasting disease of deer	2
8.	Transmissible mink encephalopathy	2
9.	Recent trends in prion research	2
	Total	16

VMC 711: Advances in Veterinary Immunology 2+1

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	Significance of HSC 1 and Origin of myeloid cells	1
2.	Lymphoid cells (T and B cells), NK cells and NKT cell	1
3.	Apoptosis and its role in homeostatic mechanism	1
4.	Ontogeny of the lymphoid tissue in mammals and birds	1
5.	Cell adhesion molecules, recirculation and trafficking, cell homing receptor	2
6.	Antigen presenting cells and their functions at cellular level	1
7.	Cytokines, chemokines and cytokine receptors	2
8.	Early development of T and B cells and its differentiation and maturation in primary lymphoid organ	1
9.	B cell development and T cell development	2
10.	Lineage commitment and memory generation	2
11.	Organization of expression of lymphocyte receptors gene	2
12.	Multiagenic organization of immunoglobulin gene	1
13.	Thymic selection of T cell repertoire.	1
14.	Concept of extrathymic origin of T cells	1
15.	Effector and memory T and B cells	1
16.	Mechanism of recombination of immunoglobulin genes and T cell receptor genes	2
17.	Clonal expansion	1
18.	Role of T cell help in B cell response	1
19.	Affinity maturation of B cells and class switching and T cell activation	1



S.No.	Topic of Syllabus	Lectures/ Practicals
20.	MHC class-I and II structure and gene arrangement, polymorphism, antigen processing and presentation mechanism	2
21.	Effector mechanisms of CTL, NK cells and NK T cell activation	2
22.	Regulation of immune response	2
23.	Role of T reg-cells, immunological tolerance and graft rejection	1
	Total	32
Practical		
1.	Purification of immunoglobulin classes, subclasses, fragmentation of antibody by enzyme digestion to F (ab) ₂ and Fc fragments, affinity chromatography techniques	2
2.	Separation of protein by SDS PAGE under reducing condition	2
3.	Western blot experiment to detect the immunogenic protein	2
4.	ELISPOT	2
5.	Cytotoxic T cell assay	2
6.	Morphological and functional assays of blood monocytes	2
7.	FACS	2
8.	MACS	2
	Total	16

VMC 712: Cytokines and Chemokines 2+ 0

S.No.	Topic of Syllabus	Lectures
Theory		
1	Properties of cytokines	2
2	General structure and function of classification of cytokines family's, cytokine secretion by Th1 and Th2 subsets	3
3	Cytokines cross regulation	2
4	Cytokine receptors: general structure of cytokine receptors, immunoglobulin superfamily receptors, class 1 and class 2 cytokine receptor families	3
5	TNF receptor families and cytokine antagonists	2
6	Cytokine related diseases	2
7	Therapeutic uses of cytokines and their receptors	2
8	Chemokines: subgroups of chemokines and their structures and functions, chemokine receptor families	3
9	Types of immunomodulators and their mechanism of action	2
10	Adjuvants: classification, mode of action, adjuvants combination and safety	2
11	Cytokine as adjuvant, PLG and microparticle as adjuvant, TLR agonist as adjuvant	2
12	Antigen delivery system and mode of action Immunostimulants: bacterial product and synthetic compound, complex carbohydrates, immune enhancing drugs, vitamins and cytokines	3
13	Immunosuppression, Neuroendocrine control of immunoregulation, Immunosuppressive agents and drugs, corticosteroids, cyclosporin's, cyclophosphamide and other agents, like irradiation and the mode of action	3
	Total	32

**VMC 713: Immunoregulation 1+0**

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Molecular mediators of immune response: lymphokines and monokines	2
2.	Idiotypic networks	2
3.	Epitope specific regulation	2
4.	Th, Tc and Treg cells	2
5.	MHC in immunoregulation, immune response genes	2
6.	Antigen specific suppressor molecules produced by T cells	2
7.	Immunosuppressive agents and immune-stimulation	2
8.	Immunoregulatory pathways	2
	Total	16

VMC 714: Advances in Vaccinology 2+0

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Different phases in vaccine development	4
2.	Direct and indirect correlates of protection	2
3.	Antigen identification and characterization employing emerging technologies such as microarrays, in vivo expression technology, signature-tagged mutagenesis and phage display technology	6
4.	Immuno-informatics applied to epitope mapping, T cell epitopes and identification of pathogenic epitopes	8
5.	Nucleic acids, marker vaccines, mucosal vaccines, bacterial ghosts as vaccines and virus-like particles	6
6.	Futuristic vaccines: anti-allergic, anti-autoimmune diseases, de-addiction vaccines and transplant survival/ prolonging vaccines	6
	Total	32

VMC 715: Current topics in Infection and Immunity 2+0

S.No.	Topic of Syllabus	Lectures
Theory		
1.	Introduction and historical developments	5
2.	Host-pathogen relationship	6
3.	Effector mechanisms of specific and non-specific immunity to different groups of microbes	6
4.	Immunobiology of major viral, bacterial and fungal diseases of animals	6
5.	Types of vaccines for infectious diseases	5
6.	Current trends in vaccine development	6
	Total	32

**VMC 716: Veterinary Microbial Biotechnology 2+1**

S.No.	Topic of Syllabus	Lectures/ Practicals
Theory		
1.	History of microbial biotechnology	1
2.	Microbes in nature	1
3.	Microbes as infectious agents of human and animals	1
4.	Host-microbe relationships	1
5.	Microbial metabolism and growth characteristics	1
6.	Microbial genetics	1
7.	Introduction to molecular biology of microorganisms: DNA, RNA and proteins structure and functions	2
8.	DNA replication, RNA transcription, reverse transcription, protein translation and regulatory mechanisms	2
9.	Bacterial eXtrachromosomal DNA elements	1
10.	Genetic engineering: restriction enzymes, DNA ligases, DNA polymerases, RNases and DNases and other enzymes	2
11.	DNA sequencing	2
12.	Plasmids and phage-derived vectors, bacterial hosts for cloning and expression of transgenes	2
13.	Genomic libraries and sequencing	1
14.	Blotting of DNA, RNA and proteins	2
15.	Polymerase chain reaction	1
16.	An introduction to Microarrays and Metagenomics	1
17.	Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines	2
18.	PCR and blotting techniques in infectious disease diagnosis	2
19.	Nucleic acid vaccines	1
20.	Vectored viral and bacterial vaccines	1
21.	Construction of defined mutants and marker vaccines using genetic manipulation techniques	2
22.	Manipulation of microbial processes for production of industrially useful substances	2
	Total	32
Practical		
1.	Extraction of nucleic acids from viruses and bacteria	2
2.	Restriction endonuclease digestion of DNA and resolution in agarose gel electrophoresis	1
3.	PCR amplification of DNA	1
4.	RT-PCR of RNA	1
5.	Insertion of DNA fragments into plasmid/ phagemid/ phage vectors	2
6.	Construction of competent E. coli host cells	2
7.	Transformation and transfection of competent E. colicells	1
8.	Screening of transformants and isolation of clones	1
9.	Sequence analysis of clones/ PCR amplicons	2
10.	Expression of genes of bacterial/ viral antigens	2
11.	Use of PCR for infectious disease diagnosis	1
	Total	16



VMC 790: Special Problem 0+1

Practical

Short research problem(s) involving contemporary issues and research techniques. Planning a short research problem or working on a published research paper or new developments.

Suggested Reading

- AM Lesk. 2002. *Introduction to Bioinformatics*. Oxford University press.
- Abbas AH, Lichtman and S. Pillai. 2017. *Cellular and Molecular Immunology: Functions and Disorders of the Immune System*, 7th Ed., Elsevier.
- B Detrick and RG Hamilton and JH Schimtz. 2016. *Manual of Molecular and Clinical Laboratory Immunology*. 8th Ed. American Society for Microbiology.
- B Markey, F Leonard, M Archambault, A Cullinane and D Maguire. 2013. *Clinical Veterinary Microbiology* 2nd Ed. MOSBY- Elsevier.
- BD Singh. 2012. *Biotechnology: Expanding Horizons*, 4thEd.Kalyani Pub.
- C Hirsh, NJ MacLachlan and RL Walker. 2004. *Veterinary Microbiology*, 2ndEdn., Wiley-Blackwell Pub.
- CC Kibbler, R Barton, Neil AR Gow, S Howell, DM MacCallum and RJ Manuel. 2018. *Oxford Textbook of Medical Mycology*, 1st Ed., Oxford University Press.
- CM Fraser, T Read and KE Nelson. 2010. *Microbial Genomes (Infectious Disease)*. 1st Edition, Humana Press.
- D Balasubramanian, CFA Bryce, K Jayaraman, J Green and K Dharmalingam. 2004. *Concepts in Biotechnology*, Revised edition, Universities Press Pub.
- DW Mount. 2001. *Bioinformatics: Sequence and genome analysis*. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
- FA Murphy, EPJ Gibbs, MK Holzmek and MJ Studdert. 1999. *Veterinary Virology*. 3rd Ed. Academic Press.
- GJ Tortora, BR Funke, CL Case, D Weber and W Bair. 2018. *Microbiology: An Introduction*, 13th Ed., Pearson Pub.
- GM Callahan and RM Yates. 2014. *Basic Veterinary Immunology*. 1stEdn., University Press of Colorado.
- JB Carter and VA Saunders. 2013. *Virology: Principles and Applications*, 2nd Ed., John Wiley and Sons Pub.
- J Glenn Songer and KW Post. 2004. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. 1st Ed., Saunders Pub.
- J Punt, S Stranford, P Jones and J Owen. 2019. *Kuby Immunology*, 8th Ed., W.H. Freeman Pub.
- J Willey, K Sandman and D Wood. 2019. *Prescott's Microbiology*, 11thEdn., McGraw-Hill Education Pub.
- J Mestecky, W Strober, MW Russell, H Cheroutre, BN Lambrecht and BL Kelsall. 2015. *Mucosal Immunology* 4th Edn., Academic Press.
- JE Coligan, AM Kruisbeek, DH Margulies, EM Shevach and W Strober. 2003. *Current Protocols in Immunology*. 3rd Edn. John Wiley and Sons.
- L Gyles, JF Prescott, J Glenn Songer and CO Thoen. 2010. *Pathogenesis of Bacterial Infections in Animals*, 4thEdn., Wiley-Blackwell Pub.
- MJ Dey and RM Schultz. 2014. *Veterinary Immunology: Principles and Practice*, 2nd Edn., CRC Press/ Taylor and Francis.
- MM Levine, JB Kaper, R Rappuoli, MA Liu and MF Good. 2004. *New Generation Vaccines*. 3rd Ed. Marcel-Dekker.
- NJ Maclachlan and EJ Dubovi. 2016. *Fenner's Veterinary Virology*. 5thEdn., Academic Press.
- PJ Quinn, BK Markey, FC Leonard, P Hartigan, S Fanning and ES Fitzpatrick. 2011. *Veterinary Microbiology and Microbial Disease*, 2nd Ed., Wiley-Blackwell Pub.
- PJ Delves, SJ Martin, DR Burton and IM Roitt. 2017. *Roitt's Essential Immunology* 13th Edition, Wiley Blackwell.



Veterinary Para-Clinical Subjects: Veterinary Microbiology

- R Tizard. 2017. *Veterinary Immunology*, 10thEdn., Saunders Publ.
- S Giguère, JF Prescott and PM Dowling. 2013. *Antimicrobial Therapy in Veterinary Medicine*, 5th Ed., John Wiley and Sons, Inc.
- SJ Flint, V Racaniello, G Rall and A Skalka. 2015. *Principles of Virology*, 4th Edition (2 volume set). ASM press
- S Jameel and L Villarreal. 2000. *Advances in Animal Virology*. Science Pub.
- Samanta. 2015. *Veterinary Mycology*. Springer, India, Private Ltd Pub.
- WJW Morrow, NA Sheikh, CS Schmidt and D Huw Davies. 2012. *Vaccinology: Principles and Practice* 1 edition Wiley-Blackwell.
- TA Brown. 2016. *Gene Cloning and DNA Analysis*. 7th Edition., Wiley Blackwell
- WJ Dodds and R Schulz. 1999. *Veterinary Vaccines and Diagnostics*. Vol. 41 (Advances in Veterinary Medicine) 1st Ed. Academic Press.
- For Ph.D. Courses: Selected articles and reviews from journals





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Veterinary Para-Clinical Subjects

– Veterinary Pathology





Course Title with Credit Load M.V.Sc. in Veterinary Pathology

Course Code	Course Title	Credit Hours
VPL 601	General Pathology*	2+1
VPL 602	Techniques in Pathology*	0+2
VPL 603	Animal Oncology	1+1
VPL 604	Clinical Pathology*	1+1
VPL 605	Necropsy Procedures and Interpretations*	1+1
VPL 606	Necropsy Conference*	0+1
VPL 607	Systemic Pathology*	2+1
VPL 608	Pathology of Infectious Diseases of Domestic Animals*	2+1
VPL 609	Toxicopathology	2+1
VPL 610	Avian Pathology*	2+1
VPL 611	Pathology of Wild/ Zoo and Aquatic Animal Diseases	2+1
VPL 612	Pathology of Laboratory Animal Diseases	2+1
VPL 691	Master's Seminar*	1+0
VPL 699	Master's Research	30

*Core Courses



Course Contents

M.V.Sc. in Veterinary Pathology

- I. Course Title** : General Pathology
II. Course Code : VPL 601
III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students with different types of degenerations, cell injuries caused by different types of irritants and inflammation.

V. Theory

Unit I

Introduction and principles of Pathology including genetic basis of disease; Cellular responses to injury: Causes and mechanisms of reversible and irreversible cell injury; Morphologic characteristics, Significance and fate of various intracellular (lipids, glycogen, proteins) and extracellular (hyaline material, amyloid, fibrinoid change, gout) accumulations/ degenerations, Endogenous and exogenous pigmentations, Cell death (necrosis, apoptosis and gangrene), Pathologic calcifications and cellular adaptive changes.

Unit II

Inflammation and repair: Introduction to inflammation, Acute inflammation-cellular and molecular events including mediators and heat shock proteins of acute inflammation; Cellular components, Morphologic classification and outcomes of acute inflammation, Chronic inflammation-causes, Morphologic features and cellular components of chronic inflammation, Healing and repair, Systemic effects of inflammation.

Unit III

Disturbances in circulation: Causes, mechanisms, Morphologic features, Significance and fate of hyperemia, Oedema, Haemorrhage, Thrombosis, Embolism, Ischaemia, infarction and shock.

Unit IV

Immune mediated reactions: Introduction to autoimmunity and immune mediated diseases, mechanisms of hypersensitivity reactions.

VI. Practical

- To study the morphologic descriptions of lesions and nomenclature of a morphologic diagnosis based on gross and/ or microscopic lesions of variety of conditions (degenerations, infiltrations, pigmentations, necrosis, circulatory and growth disturbances and different types of inflammation) in the preserved specimens/slides. Demonstration of post-mortem changes.
- Continuous assessment of students for their skills in the diagnosis of gross lesions during post-mortem examination of different tissues of domestic animals.



Preparation of histopathology slides on the selected cases followed by interaction in the student seminars/ group discussions.

VII. Suggested Reading

- McGavin MD and Zachary JF. 2017. *Pathologic Basis of Veterinary Diseases*. 6th Ed. Elsevier.
- Vegad JL. 2007. *Text Book of Veterinary General Pathology*. 2nd Ed. International Book Distr.

I. Course Title : Techniques in Pathology

II. Course Code : VPL 602

III. Credit Hours : 0+2

IV. Aim of the course

To acquaint the students with different techniques used frequently in Veterinary Pathology.

V. Practical

- Basic histopathological techniques–Collection of tissues, fixation, processing, section cutting and H and E staining of tissue sections. Collection and fixation of tissues for scanning electron microscopy, transmission electron microscopy, histochemical, toxicological, bacteriological and virological examinations. Application of micrometry and special staining techniques. Demonstration of different inclusions, bacteria and fungi in tissues.
- Principles of dark field, phase contrast and fluorescent microscopy; introduction to scanning electron microscopy and transmission electron microscopy.
- Histochemical techniques for demonstration of fat, glycogen, connective tissue, mucopolysaccharides and common enzymes, pigments and minerals Cryosectioning and application of immunohistochemical techniques–immunoperoxidase and immunofluorescence.
- Principles and applications of PCR and its variants.
- Museum specimen preparation and maintenance.

VI. Suggested Reading

- Culling CFA. 1969. *Handbook of Histological Techniques*. Butterworths.
- Lillie RD. 1965. *Histopathologic Techniques and Practical Histo-chemistry*. 3rd Ed. McGraw-Hill.
- Culling CFA. 2013. *Handbook of Histopathological and Histochemical Techniques: Including Museum Techniques* PDF, eBook (<http://mbooknom.men/go/best.php?id=B01DRY52U8>)

I. Course Title : Animal Oncology

II. Course Code : VPL-603

III. Credit Hours : 1+1

IV. Aim of the course

To acquaint the students with different types of neoplasms of domestic animals, their nature, cause, pathology and diagnosis.

V. Theory

Unit I

Tumour-Etiology, Carcinogens and oncogenesis, Nomenclature and classification, characteristics of benign and malignant tumours, Molecular mechanisms, Pathways of spread of tumors and tumor immunology



Unit II

Effects of tumour, Grading, Staging and laboratory diagnosis of tumours. Animal tumour models–experimental induction of neoplasms

Unit III

Pathology of different types of epithelial and connective tissue tumours with their characteristic identification features and epidemiology. Commonly encountered tumours of respiratory, haemopoietic, integumentary, musculoskeletal, gastrointestinal, hepatobiliary, uro-genital, nervous, ocular, ear and endocrine system.

VI. Practical

- Cytological diagnosis of tumours via impression smears and Fine Needle Aspiration Cytology.
- To study the gross and microscopic changes in different types of neoplasms.

VII. Suggested Reading

- Meuten DJ. 2016. *Tumors in Domestic Animals*. 5th Ed. Wiley-Blackwell

I. Course Title : Clinical Pathology

II. Course Code : VPL 604

III. Credit Hours : 1+1

IV. Aim of the course

To acquaint the students with clinical alterations in blood, urine, CSF and other body fluids due to different diseases.

V. Theory

Unit I

Study of changes in blood/ plasma/ serum including biochemical profile for organ function tests, Cytological examination and examination of urine, Faeces, Cerebrospinal fluid and biopsy specimens and their interpretation.

VI. Practical

Analysis of clinical samples (blood/ serum/ plasma, urine, faeces, Biopsy samples (exfoliative/ FNAC) including biochemical profile for organ function tests in different disease conditions in animals/ poultry and their interpretations.

VII. Suggested Reading

- Amy C. Valenciano, Rick L. Cowell. 2013. *Cowell and Tyler's Diagnostic Cytology and Hematology of the Dog and Cat*, 4th Ed, Elsevier
- Benzamin MM. 1985. *Outline of Veterinary Clinical Pathology*. 3rd Ed. Ludhiana, Kalyani Publishers.
- Coles EH. 1986. *Veterinary Clinical Pathology*. 4th Ed, WB Saunders.
- Douglas J., Weiss, K and Jane Wardrop. 2010. *Schalm's Veterinary Haematology*, Wiley.

I. Course Title : Necropsy Procedures and Interpretations

II. Course Code : VPL 605

III. Credit Hours : 1+1

IV. Aim of the course

To acquaint the students with necropsy procedures in large and small animals and



study of PM lesions in different diseases and to educate the students about common veterolegal problems and technically simple and legal writing of PM reports.

V. Theory

Unit I

General knowledge about the laws relating to veterinary practice, professional discipline and professional etiquettes.

Unit II

Regulations dealing with diseases of animals in India regarding epidemiology, quarantine certificate, issue of soundness certificate, etc.

Unit III

Different manners/ modes of death such as criminal assault, Cruelty to animals, malicious poisoning, Snake bite, Death due to drowning, Lightning strokes during thunderstorms; Veterolegal wounds like electrocution, Gunshot wounds, Automobile accidents, and violent death; Legal implications in animals in above conditions, doping in horses, etc.

VI. Practical

- Detailed necropsy examination of various species of large and small animals including poultry, laboratory animals and wildlife. Systematic examination of brain, lungs, heart, endocrine glands, lymph nodes, liver, gastro-intestinal tract, urinary and genital systems for gross pathological and histopathological studies and correlation of the observations to diagnose the disease conditions.
- Necropsy case presentation and report writing/ protocol preparation. Collection, preservation and dispatch of morbid materials for diagnosis of viral, bacterial, protozoan, parasitic diseases, toxic/ poisoning and for histochemistry/ histopathology.

VII. Suggested Reading

- Albert C Strafuss.1988. *Necropsy: Procedures and Basic Diagnostic Methods for Practicing Veterinarians*, Charles C. Thomas Publisher Springfield
- Benjamin Lucio-Martinez and Jodi A Korich. 2010. *Illustrated guide to Poultry Necropsy and diagnosis*, Cornell University (<https://www.slideshare.net/heshamkotb/illustrated-guide-to-poultry-necropsy-and-diagnosis>)
- D Gopala Krishna Rao. 2005. *Textbook on necropsy and histopathological techniques*, 1st Ed. Academia
- Donald B Feldman and John Curtis Seely. 1988. *Necropsy Guide: Rodents and the Rabbit*, 1st Ed. CRC Press
- Gahlot AK, Sharma SN and Tanwar RA. 2003. *Veterinary Jurisprudence*. 5th Ed. NBS Publishers, Bikaner.
- John M King, David C Dodd and Lois Roth. 2006. *The Necropsy Book*, Fifth Edition, C L Davis Foundation
- Jones TC and Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott
- Lincoln PJ and Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.
- Majó Masferrer, Natàlia, Dolz Pascual, Roser and Shivaprasad HL. 2011. *Atlas of Avian Necropsy: Macroscopic Diagnosis Sampling*, SERVET Publishers
- Rudin N and Inman K. 2002. *An Introduction to Forensic DNA Analysis*. CRC Press



- I. Course Title : Necropsy Conference**
II. Course Code : VPL 606
III. Credit Hours : 0+1

IV. Aim of the course

To promote self learning of the students in different necropsy procedures of animals including poultry and description of post-mortem lesions in different diseases/ disease conditions.

V. Practical

- Continuous assessment of students on detailed necropsy examination of various species of large and small animals including poultry; Necropsy associated cytological examinations; Systematic examination of different organs for morphologic description of gross lesions; gross photography; Collection of tissues for histopathology and based on nature of gross lesions, if possible further collection for investigation of viral/ bacterial/ protozoan/ fungal/ parasitic diseases/ toxic or poisoning, etc.
- Morphologic description of microscopic lesions; microscopic photography; correlation of gross and microscopic observations with the results of other parallel investigations to diagnose the disease conditions; presentation of select case(s) in the monthly seminars followed by report writing and final morphologic/ etiologic diagnosis, classification and preservation of microscopic slides.

VI. Suggested Reading

- Albert C Straffuss. 1988. *Necropsy: Procedures and Basic Diagnostic Methods for Practicing Veterinarians*, Charles C. Thomas Publisher Springfield.
- Benjamin Lucio-Martinez and Jodi A Korich. 2010. *Illustrated guide to Poultry Necropsy and diagnosis*, Cornell University (<https://www.slideshare.net/heshamkotb/illustrated-guide-to-poultry-necropsy-and-diagnosis>)
- D Gopala Krishna Rao. 2005. *Textbook on necropsy and histopathological techniques*, 1st Ed. Academia.
- Donald B Feldman, John Curtis Seely. 1988. *Necropsy Guide: Rodents and the Rabbit*, 1st Ed. CRC Press.
- Jones TC and Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott.
- John M King, David C Dodd and Lois Roth. 2006. *The Necropsy Book*, Fifth Edition, C L Davis Foundation.
- Majó Masferrer, Natàlia, Dolz Pascual, Roser and Shivaprasad HL. 2011. *Atlas of Avian Necropsy: Macroscopic Diagnosis Sampling*, SERVET Publishers.

- I. Course Title : Systemic Pathology**
II. Course Code : VPL 607
III. Credit Hours : 2+1

IV. Aim of the course

To teach the students about different disease conditions of haemopoietic, circulatory, respiratory, digestive, urinary and genital systems, nervous, musculoskeletal, endocrine glands and special senses.

V. Theory

Unit I

Advanced study of pathological conditions in relation to their etiology, Pathology



and pathogenesis including examples of specific infectious or non-infectious diseases affecting cardiovascular (heart, blood vessels and lymph vessels), Respiratory (nasal cavity, Larynx, Trachea, Bronchi, Lungs and pleura) and haemopoietic (bone marrow, blood, spleen, lymph node) systems.

Unit II

Advanced study of pathological conditions in relation to their etiology, Pathology and pathogenesis including examples of specific infectious or non-infectious diseases affecting different organs of digestive (buccal cavity, pharynx, oesophagus, stomach and intestines), Urinary (kidneys, ureter, urinary bladder and urethra) and genital (male and female organs including mammary gland) systems.

Unit III

Advanced study of pathological conditions in relation to their etiology, Pathology and pathogenesis including examples of specific infectious or non-infectious diseases affecting different organs of nervous (brain and spinal cord), endocrine (pituitary, thyroid, parathyroid, pancreas) musculo-skeletal systems (muscles and bones) and organs of special senses (eye, ear), skin and its appendages (hoof, tail).

VI. Practical

- To study the morphologic description of lesions and nomenclature of a morphologic diagnosis based on gross and/ or microscopic lesions in variety of organs in the preserved specimens/ slides.
- Continuous assessment of students for their skills in the morphologic description of lesions and nomenclature of a morphologic diagnosis based on gross and/ or microscopic lesions in variety of organs during post-mortem examination of domestic animals followed by interaction in the student seminars/ group discussions.

VII. Suggested Reading

- Grant Maxie. 2015. Jubb, Kennedy & Palmer's *Pathology of Domestic Animals*, 6th Ed. Saunders Ltd.
- Vegad JL and Madhu Swamy. 2010. *A text book of Veterinary Systemic Pathology*, 2nd Ed. Publisher IDBC, Lkhnow

I. Course Title : Pathology of Infectious Diseases of Domestic Animals

II. Course Code : VPL 608

III. Credit Hours : 2+1

IV. Aim of the course

To teach the students about important infectious disease conditions of domestic animals.

V. Theory

Unit I

Study of etiology, Pathology and pathogenesis of various viral diseases-Foot and mouth disease, Vesicular stomatitis, Vesicular exanthema, Vesicular disease, Rinderpest, Bovine viral diarrhoea-Mucosal disease, Bovine malignant catarrhal fever, Infectious bovine rhinotracheitis, Parainfluenza-3, Bovine respiratory syncytial virus infection, PoX diseases, Blue tongue, Contagious ecthyma, PPR, Rabies, Canine distemper, Parvovirus infections, Infectious canine hepatitis, Pseudorabies, Classical swine fever, Swine and Equine influenza, Equine infectious anaemia, African horse



sickness, Equine viral arteritis, Equine viral encephalomyelitis, Equine herpesvirus infections, Papillomatosis, Rift Valley fever, Japanese encephalitis, Ovine encephalomyelitis (Louping ill) and Prion diseases.

Unit II

Study of etiology, pathology and pathogenesis of various bacterial diseases-Tuberculosis, Johne's disease, Actinobacillosis, Actinomycosis, Brucellosis, Listeriosis, Pasteurellosis, Leptospirosis, Anthrax, Clostridial group of diseases, Streptococcal and Staphylococcal infections, Campylobacter infections, Swine erysipelas, Glasser's disease, Foot rot, Colibacillosis and Salmonellosis, Glanders, Melioidosis, Nocardiosis, Cutaneous streptothricosis, Corynebacterium infections, Chlamydial and Mycoplasma infections.

Unit III

Study of etiology, Pathology and pathogenesis of various fungal, Rickettsial and parasitic diseases-Aspergillosis, Blastomycosis, Coccidioidomycosis, Histoplasmosis, Epizootic lymphangitis, Rhinosporidiosis, Sporotrichosis, Candidiasis, Cryptococcosis, Dermatomycoses; Diseases due to commonly occurring mycotoxins; Important rickettsial diseases-Q-fever, Heart water disease, Ehrlichiosis, Anaplasmosis, Haemobartonellosis; Important protozoan diseases-Coccidiosis, Toxoplasmosis, Babesiosis, Theilariosis, Cryptosporidiosis, Trypanosomiasis and Pathology of important diseases caused by helminths.

VI. Practical

Morphologic description of lesions based on gross and/ or microscopic lesions and the study of their correlation with a specific disease in the preserved specimens/ slides.

VII. Suggested Reading

- Jones TC, Hunt RD & King NW. 1997. *Veterinary Pathology*. Blackwell Publishing.
- Grant Maxie. 2015. Jubb, Kennedy & Palmer's *Pathology of Domestic Animals*, 6th Ed. Saunders Ltd.
- Gary Procop and Bobbi Pritt. 2014. *Pathology of Infectious Diseases*, 1st Ed. Saunders

I. Course Title : Toxicopathology

II. Course Code : VPL 609

III. Credit Hours : 2+1

IV. Aim of the course

To teach student about toxicity in livestock due to plants and extraneous poisons.

V. Theory

Unit I

Introduction, classification and mode of action of different poisons.

Unit II

Study of pathogenesis, symptoms, gross and microscopic pathology of diseases caused by toxic plants, Organic and inorganic poisons commonly taken or administered maliciously to different species of domestic animals.

Unit III

Various regulatory bodies and regulatory processes, Protocols in conducting toxicopathological trials; Chronology for conducting preclinical toxicology. OECD-



Good Laboratory Practices, Toxicopathological profile including battery of tests for pharmaceutical/ toxic agents.

Unit IV

In-vitro and *In vivo* models for toxicity studies and evaluation parameters.

VI. Practical

- To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.
- Assignments on commonly occurring toxic plants of the region; Diagnosis of commonly taken or maliciously administered poisonous substances.

VII. Suggested Reading

- Jones TC, Hunt RD and King NW. 1997. *Veterinary Pathology*. Blackwell Publishing.

I. Course Title : Avian Pathology

II. Course Code : VPL 610

III. Credit Hours : 2+1

IV. Aim of the course

To teach the students about the different disease conditions of poultry.

V. Theory

Unit I

Avian inflammation and immunology, Study of etio-pathology, symptoms, transmission, and diagnosis of infectious diseases of chickens, turkeys, ducks and other birds caused by Bacteria: *Salmonella*, *Escherichia coli* and Clostridial infections, Infectious coryza, Fowl cholera, Tuberculosis and Spirochaetosis; Chlamydial and Mycoplasmal infections; Viruses: Ranikhet disease, Infectious bursal disease, Infectious bronchitis, Infectious laryngotracheitis, Marek's disease, Leukosarcoma group of diseases, Reticuloendotheliosis, Fowl pox, Avian influenza, Avian encephalomyelitis, Inclusion body hepatitis, Hydropericardium syndrome, Egg drop syndrome-76, Chicken infectious anaemia, Avian nephritis, Reovirus infections- Viral arthritis and Infectious stunting syndrome, Duck plague, Duck viral hepatitis, Coronaviral enteritis and Haemorrhagic enteritis of turkeys: Fungi and mycotoxins; Parasites-Coccidiosis, Histomoniasis, Round worm and Tape worm infections; Ecto-parasites of birds.

Unit II

Study of etio-pathology, clinical symptoms, and diagnosis of nutritional deficiencies - Vitamin and Mineral deficiencies; Metabolic diseases-Ascites, Gout, Fatty liver and kidney syndrome, Fatty liver haemorrhagic syndrome, Cage layer fatigue, etc.; Miscellaneous conditions of poultry-Heat stress, Blue comb, Breast blister, Bumble foot, Cannibalism, False layer, Internal layer, Pendulous crop, Round heart disease etc.

Unit III

Emerging and re-emerging diseases of poultry: Introduction to an emerging and a re-emerging pathogen, mechanisms of poultry pathogen's emergence, co-evolution of poultry pathogens with their vaccines and medications, common diseases of poultry susceptible to point mutations and their pathology.



VI. Practical

- Necropsy examination of the different species of poultry; morphologic description of gross and/ or microscopic lesions in the preserved specimens/ slides.
- Continuous assessment of students for their skills in the diagnosis of gross lesions in different organs of various systems during post-mortem examination of poultry. Preparation of histopathology slides on the select cases followed by interaction in the student seminars/ group discussions.

VII. Suggested Reading

- Saif YM, Barnes FJ, Glisson JR, Fadly AM, Mc Dougald LR & Swayne D. 2008. *Diseases of Poultry*. 12th Ed. Blackwell Publishing.
- Randall CJ. 1984. *A Colour Atlas of Diseases of the Domestic Fowl and Turkey*, Mosby International.
- Majó Masferrer, Natàlia, Dolz Pascual, Roser and Shivaprasad HL. 2011. *Atlas of Avian Necropsy: Macroscopic Diagnosis Sampling*, SERVET Publishers.
- Benjamin Lucio-Martinez and Jodi A Korich. 2010. *Illustrated guide to Poultry Necropsy and diagnosis*, Cornell University (<https://www.slideshare.net/heshamkotb/illustrated-guide-to-poultry-necropsy-and-diagnosis>)

I. Course Title : Pathology of Wild/ Zoo and Aquatic Animal Diseases

II. Course Code : VPL 611

III. Credit Hours : 2+1

IV. Aim of the course

To teach the pathology and diagnosis of different disease conditions of wild and aquatic animals particularly fish.

V. Theory

Unit I: Wild/ Zoo Animal diseases

Etiology, transmission, gross and microscopic pathology of some commonly occurring infectious diseases of wild animals: West Nile fever, Rabies, Foot and mouth disease, Pox, Kyasanaur forest disease, Infectious hepatitis virus, Infectious feline peritonitis, Anthrax, Tuberculosis, Colibacillosis, Clostridial infections Trypanosomosis, Babesiosis, Theileriosis; Etiology, gross and microscopic pathology of commonly occurring non-infectious diseases of Wild/ Zoo animals.

Unit II: Infectious diseases of fish

Study of etiology, gross and microscopic pathology of Bacterial diseases- Bacterial cold water disease, Bacterial fin disease, Gill rot, Furunculosis, Aeromonas septicemia, Epizootic ulcerative syndrome, Yersiniosis, Pseudomoniasis, Alteromoniasis, Pasteurellosis, Enteric septicemia of catfish, Edwardsiellosis, Vibriosis, Streptococcosis, Bacterial kidney disease, Mycobacteriosis, Nocardiosis, Epitheliocystis: Salmonid rickettsialsepticaemia, Columnaris disease; Viral diseases-Spring viremia of carp, Infectious pancreatic necrosis, Viral hemorrhagic septicaemia, Koi herpes virus disease, Infectious spleen and kidney necrosis, Carp pox, Virus nervous necrosis, Lymphocystis disease, Infectious salmon anemia, Salmon alpha virus infections, Infectious hematopoietic necrosis, Herpes viral hematopoietic necrosis, Chinese grass carp reovirusdisease, Viral hemorrhagic necrosis, Epizootic hemorrhagic necrosis; Fungal diseases- Saprolegniasis, Branchiomycosis (Gill rot), Ichthyosporidiosis, Exophiala infection, Aphanomyces and Fusarium infection; Parasitic and Protozoal diseases-Ich



or White spot disease, Costiasis, Trichodiniasis, Velvet disease, Coral fish disease, Epistylis, Red sore disease, Glossatella, Myxosporidiosis, Whirling disease, Microsporidiosis (Glugea, Pleistophora, Loma), Coccidiosis, Proliferative kidney disease, Cryptosporidiosis.

Unit III: Other diseases of Fish

Nutritional diseases-Nutritional deficiency of protein, lipid, carbohydrate, vitamins and minerals; Neoplastic conditions- Melanoma in Platyfish/ Swordtail hybrids, Hepatoma and hepatocellular carcinoma in rainbow trout, Stomatopapilloma of eels (Cauliflower disease), Papilloma of the brown bullhead, Lip Fibroma (Fibropapilloma) of Angel fish, Dermal fibrosarcomas of walleye pike, Lymphosarcoma of pike, Schwannoma/ Neurofibromas of the bicoloured damselfish; Environmental stress-Gas bubble disease, Acidosis/ Alkalosis, Thermal shock, Sun burn disease, Anoxia, Increased in dissolved CO₂ or H₂S or Ammonia concentration in water, Increased in turbidity of pond water, Algal toxicosis disease.

VI. Practical

Post-mortem examination of wild animals including wild birds. Study of gross and microscopic lesions of important infectious and non-infectious diseases of fish and wild animals

VII. Suggested Reading

- Arora BM. 1984. *Wildlife Diseases in India*. Periodical Expert Book Agency.
- Fowler ME. 1978. *Zoo and Wild Animal Medicine*. WB Saunders.
- Roberts RJ. 1979. *Fish Pathology*. Bailliere Tindall, London

I. Course Title : Pathology of Laboratory Animal Diseases

II. Course Code : VPL 612

III. Credit Hours : 2+1

IV. Aim of the course

To teach the students about pathology and diagnosis of different disease conditions of laboratory animals.

V. Theory

Unit I

Etiology, transmission, gross and microscopic pathology of some commonly occurring diseases of Rabbits: Pasteurellosis, Bordetellosis, Colibacillosis, Tyzzer's disease, Staphylococcal infections, Venereal spirochetosis, (rabbit syphilis, cuniculosis), Proliferative ileotyphilitis, Salmonellosis, Tularemia, Clostridium infections, Myxomatosis, Rabbit fibroma/ Shope fibroma, Rabbit papillomatosis, Viral hemorrhagic disease, Coccidiosis, Encephalotozoonoses, Baylisascarisprocyonis, Cestode, Mites, Fleas and lice, miscellaneous and neoplastic diseases of rabbits.

Unit II

Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Rats: Bacterial diseases-Staphylococcal dermatitis, Pasteurellosis, Streptococcal diseases, Helicobacter infection, CAR bacillus, Mycoplasma pulmonis, Pseudotuberculosis (corynobacteriosis), Tyzzer's disease, Salmonellosis, Rat bite fever; Viral diseases- Rat theilo virus (RTV-1), Parvovirus, coronavirus, pneumonia virus of mice, Hantaan virus, Sendai virus, Reovirus-3, Protozoan diseases



(Trichomonads, *Chilomastixbettencorti*, *Spironucleusmuris*, *Giardia muris*, Rat sarcodines, Rat enteric coccidian), Arthropods (Mesostigmated mites, lice of rats), Helminths (rat pinworms, Hymenolepid tapeworm, Cestodes with a rat intermediate host, rat threadworms); fungal disease (*Pneumocystis carinii*), other miscellaneous and neoplastic diseases

Unit III

Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Mice: Bacterial diseases- *Helicobacter* infection, Pasteurellosis, Staphylococcal furunculosis, *Mycoplasma pulmonis*, Cilia associated respiratory bacillus, *Corynebacterium bovis*, *Pseudomonas aeruginosa*, *Citrobacter rodentium*, Tyzzer's disease, Salmonellosis; Viral diseases- Mouse norovirus, Mouse hepatitis virus, Mouse encephalomyelitis virus, Epizootic diarrhoea of infant mice, Parvovirus, Murine cytomegalovirus, Mouse adenovirus, Ectromelia virus, Lymphocytic choriomengitis virus, Pneumonia virus of mice, Lactate dehydrogenase elevating virus, Sendai virus, Mouse thymic virus, Mouse polyoma viruses, Reo-3 virus; Parasitic diseases-Pin worms, Fur mites of mice, Mange mites, Mesostigmatid mites, Lice of mice, Trichomonads, *Chilomastixbettencorti*, *Spironucleusmuris*, *Giardia muris*, Mouse sarcodines, Mouse enteric coccidian, Mouse parental coccidian, Mouse sporozoans, Hymenolepid tapeworms, Encysted tape worm; Fungal disease (*Pneumocystis pneumonia*) and other miscellaneous and neoplastic diseases

Unit IV

Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Guinea pigs: Bacterial diseases- Antibiotic-induced enterotoxemia/haemorrhagic typhlitis, *Bordetella* pneumonia, Streptococcal pneumonia, Cervical lymphadenitis, Pododermatitis, Mastitis, Tyzzer's disease, Salmonellosis; Viral diseases- Guinea pig cytomegalovirus, Adenovirus, Parainfluenza virus, Corona-like virus, Lymphocytic choriomeningitis virus; Parasitic diseases- Coccidia, Fur mites, Helminthes, Lice of guinea pigs, Mange mites, Cryptosporidiosis, *Microsporidium* parasites and other miscellaneous conditions

Unit V

Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Hamsters, Gerbills and primates

VI. Practical

Post-mortem examination of laboratory animals. Study of gross and microscopic lesions of important infectious and non-infectious diseases of laboratory animals

VII. Suggested Reading

- Beninchka K, Garner FM and Jones TC. 1978. *Pathology of Laboratory Animals*. Vols. I, II. Springer Verlag.



Course Outline-cum-Lecture Schedule for Master Degree Programme

I. Course Title : General Pathology

II. Course Code : VPL 601

III. Credit hours : 2+1

IV. Aim of the course

To acquaint the students with different types of degenerations, cell injuries caused by different types of irritants and inflammation

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction and principles of Pathology including genetic basis of disease	3
2.	Cellular responses to injury: Causes and mechanisms of reversible and irreversible cell injury; morphologic characteristics, significance and fate of various intracellular (lipids, glycogen, proteins) and extracellular (hyaline material, amyloid, fibrinoid change, gout) accumulations/ degenerations, endogenous and exogenous pigmentations, cell death (necrosis and apoptosis), pathologic calcifications and cellular adaptive changes	9
3.	Inflammation and repair: Introduction to inflammation, acute inflammation-cellular and molecular events including mediators and heat shock proteins of acute inflammation; cellular components, morphologic classification and outcomes of acute inflammation	5
4.	Chronic inflammation-causes, morphologic features and cellular components of chronic inflammation, healing and repair, systemic effects of inflammation	5
5.	Disturbances in circulation: Causes, mechanisms, morphologic features, significance and fate of hyperemia, oedema, haemorrhage, thrombosis, embolism, ischaemia, infarction and shock	6
6.	Immune mediated reactions: Introduction to autoimmunity and immune mediated diseases, mechanisms of hypersensitivity reactions.	4
Practical		
1.	To study the morphologic descriptions of lesions and nomenclature of a morphologic diagnosis based on gross and/ or microscopic lesions of variety of conditions (degenerations, infiltrations, pigmentations, necrosis, circulatory and growth disturbances and different types of inflammation) in the preserved specimens/ slides.	6
2.	Demonstration of post-mortem changes.	2
3.	Continuous assessment of students for their skills in the diagnosis of gross lesions during post-mortem examination of different tissues of domestic animals.	4



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
4.	Preparation of histopathology slides on the select cases followed by interaction in the student seminars/ group discussions.	4

I. Course Title : Techniques in Pathology

II. Course Code : VPL 602

III. Credit hours : 0+2

IV. Aim of the course

To acquaint the students with different techniques used frequently in Veterinary Pathology

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Practical		
1.	Basic histopathological techniques-Collection of tissues, fixation, processing, section cutting and H and E staining of tissue sections. Collection and fixation of tissues for scanning electron microscopy, transmission electron microscopy, histochemical, toxicological, bacteriological and virological examinations. Application of micrometry and special staining techniques. Demonstration of different inclusions, bacteria and fungi in tissues	10
2.	Principles of dark field, phase contrast and fluorescent microscopy; introduction to scanning electron microscopy and transmission electron microscopy	5
3.	Histochemical techniques for demonstration of fat, glycogen, connective tissue, mucopolysaccharides and common enzymes, pigments and minerals	7
4.	Cryosectioning and application of immunohistochemical techniques-immunoperoxidase and immunofluorescence	3
5.	Principles and applications of PCR and its variants	2
6.	Museum specimen preparation and maintenance	5

I. Course Title : Animal Oncology

II. Course Code : VPL 603

III. Credit hours : 1+1

IV. Aim of the course

To acquaint the students with different types of neoplasms of domestic animals, their nature, cause, pathology and diagnosis.

**Lecture/ Practical schedule**

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Tumour-Etiology, carcinogens and oncogenesis, nomenclature and classification, characteristics of benign and malignant tumours, molecular mechanisms, pathways of spread of tumors and tumor immunology	4
2.	Effects of tumour, grading and staging and laboratory diagnosis of tumours. Animal tumour models-experimental induction of neoplasms	4
3.	Pathology of different types of epithelial and connective tissue tumours with their characteristic identification features and epidemiology	2
4.	Tumours of respiratory, haemopoietic, integumentary, musculoskeletal, gastrointestinal, hepatobiliary, uro-genital, nervous, ocular, ear and endocrine system	6
Practical		
1.	Cytological diagnosis of tumours via impression smears and Fine Needle Aspiration Cytology.	8
2.	To study the gross and microscopic changes in different types of neoplasms.	8

I. Course Title : Clinical Pathology

II. Course Code : VPL 604

III. Credit hours : 1 + 1

IV. Aim of the course

To acquaint the students with clinical alterations in blood, urine, CSF and other body fluids due to different diseases.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Study of changes in blood/ plasma/ serum including biochemical profile for organ function tests	8
2.	Cytological examination and examination of urine, faeces, cerebrospinal fluid and biopsy specimens and their interpretation	8
Practical		
1.	Analysis of clinical samples (blood/ serum/ plasma) and their interpretations	4
2.	Analysis of clinical samples (urine) and their interpretations	2
3.	Analysis of clinical samples (faeces) and their interpretations	2
4.	Analysis of biopsy samples (exfoliative/ FNAC) and their interpretations	4
5.	Analysis of biochemical profile for organ function tests in different disease conditions in animals	4



I. Course Title : Necropsy Procedures and Interpretations

II. Course Code : VPL 605

III. Credit hours : 0+1

IV. Aim of the course

To acquaint the students with necropsy procedures in large and small animals and study of PM lesions in different diseases.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Practical		
1.	Detailed necropsy examination of various species of large and small animals including poultry, laboratory animals and wildlife.	4
2.	Systematic examination of brain, lungs, heart, endocrine glands, lymph nodes, liver, gastro-intestinal tract, urinary and genital systems for gross pathological and histopathological studies and correlation of the observations to diagnose the disease conditions.	8
3.	Necropsy case presentation and report writing/ protocol preparation. Collection, preservation and dispatch of morbid materials for diagnosis of viral, bacterial, protozoan, parasitic diseases, toxic/ poisoning and for histochemistry/ histopathology.	4

I. Course Title : Necropsy Conference

II. Course Code : VPL 606

III. Credit hours : 0 + 1

IV. Aim of the course

To promote self-learning of the students in different necropsy procedures of animals including poultry and description of post-mortem lesions in different diseases/ disease conditions.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Practical		
1.	Continuous assessment of students on detailed necropsy examination of various species of large and small animals including poultry; necropsy associated cytological examinations; systematic examination of different organs for morphologic description of gross lesions; gross photography; collection of tissues for histopathology and based on nature of gross lesions, if possible further collection for investigation of viral/ bacterial/ protozoan/ fungal/ parasitic diseases/ toxic or poisoning, etc.	8
2.	Morphologic description of microscopic lesions; microscopic photography; correlation of gross and microscopic observations with the results of other parallel investigations to diagnose the disease conditions; presentation of select case(s) in the monthly	



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
	seminars followed by report writing and final morphologic/ etiologic diagnosis, classification and preservation of microscopic slides.	8

I. Course Title : Systemic Pathology

II. Course Code : VPL 607

III. Credit hours : 2 + 1

IV. Aim of the course

To teach the students about different disease conditions of haemopoietic, circulatory, respiratory, digestive, urinary and genital systems, nervous, musculoskeletal, endocrine glands and special senses.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Advanced study of pathological conditions in relation to their etiology, pathology and pathogenesis including examples of specific infectious or non-infectious diseases affecting cardiovascular (heart, blood vessels and lymph vessels) and respiratory (nasal cavity, larynx, trachea, bronchi, lungs and pleura).	8
2.	Advanced study of pathological conditions in relation to their etiology, pathology and pathogenesis including examples of specific infectious or non-infectious diseases affecting digestive (buccal cavity, pharynx, oesophagus, stomach and intestines) and haemopoietic (bone marrow, blood, spleen, lymph node) systems.	8
3.	Advanced study of pathological conditions in relation to their etiology, pathology and pathogenesis including examples of specific infectious or non-infectious diseases affecting urinary (kidneys, ureter, urinary bladder and urethra) and genital (male and female organs including mammary gland) systems.	8
4.	Advanced study of pathological conditions in relation to their etiology, pathology and pathogenesis including examples of specific infectious or non-infectious diseases affecting nervous (brain and spinal cord), endocrine (pituitary, thyroid, parathyroid, pancreas) musculo-skeletal systems (muscles and bones) and organs of special senses (eye, ear), skin and its appendages (hoof, tail).	8
Practical		
1.	To study the morphologic description of lesions and nomenclature of a morphologic diagnosis based on gross and/ or microscopic lesions in variety of organs in the preserved specimens/ slides.	8
2.	Continuous assessment of students for their skills in the morphologic description of lesions and nomenclature of a morphologic diagnosis based on gross and/ or microscopic lesions in variety of organs during post-mortem examination of domestic animals followed by interaction in the student seminars/ group discussions.	8



- I. Course Title : Pathology of infectious diseases of domestic animals**
II. Course Code : VPL 608
III. Credit hours : 2 + 1

IV. Aim of the course

To teach the students about important infectious disease conditions of domestic animals.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Study of etiology, pathology and pathogenesis of various viral diseases- Foot and mouth disease, Vesicular stomatitis, Vesicular exanthema, Vesicular disease, Rinderpest, Bovine viral diarrhoea-Mucosal disease, Bovine malignant catarrhal fever, Infectious bovine rhinotracheitis, Parainfluenza-3, Bovine respiratory syncytial virus infection, Pox diseases, Blue tongue, Contagious ecthyma, PPR	7
2.	Study of etiology, pathology and pathogenesis of various viral diseases- Rabies, Canine distemper, Parvovirus infections, Infectious canine hepatitis, Pseudorabies, Classical swine fever, Swine and Equine influenza, Equine infectious anaemia, African horse sickness, Equine viral arteritis, Equine viral encephalomyelitis, Equine herpesvirus infections, Papillomatosis, Rift Valley fever, Japanese encephalitis, Ovine encephalomyelitis (Louping ill) and Prion diseases.	5
3.	Study of etiology, pathology and pathogenesis of various bacterial diseases- Tuberculosis, Johne's disease, Actinobacillosis, Actinomycosis, Brucellosis, Listeriosis, Pasteurellosis, Leptospirosis, Anthrax, Clostridial group of diseases, Streptococcal and Staphylococcal infections.	5
4.	Study of etiology, pathology and pathogenesis of various bacterial diseases- Campylobacter infections, Swine erysipelas, Glasser's disease, Foot rot, Colibacillosis and Salmonellosis, Glanders, Melioidosis, Nocardiosis, Cutaneous streptococcosis, Corynebacterium infections, Chlamydial and Mycoplasma infections.	5
5.	Study of etiology, pathology and pathogenesis of various fungal diseases-Aspergillosis, Blastomycosis, Coccidioidomycosis, Histoplasmosis, Epizootic lymphangitis, Rhinosporidiosis, Sporotrichosis, Candidiasis, Cryptococcosis, Dermatomycoses; Diseases due to commonly occurring mycotoxins	5
6.	Important rickettsial diseases- Q-fever, Heart water disease, Ehrlichiosis, Anaplasmosis, Haemobartonellosis; Important protozoan diseases-Coccidiosis, Toxoplasmosis, Babesiosis, Theilariosis, Cryptosporidiosis, Trypanosomiasis and Pathology of important diseases caused by helminthes	5
Practical		
1.	Morphologic description of lesions based on gross and/ or microscopic lesions and the study of their correlation with a specific disease in the preserved specimens/ slides.	16



I. Course Title : Toxicopathology

II. Course Code : VPL 609

III. Credit Hours : 2 + 1

IV. Aim of the course

To teach student about toxicity in livestock due to plants and extraneous poisons.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction, classification and mode of action of different poisons.	4
2.	Study of pathogenesis, symptoms, gross and microscopic pathology of diseases caused by toxic plants, organic and inorganic poisons commonly taken or administered maliciously to different species of domestic animals	12
3.	Various regulatory bodies and regulatory processes, porticos in conducting toxicopathological trials. Chronology for conducting preclinical toxicology. OECD-Good Laboratory Practices, toxicopathological profile including battery of tests for pharmaceutical/ toxic agents	8
4.	<i>In-vitro</i> and <i>in-vivo</i> models for toxicity studies and evaluation parameters	8
Practical		
1.	To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.	8
2.	Assignments on commonly occurring toxic plants of the region; Diagnosis of commonly taken or maliciously administered poisonous substances.	8

I. Course Title : Avian Pathology

II. Course Code : VPL 610

III. Credit hours : 2 + 1

IV. Aim of the course

To teach the students about the different disease conditions of poultry.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Avian inflammation and immunology, Study of etio-pathology, symptoms, transmission, and diagnosis of infectious diseases of chickens, turkeys, ducks and other birds caused by Viruses: Ranikhet disease, Infectious bursal disease, Infectious bronchitis, Infectious laryngotracheitis, Marek's disease, Leukosarcoma group of diseases, Reticuloendotheliosis, Fowl pox, Avian influenza, Avian encephalomyelitis, Inclusion body hepatitis, Hydropericardium syndrome, Egg drop syndrome-76, Chicken infectious anaemia, Avian nephritis,	



SVU POST-GRADUATE STUDIES REGULATIONS 2021

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
	Reovirus infections- Viral arthritis and Infectious stunting syndrome, Duck plague, Duck viral hepatitis, Coronaviral enteritis and Haemorrhagic enteritis of turkeys	12
2.	Study of etio-pathology, symptoms, transmission, and diagnosis of infectious diseases of chickens, turkeys, ducks and other birds caused by Bacteria: <i>Salmonella</i> , <i>Escherichia coli</i> and Clostridial infections, Infectious coryza, Fowl cholera, Tuberculosis and Spirochaetosis; Chlamydial and Mycoplasmal infections; Fungi and mycotoxins; Parasites-Coccidiosis, Histomoniasis, Round worm and Tape worm infections; Ecto-parasites of birds	10
3.	Study of etio-pathology, clinical symptoms, and diagnosis of nutritional deficiencies -Vitamin and Mineral deficiencies; Metabolic diseases-Ascites, Gout, Fatty liver and kidney syndrome, Fatty liver haemorrhagic syndrome, Cage layer fatigue, etc.; Miscellaneous conditions of poultry-Heat stress, Blue comb, Breast blister, Bumble foot, Cannibalism, False layer, Internal layer, Pendulous crop, Round heart disease, etc.	6
4.	Emerging and re-emerging diseases of poultry: Introduction to an emerging and a re-emerging pathogen, mechanisms of poultry pathogen's emergence, co-evolution of poultry pathogens with their vaccines and medications, common diseases of poultry susceptible to point mutations and their pathology	4
Practical		
1.	Necropsy examination of the different species of poultry; morphologic description of gross and/ or microscopic lesions in the preserved specimens/ slides.	8
2.	Continuous assessment of students for their skills in the diagnosis of gross lesions in different organs of various systems during post-mortem examination of poultry. Preparation of histopathology slides on the select cases followed by interaction in the student seminars/ group discussions.	8

I Course Title : Pathology of Wild/ Zoo and Aquatic Animal Diseases

II. Course Code : VPL 611

III. Credit hours : 2 + 1

IV. Aim of the course

To teach the pathology and diagnosis of different disease conditions of wild and aquatic animals particularly fish

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
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Theory

1. Wild/ Zoo Animal diseases: Etiology, transmission, gross and microscopic pathology of commonly occurring infectious diseases of wild animals: West Nile fever, Rabies, Foot and mouth disease, PoX,



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
	Kyasanaur forest disease, Infectious hepatitis virus, Infectious feline peritonitis, Anthrax, Tuberculosis, Colibacillosis, Clostridial infections Trypanosomosis, Babesiosis, Theileriosis; Etiology, gross and microscopic pathology of commonly occurring non-infectious diseases of Wild/ Zoo animals.	7
2.	Infectious diseases of Fish: Study of etiology, gross and microscopic pathology of Viral diseases-Spring viremia of carp, Infectious pancreatic necrosis, Viral hemorrhagic septicaemia, Koi herpes virus disease, Infectious spleen and kidney necrosis, Carp pox, Virus nervous necrosis, Lymphocystis disease, Infectious salmon anemia, Salmon alpha virus infections, Infectious hematopoietic necrosis, Herpes viral hematopoietic necrosis, Chinese grass carp reovirus disease, Viral hemorrhagic necrosis, Epizootic hemorrhagic necrosis; Fungal diseases- Saprolegniasis, Branchiomycosis (Gill rot), Ichthyosporidiosis, Exophiala infection, Aphanomyces and Fusarium infection.	7
3.	Infectious diseases of Fish: Study of etiology, gross and microscopic pathology of Bacterial diseases- Bacterial cold water disease, Bacterial fin disease, Gill rot, Furunculosis, Aeromonas septicemia, Epizootic ulcerative syndrome, Yersiniosis, Pseudomoniasis, Alteromoniasis, Pasteurellosis, Enteric septicemia of catfish, Edwardsiellosis, Vibriosis, Streptococcosis, Bacterial kidney disease, Mycobacteriosis, Nocardiosis, Epitheliocystis: Salmonidrickettsialsepticaemia, Columnaris disease; Parasitic and Protozoal diseases-Ich or White spot disease, Costiasis, Trichodiniasis, Velvet disease, Coral fish disease, Epistylis, Red sore disease, Glossatella, Myxosporidiosis, Whirling disease, Microsporidiosis (Glugea, Pleistophora, Loma), Coccidiosis, Proliferative kidney disease, Cryptosporidiosis.	6
4.	Other diseases of Fish: Nutritional diseases- Neoplastic conditions- Melanoma in Platyfish/ Swordtail hybrids, Hepatoma and hepatocellular carcinoma in rainbow trout, Stomatopapilloma of eels (Cauliflower disease), Papilloma of the brown bullhead, Lip Fibroma (Fibropapilloma) of Angel fish, Dermal fibrosarcomas of walleye pike, Lymphosarcoma of pike, Schwannoma/ Neurofibromas of the bicoloured damselfish.	6
5.	Other diseases of Fish: Nutritional diseases- Nutritional deficiency of protein, lipid, carbohydrate, vitamins and minerals; Environmental stress- Gas bubble disease, Acidosis/ Alkalosis, Thermal shock, Sun burn disease, Anoxia, Increased in dissolved CO ₂ or H ₂ S or Ammonia concentration in water, Increased in turbidity of pond water, Algal toxicosis disease.	6
Practical		
1.	Post-mortem examination of wild animals including wild birds. Study of gross and microscopic lesions of important infectious and non-infectious diseases of fish and wild animals.	16



- I. Course Title : Pathology of Laboratory Animal Diseases**
II. Course Code : VPL 612
III. Credit hours : 2 + 1

IV. Aim of the course

To teach the students about pathology and diagnosis of different disease conditions of laboratory animals.

Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Etiology, transmission, gross and microscopic pathology of some commonly occurring diseases of Rabbits: Pasteurellosis, Bordetellosis, Colibacillosis, Tyzzer's disease, Staphylococcal infections, Venereal spirochetosis, (rabbit syphilis, cuniculosis), Proliferative ileotyphilitis, Salmonellosis, Tularemia, Clostridium infections, Myxomatosis, Rabbit fibroma/ Shope fibroma, Rabbit papillomatosis, Viral hemorrhagic disease, Coccidiosis, Enephalotozoonoses, Baylisascarisprocyonis, Cestode, Mites, Fleas and lice, miscellaneous and neoplastic diseases of rabbits	5
2.	Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Rats: Bacterial diseases-Staphylococcal dermatitis, Pasteurellosis, Streptococcal diseases, Helicobacter infection, CAR bacillus, Mycoplasma pulmonis, Pseudotuberculosis (corynobacteriosis), Tyzzer's disease, Salmonellosis, Rat bite fever; Protozoan diseases (Trichomonads, <i>Chilomastix bettencorti</i> , <i>Spiroucleus muris</i> , <i>Giardia muris</i> , Rat sarcodines, Rat enteric coccidian), Arthropods (Mesostigmated mites, lice of rats), Helminths (rat pinworms, Hymenolepid tapeworm, Cestodes with a rat intermediate host, rat threadworms).	5
3.	Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Rats: Viral diseases- Rat theilo virus (RTV-1), Parvovirus, coronavirus, pneumonia virus of mice, Hantaan virus, Sendai virus, Reovirus-3 fungal disease (<i>Pneumocystis carinii</i>), other miscellaneous and neoplastic diseases	5
4.	Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Mice: Bacterial diseases- Helicobacter infection, Pasteurellosis, Staphylococcal furunculosis, <i>Mycoplasma pulmonis</i> , Cilia associated respiratory bacillus, <i>Corynebacterium bovis</i> , <i>Pseudomonas aeruginosa</i> , Citrobacter rodentium, Tyzzer's disease, Salmonellosis; Parasitic diseases-Pin worms, Fur mites of mice, Mange mites, Mesostigmatid mites, Lice of mice, Trichomonads, <i>Chilomastix bettencorti</i> , <i>Spiroucleus muris</i> , <i>Giardia muris</i> , Mouse sarcodines, Mouse enteric coccidian, Mouse parental coccidian, Mouse sporozoans, Hymenolepid tapeworms, Encysted tape worm	5
5.	Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Mice: Viral diseases- Mouse norovirus, Mouse hepatitis virus, Mouse encephalomyelitis virus, Epizootic diarrhoea of infant mice, Parvovirus, Murine cytomegalovirus, Mouse adenovirus, Ectromelia virus, Lymphocytic choriomengitis virus, Pneumonia virus of mice, Lactate dehydrogenase elevating virus,	



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
	Sendai virus, Mouse thymic virus, Mouse polyoma viruses, Reo-3 virus; Fungal disease (<i>Pneumocystis</i> pneumonia) and other miscellaneous and neoplastic diseases	5
6.	Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Guinea pigs: Bacterial diseases- Antibiotic-induced enterotoxemia/ haemorrhagic typhlitis, <i>Bordetella</i> pneumonia, Streptococcal pneumonia, Cervical lymphadenitis, Pododermatitis, Mastitis, Tyzzer's disease, Salmonellosis; Viral diseases- Guinea pig cytomegalovirus, Adenovirus, Parainfluenza virus, Corona-like virus, Lymphocytic choriomeningitis virus; Parasitic diseases- Coccidia, Fur mites, Helminthes, Lice of guinea pigs, Mange mites, Cryptosporidiosis, Microsporidium parasites and other miscellaneous conditions	5
7.	Etiology, transmission, gross and microscopic pathology of commonly occurring diseases of Hamsters, Gerbills and primates	2
Practical		
1.	Post-mortem examination of laboratory animals. Study of gross and microscopic lesions of important infectious and non-infectious diseases of laboratory animals.	16



Course Title with Credit Load Ph.D. in Veterinary Pathology (VPL)

Course Code	Course Title	Credit Hours
VPL 701	Molecular and Ultrastructural Basis of Cell Injury*	2+1
VPL 702	Molecular Basis of Inflammation	1+1
VPL 703	Molecular Basis of Neoplasia	1+1
VPL 704	Immunopathology*	2+1
VPL 705	Advances in Diagnostic Pathology	1+2
VPL 706	Pathology of Nutritional and Metabolic Disturbances	2+1
VPL 707	Pathology of Important Emerging and Re-Emerging Diseases of Pets and Livestock	2+1
VPL 708	Research Methodology in Pathology*	1+0
VPL 709	Necropsy Conference I*	0+1
VPL 790	Special Problem	0+1
VPL 791	Doctoral Seminar-I*	1+0
VPL 792	Doctoral Seminar-II*	1+0
VPL 799	Doctoral Research	75

*Core courses



Course Contents

Ph.D. in Veterinary Pathology (VPL)

- I. Course Title** : **Molecular and Ultrastructural Basis of Cell Injury**
II. Course Code : **VPL 701**
III. Credit Hours : **2+1**

IV. Aim of the course

To teach the students about different molecular including ultrastructural changes in diseases conditions.

V. Theory

Unit I

Study of cells- cell morphology, interpretation of normal and abnormal cells.

Unit II

Overview of Cell injury, Targets of cell injury-Cell membranes, Aerobic respiration, structural proteins and enzymes and genetic apparatus of the cell; Mechanisms of cell injury-hypoxia, Injury by free radicals, Chemical injury, Infectious agents, other forms of cell injury-immune mediated reactions, Genetic derangements; Mechanisms of cell membrane damage; Mechanisms of DNA damage-base loss, Base modification, chemical modification, Replication errors, Inter-strand cross-links, DNA-protein cross-links, Strand breaks. Molecular and immunopathological changes associated with different types of cell injuries.

Unit III

Morphology of Reversible and irreversible cell injury with particular emphasis on ultra structural changes in the cells and organelles: Morphology of cell death-necrosis, Apoptosis and autolysis, Mechanism of apoptosis, Intracellular and extracellular accumulations, Pigment and tissue deposits, Consequences of cell injury Cellular adaptations-hyperplasia, Hypertrophy, Atrophy, Metaplasia and dysplasia.

Unit IV

Mechanism of other types of cell death, viz., Pyroptosis, Ferroptosis, Autophagy, ETOSIS, etc.

VI. Practical

Collection and preparation of specimens for electron microscopic studies. Interpretation of ultra-structural changes and their correlation with gross and histopathological findings

VII. Suggested Reading

- Selected articles from journals.



- I. Course Title : Molecular Basis of Inflammation**
II. Course Code : VPL 702
III. Credit Hours : 1+1

IV. Aim of the course

To teach the students about molecular mechanisms of inflammations.

V. Theory

Unit I

Cellular, molecular and immunopathological changes associated with different types of inflammation. Acute inflammation, Vascular events of acute inflammation, Cellular events in acute inflammation, Leucocyte-endothelial interactions, Leucocyte adhesion molecules, Endothelial adhesion molecule receptors, Leucocyte chemotactic factors, Microbicidal activity of leucocytes, Leucocyte activation.

Unit II

Plasma derived mediators of inflammation-Complement system, Kinin system, Coagulation system and Fibrinolytic system; Cell derived mediators of inflammation-vasoactive amines, lipid mediators, cytokines, chemokines, oxygen radicals and nitric oxide, Cellular components of inflammation, types of exudative inflammation.

Unit III

Chronic inflammation and its types, Elements of chronic inflammation, Healing and repair, Wound healing mediators and their functions, Repair of bone, Repair of nervous tissue and myocardium.

VI. Practical

Molecular alterations and their correlation with gross and microscopic inflammatory changes

VII. Suggested Reading

- Selected articles from journals.

- I. Course Title : Molecular Basis of Neoplasia**
II. Course Code : VPL 703
III. Credit Hours : 1+1

IV. Aim of the course

To teach the students about molecular mechanisms of neoplasia and diagnostic techniques.

V. Theory

Unit I

Tumour characteristics, differentiation and proliferation, molecular basis of cancer, tumour stromal interaction, molecular mechanisms of invasion and metastasis of tumours, molecular changes underlying tumour progression and heterogeneity, tumour biology and growth.

Unit II

Tumour genetics, immunohistochemical/ including markers associated tumour diagnosis.



Unit III

Application of cytological, histopathological, immunohistochemical and molecular techniques in diagnosis and prognosis of various tumour conditions.

VI. Suggested Reading

- Selected articles from journals.

I. Course Title : Immunopathology

II. Course Code : VPL 704

III. Credit Hours : 2+1

IV. Aim of the course

To teach the students about immune mediated and autoimmune diseases of animals.

V. Theory

Unit I

Principles of immunopathology, Etiopathology of hypersensitivity reactions and immune complex diseases; Autoimmunity, mechanisms of autoimmunity, Genetic, microbial and environmental factors in autoimmunity.

Unit II

Study of etiology, pathology and pathogenesis of commonly encountered Immunoproliferative disorders (Multiple myeloma, lymphoma, leukemia), Hypersensitivity diseases, Autoimmune diseases and immune deficiencies in domestic animals.

VI. Practical

Immune complexes-quantification and determination by various techniques, Enumeration of various populations of lymphocytes by different techniques, Determination of C3 levels, Autoimmune reaction by demonstrating auto-antibodies, Gross and microscopic pathology of hypersensitivity reactions (class IV and others).

VII. Suggested Reading

- Selected articles from journals.

I. Course Title : Advances in Diagnostic Pathology

II. Course Code : VPL 705

III. Credit Hours : 1+2

IV. Aim of the course

To teach the students about current diagnostic techniques for diagnosis of different diseases.

V. Theory

Unit I

Principles and applications of Scanning electron microscopy, Transmission electron microscopy, Laser scanning confocal microscopy, Telemicroscopy-Virtual slide microscopy.

Unit II

Current techniques for diagnosis of animal diseases namely ELISA, PCR and its



variants, Flow cytometry (FCM), *In-situ* hybridization, Bio chip techniques (DNA chip, Protein microarray, Tissue microarray), Chromatography, Spectrophotometry and Immunodiffusion technique, Biopsy techniques, Use of laboratory animals, etc.

Unit III

In-vitro cell culture techniques (commonly used cell lines, chicken embryo), cytopathic effect of different viruses and their interpretations.

VI. Practical

Principles and practice of advance techniques for the diagnosis of animal diseases.

VII. Suggested Reading

- Selected articles from journals.

I. Course Title : Pathology of Nutritional and Metabolic Disorders

II. Course Code : VPL 706

III. Credit Hours : 2+1

IV. Aim of the course

To teach the students about nutritional and metabolic disorder of animals.

V. Theory

Unit I

Pathogenesis, gross and microscopic pathology of nutritional imbalances, viz., carbohydrate, protein, fats, vitamins and macro and microelements.

Unit II

Pathogenesis, gross and microscopic pathology of different metabolic diseases namely Milk fever, Ketosis, Pregnancy toxemia, Tetany, Azoturia, Equine hyperlipidemia, downer's cow and rheumatism like syndrome and post parturient hemoglobinuria in domestic animals and diabetes mellitus in dogs.

VI. Practical

Estimation of certain minerals in sera of natural and experimentally induced deficiencies in domestic animals. To study the haematological, gross and microscopic pathological alterations caused by nutritional and metabolic disorders.

VII. Suggested Reading

- Selected articles from journals.

I. Course Title : Pathology of Important Emerging and Re-Emerging Diseases

II. Course Code : VPL-707

III. Credit Hours : 2+1

IV. Aim of the course

To teach the students about important emerging, re-emerging, exotic and transboundary diseases of pets and livestock.

V. Theory

Unit I

Advances in pathogenesis and pathology including molecular basis of important viral infections namely Foot and mouth disease, Vesicular stomatitis, Vesicular



exanthema, Rinderpest, Bovine malignant catarrhal fever, Infectious bovine rhinotracheitis, Parainfluenza-3, Bovine respiratory syncytial virus infection, Blue tongue, Contagious ecthyma, Pox diseases, Peste des petits ruminants, Rabies, Canine distemper, parvovirus infections, Infectious canine hepatitis, Pseudorabies, Hog cholera/ swine fever, swine influenza, Rift valley fever, Scrapie, Bovine spongiform encephalopathy, Japanese encephalitis, Diseases caused by Nipah virus, Kyasanaur forest disease, West Nile fever, Hendravirus, Ebola virus, Crimean-Congo haemorrhagic fever, Chikungunya virus, Ganjam virus, Marburg virus, etc.

Unit II

Advances in pathogenesis and pathology including molecular basis of important bacterial infections namely Tuberculosis, Johne's disease, Actinobacillosis, Actinomycosis, Brucellosis, Listeriosis, Pasteurellosis, Leptospirosis, Anthrax, Clostridial group of diseases, Swine erysipelas, Glasser's disease, Colibacillosis and Salmonellosis, *Corynebacterium* infections, Chlamydial and Mycoplasmal infections.

Unit III

Advances in pathogenesis and pathology including molecular basis of important fungal infections namely Aspergillosis, Blastomycosis, Coccidioidomycosis, Histoplasmosis, Rhinosporidiosis, Sporotrichosis, Candidiasis, Cryptococcosis, Dermatomycoses, diseases due to commonly occurring mycotoxins-Aflatoxins, Ochratoxin, Zearalenone, T-2 toxins, Rubratoxin, Fumonisin, Moniliformin, etc.

VI. Practical

Study of clinical and gross alterations and histopathology of some important emerging and enzootic diseases.

VII. Suggested Reading

- Selected articles from Journals.

I. Course Title : Research Methodology in Pathology

II. Course Code : VPL 708

III. Credit Hours : 1+0

IV. Aim of the course

To provide exposure to the students on different methodologies indispensable in Pathology research through available scientific literature in world class journals.

V. Theory

Unit I

Literature based study: Use of various experimentation techniques in pathology research, Animal experimentation techniques, Planning and design of various types of experiments through study of literature for selection of appropriate methodology and evaluation parameters including scoring system, Data evaluation methods, etc.

Unit II

Introduction to OECD-GLP guidelines, Reference studies through literature for safety evaluation of drug/ plant/ plant molecules using *In-vitro* and *In vivo* techniques, Determination and calculation of LD₅₀, ID₅₀, MIC, MTD, etc., use of modern molecular techniques in experimental pathology research.



VI. Suggested Reading

- Selected articles from journals.

I. Course Title : Necropsy Conference-I

II. Course Code : VPL-709

III. Credit Hours : 0+1

IV. Aim of the course

To promote self learning of the students in different necropsy procedures of animals including poultry and description of post-mortem lesions in different diseases/ disease conditions.

V. Practical

- Continuous assessment of students on detailed necropsy examination of various species of large and small animals including poultry; necropsy associated cytological examinations; systematic examination of different organs for morphologic description of gross lesions; gross photography; collection of tissues for histopathology and based on nature of gross lesions, if possible further collection for investigation of viral/ bacterial/ protozoan/ fungal/ parasitic diseases/ toxic or poisoning, etc.
- Morphologic description of microscopic lesions; microscopic photography; correlation of gross and microscopic observations with the results of other parallel investigations to diagnose the disease conditions; presentation of select case(s) in the monthly seminars followed by report writing and final morphologic/ etiologic diagnosis, classification and preservation of microscopic slides.

VI. Suggested Reading

- D Gopala Krishna Rao. 2005. *Textbook on necropsy and histopathological techniques*, 1st Ed. Academia.
- Donald B Feldman, John Curtis Seely. 1988. *Necropsy Guide: Rodents and the Rabbit*, 1st Ed. CRC Press.
- Albert C Strafuss. 1988. *Necropsy: Procedures and Basic Diagnostic Methods for Practicing Veterinarians*, Charles C. Thomas Publisher Springfield.
- Jones TC and Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott.
- John M King, David C Dodd and Lois Roth. 2006. *The Necropsy Book*, Fifth Edition, C L Davis Foundation.
- Majó Masferrer, Natàlia, Dolz Pascual, Roser and Shivaprasad HL. 2011. *Atlas of Avian Necropsy: Macroscopic Diagnosis Sampling*, SERVET Publishers.
- Benjamin Lucio-Martinez and Jodi A Korich. 2010. *Illustrated guide to Poultry Necropsy and diagnosis*, Cornell University (<https://www.slideshare.net/heshamkotb/illustrated-guide-to-poultry-necropsy-and-diagnosis>).

I. Course Title : Special Problem

II. Course Code : VPL 790

III. Credit Hours : 0+1

IV. Aim of the course

To provide expertise in handling practical research problems.

V. Practical

Short research problem(s) involving contemporary issues and research techniques.



VI. List of some selected Journals

- *American Journal of Veterinary Medical Association*
- *Annals of Nutrition and Metabolism*
- *Annual Review of Nutrition*
- *Avian Diseases*
- *Avian Pathology*
- *Cancer Research*
- *Cellular and Molecular Biology*
- *Current Contents*
- *European Journal of Nutrition*
- *Genomics, Proteomics and Bioinformatics*
- *Indian Journal of Animal Sciences*
- *Indian Journal of Poultry Science*
- *Indian Journal of Veterinary Pathology*
- *Indian Veterinary Journal*
- *Journal of Applied Toxicology*
- *Journal of Comparative Pathology*
- *Journal of Ethnopharmacology*
- *Journal of Immunology and Immunopathology*
- *Journal of Pathology*
- *Journal of Research in Veterinary Science*
- *Phytomedicine*
- *Toxicology Letters*
- *Toxicon*
- *Trends in Immunology*
- *Veterinary Bulletin*
- *Veterinary Immunology and Immunopathology*
- *Veterinary Pathology*

e-Resources

- www.iavp.org (Indian Journal of Veterinary Pathology)
- www.vetpathology.org (Veterinary Pathology)
- www.tandf.co.uk (Avian Pathology)
- www.avdi.allenpress.com (Avian Diseases)
- www.elsevier.com/locate/vetimm (Veterinary Immunology and Immuno- pathology).



Course Outline-cum-Lecture Schedule for Doctoral Degree Programme

- I. Course Title** : Molecular and Ultra structural Basis of Cell Injury
II. Course Code : VPL 701
III. Credit Hours : 2 + 1
IV. Aim of the course

To teach the students about different molecular including ultrastructural changes in diseases conditions.

Lecture/ Practical schedule

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Study of cells- cell morphology, interpretation of normal and abnormal cells	6
2.	Overview of Cell injury, Targets of cell injury-Cell membranes, aerobic respiration, structural proteins and enzymes and genetic apparatus of the cell; mechanisms of cell injury-hypoxia, injury by free radicals, chemical injury, infectious agents, other forms of cell injury-immune mediated reactions, genetic derangements; mechanisms of cell membrane damage; mechanisms of DNA damage-base loss, base modification, chemical modification, replication errors, inter-strand cross-links, DNA-protein cross-links, strand breaks. Molecular and immunopathological changes associated with different types of cell injuries	10
3.	Morphology of Reversible and irreversible cell injury with particular emphasis on ultra structural changes in the cells and organelles: Morphology of cell death-necrosis, apoptosis and autolysis, mechanism of apoptosis, intracellular and extracellular accumulations, pigment and tissue deposits, consequences of cell injury	10
4.	Cellular adaptations-hyperplasia, hypertrophy, atrophy, metaplasia and dysplasia	4
5.	Mechanism of other types of cell death, viz., pyroptosis, ferroptosis, autophagy, ETOSIS, etc.	2
Practical		
1.	Collection and preparation of specimens for electron microscopic studies. Interpretation of ultra-structural changes and their correlation with gross and histopathological findings	16



- I. Course Title : Molecular Basis of Inflammation**
II. Course Code : VPL 702
III. Credit Hours : 1 + 1

IV. Aim of the course

To teach the students about molecular mechanisms of inflammations.

Lecture/ Practical schedule

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Cellular, molecular and immunopathological changes associated with different types of inflammation. Acute inflammation, Vascular events of acute inflammation, Cellular events in acute inflammation, Leucocyte-endothelial interactions, Leucocyte adhesion molecules, Endothelial adhesion molecule receptors, Leucocyte chemotactic factors, Microbicidal activity of leucocytes, Leucocyte activation.	6
2.	Plasma derived mediators of inflammation-Complement system, Kinin system, Coagulation system and Fibrinolytic system; Cell derived mediators of inflammation-vasoactive amines, lipid mediators, cytokines, chemokines, oxygen radicals and nitric oxide, Cellular components of inflammation, types of exudative inflammation.	6
3.	Chronic inflammation and its types, Elements of chronic inflammation, Healing and repair, Wound healing mediators and their functions, Repair of bone, Repair of nervous tissue and myocardium.	4
Practical		
1.	Molecular alterations and their correlation with gross and microscopic inflammatory changes.	16

- I. Course Title : Molecular Basis of Neoplasia**
II. Course Code : VPL 703
III. Credit Hours : 1 + 1

IV. Aim of the course

To teach the students about molecular mechanisms of neoplasia and diagnostic technique.

Lecture/ Practical schedule

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Tumour characteristics, differentiation and proliferation, molecular basis of cancer, tumour stromal interaction, molecular mechanisms of invasion and metastasis of tumours, molecular changes underlying tumour progression and heterogeneity, tumour biology and growth.	8



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Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
2.	Tumour genetics, immunohistochemical/ including markers associated tumour diagnosis.	8
Practical		
1.	Application of cytological, histopathological, immunohistochemical and molecular techniques in diagnosis and prognosis of various tumour conditions.	16

I. Course Title : Immunopathology

II. Course Code : VPL 704

III. Credit Hours : 2 + 1

IV. Aim of the course

To teach the students about immune mediated and autoimmune diseases of animals.

Lecture/ Practical schedule

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Principles of immunopathology, Etiopathology of hypersensitivity reactions and immune complex diseases; Autoimmunity, mechanisms of autoimmunity, Genetic, microbial and environmental factors in autoimmunity.	16
2.	Study of etiology, pathology and pathogenesis of commonly encountered Immunoproliferative disorders (Multiple myeloma, lymphoma, leukemia), hypersensitivity diseases, autoimmune diseases and immune deficiencies in domestic animals.	16
Practical		
1.	Immune complexes-quantification and determination by various techniques, enumeration of various populations of lymphocytes by different techniques, determination of C3 levels.	8
2.	Autoimmune reaction by demonstrating auto-antibodies, gross and microscopic pathology of hypersensitivity reactions (class IV and others).	8

I. Course Title : Advances in Diagnostic Pathology

II. Course Code : VPL 705

III. Credit Hours : 1 + 2

IV. Aim of the course

To teach the students about current diagnostic techniques for diagnosis of different diseases.

**Lecture/ Practical schedule**

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Principles and applications of Scanning electron microscopy, Transmission electron microscopy, Laser scanning confocal microscopy, Telemicroscopy-Virtual slide microscopy	4
2.	Current techniques for diagnosis of animal diseases namely ELISA, PCR and its variants, Flow cytometry (FCM), <i>In-situ</i> hybridization, Bio-chip techniques (DNA chip, Protein microarray, Tissue microarray), Chromatography, Spectrophotometry and Immunodiffusion technique, Biopsy techniques, Use of laboratory animals, etc.	8
3.	<i>In-vitro</i> cell culture techniques (commonly used cell lines, chicken embryo), cytopathic effect of different viruses and their interpretations	4
Practical		
1.	Principles and practice of advance techniques for the diagnosis of animal diseases	32

I. Course Title : Pathology of Nutritional and Metabolic Disorders

II. Course Code : VPL 706

III. Credit Hours : 2 + 1

IV. Aim of the course

To teach the students about nutritional and metabolic disorder of animals.

Lecture/ Practical schedule

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Pathogenesis, gross and microscopic pathology of nutritional imbalances, viz., carbohydrate, protein, fats, vitamins and macro and microelements	16
2.	Pathogenesis, gross and microscopic pathology of different metabolic diseases namely milk fever, ketosis, pregnancy toxaemia, tetany, azoturia, equine hyperlipidemia, downer's cow and rheumatism like syndrome and post parturient hemoglobinuria in domestic animals and diabetes mellitus in dogs	16
Practical		
1.	Estimation of certain minerals in sera of natural and experimentally induced deficiencies in domestic animals	8
2.	To study the haematological, gross and microscopic pathological alterations caused by nutritional and metabolic disorders	8



- I. Course Title : Pathology of Important Emerging and Re-Emerging diseases**
- II. Course Code : VPL 707**
- III. Credit Hours : 2 + 1**
- IV. Aim of the course**

To teach the students about important emerging, re-emerging, exotic and transboundary diseases of pets and livestock.

Lecture/ Practical schedule

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Advances in pathogenesis and pathology including molecular basis of important viral infections namely Foot and mouth disease, Vesicular stomatitis, Vesicular exanthema, Rinderpest, Bovine malignant catarrhal fever, Infectious bovine rhinotracheitis, Parainfluenza-3, Bovine respiratory syncytial virus infection, Blue tongue, Contagious ecthyma, PoX diseases, Peste des petits ruminants, Rabies, Canine distemper, parvovirus infections, Infectious canine hepatitis, Pseudorabies	8
2.	Advances in pathogenesis and pathology including molecular basis of important viral infections namely Hog cholera/ swine fever, swine influenza, Rift valley fever, Scrapie, Bovine spongiform encephalopathy, Japanese encephalitis, Diseases caused by Nipah virus, Kyasanaur forest disease, West Nile fever, Hendraviruses, Ebola virus, Crimean-Congo haemorrhagic fever, Chikungunya virus, Ganjam virus, Marburg virus, etc.	8
3.	Advances in pathogenesis and pathology including molecular basis of important bacterial infections namely Tuberculosis, Johne's disease, Actinobacillosis, Actinomycosis, Brucellosis, Listeriosis, Pasteurellosis, Leptospirosis, Anthrax, Clostridial group of diseases, Swine erysipelas, Glasser's disease, Colibacillosis and Salmonellosis, Corynebacterium infections, Chlamydial and Mycoplasmal infections	8
4.	Advances in pathogenesis and pathology including molecular basis of important fungal infections namely Aspergillosis, Blastomycosis, Coccidioidomycosis, Histoplasmosis, Rhinosporidiosis, Sporotrichosis, Candidiasis, Cryptococcosis, Dermatomycoses, diseases due to commonly occurring mycotoxins-Aflatoxins, Ochratoxin, Zearalenone, T-2 toxins, Rubratoxin, Fumonisin, Moniliformin, etc.	8
Practical		
1.	Study of clinical and gross alterations and histopathology of some important emerging and enzootic diseases.	16

- I. Course Title : Research Methodology in Pathology**
- II. Course Code : VPL 708**
- III. Credit Hours : 1+0**
- IV. Aim of the course**

To provide exposure to the students on different methodologies indispensable in Pathology research through available scientific literature in world class journals

**Lecture/ Practical schedule**

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Literature based study: Use of various experimentation techniques in pathology research, animal experimentation techniques, Planning and design of various types of experiments through study of literature for selection of appropriate methodology and evaluation parameters including scoring system, data evaluation methods, etc.	8
2.	Introduction to OECD-GLP guidelines, Reference studies through literature for safety evaluation of drug/ plant/ plant molecules using <i>In-vitro</i> and <i>In vivo</i> techniques, Determination and calculation of LD ₅₀ , ID ₅₀ , MIC, MTD, etc., use of modern molecular techniques in experimental pathology research	8

I. Course Title : Necropsy Conference I

II. Course Code : VPL 709

III. Credit Hours : 0 + 1

IV. Aim of the course

To promote self-learning of the students in different necropsy procedures of animals including poultry and description of post-mortem lesions in different diseases/ disease conditions.

Lecture/ Practical schedule

Sr. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Practical		
1.	Continuous assessment of students on detailed necropsy examination of various species of large and small animals including poultry; necropsy associated cytological examinations; systematic examination of different organs for morphologic description of gross lesions; gross photography; collection of tissues for histopathology and based on nature of gross lesions, if possible further collection for investigation of viral/ bacterial/ protozoan/ fungal/ parasitic diseases/ toxic or poisoning, etc.	8
2.	Morphologic description of microscopic lesions; microscopic photography; correlation of gross and microscopic observations with the results of other parallel investigations to diagnose the disease conditions; presentation of select case(s) in the monthly seminars followed by report writing and final morphologic/ etiologic diagnosis, classification and preservation of microscopic slides	8





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Veterinary Para-Clinical Subjects

– Veterinary Parasitology





Course Title with Credit Load M.V.Sc. in Veterinary Parasitology

Course Code	Course Title	Credit Hours
VPA 601	Platyhelminthes-I*	1+1
VPA 602	Platyhelminthes-II*	1+1
VPA 603	Nemathelminthes and Acanthocephala*	2+1
VPA 604	Arthropod Parasites*	2+1
VPA 605	Parasitic Protozoa*	2+1
VPA 606	Diagnostic Parasitology	0+2
VPA 607	Clinical Parasitology	1+1
VPA 608	Management of Parasitic Diseases	1+1
VPA 609	Immunoparasitology	2+1
VPA 610	Parasitic Zoonoses	2+0
VPA 611	Parasites of Wildlife	1+1
VPA 691	Master's Seminar*	1+0
VPA 699	Master Research	30

*Core Courses



Course Contents

M.V.Sc. in Veterinary Parasitology

I. Course Title : Platyhelminthes-I

II. Course Code : VPA 601

III. Credit Hours : 1+1

IV. Aim of the course

To study the morphology, biology, pathogenesis and control measures for trematode parasites of veterinary importance.

V. Theory

Unit I

Introduction, classification, general account and economic importance of trematodes.

Unit II

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, Treatment and control measures of trematodes belonging to families: Dicrocoeliidae, Opisthorchiidae and Fasciolidae.

Unit III

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of trematodes belonging to families: Echinostomatidae, Heterophyidae, Plagiorchiidae, Troglotrematidae, Prosthogonimidae, Nanophyetidae and Paragonimidae.

Unit IV

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of trematodes belonging to families: Notocotylidae, Brachylemidae, Cyclocoelidae, Paramphistomatidae and Schistosomatidae.

Unit V

Classification, characters of snails and control strategies of molluscs of veterinary importance.

VI. Practical

- Collection, preservation/ processing and identification of trematode parasites; their eggs and intermediate hosts.
- Observation on parasitic stages in host tissues and associated pathological lesions.
- Identification of molluscs of veterinary importance and examination of molluscs for various developmental stages of trematode parasites.

I. Course Title : Platyhelminthes-II

II. Course Code : VPA 602

III. Credit Hours : 1+1

IV. Aim of the course

To study the morphology, biology, pathogenesis and control measures for cestode



parasites of veterinary importance.

Unit I

Introduction, classification, general account and economic importance of cestodes

Unit II

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of cestodes belonging to families: Diphyllbothriidae, Mesocestoididae and Taeniidae.

Unit III

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of cestodes belonging to families: Davaineidae, Hymenolepididae, Dipylidiidae and Dilepididae.

Unit IV

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, Treatment and control measures of cestodes belonging to families: Anoplocephalidae and Thysanosomidae.

V. Practical

Collection, preservation/ processing and identification of cestode parasites; their eggs, larval stages and intermediate hosts. Parasitic stages in host tissues and associated pathological lesions.

I. Course Title : Nematelminthes and Acanthocephala

II. Course Code : VPA 603

III. Credit Hours : 2+1

IV. Aim of the course

To study the morphology, biology, pathogenesis, diagnosis and control of nematodes and thorny-headed worms of veterinary importance.

V. Theory

Unit I

Introduction, classification, general account and economic importance of nematodes and thorny-headed worms.

Unit II

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of nematodes belonging to families: Ascarididae, Anisakidae, Oxyuridae, Heterakidae and Subuluridae.

Unit III

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment, and control measures of nematodes belonging to families: Rhabditidae, Strongyloididae and Strongylidae.

Unit IV

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment, and control measures of nematodes belonging to families: Trichonematidae, Amidostomidae, Stephanuridae, Syngamidae and Ancylostomatidae.



Unit V

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of nematodes belonging to families: Filaroididae, Trichostrongylidae, Ollulanidae, Dictyocaulidae and Metastrongylidae.

Unit VI

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of nematodes belonging to families: Spiruridae, Thelaziidae, Acuariidae, Tetrameridae, Physalopteridae, Gnathostomatidae, Filariidae, Setariidae, Onchocercidae and Dracunculidae.

Unit VII

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of nematodes belonging to families: Trichinellidae, Trichuridae, Capillariidae and Dioctophymatidae.

Unit VIII

Morphology, Epidemiology, Life cycle, Pathogenesis, Clinical signs, Diagnosis, treatment and control measures of thorny headed worms belonging to families: Polymorphidae, Oligacanthorhynchidae and Gnathobdellidae.

V. Practical

Collection, preservation/ processing and identification of nematode parasites and thorny headed worms; their eggs and larvae and associated pathological lesions.

I. Course Title : Arthropod Parasites

II. Course Code : VPA 604

III. Credit Hours : 2+1

IV. Aim of the course

To study the morphology, biology, vector potential of the arthropods of veterinary importance and their control measures

V. Theory

Unit I

Introduction, Classification, Harmful effects and Economic importance of arthropod parasites.

Unit II

Distribution, Morphology, Life cycle, Seasonal pattern, Pathogenesis, Vector potentiality, Economic significance and control of arthropods belonging to the families: Culicidae, Ceratopogonidae, Simuliidae and Psychodidae.

Unit III

Distribution, Morphology, Life cycle, Seasonal pattern, Pathogenesis, Vector potentiality, Economic significance and control of arthropods belonging to the families: Tabanidae, Gasterophilidae, Muscidae, Cuterebridae and Glossinidae.

Unit IV

Distribution, Morphology, Life cycle, Seasonal pattern, Pathogenesis, Vector potentiality, Economic significance and control of arthropods belonging to the families: Oestridae, Sarcophagidae, Calliphoridae and Hippoboscidae. Importance



of blow flies in forensic entomology and treatment of wounds.

Unit V

Distribution, Morphology, Life cycle, Seasonal pattern, Pathogenesis, Economic significance and control of arthropods belonging to the families: Pediculidae, Haematopinidae, Linognathidae, Menoponidae, Philopteridae and Trichodectidae.

Unit VI

Distribution, Morphology, Life cycle, Seasonal pattern, Pathogenesis, Economic significance and control of arthropods belonging to the Orders- Siphonaptera and Hemiptera, Cimicidae and Reduviidae.

Unit VII

Distribution, Life cycle, Seasonal pattern, Vector potentiality, Pathogenesis economic significance and control of acarines belonging to the families: Argasidae and Ixodidae.

Unit VIII

Distribution, Morphology, Life cycle, Seasonal pattern, Pathogenesis, Economic significance and control of acarines belonging to the families: Sarcoptidae, Psoroptidae, Demodicidae, Trombiculidae, Dermanyssidae. Cytoditidae and Linguatulidae.

Unit IX

Chemical, Biological, Immunological control measures and integrated pest management. Detection and mechanisms of acaricidal resistance.

V. Practical

Collection, preservation/ processing, identification, differentiation of arthropod parasites and their developmental stages; associated lesions and skin scraping examination.

I. Course Title : Parasitic Protozoa

II. Course Code : VPA 605

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the morphology, Life cycle, Pathogenesis, Diagnosis and control of protozoan parasites of veterinary importance.

V. Theory

Unit I

Introduction, classification, general account and economic importance of protozoan parasites.

Unit II

Morphology, Epidemiology, Pathogenesis, Clinical signs, Diagnosis, and control measures of protozoan parasites belonging to the families: Trypanosomatidae, Monocercomonadidae, Trichomonadidae, Hexamitidae and Endamoebidae.

Unit III

Morphology, Epidemiology, Pathogenesis, Clinical signs, Diagnosis and control measures of protozoan parasites belonging to the families: Eimeriidae, Cryptosporidiidae and Sarcocystidae.



Unit

Morphology, Epidemiology, Pathogenesis, Clinical signs, Diagnosis, Treatment and control measures of protozoan parasites belonging to the families: Plasmodiidae, Babesiidae, Theileriidae, Haemogregarinidae and Balantidiidae.

Unit V

Morphology, Epidemiology, Pathogenesis, Clinical signs, Diagnosis and control measures of Rickettsiales in relation to haemoprotozoans.

VI. Practical

Collection, Preservation/ Processing, Identification of parasitic protozoa in clinical material and host tissues. Special techniques for certain protozoans such as coccidia and Cryptosporidia.

I. Course Title : Diagnostic Parasitology

II. Course Code : VPA 606

III. Credit Hours : 0+2

IV. Aim of the course

To learn the techniques associated with isolation, Identification and preservation of the endo and ectoparasites of veterinary importance and their vectors.

V. Practical

Microscopy and micrometry, Preparation of Romanowsky stains. Collection, preservation, Processing and examination of faecal and blood samples; Lymph node biopsy, Skin scrapings, Nasal washings, Sputum, genital discharges/ washings and urine samples from animals for parasitological examinations. Quantitative faecal examination, Maintenance of fly and tick colonies in laboratory for experimental purposes and testing of drugs; tick dissection for vector potential. Collection of aquatic snails from field and their examination for the presence of different parasitic stages. Collection, fixation, staining, whole mounts and identification of parasites. Culturing techniques for important parasites, pasture larval count, worm count and assessment of worm burden.

Remote Sensing (RS) and Geographic Information System (GIS) as tools for mapping parasitic diseases.

I. Course Title : Clinical Parasitology

II. Course Code : VPA 607

III. Credit Hours : 1+1

IV. Aim of the course

Collection, preservation and examination of clinical material for parasitological investigations and interpretations.

V. Theory

Unit I

Collection, preservation and dispatch of clinical material to laboratory for diagnosis

Unit II

History, clinical signs, gross and microscopic examination of diagnostic material.



Unit III

Animal sub-inoculation technique; blood and lymph node biopsy smear examination; histopathology of affected organs.

VI. Practical

Identification, observation of parasitic stages in host tissues, excretions, secretions and associated pathological lesions. Special techniques for haemoparasites and coccidians.

I. Course Title : Management of Parasitic Diseases

II. Course Code : VPA 608

III. Credit Hours : 1+1

IV. Aim of the course

To study the integrated approach for the control of helminths, arthropods and protozoan parasites of veterinary importance.

V. Theory

Unit I

Conventional and novel methods for control of helminth infections in livestock – anthelmintics, their mode of action, characteristic of an ideal anthelmintic drug, Anthelmintic resistance, Spectrum of activity, Delivery devices and integrated control method. Immunological control, Deworming schedule, Snail and other intermediate host control. Ethno veterinary practices.

Unit II

Conventional and novel methods of control of protozoan parasites–antiprotozoal drugs, Their mode of action, Integrated control method including immunological control.

Unit III

Conventional and novel methods of control with insecticides/ acaricides. Methods of application, their mode of action, insecticide resistance, biological control, integrated control method, genetic control and immunological control.

VI. Practical

In vivo and *in-vitro* detection of efficacy of control agents and resistance to anthelmintics, anticoccidials, insecticides and acaricides.

I. Course Title : Immunoparasitology

II. Course Code : VPA 609

III. Credit Hours : 2+1

IV. Aim of the course

To study the host immune response against endo and ectoparasites of veterinary importance with special reference to immunoprophylaxis and immunodiagnosis.

V. Theory

Unit I

Introduction, types of parasite-specific antigens and their characterization.



Unit II

Types of immunity in parasitic infections.

Unit III

Invasive and evasive mechanisms, immunomodulators and their uses.

Unit IV

Immune responses in helminths, arthropods and protozoa of veterinary importance.

Unit V

Immunological control against parasitic diseases.

VI. Practical

Preparation of various antigens (somatic, excretory-secretory) and their fractionation and characterization and demonstration of various immunodiagnostic methods for the diagnosis of parasitic infections.

I. Course Title : Parasitic Zoonoses

II. Course Code : VPA 610

III. Credit Hours : 2+0

IV. Aim of the course

To study important parasites of zoonotic significance.

Unit I

Introduction to the concept of Zoonotic infections, Definitions, Various classifications of zoonoses, Host-parasite relationships, Modes of infections and factors influencing prevalence of zoonoses.

Unit II

A detailed study of Transmission, Epidemiology, Diagnosis and Control of common protozoa of zoonotic importance.

Unit III

A detailed study of Transmission, Epidemiology, Diagnosis and Control of common helminths of zoonotic importance.

Unit IV

A detailed study of Transmission, Epidemiology, Diagnosis and Control of common arthropods of zoonotic importance.

I. Course Title : Parasites of Wildlife

II. Course Code : VPA 611

III. Credit Hours : 1+1

IV. Aim of the course

To study the biology and control measures for major parasitic diseases of zoo and wild animals.

V. Theory

Unit I

A detailed study of protozoa of zoo and wild animals with particular emphasis on



morphological features, Geographical distribution Epidemiology, Diagnosis and management.

Unit II

A detailed study of arthropod parasites of zoo and wild animals with particular emphasis on morphological features, Geographical distribution, Epidemiology, diagnosis and management.

Unit III

A detailed study of helminth parasites of zoo and wild animals with particular emphasis on morphological features, Geographical distribution, Epidemiology, diagnosis and management.

VI. Practical

Methods for investigating parasitic diseases of captive and wild animals. Collection and identification of parasites. Visits to zoos and biological parks/ sanctuaries for collection of samples.



Course Outline-cum-Lecture Schedule for Master Degree Programme

- I. Course Title** : Platyhelminthes-I
II. Course Code : VPA 601
III. Credit Hours : 1+1
IV. Aim of the course

To study the morphology, biology, pathogenesis and control measures for trematode parasites of veterinary importance

Lecture	Topic
Theory	
1-2	Introduction, history, classification, general account and economic importance of trematodes
3-4	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Dicrocoeliidae and Opisthorchiidae
5-6	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Strigeidae and Fasciolidae
7-8	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Echinostomatidae, Heterophyidae, Plagiorchiidae and Troglotrematidae
9-10	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Prosthogonimidae, Nanophyetidae and Paragonimidae
11-12	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Notocotylidae, Brachylemidae, and Paramphistomatidae
13-14	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Cyclocoelidae and Schistosomatidae
15-16	Classification and characters of snails and Control strategies of molluscs of veterinary importance
Practicals	
1-5	Collection, preservation/ processing and identification of trematode parasites; their eggs and intermediate hosts
6-11	Observation on parasitic stages in host tissues and associated pathological lesions caused by trematodes
12-16	Identification of molluscs of veterinary importance and examination of molluscs for various developmental stages of trematode parasites.



- I. Course Title : Platyhelminthes-II**
II. Course Code : VPA 602
III. Credit Hours : 1+1

IV. Aim of the course

To study the morphology, biology, pathogenesis and control measures for cestode parasites of veterinary importance

Lecture	Topic
Theory	
1-2	Introduction, history, classification, general account and economic importance of cestodes
3-4	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to family: Dipyllobothriidae
5	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to family: Mesocestoididae
6-8	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to family: Taeniidae
9-10	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Davaineidae and Hymenolepididae
11-12	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Dipylidiidae and Dilepididae
13-14	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to family: Anoplocephalidae
15-16	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to family: Thysanosomidae
Practicals	
1-8	Collection, preservation/ processing and identification of cestode parasites; their eggs, larval stages and intermediate hosts.
9-16	Observation on parasitic stages in host tissues and associated pathological lesions

- I. Course Title : Nematelminthes and Acanthocephala**
II. Course Code : VPA 603
III. Credit Hours : 2+1

IV. Aim of the course

To study the morphology, biology, pathogenesis and control measures of nematodes and thorny-headed worms of veterinary importance

Lecture	Topic
1-2	Introduction, history, classification, general account and economic importance of nematodes and thorny-headed worms
2-4	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to family: Ascarididae
5-6	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Anisakidae and Oxyuridae
7-8	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Heterakidae and Subuluridae



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Lecture	Topic
9-10	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Rhabditidae and Strongyloididae
11-12	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to family: Strongylidae.
13-14	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichonematidae and Amidostomidae
15-16	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Stephanuridae and Syngamidae
17-18	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to family: Ancylostomatidae.
19-20	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Filaroididae and Trichostrongylidae
21-22	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Ollulanidae, Dictyocaulidae and Metastrongylidae
23-24	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Spiruridae, Thelaziidae, Acuariidae, Tetrameridae, Physalopteridae, and Gnathostomatidae
25-26	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Filariidae, Setariidae, Onchocercidae and Dracunculidae.
27-28	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichinellidae and Trichuridae
29-30	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Capillariidae and Dioctophymatidae
31-32	Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Polymorphidae, Oligacanthorhynchidae and Gnathobdellidae.

Practicals

1-16	Collection, preservation/ processing and identification of nematode parasites and thorny headed worms; their eggs and larvae and associated pathological lesions.
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I. Course Title : Arthropod Parasites

II. Course Code : VPA 604

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the morphology, biology, vector potential of the arthropods of veterinary importance and their control measures.

Lecture	Topic
1-2	Introduction, classification harmful effects and economic importance of arthropod parasites.



Veterinary Para-Clinical Subjects: Veterinary Parasitology

Lecture	Topic
3-4	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, vector potential, economic significance and control of arthropods belonging to the family: Culicidae
5-6	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, vector potential, economic significance and control of arthropods belonging to the family: Ceratopogonidae
7-8	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, vector potential, economic significance and control of arthropods belonging to the families: Simuliidae and Psychodidae.
8-9	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, vector potential, economic significance and control of arthropods belonging to the families: Tabanidae and Gasterophilidae
10-11	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, vector potential, economic significance and control of arthropods belonging to the families: Muscidae, and Glossinidae
12-14	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, vector potential, economic significance and control of arthropods belonging to the families: Oestridae, Sarcophagidae, Calliphoridae and Hippoboscidae. Importance of blow flies in forensic entomology and treatment of wounds
15-18	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, economic significance and control of arthropods belonging to the families: Pediculidae, Haematopinidae, Linognathidae, Menoponidae, Philopteridae and Trichodectidae
19-20	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, economic significance and control of arthropods belonging to the order: Siphonaptera and families: Cimicidae and Reduviidae
21-25	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, vector potential, economic significance and control of arthropods belonging to the families: Argasidae and Ixodidae
26-30	Distribution, morphology, life cycle, seasonal pattern, pathogenesis, economic significance and control of acarines belonging to the families: Sarcoptidae, Psoroptidae, Demodicidae, Trombiculidae, Dermanyssidae. Cytoditidae and Linguatulidae.
31-32	Chemical, biological, immunological control measures and integrated pest management. Detection and mechanisms of acaricidal resistance

Practicals

- 1-16 Collection, preservation/ processing, identification, differentiation of arthropod parasites and their developmental stages; associated lesions and skin scraping examination

I. Course Title : Parasitic Protozoa

II. Course Code : VPA 605

III. Credit Hours : 2+1

IV. Aim of the course

To study the morphology, life cycle, pathogenesis, diagnosis and control of protozoan parasites of veterinary importance.

Lecture	Theory
1-3	Introduction, History, Classification and General account and economic importance of protozoan parasites.



SVU POST-GRADUATE STUDIES REGULATIONS 2021

Lecture	Topic
4-7	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Trypanosomatidae
8-10	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Monocercomonadidae and Trichomonadidae
11-12	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Hexamitidae and Endamoebidae
13-14	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Endamoebidae
15-16	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Eimeriidae.
17-18	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Cryptosporidiidae.
19-22	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Sarcocystidae.
23	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Plasmodiidae.
24-26	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Babesiidae.
27-28	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Theileriidae.
29-30	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the family Haemogregarinidae and Balantidiidae
31-32	Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of Rickettsiales like <i>Anaplasma</i> , <i>Ehrlichia</i> , <i>Haemobartonella</i> and others.

Practicals

- 1-4 Collection, preservation/ processing, identification of protozoan parasites based on faecal examination.
- 5-8 Collection, preservation/ processing, identification of protozoan parasites based on blood examination.
- 9-12 Observations on parasite stages in host tissues and the attendant pathological lesions.
- 13-16 Diagnosis of protozoan parasites of Veterinary importance.

I. Course Title : Diagnostic Parasitology

II. Course Code : VPA 606

III. Credit Hours : 0+2

Aim of the course

To learn the techniques associated with isolation, identification and preservation of the endo and ectoparasites of veterinary importance and their vectors.

Lecture	Topic
Practical	
1-2	Microscopy and micrometry, Preparation of Romanowsky stain.
3-8	Collection, preservation, processing and examination of faecal and blood samples; lymph node biopsy, skin scrapings, nasal washings sputum, genital discharges/ washings and urine samples from animals for parasitological examinations.



Veterinary Para-Clinical Subjects: Veterinary Parasitology

Lecture	Topic
9-12	Quantitative faecal examination.
13-16	Maintenance of fly and tick colonies in laboratory for experimental purposes and testing of drugs; tick dissection for vector potential.
17-20	Collection of aquatic snails from field and their examination for the presence of different parasitic stages.
21-24	Collection, fixation, staining, whole mounts and identification of parasites.
25-28	Culturing techniques for important parasites, pasture larval count, worm count and assessment of worm burden.
29-32	Remote Sensing (RS) and Geographic Information System (GIS) as tools for mapping parasitic diseases.

I. Course Title : Clinical Parasitology

II. Course Code : VPA 607

III. Credit Hours : 1+1

IV. Aim of the course

Collection of clinical material, examination/ investigation and its preservation for interpretations.

Lecture	Topic
Theory	
1-3	Unit I: Collection, preservation and dispatch of clinical material to laboratory for diagnosis.
4-8	Unit II: History, clinical signs, gross and microscopic examination of diagnostic material.
9-10	Unit III: Animal sub-inoculation tests.
11-13	Unit III: Blood and biopsy smear examination.
14-16	Unit III: Histopathology of affected organs.
Practical	
1-12	Identification, observation of parasitic stages in host tissues, excretions, secretions and associated pathological lesions.
7-12	Special techniques for <i>Cryptosporidium</i> oocysts in faecal samples. Sporulation of coccidial oocysts.

I. Course Title : Management of Parasitic Diseases

II. Course Code : VPA 608

III. Credit Hours : 1+1

IV. Aim of the course

To study the integrated approach for the control of helminths, arthropods and protozoan parasites of veterinary importance.

Lecture	Topic
Theory	
1-6	Unit I: Conventional and novel methods of control of helminth infection in livestock – anthelmintics, their mode of action, characteristic of an ideal anthelmintic drug, anthelmintic resistance, spectrum of activity, delivery devices, integrated



SVU POST-GRADUATE STUDIES REGULATIONS 2021

Lecture	Topic
	control method. Immunological control. Deworming schedule. Snail and other intermediate host control.
7-11	Unit II: Conventional and novel methods of control of protozoan parasites- antiprotozoal drugs, their mode of action, integrated control method including immunological control.
12-16	Unit III Conventional and novel methods of control with insecticides/ acaricides. Methods of application, their mode of action, insecticide resistance, biological control, integrated control method, genetic control and immunological control.
Practical	
1-6	<i>In vivo</i> detection of efficacy of and resistance to parasitocidal agents.
7-16	<i>In-vitro</i> detection of efficacy of and resistance to parasitocidal agents

I. Course Title : Immunoparasitology

II. Course Code : VPA 609

III. Credit Hours : 2+1

IV. Aim of the course

To study the host immune response against the endo and ectoparasites of veterinary importance with special reference to immunoprophylaxis and immunodiagnosis.

Lecture	Topic
Theory	
1-7	Unit I: Introduction, types of parasite-specific antigens and their characterization.
8-13	Unit II: Types of immunity in parasitic infections.
14-18	Unit III: Invasive and evasive mechanisms, immunomodulators and their uses.
19-27	Unit IV: Immune responses in helminths, arthropods and protozoa of veterinary importance.
28-32	Unit V: Immunological control against parasitic diseases
Practical	
1-9	Preparation of various antigens (somatic, excretory-secretory) and their fractionation and characterization and
10-16	Demonstration of various immunodiagnostic methods for the diagnosis of parasitic infections

I. Course Title : Parasitic Zoonoses

II. Course Code : VPA 610

III. Credit Hours : 2+0

IV. Aim of the course

To study important parasites of zoonotic significance.

Lecture	Topic
Theory	
1-3	Unit I: Introduction to the concept of zoonotic infections
4-6	Unit I: Definition and various classifications of zoonoses.



Veterinary Para-Clinical Subjects: Veterinary Parasitology

Lecture	Topic
7-10	Unit I: Host-parasite relationships, modes of infections, factors influencing prevalence of zoonoses.
11-18	Unit II: A detailed study of transmission, epidemiology, diagnosis and control of major protozoa of zoonotic importance.
19-25	Unit III: A detailed study of transmission, epidemiology, diagnosis and control of major helminths of zoonotic importance.
26-32	Unit IV: A detailed study of transmission, epidemiology, diagnosis and control of major arthropods of zoonotic importance.

I. Course Title : Parasites of Wildlife

II. Course Code : VPA 611

III. Credit Hours : 1+1

IV. Aim of the course

To study the biology and control measures for major parasitic diseases of zoo and wild animals.

Lecture

Theory

- 1-6 Unit I: A detailed study of protozoa of zoo and wild animals with particular emphasis on morphological features, geographical distribution epidemiology, diagnosis and management.
- 7-12 Unit II: A detailed study of arthropod parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.
- 13-16 Unit III: A detailed study of helminth parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management

Practical

- 1-6 Methods for investigating parasitic diseases of captive and wild animals.
- 7-16 Collection and identification of parasites. Visits to zoos and biological parks/sanctuaries for collection of samples.
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Course Title with Credit Load Ph.D. in Veterinary Parasitology

Course Code	Course Title	Credits Hours
VPA 701	Advances in Helminthology-I	2+1
VPA 702	Advances in Helminthology-II	2+1
VPA 703	Entomology and Acarology	2+1
VPA 704	Advances in Protozoology	2+1
VPA 705	Immunology of Parasitic Diseases*	1+2
VPA 706	Molecular Diagnostics and Vaccine Development in Parasitology*	2+1
VPA 707	Host Parasite Interactions	2+0
VPA 708	<i>In-vitro</i> Cultivation of Parasites	1+2
VPA 709	Emerging and Re-Emerging Parasitic Diseases	2+0
VPA 710	Biology and Ecology of Parasites	3+0
VPA 711	Molecular Veterinary Parasitology	2+0
VPA 712	Parasite Epidemiology *	2+0
VPA 790	Special Problem	0+1
VPA 791	Doctoral Seminar-I *	1+0
VPA 792	Doctoral Seminar-II*	1+0
VPA 799	Doctoral Research	75

*Core courses



Course Contents

Ph.D. in Veterinary Parasitology

- I. Course Title** : **Advances in Helminthology-I**
II. Course Code : **VPA 701**
III. Credit Hours : **2+1**

IV. Aim of the course

Developments in the area of molecular biology, pathogenesis, diagnosis and control of trematodes and cestodes.

V. Theory

Unit I

Advanced studies on Taxonomy, Molecular biology, Pathogenesis and Immunology of trematodes and their larval stages.

Unit II

Advanced studies on Taxonomy, Molecular biology, Pathogenesis and Immunology of cestodes and larval stages.

VI. Practical

Morphological, Pathological and Immunological studies of trematode and cestode parasites.

- I. Course Title** : **Advances in Helminthology-II**
II. Course Code : **VPA 702**
III. Credit Hours : **2+1**

IV. Aim of the course

To study the recent developments in the area of molecular biology, pathogenesis, diagnosis of nematode parasites and thorny headed worms with an objective of better control.

V. Theory

Unit I

Advanced studies on Taxonomy, Molecular biology, Pathogenesis and Immunology of nematode parasites and their larval stages.

Unit II

Advanced studies on Taxonomy, Molecular biology, Pathogenesis and Immunology of thorny-headed worms.

VI. Practical

Morphological, Pathological and Immunological studies of various nematodes and thorny-headed worms.



- I. Course Title : Entomology and Acarology**
II. Course Code : VPA 703
III. Credit Hours : 2+1

IV. Aim of the course

To study the recent scientific developments on biology and control measures for arthropods of veterinary importance.

V. Theory

Unit I

Origin, Evolution, Regional/ Seasonal distribution and Forecasting of insect and acarine population.

Unit II

Population dynamics of insects and acarines in relation to biotic and abiotic factors

Unit III

Recent developments pertaining to insects of veterinary importance.

Unit IV

Recent developments pertaining to arachnids of veterinary importance.

Unit V

Chemical, Biological, Herbal and Immunological control measures and integrated pest management. Modulation of vector competence to transmit parasitic infections using molecular genetics by developing transgenic vectors.

VI. Practical

Collection and identification of arthropods; Demonstration of the infective stages in vectors. Immuno pathological changes produced in the host tissues due to the infestation of arthropods.

- I. Course Title : Advances in Protozoology**
II. Course Code : VPA 704
III. Credit Hours : 2+1

IV. Aim of the course

To study the recent developments in molecular biology, pathogenesis, diagnosis and control of protozoan parasites of veterinary importance

V. Theory

Unit I

Advanced studies on Taxonomy, Molecular biology, Pathogenesis and Immunology of intestinal protozoa.

Unit II

Advanced studies on Taxonomy, Molecular biology, Pathogenesis and Immunology of haemoprotozoans.

Unit III

Advanced studies on Taxonomy, Molecular biology, Pathogenesis and Immunology of tissue and other protozoa.



VI. Practical

Morphological, pathological and immunodiagnosis of protozoan diseases

I. Course Title : Immunology of Parasitic Diseases

II. Course Code : VPA 705

III. Credit Hours : 1+2

IV. Aim of the course

To study the immune mechanisms operating in different parasitic infections and to identify the immunodominant/ immunoprotective antigens for diagnosis and control of parasitic diseases.

Unit I

To study the salient features of immune responses in relation to trematode, cestode, nematode and protozoan infections in livestock. Immune responses to arthropod infestations.

Unit II

Principles and applications of immunodiagnostic methods for parasitic diseases.

Unit III

Standardization of immunodiagnostic methods for parasitic diseases.

Unit IV

Identification of candidate antigens for diagnosis and vaccine development.

V. Practical

Methods for purification of antigens, fractionation and characterization of antigens, identification of candidate antigens as drug targets, raising of hyperimmune sera, development and standardization of immunodiagnostic methods for the diagnosis and control of parasitic infections.

I. Course Title : Molecular Diagnostics and Vaccine Development for Parasitic Diseases

II. Course Code : VPA 706

III. Credit Hours : 2+1

IV. Aim of the course

To understand the principles of development of sensitive molecular tools for rapid and field oriented tests. Identification of diagnostic and vaccine targets for detection and control of parasites of livestock and pets.

V. Theory

Unit I

Introduction to molecular taxonomy of parasites.

Unit II

Genome organisation in parasites of veterinary importance. Structure and function of nucleic acids.

Unit III

Basic plan of gene cloning, and expression in heterologous host. Production of



recombinant protein and downstream processing for diagnostic/ prophylactic applications.

Unit IV

General concept of protein synthesis. Identification and molecular characterization of proteins of diagnostic/ prophylactic relevance of parasitic origin.

Unit V

Nucleic acid based techniques for genetic characterization and sensitive diagnosis of parasitic infections; PCR, LAMP, Nucleic acid hybridization technique, pyrosequencing, Real Time PCR, DNA Microarray, Microsatellite analysis, RNAi, Reverse Genetic Approaches and their applications.

Unit VI

Hybridoma technology. Principle of production of monoclonal antibody. The diagnostic application of monoclonal antibodies of parasitic infection.

Unit VII

DNA vaccine, Vector vaccine, Recombinant protein based vaccine, Subunit vaccine, Principle and Application.

VI. Practical

Identification, Characterization, and Purification of Recombinant Protein Antigens; SDS-PAGE and Western Blotting, Extraction and quantification of nucleic acid and PCR and related techniques.

I. Course Title : Host Parasite Interactions

II. Course Code : VPA 707

III. Credit Hours : 2+0

IV. Aim of the course

To study different level of host-parasite interactions/ association with an objective of efficient control.

V. Theory

Unit I

Introduction, Distribution of parasites on/ in the host, Morphological adaptation for better survival in/ on the host.

Unit II

Behavioural defences, Host immune responses and Genetic resistance to parasites.

Unit III

Establishment of parasites in immune competent, Susceptible, Intermediate and Abnormal hosts, Chronicity of parasitic infections, Immuno evasive strategies of the parasites and host-parasite equilibrium.

Unit IV

Pathological consequences of host parasite interactions in relation to malnutrition and micronutrient metabolism.



- I. Course Title** : ***In-vitro* Cultivation of Parasites**
II. Course Code : **VPA 708**
III. Credit Hours : **1+2**

IV. Aim of the course

Development and standardization of *in-vitro* techniques for parasite cultivation.

V. Theory

Unit I

Introduction, problems and goals of *in-vitro* cultivation of parasites.

Unit II

In-vitro cultivation of genital, Intestinal flagellates and Intestinal ciliates.

Unit III

In-vitro cultivation of intestinal protozoa.

Unit IV

In-vitro cultivation of haemoprotozoa.

Unit V

In-vitro techniques, media and tissue culture for cultivation of helminths and their larval stages.

Unit VI

In-vitro mass rearing and colonization of ticks, flies and other insects.

VI. Practical

Preparation of media, sterilization methods and cultivation of different parasites.

- I. Course Title** : **Emerging and Re-Emerging Parasitic Diseases**
II. Course Code : **VPA 709**
III. Credit Hours : **2+0**

IV. Aim of the course

To study the emerging and re- emerging parasitic diseases.

V. Theory

Unit I

Emerging and re-emerging helminthic diseases.

Unit II

Emerging and re-emerging protozoan diseases.

Unit III

Emerging and re-emerging vector- borne diseases.

- I. Course Title** : **Biology and Ecology of Parasites**
II. Course Code : **VPA 710**
III. Credit Hours : **3+0**

IV. Aim of the course

Study of the bionomics and ecology of the parasites.



V. Theory

Unit I

Ultrastructure, Physiology, Biochemistry and Bionomics of trematodes and cestodes of veterinary importance.

Unit II

Ultrastructure, Physiology, Biochemistry and Bionomics of nematodes of veterinary importance.

Unit III

Ultrastructure, Physiology, Biochemistry and Bionomics of important arthropod parasites.

Unit IV

Ultrastructure, Physiology, Biochemistry and Bionomics of important protozoan parasites.

Unit V

Ecology related definitions, Environmental changes and ecological disturbances due to natural phenomenon and human interventions (demographic, societal and agricultural changes global warming, floods, hurricanes and pollution.

Unit VI

Principles of Remote Sensing, GIS and their role in Veterinary Parasitology.

I. Course Title : Molecular Veterinary Parasitology

II. Course Code : VPA 711

III. Credit Hours : 2+0

IV. Aim of the course

To give an insight into molecular biology of parasites of veterinary importance, their transmission and control. Molecular, immunological and genetic aspects of common parasites of veterinary importance and vector-host-parasite interaction.

V. Theory

Unit I

Introduction to molecular biology of parasites-Biological molecules (carbohydrate, protein and nucleic acid)- Eukaryotic cell structure, cell membrane and organelles-kinetoplast, apicoplast, cilia, flagella biology-Eukaryotic cell metabolism and cell respiration-Oxidative phosphorylation-anaerobic metabolism in parasites-fatty acid metabolism of parasites-cellular reproduction mendelian genetics in parasites and vectors- Genome of parasites of veterinary importance, genome size- molecular taxonomy-DNA barcoding-phylogenetics.

Unit II

Genetic code- Gene expression-Transcription and Translation-post translational modifications- RNA interference in parasites-CRISPR/ Cas9 inparasites-metagenome-microbiome-transcriptome of parasites-transgenic and para transgenic approach in parasites-drug resistance mechanisms.

Unit III

Molecular biology of helminth parasites such as *Fasciola* spp, *Schistosoma* spp, *Taenia* spp, *Echinococcus* spp, *Toxocara* spp, *Haemonchus* spp., *Dictyocaulus* spp.



- I. Course Title : Parasite Epidemiology**
II. Course Code : VPA 712
III. Credit Hours : 2+0

IV. Aim of the course

To study the disease and transmission characteristics, descriptive epidemiology of infectious diseases.

V. Theory

Unit I: Introduction to epidemiological concepts

Definitions, aims and uses of epidemiological studies, Approaches of epidemiology (descriptive, analytical and experimental), Types of epidemiological studies along with their advantages and disadvantages, Features of parasitic disease epidemiology. Measures of disease frequency: Morbidity and mortality (Rate, Ratio, Proportional rate), Measures of morbidity (Cumulative incidence, Incidence rate, Attack rate, Prevalence-Point and Period) and mortality (Cumulative Mortality, Mortality rate, Death rate, Age/ Sex/ Breed death rate, Case fatality proportion, Cause specific death rate, etc.). The epidemiological triangle, iceberg concept, endemic stability, herd immunity concept, etc.

Unit II: Methods in epidemiology

Cross-sectional, case control and cohort studies. Techniques of epidemiological surveys.

Types of sampling- Non-probability sampling (target sampling, choice sampling, etc.), Probability sampling (Random samples, systemic sampling, stratified sampling, cluster sampling, etc.). Sample size calculation for different epidemiological and experimental studies.

Unit III: Advances in Epidemiological techniques

Sero-epidemiological methods used in important parasitic disease-Uses and limitations, Properties and Evaluation. Molecular epidemiology- Principles, laboratory methods, Bioinformatics in molecular epidemiology. Serological and molecular epidemiology of important parasites. Remote sensing and geographic information system- Scope and applications in Veterinary Parasitology.

Unit IV: Epidemiology of Important Parasitic Diseases

Epidemiological factors affecting distribution and transmission of important parasitic diseases of animals and birds- Agent Factors/ Disease Patterns, Environment and Disease Patterns, Social Factors and Disease Patterns, etc. Parasitic disease monitoring and evaluation, outbreak investigations and surveillance. Forecasting of parasitic diseases

VI. Suggested Reading

- Abubakar I, Stagg HR, Cohen T and Rodrigues LC. 2016. *Infectious Disease Epidemiology*, 1st Edn, Oxford University Press.
- Alan Gunn and Sarah Jane Pitt. 2012. *Parasitology: An integrated Approach*, 1st Edition, Wiley.
- Angela ER, Taylor and John R Baker. 1968. *In-vitro cultivation of parasites*, 1st Edition, Blackwell Scientific Pub.
- Atkinson CT, Thomas NJ and Hunter DB. 2009. *Parasitic diseases of wild birds*, 1st Edition, John Wiley and Sons, Inc



- Bhatia BB, Pathak KML and Juyal PD. 2014. *Textbook of Veterinary Parasitology*, 3rd Edition, Kalyani Publishers
- Boothroyd JC and Komuniecki R. 1995. *Molecular Approaches to Parasitology*. 1st Edition, Wiley-liss Publication, New York.
- Cohen S and Sadun EH. 1976. *Immunology of Parasitic Infections*, 1st Edition, Blackwell Scientific Publications
- David P Huges, Jacques Brodeur and Frederic Thomas. 2012. *Host manipulation by parasites*, Oxford University Press
- Elizabeth A Zeibeg. 2012. *Clinical Parasitology- A practical approach*. 2nd edition, Elsevier Health Sciences
- GW Krantz and DE Walter. 2009. *A manual of Acarology*, 3rd Edition, Texas Tech University Press
- Hendrix CM and Robinson E. 2017. *Diagnostic Parasitology for Veterinary Technicians*. 5th Edition. St. Louis, Missouri: Elsevier Inc
- Joanne P. 2009. *Advances in Parasitology Natural history of host- parasite interactions*- 1st edition, Vol 68 Academic Press
- Kennedy MW and Harnett W. 2001. *Parasitic nematodes: molecular biology, biochemistry, immunology*, 2nd Edition, CABI Publishing
- Kettle DS. 1995. *Medical and Veterinary Entomology*, 2nd Edition, CAB International
- Levine ND. 1999. *Veterinary Protozoology*, 1st edition, Wiley-Blackwell
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- Marr JJ, Nilsen TW and Komuniecki RW. 2003. *Molecular Medical Parasitology*, 1st Edition, Elsevier
- Mehlhorn H. 2016. *Animal Parasites: Diagnosis, Treatment, Prevention*. 1st Edition, . Springer International Publishing
- Pittaway AR. 1991. *Arthropods of Medical and Veterinary Importance*, 1st Edition, CAB International
- Richard Wall and David Shearer. 1997. *Veterinary Entomology*, 1st Edition, Springer, Dordrecht
- Samuel W, Pybus M and Kocan A. 2001. *Parasitic Diseases of Wild Mammals*, 2nd Edition, Iowa State Univ. Press.
- Smyth JD. 1995. *Introduction to Animal Parasitology*, 3rd Edn., Cambridge University Press
- Soulsby E JL. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals* 7th Edition, Baillière Tindall, London
- Taylor MA, Coop RL and Wall RL. 2015. *Veterinary Parasitology*, 3rd Edn, Wiley- Blackwell Publishers
- Tibor Kassai. 1999. *Veterinary Helminthology*, 1st Edition, Butterworth-Heinemann publishers
- Urquhart GM, Armour J, Duncan JL, Dunn AM and Jennings FW. 1996. *Veterinary Parasitology*, 2nd Edition, Blackwell Science, London, UK
- Wakelin D. 1996. *Immunity to Parasites*. 2nd Edition, Cambridge University Press
- Walker A. 1994. *Arthropods of Humans and Domestic Animal: A Guide to Preliminary Identification*, 1st Edition, Springer Netherlands
- Zajac AM and Conboy GA. 2012. *Veterinary Clinical Parasitology*, 8th Edition, Wiley-Blackwell.
- Protozoological abstracts
- Advances in Parasitology
- Trends in Parasitology
- Experimental Parasitology
- Relevant Research/ Review articles



Course Outline-cum-Lecture Schedule Doctoral Degree Programme

I. Course Title : Advances in Helminthology-I

II. Course Code : VPA 701

III. Credit Hours : 2+1

IV. Aim of the course

Developments in the area of molecular biology, pathogenesis, diagnosis and control of trematodes and cestodes.

Lecture	Topics
Theory	
1-16	Unit I: Advanced studies on taxonomy, molecular biology, pathogenesis and immunology of trematodes and their larval stages.
17-32	Unit II: Advanced studies on taxonomy, molecular biology, pathogenesis and immunology of cestodes and larval stages.
Practicals	
1-9	Morphological, pathological and immunological studies of trematode parasites. 10-
16	Morphological, pathological and immunological studies of cestode parasites.

I. Course Title : Advances in Helminthology-II

II. Course Code : VPA 702

III. Credit Hours : 2+1

IV. Aim of the course

To study the recent developments in the area of molecular biology, pathogenesis, diagnosis of nematode parasites and thorny headed worms with an objective of better control.

Lecture	Topics
Theory	
1-28	Unit I: Advanced studies on taxonomy, molecular biology, pathogenesis and immunology of nematode parasites and their larval stages.
30-32	Unit II: Advanced studies on taxonomy, molecular biology, pathogenesis and immunology of thorny-headed worms.
Practicals	
1-14	Morphological, pathological and immunological studies of various nematodes
15-16	Morphological, pathological and immunological studies of various thorny-headed worms



- I. Course Title : Advances in Entomology and Acarology**
II. Course Code : VPA 703
III. Credit Hours : (2+1)

IV. Aim of the course

To study the recent scientific developments on biology and control measures for arthropods of veterinary importance.

Lecture	Topics
Theory	
1-5	Unit I: Origin, evolution, regional/ seasonal distribution and forecasting of insect and acarine population
6-14	Unit II: Population dynamics of insects and acarines in relation to biotic and abiotic factors
15-21	Unit III: Recent developments pertaining to insects of veterinary importance.
22-27	Unit IV: Recent developments pertaining to arachnids of veterinary importance
28-32	Unit V: Chemical, biological, herbal and immunological control measures and integrated pest management. Modulation of vector competence to transmit parasitic infections using molecular genetics by developing transgenic vectors
Practicals	
1-11	Collection and identification of arthropods; demonstration of the infective stages in vectors
12-16	Immunopathological changes produced in the host tissues due to the infestation of arthropods

- I. Course Title : Advances in Protozoology**
II. Course Code : VPA 704
III. Credit Hours : (2+1)

IV. Aim of the course

To study the recent developments in molecular biology, pathogenesis, diagnosis and control of protozoan parasites of veterinary importance.

Lecture	Topics
Theory	
1-5	Unit I: Advanced studies on taxonomy, molecular biology, pathogenesis and immunology of intestinal protozoa
6-14	Unit II: Advanced studies on taxonomy, molecular biology, pathogenesis and immunology of haemoprotozoans
15-21	Unit III: Advanced studies on taxonomy, molecular biology, pathogenesis and immunology of tissue and other protozoa
Practicals	
1-16	Morphological, pathological and immunodiagnosis of protozoan diseases.

- I. Course Title : Immunology of Parasitic Diseases**
II. Course Code : VPA 705
III. Credit Hours : (1+2)

IV. Aim of the course

To study the immune mechanisms operating in different parasitic infections and



to identify the immunodominant/ immunoprotective antigens for diagnosis and control of parasitic diseases.

Lecture	Topics
Theory	
1-4	Unit I: To study the salient features of immune responses in relation to trematode, cestode, and nematode infections in livestock
5-7	Unit I: To study the salient features of immune responses to protozoan infections in livestock
8-9	Unit I: To study the salient features of immune responses to arthropod infestations
10-11	Unit II: Principles and applications of immunodiagnostic methods for parasitic diseases
12-13	Unit III: Standardization of immunodiagnostic methods for parasitic diseases
14-16	Unit IV: Identification of candidate antigens for diagnosis and vaccine development
Practicals	
1-16	Methods for purification of antigens, fractionation and characterization of antigens, identification of candidate antigens as drug targets,
17-20	Raising of hyperimmune sera
21-32	Development and standardization of immunodiagnostic methods for the diagnosis and control of parasitic infections

I. Course Title : Molecular Diagnostics and Vaccine Development for Parasitic Diseases

II. Course Code : VPA 706

III. Credit Hours : (2+1)

IV. Aim of the course

To understand the principles of development of sensitive molecular tools for rapid and field oriented tests. Identification of vaccine targets for control of parasites of livestock and pets.

Lecture	Topics
Theory	
1-3	Unit I: Introduction. Molecular taxonomy of parasites
4-8	Unit II: Genome organisation in parasites of veterinary importance. Structure and function of nucleic acids
9-14	Unit III: Basic plan of gene cloning, and expression in heterologous host. Production of recombinant protein and downstream processing for diagnostic/ prophylactic applications
15-17	Unit IV: General concept of protein synthesis. Identification and molecular characterization of proteins of diagnostic/ prophylactic relevance of parasitic origin
18-26	Unit V: Nucleic acid based techniques for genetic characterization and sensitive diagnosis of parasitic infections; PCR, LAMP, nucleic acid hybridization technique, pyrosequencing, real time PCR, DNA microarray, microsatellite analysis, RNAi, reverse genetic approaches and their applications, etc.
27-28	Unit VI: Hybridoma technology. Principle of production of monoclonal antibody. The diagnostic application of monoclonal antibodies of parasitic infection
29-32	Unit VII: DNA vaccine, vector vaccine, recombinant protein based vaccine, subunit vaccine, principle and application



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Lecture	Topics
Practicals	
1-11	Identification, characterization, and purification of recombinant protein antigens; SDS-PAGE and western blotting,
12-16	Extraction and quantification of nucleic acid and PCR

I. Course Title : Host Parasite Interactions

II. Course Code : VPA 707

III. Credit Hours : (2+0)

IV. Aim of the course

To study different level of host-parasite interactions/ association with an objective of efficient control.

Lecture	Topics
Theory	
1-6	Unit I: Introduction, distribution of parasites on/ in the host, morphological adaptation for better survival in/ on the host
7-14	Unit II: Behavioural defences, host immune responses and genetic resistance to parasites
15-26	Unit III Establishment of parasites in immune competent, susceptible, intermediate and abnormal hosts, chronicity of parasitic infections, immunoevasive strategies of the parasites and host-parasite equilibrium
27-32	Unit IV: Pathological consequences of host parasite interactions in relation to malnutrition and micronutrient metabolism

I. Course Title : In-vitro Cultivation of Parasites

II. Course Code : VPA 708

III. Credit Hours : (1+2)

IV. Aim of the course

Development and standardization of *in-vitro* techniques for parasite cultivation.

Lecture	Topics
Theory	
1-2	Unit I: Introduction, problems and goals of <i>in-vitro</i> cultivation of parasites
3-6	Unit II: <i>In-vitro</i> cultivation of genital, intestinal flagellates and intestinal ciliates
7-9	Unit III: <i>In-vitro</i> cultivation of intestinal protozoa
10-11	Unit IV: <i>In-vitro</i> cultivation of haemoprotozoa
12-13	Unit V: <i>In-vitro</i> techniques, media and tissue culture for cultivation of helminths and their larval stages
14-16	Unit VI: <i>In-vitro</i> mass rearing and colonization of ticks, flies and other insects
Practicals	
1-7	Preparation of media, sterilization methods and cultivation of genital, intestinal flagellates and intestinal ciliates
8-16	Preparation of media, sterilization methods and cultivation of intestinal and haemoprotozoa protozoa



Veterinary Para-Clinical Subjects: Veterinary Parasitology

Lecture	Topics
17-24	Preparation of media, sterilization methods and cultivation of helminths and their larval stages
25-32	Preparation of media, sterilization methods and cultivation of ticks, flies and other insects

I. Course Title : Emerging and Re-Emerging Parasitic Diseases

II. Course Code : VPA 709

III. Credit Hours : (2+0)

IV. Aim of the course

To study the emerging and re-emerging parasitic diseases.

Lecture	Topics
Theory	
1-10	Unit I: Emerging and re-emerging helminthic diseases
11-21	Unit II: Emerging and re-emerging protozoan diseases
22-32	Unit III: Emerging and re-emerging vector-borne diseases

I. Course Title : Biology and Ecology of Parasites

II. Course Code : VPA 710

III. Credit Hours : (3+0)

IV. Aim of the course

Study of the bionomics and ecology of the parasites.

Lecture	Topics
Theory	
1-5	Unit I: Ultrastructure, physiology, biochemistry and bionomics of trematodes of veterinary importance
6-10	Unit I: Ultrastructure, physiology, biochemistry and bionomics of cestodes of veterinary importance
11-20	Unit II: Ultrastructure, physiology, biochemistry and bionomics of nematodes of veterinary importance
21-30	Unit III: Ultrastructure, physiology, biochemistry and bionomics of important arthropod parasites
31-40	Unit IV: Ultrastructure, physiology, biochemistry and bionomics of important protozoan parasites
41-45	Unit V: Ecology related definitions, Environmental changes and ecological disturbances due to natural phenomenon and human interventions (demographic, societal and agricultural changes global warming, floods, hurricanes and pollution)
46-48	Unit VI: Principles of Remote Sensing, GIS and their role in Veterinary Parasitology

I. Course Title : Molecular Veterinary Parasitology

II. Course Code : VPA 711

III. Credit Hours : (2+0)

IV. Aim of the course

To give a deep insight into molecular biology of parasites of veterinary importance,



their transmission and control. Molecular, immunological and genetic aspects of selected parasites of veterinary importance and vector-host-parasite interaction.

Lecture	Topics
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Theory

- 1-2 Unit I: Introduction to molecular biology of parasites-Biological molecules (carbohydrate, protein and nucleic acid)
- 3-6 Unit I: Eukaryotic cell structure, cell membrane and organelles- kinetoplast, apicoplast, cilia, flagella biology
- 7-11 Unit I: Eukaryotic cell metabolism and cell respiration-Oxidative phosphorylation-anaerobic metabolism in parasites-fatty acid metabolism of parasites-cellular reproduction mendelian genetics in parasites and vectors
- 12-16 Unit I: Genome of parasites of veterinary importance, genome size- molecular taxonomy-DNA barcoding-phylogenetics
- 17-22 Unit II: Genetic code- Gene expression-Transcription and Translation-post translational modifications- RNA interference in parasites-CRISPR/ Cas9 in parasites
- 23-27 Unit II: Metagenome-microbiome-transcriptome of parasites-transgenic and para transgenic approach in parasites-drug resistance mechanism and genetics
- 28-32 Unit III: Molecular biology of selected helminth parasites (*Fasciola* spp, *Schistosoma* spp, *Taenia* spp, *Echinococcus* spp, *Toxocara* spp, *Haemonchus* spp, *Dictyocaulus* spp etc)

I. Course Title : Parasite Epidemiology

II. Course Code : VPA 712

III. Credit Hours : (2+0)

IV. Aim of the course

To study the disease and transmission characteristics, descriptive epidemiology of infectious agents.

Lecture	Topics
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Theory

- 1-4 Unit I: Introduction to epidemiological concepts-Definitions, aims and uses of epidemiological studies, approaches of epidemiology (descriptive, analytical and experimental), types of epidemiological studies along with their advantages and disadvantages, features of parasitic disease epidemiology
- 5-8 Unit I: Introduction to epidemiological concepts- Measures of disease frequency: Morbidity and mortality (Rate, Ratio, Proportional rate), Measures of morbidity (Cumulative incidence, Incidence rate, Attack rate, Prevalence-Point and Period) and mortality (Cumulative Mortality, Mortality rate, Death rate, Age/ Sex/ Breed death rate, Case fatality proportion, Cause specific death rate, etc.). The epidemiological triangle, iceberg concept, endemic stability, herd immunity concept, etc.
- 9-12 Unit II: Methods in epidemiology Cross-sectional, case control and cohort studies. Techniques of epidemiological surveys Types of sampling- Non-probability sampling (target sampling, choice sampling, etc.), Probability sampling (Random samples, systemic sampling, stratified sampling. cluster sampling, etc.). Sample size calculation for different epidemiological and experimental studies



Veterinary Para-Clinical Subjects: Veterinary Parasitology



Lecture	Topics
13-16	Unit II: Methods in epidemiology Epidemiological Measures of Association-Strength of association (Relative risk, odds ratio), Effect of association (Attributable rate), effect/ importance of association
17-20	Unit III: Advances in Epidemiological techniques Sero-epidemiological methods used in important parasitic disease-Uses and limitations, properties and evaluation. Molecular epidemiology- Principles, laboratory methods, bioinformatics in molecular epidemiology
21-24	Unit III: Advances in Epidemiological techniques Serological and molecular epidemiology of important parasites. Remote sensing and geographic information system- Scope and applications in Veterinary Parasitology
25-28	Unit IV: Epidemiology of Important Parasitic Diseases Epidemiological factors affecting distribution and transmission of important parasitic diseases of animals and birds- Agent Factors/ Disease Patterns, Environment and Disease Patterns, Social Factors and Disease Patterns, etc.
29-32	Unit IV: Epidemiology of Important Parasitic Diseases Parasitic disease monitoring and evaluation, outbreak investigations and surveillance Forecasting of parasitic diseases





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Veterinary Para-Clinical Subjects

– Veterinary Public Health and Epidemiology





Course Title with Credit Load

M.V.Sc. in Veterinary Public Health and Epidemiology

Course Code	Course Title	Credit	Hours
VPE 601	Concepts in Veterinary Public Health and One Health*	2+0	
VPE 602	Zoonoses-I*	2+1	
VPE 603	Zoonoses-II*	2+1	
VPE 604	Principles of Epidemiology*	2+1	
VPE 605	Hygiene and Safety of Foods of Animal and Aquatic Origin*	2+1	
VPE 606	Food-borne Infections and Intoxications	2+1	
VPE 607	Food Safety Standards, and Regulations	2+1	
VPE 608	Environmental Hygiene and Safety	2+1	
VPE 609	Applied Epidemiology	2+1	
VPE 610	Biosecurity, Bioterrorism and Disaster Management	2+0	
VPE 611	Laboratory Techniques in Veterinary Public Health*	0+3	
VPE 691	Master's seminar*	0+1	
VPE 699	Master's research		30

*Core courses



Course Contents

M.V.Sc. in Veterinary Public Health and Epidemiology

- I. Course Title** : Concepts in Veterinary Public Health and One Health
II. Course Code : VPE 601
III. Credit Hours : 2+0
IV. Aim of the course

To equip students with One Health concepts and advanced skills in public health aspects of infectious disease, intelligence, response, prevention and mitigation.

V. Theory

Unit I

VPH administration; organization, administration and implementation of VPH services/ programs; Structure and function of VPH agencies/ organizations of national and international importance. VPH team, administration and functions; responsibilities of veterinarians in public health team.

Unit II

Definition: One Health. Historical emergence of the concept. Scope, Objective and Area of activities of One Health. Strategic frame-work. Purpose for creation of Veterinary Public Health and Epidemiology –NET.

Unit III

Global burden of disease, Coordinated and systemic disease control response, Ecosystem, Urbanization intensive agriculture and animal husbandry practices, Host-pathogen interaction, Anti-microbial resistance and climate change.

VI. Suggested reading

- Calvin W Schwabe. 1984. *Veterinary Medicine and Human health*. Williams and Wilkins
- Sherikar AT, Bachhil VN and Thapliyal DC. 2013. *Text book of Elements of Veterinary Public Health*, ICAR, Govt. of India.
- Zinsstag J, Schelling E, Waltner-Toews D, Whittaker M and Tanner M. 2015. *One Health: the theory and practice of integrated health approaches*. CABI.

- I. Course Title** : Zoonoses-I
II. Course Code : VPE 602
III. Credit Hours : 2+1
IV. Aim of the course

To impart knowledge on Epidemiology, Etiology, Transmission pattern, Public health significance, Diagnosis and Management of important bacterial, Mycotic and Chlamydial zoonotic diseases.

V. Theory

Unit I

Definition and classification, Factors affecting the occurrence of zoonoses; Disease



management strategies, Disease burden on population and socioeconomic impacts.

Unit II

History, Etiology, Epidemiology, Diagnosis and management of important Bacterial zoonoses, viz., Anthrax, Brucellosis, Tuberculosis, Leptospirosis, Salmonellosis, Borreliosis, Cat scratch disease, Glanders, Lyme disease, Malidiosis, Streptococcosis, Plague, Rat bite fever, Tetanus, Tularemia, Yersiniosis, Staphylococcosis, Vibriosis, Listeriosis, Campylobacteriosis and others.

Unit III

History, Etiology, Epidemiology, Diagnosis and Management of important Mycotic zoonoses, viz., Dermatophytosis, Blastomycosis, Coccidioidomycosis, Cryptococcosis, Histoplasmosis, Aspergillosis, Candidiasis, Rhinosporidiosis, Sporotrichosis and others.

Unit IV

History, Etiology, Epidemiology, Diagnosis and Management of Chlamydiosis (Psittacosis and Ornithosis) and Prions diseases, viz., Creutzfeldt-Jakob Disease (CJD); Variant Creutzfeldt-Jakob Disease (vCJD), Kuru. Bovine Spongiform Encephalopathy (BSE), Chronic Wasting Disease (CWD) and Scrapie.

VI. Practical

Isolation and identification of important Bacterial, Mycotic and Chlamydial agents of public health significance from host, Vehicle and environment.

VII. Suggested reading

- Bauerfeind R, Graevenitz AV, Kimmig P, Schiefer HG, Schwarz T, Slenczka W and Zahner H. 2016. *Zoonoses: infectious diseases transmissible from animals and humans* (No. Ed. 4). American Society for Microbiology (ASM).
- Mahendra Pal. Zoonoses.
- Narayan KG *Epidemiology, Diagnosis and Management of Zoonoses*.
- Pedro N Acha and Boris Szyfres. *Zoonoses and Communicable Diseases Common to Man and Animals*.
- Seyedmousavi S, De Hoog GS, Guillot J and Verweij PE. 2018. *Emerging and Epizootic Fungal Infections in Animals*. Springereds.
- Thapliyal DC. 1999. *Diseases of animals transmissible to man*. 1st ed. International Book Distributing Company, Lucknow.
- *Zoonoses: Recognition Control and Prevention* (Martin E, Jones EH, Hubbart WT and Hagstard HV)

I. Course Title : Zoonoses-II

II. Course Code : VPE 603

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge on Epidemiology, Etiology, Transmission pattern, Public health significance, Diagnosis and Management of important Viral, Rickettsial and Parasitic zoonotic diseases.

V. Theory

Unit I

Disease burden, History, Etiology, Epidemiology, Transmission pattern, Diagnosis and management of important viral zoonoses, viz., Japanese encephalitis, Tick-



borne encephalitis, Encephalomyelitis, Rabies, Influenza, KFD, Rift valley fever, Chickungunya, FMD, and Enteroviruses.

Unit II

Disease burden, History, Etiology, Epidemiology, Transmission pattern, Diagnosis and management of important viral zoonoses, viz., Crimean-Congo haemorrhagic fever, Dengue, West-Nile fever, Yellow fever, Rift-valley fever, Equine encephalitis, Louping ill, Ebola, Marburg, Hantavirus, Zika, Hendra, Nipah and Corona viruses.

Unit III

Disease burden, History, Etiology, Epidemiology, Transmission pattern, Diagnosis and Management of important Rickettsial zoonoses, viz., Q fever, Typhus fever group.

Unit IV

Disease burden, Etiology, Host range, Epidemiology, Transmission pattern, Diagnosis and Management of important Parasitic zoonoses, viz., Hydatidosis, Taeniosis, Trichinosis, Fascioliosis, Fasciolopsiosis, Toxoplasmosis, Trypanosomosis, Cryptosporidiosis, Cysticercosis, Leishmaniosis, Sarcocystosis, Dracunculosis, Paragonimosis and Diphylobothriosis.

VI. Practical

Isolation and identification methods for important viral and parasitic agents of public health significance from host, vehicle and environment.

VII. Suggested Reading

- Bauerfeind R, Graevenitz AV, Kimmig P, Schiefer HG, Schwarz T, Slenczka W and Zahner H. 2016. *Zoonoses: infectious diseases transmissible from animals and humans* (No. Ed. 4). American Society for Microbiology (ASM).
- Mackie and Mc. Cartney. *Practical Medical Microbiology*.
- Parija SC. *Text book of Medical Parasitology*.
- Pedro N Acha and Boris Szyfres. *Zoonoses and Communicable Diseases Common to Man and Animals*.
- Soulsby JL *Helminthes, Arthropods and Protozoa of Domesticated Animals*.
- Steele JL. *CRC Handbook series in Zoonoses*.
- Thapliyal DC. 1999. *Diseases of animals transmissible to man*. 1st ed. International Book Distributing Company, Lucknow.

I. Course Title : Principles of Epidemiology

II. Course Code : VPE 604

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge on the principles and concepts employed for epidemiological investigation of the diseases.

V. Theory

Unit I

Historical perspective and scope of veterinary epidemiology. Theories of disease causation and advancement in the concepts of disease causation, Iceberg concept. Koch's postulates of disease causation. Epidemiological triangles, Disease causing wheels, webs and pies.



Unit II

Definitions: Epidemic, Endemic, Pandemic and Sporadic diseases. Qualitative and quantitative approaches to epidemiology. Measurement of disease. Endemic stability and herd immunity, Basic reproductive ratio, Trends and spatial distribution of disease, Epidemic curve and their utility.

Unit III

Transmission of disease and role of ecology in maintenance of disease agents. Type of epidemiological methods. Landscape and molecular methods used in the epidemiological investigation.

Unit IV

Epidemiological Studies-Observational (Case-control, cohort and cross-sectional studies) and experimental studies (field and clinical trials). Disease surveys, monitoring and surveillance. Epidemiological data bases.

Unit V

Definition, scope and limitation of serological epidemiology and interpretation of results. Characteristics of ideal serological test, multiple testing and evaluation of tests. Investigation of disease outbreaks. Strategies of disease control and eradication.

VI. Practical

Data collection from various sources, analysis and interpretation. Serum collection method demonstration. Analytical diagnostic and relative sensitivity and specificity calculation. use of software for data analysis.

VII. Suggested Reading

- Elliot P, Wakefield JC, Best NG and Briggs DJ. 2000. *Spatial Epidemiology: methods and applications*; Oxford University Press.
- Martin SW, Meek AH and Willeberg P. 1986. *Veterinary Epidemiology: Principles and methods*. IOWA State University Press/ Ames, Iowa. USA.
- Pfeiffer D. 1998. *Veterinary Epidemiology. An Introduction. Institute of Veterinary, Animal and Biomedical Sciences*. Massey University, Palmerston, New Zealand.
- Salman M. 2008. *Animal disease surveillance and survey systems: methods and applications*. John Wiley and Sonsed.
- Thrusfield M. 1995. *Veterinary Epidemiology*: Blackwell Science Ltd. Oxford, UK.

I. Course Title : Hygiene and Safety of foods of Animal and Aquatic origin

II. Course Code : VPE 605

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students about principles of food hygiene and quality improvement practices.

V. Theory

Unit I

Principles of food hygiene in relation to foods of animal and aquatic origin. Importance of food hygiene in public health. Impact of environmental sanitation and other factors on food quality. General principles of prevention of food-borne illnesses, risk analysis.



Unit II

Importance and objectives of milk hygiene. Hygienic production, Handling, Transportation, Storage and marketing of milk. Mastitis. Milk spoilage and preservation. Milk-borne diseases of public health significance. Milk allergy-lactose intolerance. Residues of pesticide and antibiotics in milk and its impact on human health. Milk spoilage. Milk adulteration, synthetic milk. Milk plant hygiene and sanitation.

Unit III

Objectives and importance of meat hygiene. Hygienic practices at farm and during transportation of food animals including poultry. Hygienic meat production-an overview. Adulteration. Speciation, spoilage and preservation of meat. Meat-borne diseases of public health significance. Treatment and safe disposal of slaughter-house by-products. Hygienic practices in abattoirs.

Unit IV

Fish, fisheries and ichthyology: an introduction. Environmental factors affecting aquatic food hygiene. Hygienic production, Handling, Preservation, Transportation and marketing of aquatic foods. Microbiology and Spoilage of aquatic foods. Safe disposal of fish byproducts. Fish-borne diseases of public health significance.

VI. Practical

Collection of meat/ milk/ egg/ fish samples for determination of physical as well as microbiological quality. Examination of meat/ milk samples for possible adulteration.

VII. Suggested reading

- FAO (Manual No. 79). *Manual on simple methods of Meat preservation*.
- Marriott NG, Schilling MW and Gravani RB. 2018. *Principles of Food sanitation*; Springer.
- Nollet LM and Toldrá F. 2016. *Safety Analysis of Foods of Animal origin*, CRC Press.ed.
- Norer R. 2016. *Genetic Technology and Food Safety*; Springer International Publishing.ed.
- Wro and Bruno. *Fish Disease and Disorders – Viral Bacterial and Fungal Infections*.

I. Course Title : Food-borne Infections and Intoxications

II. Course Code : VPE 606

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge about illnesses arising due to consumption of contaminated foods.

V. Theory

Unit I

Definition: Food borne infection, Food intoxication, Bacterial toxins, Toxi-infection, etc. Classification, Epidemiology, Disease burden and Economics of food-borne diseases. Reservoirs of food-borne pathogens and its mode of transmission. Vehicles of pathogens. Measures employed for prevention and control of food-borne diseases. Food- poisoning outbreak investigation and management.

Unit II

Epidemiology, Economic, Diagnosis and Management of bacterial food-borne infections and intoxications due to *Salmonella*, *Campylobacter*, *Clostridium*,



Staphylococcus, Listeria monocytogenes, Vibrio parahaemolyticus, E.coli, Bacillus cereus, Shigella, Yersinia enterocolitica and others. Types of bacterial toxins and its manifestations.

Unit III

Epidemiology, Economics, Diagnosis and Management of food-borne Viral pathogens: Hepatitis viruses, Enteroviruses, Noroviruses, Rotaviruses and other. Food-borne parasitic and rickettsial infections.

Unit IV

Illness due to food additives, seafood toxins, mycotoxins, biocides, plant origin toxins, heavy metals, veterinary drugs, hormones, etc. in foods. Anti-microbial resistance (AMR) in food-borne pathogens-definition, current status, factors responsible, mechanism of resistance, mode of transmission and control.

VI. Practical

Food-borne disease outbreak investigation. Detection, characterization and quantitation of food-borne pathogens, toxins, antibiotics, pesticides and additives in foods.

VII. Suggested reading

- Cliver DO, Potter M and Riemann HP. 2011. *Food borne Infections and Intoxications*; Elsevier.
- D'Mello JPF. *Food Safety-Contaminants and Toxins*.
- Jay JM, Loessner MJ and Golden DA. 2008. *Modern food microbiology*; Springer Science and Business Media.
- Hubbert WT. *Food Safety and Quality Assurance-Foods of Animal Origin*.
- Vernam AH. 1991. *Food-borne pathogens*; Wolfe Publishing Ltd, London.

I. Course Title : Food Safety Standards and Regulations

II. Course Code : VPE 607

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students with various parameters responsible for the production of hygienic and safe foods for human consumption.

V. Theory

Unit I

Indicators of food quality and spoilage (biological and others). Food plant hygiene and sanitation. Hurdle technique and its relevance. Microbiological criteria for food quality.

Unit II

Food standards- National, International, Private standards. GSP, GMP, HACCP and ISO 22000, etc. Genesis of food safety standards, Mechanism of food safety standards formulation, Agencies associated in food standard formulation, Role of WTO, FSSAI, BIS and others in standard formulation. National and international regulations and legislation enacted for quality food production.

Unit III

Food safety regulations in reference to the Pesticides, Veterinary drugs residues, Heavy metals, Hormones and others (MRLs, ADIs, etc.). Traceability system, Organic food production.



VI. Practical

Detection of Pesticides, Veterinary drug residues, Heavy metal in food samples. Visits to the various food processing units for examining the compliance of HACCP/ FSSAI regulations and other standards. Microbiological assessment of cleanliness of surface and equipment in abattoir/ meat/ milk plant

VII. Suggested Reading

- Fortin ND. 2016. *Food Regulation: law, science, policy, and practice*. John Wiley and Sons.
- Joint FAO. 2004. *Codex alimentarius: food hygiene basic texts* (No. Ed. 3). Food and Agriculture Organization of the United Nations.
- Josling TE, Roberts D and Orden D. 2004. *Food Regulation and Trade: toward a safe and open global system*; Peterson Institute Press.
- Van Der Meulen and Bernd. 2011. *Private Food Law: Governing food chains through contract law, self-regulation, private standards, audits and certification Schemes*. The Netherlands: Wageningen Academic Publishers.
- Vos E. 1999. *Institutional frameworks of community health and safety legislation: Committees, agencies, and private bodies*. Hart.

I. Course Title : Environmental Hygiene and Safety

II. Course Code : VPE 608

III. Credit Hours : 2+1

IV. Aim of the course

To impart education about environment, environmental pollutants and its manifestations on animal and human health.

V. Theory

Unit I

Introduction to environment, Environmental hygiene, Pollutants and its impact on animal/ human health. Green-house gasses and its effect. Microbial pollution. Environmental risk assessment and management.

Unit II

Nature and characteristics of various environmental pollutants. Pollutions of soil, air and water and its effects on health. Impact of noise pollution on health.

Unit III

Genetic risk from Environmental agents, Health problems due to nuclear energy, Microwave, Electro-magnetic and other radiation pollution, Environmental estrogens, Pesticides pollution. Industrial pollution as well as pollution due to plastic and petrochemical products.

Unit IV

Role of live-stock in environmental pollution, Dissemination of excreted pathogens, animal-waste and human risk, principles of safe disposal of bio-medical waste and recycling of wastes

Unit V

Contamination of environment with heavy metals, pesticides, veterinary drug residues and its impact on human health. National and international pollution control agencies and its role in management of environmental pollution. Regulations on control of environmental pollution.



VI. Practical

Determination of portability of drinking water, Estimation and detection of pathogenic microbes in water, air, soil, animal products, sewage, and animal waste; Visit of sewage and waste disposal plants/ sites.

VII. Suggested reading

- Fairman R, Mead CD and Williams WP. 1998. *Environmental risk assessment: approaches, experiences and information sources*.
- Frumkin H. 2016. *Environmental health: from global to local*. John Wiley and Sons.ed.
- Levy BS. 2006. *Occupational and environmental health: recognizing and preventing disease and injury*. Lippincott Williams and Wilkins. ed.
- Linkov I and Ramadan AB. 2004. *Comparative risk assessment and environmental decision making (8)*. Springer Science and Business Media.Ed.
- Ray M. *Environmental Pollution: Impact of technology on quality of life*.
- Richard B Philp. *Environmental Hazards and Human Health*

I. Course Title : Applied Epidemiology

II. Course Code : VPE 609

III. Credit Hours : 2+1

IV. Aim of the courses

To impart education on applied aspects of epidemiology.

V. Theory

Unit I

Introduction to applied epidemiology. Models, modelling and types of models. Epidemiological and economic models. Principles and classification of models. Deterministic and stochastic models. Empirical and explanatory models. Application of models in disease forecasting. Modelling in disease prevention and control.

Unit II

Disease occurrence, Ecology of disease, Monitoring and surveillance. Outbreak investigation protocol. Path, regression and discriminate analyses. Time series analysis and analysis of variance.

Unit III

Animal disease economics (cost-benefit analysis, internal rate of return, payback period, partial budgeting), decision analysis. Bayesian analysis. Monte-Carlo and Markovian processes and system evaluation. Uses of multivariate analysis.

Unit IV

Disease outbreaks, Participatory epidemiology, Disease reporting system, Tracing and notification. Disease control strategies, Risk assessment, EXotic diseases, Trans-boundary diseases, Vaccination.

Unit V

Definition; Disease intelligence. Tele-epidemiology. Remote sensing, Geographic information system, Disease surveillance and Early warning system.

VI. Practical

Survey, Sampling and Data presentation. Measurements of disease occurrence, Outbreak investigation and reporting. Use of epidemiological software.



VII. Suggested Reading

- Brownson RC and Petitti DB. 1998. *Applied Epidemiology: theory to practice*. Oxford University Press.
- Durr PA and Gatrell AC. 2004. *GIS and spatial analysis in veterinary science*. Cabi. Ed.
- Toma B, Dufour B, Sanaa M, Benet JJ, Moutou F, Louza A and Ellis P. 1999. *Applied Veterinary Epidemiology and the control of disease in populations*. 7 Avenue du Général de Gaulle.
- Twisk JW. 2013. *Applied longitudinal data analysis for epidemiology: a practical guide*. Cambridge university press.

I. Course Title : Bioterrorism and Disaster Management

II. Course Code : VPE 610

III. Credit Hours : 2+0

IV. Aim of the course

To equip the students with latest information of various types of disaster and its management, biological weapons used in bioterrorism, biological hazards and remedial measures, biomedical hazards and their prevention.

V. Theory

Unit I

Definition: Bioterrorism. Major agents used as biological weapons, Hazard analysis and combating bioterrorism. Bio-ethics and social ethics, Advisory role of veterinarians during such events.

Unit II

Definitions, Natural and man- made disaster, Impact analysis and classification of disaster scale, Essential preparations to manage disaster, Role of central, State and Local government bodies in disaster management, Role of veterinarians/ veterinary public health personnel during emergency/ Disaster and sequence of emergency medical services.

Unit III

Effect of natural disasters like floods, Prolonged draughts, Forest fires, Earthquakes, Tsunami and Tidal damages, Storms, etc. on human as well as animal population, post-disaster disease susceptibility and remedial measures.

Unit IV

Biosecurity– definition, importance, methods used for pathogen inventory, Food processing/ quarantine units/ animals/ poultry farms, etc. Biomedical hazards and biosafety in the laboratories. Occupational health risk and its management.

VI. Suggested Reading

- Antosia RE and Cahill JD. 2006. *Handbook of bioterrorism and disaster medicine*. Springer.ed.
- Hodgkinson PE and Stewart M. 1991. *Coping with catastrophe: A handbook of disaster management*. Taylor and Frances/ Routledge.
- Van De Walle B, Turoff M and Hiltz SR. 2014. *Information systems for emergency management*. Routledge.
- Van Oosterom P, Zlatanova S and Fendel E. 2006. *Geo-information for disaster management*. Springer Science and Business Media.Ed.



- I. Course Title : Laboratory Techniques in Veterinary Public Health**
II. Course Code : VPE 611
III. Credit Hours : 0+3

IV. Aim of the course

To impart practical exposure of laboratory techniques in Veterinary Public Health to the students.

V. Practical

Unit I

General practices: Use of PPE (Personal Protective Equipment) and biosafety cabinets, Preparation of glass-wares, cultural media, buffer solution, solutions of different molarity and other laboratory materials. Sampling methods for biological materials. Quality analysis of milk, meat, water and other food materials and others.

Unit II

Microbiological techniques: Plate counts, Enumeration and isolation of psychrophilic, Thermophilic and thermoduric organisms in food samples, Enumeration, isolation and identification of important food-borne pathogens, Detection of bacterial toxin involved in food-poisoning, Detection of viral pathogens in various samples. Isolation, identification and enumeration of yeast/ molds/ spores in food samples.

Unit III

Immunological/ Serological and electrophoretic techniques: AGPT, Precipitation tests, Agglutination test, Haem-agglutination test, Polyacrylamide gel electrophoresis, Counter immuno- gel electrophoresis, ELISA, FAT, Intra-dermal inoculation tests and others.

Unit IV

Detection and quantification of residues of pesticides and drugs using immunological and chromatographic methods.

Unit V

Methods for isolation and quantitation of genomic DNA/ RNA from bacterial and other biological specimens using Latest molecular techniques and others. Laboratory records and log books of equipment.

VI. Suggested Reading

- Bremner A and Jhonston M. *Poultry Meat Hygiene and Inspection*.
- Duncan JR and Prasse KW. 1986. *Veterinary Laboratory Medicine* (No. Ed. 2). Iowa State University Press.
- Garvin ML *Infectious Waste Management-A practical guide*.
- Gradwohls' *Clinical Lab Methods and Diagnosis*.
- Jerome KR. 2016. *Lennette's laboratory diagnosis of viral infections*. CRC (Sonnenwirth and Jarett) Press. ed.
- Prasad J and Neeraj. *Principles and Practice of Animal Health and Hygiene*.
- Rupprecht C and Nagarajan T. 2015. *Current laboratory techniques in rabies diagnosis, research and prevention* (Vol. 2). Academic Press.ed.



Course Outline-cum-Lecture Schedule for Master Degree Programme

I. Course Title	: Concepts in Veterinary Public Health and One Health
II. Course Code	: VPE 601
III. Credit Hours	: 2+0

Lecture(s)	Topic
Theory	
1-2	VPH administration: organization, administration and implementation of VPH services/ programs
3-4	Structure and function of VPH agencies/ organizations at national and international levels
5-6	VPH team; administration and functions; responsibilities of veterinarians in the public health team
7	One Health: Definition, historical emergence of the concept. Scope, objectives and activities of One Health
8-9	One Health Umbrella, stewardship of VPH for the implementation of one health activities
10	Strategic framework of One Health activities
11-12	One Health approaches for control of zoonoses and ensuring food safety
13	One Health approaches for combating antimicrobial resistance
14	One health policies, legislations and research
15-16	Transdisciplinary approach of eco-health concepts; one health integrating policy, science and practices
17	Genesis of veterinary public health and epidemiology as a discipline
18-19	Global burden of disease – need for inter-sectoral and inter-disciplinary collaboration
20-21	Coordinated and systemic disease control response
22	Ecosystems, urbanization, intensive agriculture and animal husbandry practices
23	Exploring host-pathogen interactions for better multi-sectoral responses at the human-animal-ecosystem interface addressing food safety, zoonoses, and other public health threats
24	Climate change and need for multi-sectoral and collateral/ multi-lateral collaborations
25	Sharing of epidemiological data and laboratory information on zoonoses and food safety problems across sectors
26	Integration of one health approaches for the promotion of ecosystem and wildlife health
27	Organizations and agencies working to mitigate health challenges based on 'One Health Approach'
28	One Health Initiative as a union of human and veterinary medicine
29	Local, regional, national and international One Health networks
30	One Health in the paradigm of preventive health care and herd health management
31-32	Case study that integrate veterinary public health with one health



- I. Course Title : Zoonoses-I**
II. Course Code : VPE 602
III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Definition and classification of zoonoses
2	Factors affecting occurrence of zoonoses
3	Disease management strategies
4	Zoonotic disease burden on population
5	Socioeconomic impact of zoonoses
6	Public health implications of bacterial zoonoses
7-9	History, etiology, epidemiology, diagnosis and management of anthrax, brucellosis and tuberculosis
10	History, etiology, epidemiology, diagnosis and management of leptospirosis
11-12	History, etiology, epidemiology, diagnosis and management of plague, rat bite fever, borreliosis and lyme disease
13-14	History, etiology, epidemiology, diagnosis and management of glanders, malidiosis, streptococcosis
15	History, etiology, epidemiology, diagnosis and management of salmonellosis
16	History, etiology, epidemiology, diagnosis and management of campylobacteriosis
17	History, etiology, epidemiology, diagnosis and management of yersiniosis and vibriosis
18-19	History, etiology, epidemiology, diagnosis and management of tetanus, listeriosis, staphylococcosis and tularemia, etc.
20	History, etiology, epidemiology, diagnosis and management of cat scratch disease,
21	History, etiology, epidemiology, diagnosis and management of mycotic zoonoses – General considerations
22-23	History, etiology, epidemiology, diagnosis and management of dermatophytosis, blastomycosis and coccidioidomycosis
24	History, etiology, epidemiology, diagnosis and management of cryptococcosis and histoplasmosis
25	History, etiology, epidemiology, diagnosis and management of aspergillosis and candidiasis
26	History, etiology, epidemiology, diagnosis and management of rhinosporidiosis, sporotrichosis and others
27	History, etiology, epidemiology, diagnosis and management of chlamydiosis (psittacosis and ornithosis)
28	History, etiology, epidemiology, diagnosis and management of prion diseases - Creutzfeldt-Jakob Disease (CJD) and variants
29-30	History, etiology, epidemiology, diagnosis and management of prion diseases - bovine spongiform encephalopathy (BSE), kuru, chronic wasting disease (CWD) and scrapie
31-32	Case studies pertaining to important zoonoses of India
Practical	
1.	Sampling and laboratory preparedness for handling zoonotic bacterial and fungal agents
2.	Isolation, identification and characterization of agents of <i>Bacillus anthracis</i> and zoonotic <i>Mycobacterium</i> species.
3.	Isolation, identification and characterization of zoonotic <i>Streptococcus</i> and <i>Staphylococcus</i> species.



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Lecture(s)	Topic
4.	Isolation, identification and characterization of agents of <i>Clostridium tetani</i> and zoonotic <i>Listeria</i> species.
5.	Isolation, identification and characterization of zoonotic <i>Leptospira</i> and <i>Borrelia</i> species.
6.	Isolation, identification and characterization of <i>Burkholderia mallei</i> and <i>Burkholderia pseudomallei</i>
7.	Isolation, identification and characterization of zoonotic <i>Brucella</i> species
8.	Isolation, identification and characterization of food-borne and zoonotic <i>Salmonella</i> species including serotyping of isolates
9.	Isolation, identification and characterization of zoonotic <i>Yersinia</i> and <i>Vibrio</i> species
10.	Isolation, identification and characterization of zoonotic agents responsible for rat bite fever, cat scratch disease, tularemia, etc.
11.	Isolation and identification of zoonotic fungal agents of public health significance from the host, vehicle and environment associated with superficial mycozoonoses
12.	Isolation, identification and characterization of important mycotic agents of public health significance associated with systemic mycozoonoses – blastomycosis and coccidioidomycosis
13.	Isolation, identification and characterization of important mycotic agents of public health significance associated with systemic mycozoonoses – cryptococcosis and histoplasmosis
14.	Isolation, identification and characterization of important mycotic agents of public health significance associated with systemic mycozoonoses - aspergillosis, candidiasis, rhinosporidiosis and sporotrichosis
15.	Isolation, identification and characterization of important chlamydial agents of public health significance from host, vehicle and environment
16.	Laboratory detection of prion diseases

I. Course Title : Zoonoses-II

II. Course Code : VPE 603

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1-3	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of Japanese encephalitis, Tick-borne encephalitis and Encephalomyelitis
4-8	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of Rabies, Influenza, KFD, Rift valley fever and Chikungunya
9	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of FMD and Enteroviruses
10	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of Crimean-Congo haemorrhagic fever
11-12	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of Dengue, West-Nile fever and Yellow fever
13	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of Rift-valley fever, Louping ill
14	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of equine encephalitis
15-16	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis



Lecture(s)	Topic
17-18	and management of Ebola, Marburg and Hantavirus Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of Hendra Nipah and Zika virus
19	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of corona viruses
20	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of important rickettsial zoonoses
21	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of Q fever
22	Disease burden, history, etiology, epidemiology, transmission pattern, diagnosis and management of typhus fever group
23-25	Disease burden, etiology, host range, epidemiology, transmission pattern, diagnosis and management of hydatidosis, taeniosis/ cysticercosis and Trichinosis
26	Disease burden, etiology, host range, epidemiology, transmission pattern, diagnosis and management of fasciolosis and fasciolopsiosis
27	Disease burden, etiology, host range, epidemiology, transmission pattern, diagnosis and management of Toxoplasmosis
28-29	Disease burden, etiology, host range, epidemiology transmission pattern, diagnosis and management of Trypanosomosis and Leishmaniosis
30	Disease burden, etiology, host range, epidemiology, transmission pattern, diagnosis and management of Cryptosporidiosis
31	Disease burden, etiology, host range, epidemiology, transmission pattern, diagnosis and management of Sarcocystosis and Dracunculiosis
32	Disease burden, etiology, host range, epidemiology, transmission pattern, diagnosis and management of Paragonimiosis and Diphylobothriosis
Practical	
1.	Detection and characterization of zoonotic viral and parasitic agents from host, vehicle, environment, etc. - Sampling and laboratory preparations
2.	Detection and characterization of Japanese encephalitis, chikungunya and dengue viruses
3.	Detection and characterization of encephalomyelitis, Rift valley fever, West-Nile fever, yellow fever, louping ill and equine encephalitis viruses
4.	Detection and characterization of rabies and influenza viruses
5.	Detection and characterization of FMD and entero-viruses
6.	Detection and characterization of KFD, tick-borne encephalitis and Crimean-Congo haemorrhagic fever viruses
7.	Detection and characterization of zoonotic Ebola, Marburg, Hanta, Zika, corona, Hendra and Nipah viruses
8.	Isolation, identification and characterization of agents responsible for Q fever, typhus fever and other rickettsial zoonoses
9.	Detection and characterization of agents responsible for hydatidosis, taeniosis/ cysticercosis and trichinellosis
10.	Detection and characterization of agents responsible for fasciolosis and fasciolopsiosis
11.	Detection and characterization of <i>Toxoplasma gondii</i>
12.	Detection and characterization of zoonotic <i>Trypanosoma</i> species
13.	Detection and characterization of zoonotic <i>Cryptosporidium</i> species of health significance
14.	Detection and characterization of zoonotic <i>Leishmania</i> species
15.	Detection and characterization of zoonotic <i>Sarcocystis</i> species
16.	Detection and characterization of zoonotic agents responsible for dracunculiosis, paragonimiosis and diphylobothriosis



I. Course Title	: Principles of Epidemiology
II. Course Code	: VPE 604
III. Credit Hours	: 2+1

Lecture(s)	Topic
Theory	
1	Historical perspective and scope of veterinary epidemiology
2	Disease causation -theories of disease causation, recent advancements and iceberg concept
3	Koch's postulates and Evan's rules
4	Epidemiological triangle
5	Epidemic, endemic, pandemic and sporadic diseases
6	Qualitative and quantitative approaches to epidemiology
7	Measurement of disease in populations
8	Endemic stability and herd immunity
9	Basic reproductive ratio
10	Trends in spatial and temporal distribution of disease
11	Epidemic curve and its applications
12	Transmission of disease
13	Role of ecology in maintenance of disease agents
14	Epidemiological methods
15	Landscape epidemiology
16	Molecular epidemiology
17	Epidemiological studies
18	Observational studies - case-control studies
19	Observational studies - cohort studies
20	Observational studies - cross-sectional studies
21	Experimental studies - field trials
22	Experimental studies - clinical trials
23	Disease surveys
24	Monitoring and surveillance
25	Epidemiological databases
26	Definition, scope and limitations of serological epidemiology and interpretation of results
27	Characteristics of ideal disease diagnostic tests
28	Multiple diagnostic testing
29	Evaluation of diagnostic tests
30	Investigation of disease outbreaks
31	Strategies of disease control
32	Disease eradication
Practical	
1.	Collection of data from various sources, analysis and interpretation
2.	Demonstration of sample (serum) collection
3.	Evaluation of diagnostic tests
4.	Analytical diagnostic and relative sensitivity and specificity calculation
5.	Use of software for data analysis
6.	Designing and interpretation of a case-control study
7.	Designing and interpretation of a cohort study
8.	Designing and interpretation of a cross-sectional study
9.	Designing and interpretation of a field trials
10.	Designing and interpretation of a clinical trials
11.	Determination of vaccines effectiveness
12.	Designing of a survey



Lecture(s)	Topic
13.	Spatio-temporal distribution of disease
14.	Outbreak investigation
15.	Case study on disease eradication
16.	Case study on disease monitoring and surveillance

I. Course Title : Hygiene and Safety of foods of Animal and Aquatic origin

II. Course Code : VPE 605

III. Credit Hours : 2+1

Lecture(s)	Topic
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Theory

- 1 Importance of food hygiene in relation to the public health
- 2 Principles of food hygiene in relation to foods of animal origin (including aquatic origin foods)
- 3 Environmental sanitation in food establishments
- 4 Food quality - perspectives
- 5 Prevention of foodborne illnesses - principles
- 6 Risk analysis
- 7 Milk hygiene - importance and objectives
- 8 Hygienic production, handling, transportation, storage and marketing of milk and milk products
- 9 Mastitis in dairy animals and its public health significance
- 10 Spoilage of milk
- 11 Preservation of milk
- 12 Milk-borne diseases of public health significance
- 13 Epidemiology of milk allergy and lactose intolerance
- 14 Public health impact pesticide residues in milk supply chain
- 15 Antimicrobial residues in milk supply chain and their public health impact
- 16 Adulteration of milk and dairy products
- 17 Public health implications of synthetic milk
- 18 Milk plant hygiene and sanitation
- 19 Meat hygiene - importance and objectives
- 20 Hygienic meat production including hygienic practices at abattoirs
- 21 Hygienic practices at farm and during transportation of food animals including poultry
- 22 Adulteration of meat and meat speciation
- 23 Spoilage of meat and meat products
- 24 Preservation of meat
- 25 Meat-borne diseases of public health significance
- 26 Safe disposal of slaughter house byproducts
- 27 Fish, fisheries and ichthyology
- 28 Environmental factors affecting aquatic food hygiene
- 29 Hygienic production, handling, preservation, transportation and marketing of aquatic foods
- 30 Microbial profile and spoilage of aquatic foods
- 31 Disposal of fishery waste
- 32 Fish-borne diseases of public health significance



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Lecture(s)	Topic
Practical	
1.	Collection of samples of meat, milk, egg and fish for physicochemical and microbial analysis
2.	Analysis of foods of animal origin for physicochemical quality
3.	Analysis of foods of animal origin for microbial quality
4.	Detection of adulteration, debasement, substitution and admixing of animal origin foods and products
5.	Recent methods of speciation of meat
6.	Determination of spoilage in foods of animal origin
7.	Extension of shelf life of perishable foods of animal origin
8.	Detection of mastitis in dairy animals and linking it to consumer's health
9.	Study of supply chains of milk, meat, egg and fish
10.	Evaluation of food plant, equipment and the environment for compliance
11.	Microbial risk analysis
12.	Risk analysis for residues of public health significance in foods of animal origin
13.	Source tracing of foodborne outbreaks using molecular, bioinformatics or epidemiological tools
14.	Evaluation of fish and aquatic harvest for quality and safety
15.	Visit to milk/ meat/ egg/ fish processing unit for the demonstration of food quality and safety checkpoints
16.	Study of databases, information communication tools (ICT) and dedicated websites related to quality and safety of animal origin foods

I. Course Title : Food-borne Infections and Intoxications

II. Course Code : VPE 606

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Definitions: Foodborne infections, Food intoxications, Toxi-infections, Bacterial toxins, etc.
2-3	Classification, epidemiology, disease burden and economics of foodborne diseases.
4	Fungal toxins
5	Plant, algal, and other toxins
6	Reservoirs of food-borne pathogens
7	Mode of transmission of food-borne pathogens
8	Vehicles of pathogens
9	Measures employed for prevention and control of food-borne diseases
10-11	Food- poisoning outbreak investigation
12	Management of food- poisoning outbreak
13-15	Epidemiology, economic, diagnosis and management of bacterial food-borne diseases
16-17	Foodborne disease due to <i>Salmonella</i> and <i>Campylobacter</i> species
18-19	Foodborne disease due to <i>Clostridium</i> , <i>Staphylococcus</i> , <i>Listeria</i> and <i>Bacillus</i> species
20-22	Foodborne diseases due to species of <i>Vibrio</i> , <i>Escherichia</i> , <i>Shigella</i> , <i>Yersinia</i> , etc.
23	Types of bacterial toxins and their manifestations
24-25	Epidemiology, economics, diagnosis and management of food-borne viral pathogens
26	Foodborne diseases due to hepatitis viruses and entero-viruses
27	Foodborne diseases due to noroviruses, rotaviruses, etc.
28	Food- borne rickettsial infections



Veterinary Para-Clinical Subjects: Veterinary Public Health and Epidemiology

Lecture(s)	Topic
29	Food- borne parasitic infections
30	Illness due to additives in foods, seafood toxins, mycotoxins, biocides and plant origin toxins
31	Illness due to food heavy metals, veterinary drugs, hormones, etc. in foods
32	Anti-microbial resistance (AMR) in food-borne pathogens-definition, current status, factors responsible, mechanism of resistance, mode of transmission and control

Practical

1. Food-borne disease outbreak investigation
2. Detection and characterization of food-borne bacterial pathogens in foods of animal origin
3. Detection and characterization of food-borne viral pathogens in foods of animal origin
4. Detection, quantification and characterization of microbial toxins in foods of animal origin
5. Detection of antimicrobial resistance in foodborne pathogens and their molecular and epidemiological characterization
6. Detection and characterization of rickettsial pathogens in foods of animal origin
7. Detection and characterization of parasites of public health in foods of animal origin
8. Detection, quantification and characterization of toxic compounds in the fish and aquatic food supply chain
9. Detection and quantification of antimicrobials in foods of animal origin
10. Detection and quantification of phytotoxins, biocides, etc. in foods of animal origin
11. Detection and quantification of pesticides residues in foods of animal origin
12. Detection and quantification of residues of metals and other environmental contaminants in foods of animal origin
13. Detection and quantification of additives in foods of animal origin
14. Detection and quantification of veterinary drugs in foods of animal origin
15. Case study on food-borne microbial disease relevant to the region
16. Case study on non-microbial hazard relevant to the region

I. Course Title : Food Safety Standards and Regulations

II. Course Code : VPE 607

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Indicators of food quality and safety
2	Food spoilage (biological, chemical, etc.)
3	Food plant hygiene
4	Sanitation program for the food plant
5	Hurdle technique and its relevance
6	Microbiological food quality criteria
7-8	National and international food standards
9	Private food standards
10	Prerequisite programs for food safety - GAP, GMP, etc.
11	Application of ISO 9000 series to food establishments
12-13	HACCP, ISO 22000



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Lecture(s)	Topic
14	Genesis of food safety standards
15	Mechanisms of food safety standard formulation
16	Agencies associated in food standard formulation
17	Role of WTO and FSSAI in standard formulation
18	Role of BIS and other agencies in standard formulation
19	Role of EIC/ EIA
20	National regulations and legislations related to quality food production
21	International regulations related to quality food production
22-26	Food safety regulations in reference to pesticides, veterinary drug, heavy metals, hormones and other residues (MRL, ADI, etc.)
27	Traceability system for foods of animal origin
28	Organic food production
29	Packaging of foods of animal origin – specifications and standards
30	Public health implications of <i>in-vitro</i> and cultured meats as well as meat obtained from genetically modified and unconventional animals
31	SWOT analysis of emerging and novel technologies related to the quality and safety of foods of animal origin
32	Case study related to food standards

Practical

1. Detection of pesticide residues in foods of animal origin
2. Detection of veterinary drug residues in foods of animal origin
3. Detection of heavy metal residues in foods of animal origin
4. Estimation of MRL/ MPL
5. Estimation of NOEL, ADI, etc.
6. Microbiological assessment of cleanliness of food plant surface
7. Microbiological assessment of equipment in abattoir/ meat/ milk plant
8. Visit to food processing units for examining compliance of HACCP/ FSSAI regulations and other standards
9. Demonstration of traceability system for foods of animal origin
10. Demonstration of compliance of organic production of foods of animal origin
11. Demonstration of registration and licensing of food business operator (FBO) under FSSAI regime
12. Evaluation of detergents and sanitizers used in the food plant
13. Inventory management and hygiene audit of food plant
14. Occupational safety at food plant
15. Case study on HACCP
16. Case study on ISO 22000

I. Course Title : Environmental Hygiene and Safety

II. Course Code : VPE 608

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Introduction to the environment and environmental hygiene
2	Impact of environmental pollutants on animal and human health
3	Characteristics of various environmental pollutants
4	Nature and impact of microbial pollution
5	Nature and impact of pollution due to chemical pollutants



Veterinary Para-Clinical Subjects: Veterinary Public Health and Epidemiology

Lecture(s)	Topic
6	Environmental risk assessment (microbial and non-microbial hazards)
7	Pollutions of soil, air and water and their effects on human, animal and environmental health
8	Dissemination of pathogens and pollutants in the environment
9	Global warming, enhanced green-house effect and climate change- impact on human, animal and environmental health
10	Impact of noise pollution on human and animal health
11	Management of environmental pollution
12	Industrial pollution including impact of plastic and petrochemical products
13	Genetic risk associated with environmental pollutants
14	Health problems due to nuclear energy, microwave, electro-magnetic and other radiation pollutions
15	Pollution due to agrochemicals and pesticides
16-17	Contamination and impact of heavy metals and veterinary drug residues
18	Role of livestock in environmental pollution
19	Public health impact of animal-waste
20	Recycling of wastes
21	Principles of safe disposal of bio-medical waste
22	Food chain consequences of environmental pollutants, contaminants and toxicants
23	Implications of genetically modified organisms on the animal, human and environmental health - regulations and compliance
24	Management of environmental pollution – conventions, treaties, agreements, etc.
25-26	Role of national and international pollution control agencies in the management of environmental pollution.
27	Regulations pertaining to environmental pollution and its control
28	Hygiene and safety at specialized laboratories
29	Designing and maintenance of laboratories that handle high risk pathogens
30	Environmental risk assessment of hazards of regional/ national importance
31	Case studies involving livestock and the environment
32	Case studies indicating human health impact associated livestock

Practical

1. Determination of potability of the drinking water
 2. Detection of pollutants in the water
 3. Detection of pollutants in the air
 4. Detection of pollutants in the soil
 5. Detection of pollutants in the animal products
 6. Detection of pollutants in the sewage
 7. Detection of pollutants in the animal waste
 8. Detection and quantification of environmental pollutants, toxicants and contaminants that affect animal, human and environmental health
 9. Sustainable methods for animal waste disposal/ economic utilization arising from intensive animal husbandry
 10. Cost-benefit analysis of environment friendly animal waste disposal approaches
 11. Detection and quantification of genetically modified organisms
 12. Structure and function of institutional biosafety committee (IBSC)
 13. Environmental monitoring of pollutants – markers and methods
 14. Preparation of feasibility report or projects pertaining to selected environmental pollutant(s) of regional importance
 15. Visit to sewage/ waste recycling/ disposal plant/ processing unit
 16. Case studies on risk mapping, environmental risk assessment, pollution mitigation, etc.
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I. Course Title : Applied Epidemiology
II. Course Code : VPE 609
III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	An introduction to applied epidemiology
2	Models, modeling and types of model
3	Epidemiological and economic models
4	Principles and classification of models
5	Deterministic and stochastic models
6	Empirical and explanatory models
7	Application of models in disease forecasting
8	Modeling in disease prevention and control
9	Disease occurrence and ecology of disease
10	Monitoring and surveillance
11	Outbreak investigation protocol
12	Path, regression and discriminate analyses
13	Time series analysis
14	Statistical analysis of the data - Analysis of variance
15	Animal disease economics - cost-benefit analysis, internal rate of return payback period, etc.
16	Animal disease economics - partial budgeting
17	Animal disease economics - decision analysis
18	Bayesian analysis
19	Monte-Carlo and Markovian processes and system evaluation
20	Multivariate analysis
21	Disease outbreaks and participatory epidemiology
22	Disease reporting system - tracing and notification
23	Disease control strategies
24	Risk assessment
25	Exotic diseases and trans-boundary diseases
26	Vaccination for the prevention of diseases
27	Disease intelligence
28	Tele-epidemiology
29	Application of remote sensing technology
30	Geographic information system
31	Disease surveillance and early warning system
32	
Practical	
1.	Survey of animal diseases
2.	Biostatistics for establishing disease causality, association and measurements
3.	Profanity and non-probability sampling methods
4.	Presentation of disease data
5.	Measurements of disease occurrence in populations
6.	Outbreak investigation
7.	Disease reporting systems
8.	Demonstration of epidemiological software
9.	Estimation of disease burden and economics of animal/ zoonotic diseases
10.	Modeling of animal diseases
11.	Demonstration of cartography and disease mapping using computer software
12.	Demonstration of global positioning system (GPS), remote sensing technology and geographic information system (GIS)



Lecture(s)	Topic
13.	Working modality on disease surveillance and monitoring
14.	Demonstration of disease early warning system
15.	Disease modeling
16.	Case study on disease reporting and notifiable disease

I. Course Title : Biosecurity, Bioterrorism and Disaster Management

II. Course Code : VPE 610

III. Credit Hours : 2+0

Lecture(s)	Topic
Theory	
1.	Introduction and definitions related to the bioterrorism
2.	Potential biological weapons
3.	Categorization agents of bioterrorism
4.	Hazard analysis in bioterrorism
5.	Strategies for combating bioterrorism
6.	Bio-ethics, social ethics and advisory role of veterinarians during the event of bioterrorism
7.	Disaster – Definitions, categorization (natural and man-made disasters)
8.	Impact analysis of disasters
9.	Classification of disaster scale
10.	Essential preparations for the management of disasters
11.	Role of central, state and local government bodies in disaster management
12.	Role of veterinarians/ veterinary public health personnel during emergency/ disasters
13.	Sequence of emergency services
14.	Effect of natural disasters on human and animal populations
15.	Nature and characteristics of disasters - floods, tsunami, tides, etc.
16.	Nature and characteristics of disasters - prolonged draughts, forest fires, etc.
17.	Nature and characteristics of disasters - earthquakes, storms, etc.
18.	Post-disaster disease susceptibility and remedial measures
19.	Biosecurity– definition, importance, methods, pathogen inventory, etc.
20.	Biosecurity at food processing establishments
21.	Biosecurity at livestock/ poultry farms
22.	Biosecurity at specialized animal facilities
23.	Quarantine measures for disease prevention – structure and functions
24.	Biomedical hazards at hospitals, laboratories and special animal handling units
25.	Laboratory biosafety – principles, requirements and applications
26.	Biosafety at the specialized laboratories
27.	Occupational health risk and its management
28.	National and international laboratory safety compliance
29.	Prediction, early warning or forecasting systems for disasters
30.	Case study related to bioterrorism
31.	Case study related to biosafety
32.	Case study related to disaster



I. Course Title : Laboratory Techniques in Veterinary Public Health
II. Course Code : VPE 611
III. Credit Hours : 0+3

Class	Topic
Practical	
1	General laboratory practices – safety precautions, hazardous material disposal, maintenance and compliance with existing norms
2	Personal safety and use of PPE (personal protective equipment) in the laboratory
3	Laminar airflows– uses, types of cabinets, SOPs, applications, etc.
4	Biosafety cabinets – uses, types of cabinets, SOPs, applications, etc.
5	Preparation of glassware and plastic wares
6-8	Preparation of culture media
9-10	Preparation of buffers and solutions of different for laboratory use
11-12	Sampling methods
13-14	Techniques for quality analysis of milk and milk product
15-16	Techniques for quality analysis of meat and meat products (including poultry and egg)
17-18	Techniques for quality analysis of food/ feed and environmental samples
19	Analysis of water for quality and safety
20-21	Microbiological techniques: Plate counts - psychrophilic, mesophilic, thermophilic and thermoduric organisms
22-23	Microbiological techniques: enumeration techniques for psychrophilic, mesophilic, thermophilic and thermoduric organisms from samples of foods of animal origin
24-26	Techniques for isolation and identification of foodborne and zoonotic pathogens
27-28	Techniques for detection of microbial toxins associated with food-poisoning and outbreaks
29-30	Techniques for detection and confirmation of viral pathogens
31-32	Techniques for isolation, identification, enumeration, confirmation and characterization of fungi of public health significance
33-34	Immunological techniques used for the detection of zoonotic agents - hypersensitivity based tests
35-36	Serological techniques: precipitation and agglutination tests, counter immune-electrophoresis, ELISA, etc.
37-38	Electrophoresis (AGE, PAGE, SDS-PAGE, etc.) techniques
39-40	Chromatographic methods
41-42	Techniques for the detection and quantification of pesticides residues
43-44	Techniques for the detection and quantification of drugs using immunological and chromatographic methods
45	Methods for isolation and quantification of nucleic acids from pathogens from diverse biological specimens using latest molecular techniques
46-47	Molecular techniques for the detection and characterization of organisms of veterinary public health significance – PCR and other molecular techniques
48	Maintenance of laboratory records, log books of equipment and laboratory accreditation (NABL)



Course Title with Credit Load Ph.D. in Veterinary Public Health and Epidemiology

Course Code	Course Title	Credit	Hou rs
VPE 701	Advances in Veterinary Public Health and Epidemiology*	2+1	
VPE 702	Emerging, Re-emerging Zoonoses and One Health*	2+1	
VPE 703	Foods of Animal/ Aquatic origin* Advances in Food Safety and Quality Control of	2+1	
VPE 704	Biosecurity and Occupational Health Safety	2+1	
VPE 705	Recent Concepts in Epidemiology and Disease Forecasting	2+1	
VPE 706	Risk Analysis and Predictive Modelling	2+1	
VPE 707	Advances in Environmental Hygiene	2+1	
VPE 708	Herd Health Management and Disease Economics Chronic diseased	2+1	
VPE 709	Epidemiology of Trans-boundary, Non-infectious and	2+1	
VPE 710	Ecology and Animal/ Human Health	2+0	
VPE 711	Diagnostic Approaches in Epidemiology	2+1	
VPE 712	Surveys, Surveillance and Data Management	2+1	
VPE 713	Research Methodology and Publication Ethics in VPE*	2+0	
VPE 790	Special Problem	0+1	
VPE 791	Doctoral Seminar-I*	0+1	
VPE 792	Doctoral Seminar-II*	0+1	
VPE 799	Doctoral Research		75

*Core Courses



Course Contents

Ph.D. in Veterinary Public Health and Epidemiology

I. Course Title : **Advances in Veterinary Public Health and Epidemiology**

II. Course Code : **VPE 701**

III. Credit Hours : **2+1**

IV. Aim of the course

To acquaint with current/ contemporary issues concerning the veterinary public health, veterinary epidemiology and the one health.

V. Theory

Unit I

Contemporary status of Veterinary Public Health in India and abroad. Public Health in the 21st Century. Veterinary public health and its role in the society. Role of veterinary public health professionals in prevention and control of zoonoses. Organization and administration of veterinary public health agencies structure and functions. Data analysis framework in healthcare and social sectors. Evidence-based information updates on current VPH topics. Global animal disease surveillance.

Unit II

Recent diagnostic tools used for emerging public health problems including zoonoses. Molecular surveillance of recent pandemics of zoonoses. Modes of evolutionary emergence of disease agents pertinent to VPE.

Unit III

Application of bioinformatics, biotechnological and computational tools in food hygiene, safety, quality assurance and environmental health protection. Global pandemic threat preparedness. Emerging Disease Surveillance and Control. Biomedical models in veterinary public health.

VI. Practical

Estimation of burden of food-borne zoonotic diseases. Special problems related to field investigations of outbreaks of food poisoning and zoonotic diseases in a community. Application of recent analytical methods and *in-silico* techniques for public health research. Visits to hospitals to acquaint the students with public health related problems.

VII. Assignments

Each student will select at least two recent articles from journals related to the course and discuss the same in the class through presentation.

VIII. Suggested reading

- Eldridge BF and Edman JD. eds., 2012. *Medical entomology: A textbook on public health and veterinary problems caused by arthropods*. Springer Science and Business Media



- Noordhuizen, Josephus Pieter Thérèse Maria K Frankena, Michael V Thrusfield and EA M Graat. *Application of quantitative methods in veterinary epidemiology*. Wageningen Pers, 2001.
- Schwabe CW, Riemann HP and Franti CE. 1977. *Epidemiology in veterinary practice*. Lea and Febiger.
- Thrusfield M. 2018. *Veterinary epidemiology*. John Wiley and Sons.

I. Course Title : Emerging, Re-emerging Zoonoses and One Health

II. Course Code : VPE 702

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students with emerging and re-emerging zoonotic diseases.

V. Theory

Unit I

Status of emerging and re-emerging zoonotic infections, National and international interests in zoonoses, Measurement and economics of zoonoses, Latest diagnostic and Management planning for zoonoses. Factors responsible for emergence and re-emergence of zoonotic diseases. Health threats at the human- animal-ecosystems/ environment interface (HAEI), a tripartite concept of OIE, WHO and FAO.

Unit II

Current challenges and strategies, euzoonoses, xenozoonoses, nosocomial zoonoses, newer zoonotic agents, viz., cat-scratch disease, rat bite fever, Creutzfeld-Jacob disease, Ebola, Marburg, Lassa, Nipah, Menangle, Herpes B, SARS, AI, ZIKA, MERS, etc.

Unit III

Simian and human immunodeficiency, bovine spongiform encephalopathy, hepatitis A and E, Toro, influenza viruses; re-emerging zoonoses with new pathology, viz., neuro-cysticercosis, campylobacteriosis, rabies, Guillain-Barre Syndrome, tuberculosis.

Unit IV

Safety regulations in laboratories, hospitals and biological plants. Use of bio safety cabinets. Bio security.

VI. Practical

Special problems related to emerging/ re-emerging/ prevalent zoonotic diseases in India. Status of Brucellosis and Tuberculosis in the India, OIE recommended diagnostic tests, vaccines/ strategies for prevention and control. Visits to rural health centres to acquire status of zoonotic diseases.

VII. Assignments

Each student will select at least two recent articles from journals related to course and discuss the same in the class through presentation.

VIII. Suggested reading

- Calvin W Schwabe. 1984. *Veterinary Medicine and Human health*. Williams and Wilkins
- Rezza G and Ippolito G. eds. 2017. *Emerging and Re-emerging Viral Infections*. Springer.
- Singh SK. ed. 2015. *Human Emerging and Re-emerging Infections*. John Wiley and Sons.



I. Course Title : Advances in Food Safety and Quality Control of Foods of Animal/ Aquatic

II. Course Code : VPE 703

III. Credit Hours : 2+1

IV. Aim of the course

To provide expertise to students the advances in the food safety, quality control and quality assurance of animal origin foods.

V. Theory

Unit I

Food supply chain. Food handling practices. New age voluntary and mandatory food standards. Types and evolution of food standards. Characteristics of food safety hazards. Quality control, assurance and food safety specifications for animal origin foods such as meat, milk, egg and fish. Trends in green technologies in food production and processing. Impacts and performance of organic farming *vis-a-vis* conventional farming.

Unit II

Recent innovations in shelf-life extension, preservation and packaging. Requirements for food testing and calibration Laboratory Mechanism of food spoilage (microbial and non-microbial). Nature of major food-borne infections and intoxications. Traceability system. Waste reduction along the food supply chain.

Unit III

Rapid detection of food safety hazards. Food safety risk assessment. Quality assurance schemes applicable to foods of animal origin. Elements of national food control system. National food control systems. Global considerations and role of committees and agencies associated with food safety, quality control and quality assurance.

Unit IV

Genesis of food quality/ safety standard. Food quarantine and export guidelines, specifications and standards. National and international food safety compliances. Traceability of foods of animal origin.

VI. Practical

Special problems on quality and safety of foods of animal origin foods. Detection, enumeration and identification of major food-borne pathogens. Visits to food processing establishments. Environmental impact assessment of production of foods of animal origin.

VII. Assignments

Each student will select at least two recent articles from journals related to course and discuss the same in the class through presentation.

VIII. Suggested reading

- Marriott NG, Schilling MW and Gravani RB. 2018. *Principles of food sanitation*. Springer.
- Nollet LM and Toldrá F. eds., 2016. *Safety analysis of foods of animal origin*. CRC Press
- Paustenbach DJ. ed., 2015. *Human and Ecological Risk Assessment: Theory and Practice* (Wiley Classics Library). John Wiley and Sons.
- Toldrá F and Nollet LM. eds., 2017. *Advances in food diagnostics*. John Wiley and Sons.



- I. Course Title : Biosecurity and Occupational Health Safety**
II. Course Code : VPE 704
III. Credit Hours : 2+1

IV. Aim of the course

To acquaint students with biosafety and occupational health safety.

V. Theory

Unit I

Definitions. Physical, Chemical and Biological hazards. Bio-safety and bio-security. Elements of bio-security and bio-containment. Biosecurity requirements. Containment Barriers. Equipment safety. Risk assessment. Bio-safety levels. Laboratory safety. Bio-safety in microbiological and biomedical laboratories.

Unit II

Risk groups, Classification of organisms by risk groups. Classification of occupational groups. Laboratory designs. Transmission, spread, Maintenance and control of diseases affecting various occupational groups in contact with animals and their public health significance. Diseases associated with various occupations.

Unit III

Occupational safety and health. Occupational Health and Safety (OHS) management system standard ISO 45001. regulations pertaining to the Occupational safety and health. Occupational Safety and Health Administration. International Labour Organization.

VI. Practical

Diagnosis of occupational diseases of public health significance. Handling of Bio-safety cabinets. Relation of risk group to bio-safety levels, practices and equipment. Visit to BSL-3 and BSL-4 laboratories.

VII. Suggested reading

- Fleming DO and Hunt DL. 2006. *Biological safety: principles and practices* (No. Ed. 4). ASM Press.
- Guillén J. ed. 2017. *Laboratory Animals: Regulations and Recommendations for the Care and Use of Animals in Research*. Academic Press.
- Rabinowitz PM, Lefkowitz RY, Conti LA, Redlich CA and Weigler BJ. 2015. *Occupational health of laboratory animal workers*. In *Laboratory Animal Medicine* (pp. 1381-1402). Academic Press.
- World Health Organization. 2016. *Assessment Tool for Key Processes associated with the Design, Construction, Operation, Maintenance and Regulation of BSL-3 Facilities in the WHO African Region*.

- I. Course Title : Recent Concepts in Epidemiology and Disease Forecasting**
II. Course Code : VPE 705
III. Credit Hours : 2+1

IV. Aim of the course

To learn about different epidemiological aspects of major diseases and to develop suitable disease forecasting system.



V. Theory

Unit I

Review of epidemiological concepts and applications, recent concepts.

Unit II

Epidemiology of economically important diseases in the region (haemorrhagic septicaemia, foot and mouth disease, surra, brucellosis, PPR, swine fever, IBD, NCD, avian Influenza, sheep pox, contagious ecthyma, etc).

Unit III

Geographical Information System and its applications in epidemiology, various expert systems and their role in epidemiology.

Unit IV

Modelling and application of various models in disease forecasting. Epidemiological software and its applications, global and national early warning system.

VI. Practical

Epidemiological exercises of economically important diseases in the region, use of Geographical Information System in epidemiology, various expert systems, modelling and various models used in disease forecasting, development of suitable epidemiological software for the prevailing problems to attend disease outbreaks including laboratory investigations and reporting of routes.

VII. Suggested reading

1. Beaglehole R, Bonita R and Kjellstrom T. 1993. *Basic Epidemiology*, World Health Organization, Geneva.
2. Lilienfeld DE and Stolley P. 1994. *Fundamentals of Epidemiology*, 3rd ed., Oxford University Press, New York
3. Noordhuizen JPTM, Frankena K, van der Hoofd CM and Graat EAM: *Application of quantitative methods in Veterinary Epidemiology*. Wageningen Pers, Wageningen, The Netherlands. 1997.
4. Raj S Bhopal. 2016. *Concepts of Epidemiology: Integrating the ideas, theories, principles and methods of epidemiology*. 3rd Ed., Oxford University Press. Oxford.

I. Course Title : Risk Analysis and Predictive Modelling

II. Course Code : VPE 706

III. Credit Hours : 2+1

IV. Aim of the courses

To Acquaint the students with the latest knowledge on prediction of infections and the extent of risk in the population

Unit 1

Definitions. History of risk analysis. Relevance of risk analysis (RA) to food sector. Principles of risk analysis. Risk analysis components (risk assessment, management and communication). Microbial Risk Assessment (MRA) involving hazard identification, exposure assessment, hazard characterization, and risk characterization. Methodologies used in RA/ MRA. Qualitative and quantitative risk analysis. Quantitative Microbial Risk Assessment (QMRA) for foods of animal origin including water. Application of mathematical models to study propagation of microbial hazards from farm-to-fork. Risk-based decision-making.



Unit II

Variability and uncertainty inherent to biological data. Measurement and modelling of uncertainty and variability during risk assessment. Risk assessment, risk analysis and HACCP. Linking microbial food safety with risk assessment. Relevance of assumptions and observed data for predictive models. Study of software packages used for risk analysis.

Unit III

Mathematical modelling of microbial growth rate. Predictive modelling tools for food safety management. Microbial modelling for the prediction of product shelf life and safety. Applications of predictive modelling of microbial behaviour in foods.

V. Practical

Modelling of infectious diseases using computational and mathematical methods. Building and analysing models of infectious diseases. Study of population-level processes for infectious diseases of animals and humans. Performing risk analysis for selected food safety hazards using microbial risk analysis tools. Risk assessment using through simulation modelling.

VI. Suggested reading

1. Haas CN, Rose JB and Gerba CP. 1999. *Quantitative microbial risk assessment*. John Wiley and Sons.
2. Lelieveld HL, Holah J and Gabric D. eds., 2016. *Handbook of hygiene control in the food industry*. Woodhead Publishing.
3. Pastorok RA, Bartell SM, Ferson S and Ginzburg LR. eds., 2016. *Ecological modeling in risk assessment: chemical effects on populations, ecosystems, and landscapes*. CRC Press.
4. Subramaniam P and Wareing P. eds., 2016. *The stability and shelf life of food*. Woodhead Publishing.

I. Course Title : Advances in Environmental Hygiene

II. Course Code : VPE 707

III. Credit Hours : 2+1

IV. Aim of the course

To update knowledge on modern environmental pollution problem and control.

V. Theory

Unit I

Current status of problems pertaining to environmental hygiene, air, soil and water pollution, Disinfection procedures, Impact of global warming and other environmental problems leading to change in ecology of diseases and impact on human/ animal health; Carbon footprint, Eco-philosophy, Environmental ethics and Environmental economics, Environmental conflicts and cooperation.

Unit II

Environmental risks their assessment and management and reporting, modern global information, surveillance and monitoring systems, decision making and public awareness. Role of VPH in National Sanitation Programmes such as Swachh Bharat Abhiyan.

Unit III

International environmental management efforts, participatory international organizations and their selected programmes and selected legislations.



VI. Practical

Detection and monitoring/ estimation of air, soil and water pollution; detection of pathogens from environmental sources. Visits to water/ sewage treatment plants.

Assignments

Each student will select at least two recent articles from journals related to course and discuss the same in the class through presentation.

VII. Suggested reading

1. Curtis SE. 1983. *Environmental management in animal agriculture*. Iowa State University Press.
2. Frumkin H. ed., 2016. *Environmental health: from global to local*. John Wiley and Sons.
3. Paustenbach DJ. ed., 2015. *Human and Ecological Risk Assessment: Theory and Practice* (Wiley Classics Library). John Wiley and Sons.
4. Sparling DW. 2016. *Ecotoxicology essentials: environmental contaminants and their biological effects on animals and plants*. Academic Press.

I. Course Title : Herd Health Management and Disease Economics

II. Course Code : VPE 708

III. Credit Hours : 2+1

IV. Aim of the course

Adoption of holistic approach to address issues of herd health without affecting production.

V. Theory

Unit I

General principles, interactions between health and production and herd immunity.

Unit II

Dairy cattle: mastitis, brucellosis and haemo-protozoan control and health management of dairy cows and calves.

Unit III

Health and production in swine, sheep, goats and poultry, vaccination, biosecurity practices for prevention and control of diseases.

VI. Practical

Visit to various bovine, equine, sheep, goat and poultry farms, assessment of their problems, systematic programmes for prevention and control of specific diseases and its impact, calculation of disease economics. Animal-house hygienic practices.

Assignments

Each student shall select at least two recent articles from journals related to course and discuss the same in the class through presentation.

VII. Suggested Reading

- Dijkhuizen AA and Morris RS. 1997. *Animal health economics. Postgraduate Foundation in Veterinary Science*, University of Sydney, Sydney, Australia.
- FAO. 2016. *Economic analysis of animal diseases*. FAO Animal Production and Health Guidelines. No. 18. Rome.
- Schwabe CW. 1984. *Veterinary Medicine and Human Health*, Baltimore: Williams and Wilkins
- Rushton, Jonathan. 2009. *The economics of animal health and production*. CABI.



- I. Course Title : Epidemiology of Trans-boundary, Non-infectious and Chronic Diseases**
- II. Course Code : VPE 709**
- III. Credit Hours : 2+1**

IV. Aim of the course

To provide students the expertise in elucidating epidemiology of non-infectious and chronic diseases.

V. Theory

Unit I

Establishment of causality and associations in non-infectious and chronic diseases. Characteristics of Koch's/ Henle-Koch postulates and Evans' rules of disease causation. Unified principles of establishing causality for both infectious and non-infectious diseases. Infectious disease and chronic disease connections. Causal role of infectious agents in cancer (relating criteria). Establishment of trends in disease occurrence. Epidemiology of non-infectious and chronic diseases affecting different systems in various animal species.

Unit II

Emerging infectious determinants of chronic diseases- reasons for emergence, range of pathways and epidemiology of chronic non-infectious disease. Study of characteristics of risk factors (genetic, physiological, environmental, behavioral, etc) associated with non-infectious and chronic diseases. Demographic, epidemiological and nutrition transition. Social determinants of non-communicable diseases. Spatial and temporal epidemiology of non-infectious diseases, viz., nutritional, reproductive, chemical poisoning, toxicity (pesticides, poisonous plants), metabolic diseases, toxicities, neoplastic and other miscellaneous diseases.

Unit III

Global status of non-communicable diseases. Modelling of non-infectious non-communicable diseases or chronic diseases. Economic Impact of chronic diseases. Prevention and control: current status and future perspectives.

VI. Practical

Measurement of burden of non-infectious and chronic diseases (mortality, morbidity, survival, risk factors, etc.). Controlled trials and short research problem(s) involving contemporary issues and research techniques. Animal models for the study of non-infectious and chronic diseases. Survey of non-infectious and chronic diseases using animal disease model systems.

VII. Suggested Reading

- Baldock C, Forman T, Geering B and Taylor B. 1999. *New Technologies in the fight against transboundary animal diseases*. In: FAO-Japan Cooperative Project: Collection of Information on Animal Production and Health. Rome, Italy: The Food and Agricultural Organization of the United Nations.
- Fernández PJ and White WR. 2016. *Atlas of transboundary animal diseases*. OIE (World Organisation for Animal Health).
- Martin SW, Meek AH and Willeberg P: *Veterinary epidemiology. Principles and methods*. 1986, IOWA State University Press/ Ames, Iowa, USA
- Noordhuizen JPTM, Frankena K, van der Hoofd CM and Graat EAM: *Application of*



quantitative methods in veterinary epidemiology. Wageningen Pers, Wageningen, Netherlands. 1997.

- Thrusfield M: *Veterinary epidemiology*. 1995. Blackwell Science Ltd. Oxford, UK.

- I. Course Title : Ecology and Animal/ Human Health**
II. Course Code : VPE 710
III. Credit Hours : 2+0

IV. Aim of the course

To acquaint students about ecological basis of disease.

V. Theory

Unit I

Establishment of links between animal/ human health with the ecosystems. Assessment of changing trends in the environments and its on the animal/ human health. Study of emerging public health threats linked to the changes in the environment. Study of landscape epidemiology of diseases. Study of contemporary issues centered on ecological and evolutionary perspectives of infectious diseases.

Unit II

Animal-human-ecosystem interface. Study of ecological/ environmental factors influencing spatio-temporal occurrence of disease such as temperature, rainfall and other environmental factors. Ecological conditions and evolutionary dynamics. Disease ecology based explanatory and predictive models. Elucidation of natural history and host-parasite interactions linked to the ecological factors.

Unit III

Ecology of vector borne diseases. Vector dynamics and ecology. Study extrinsic incubation period. Understanding of critical risk factors of spread such as timing, distribution, abundance of competent vectors.

Unit IV

Study of cyclical patterns of disease. Mapping environmental conditions with disease. Establishing functional links between environmental modifications and disease. Linking climate change with disease occurrence. Study of dynamics of ENSO with climate change and disease. Evolution of disease alert and forecasting systems. Use of global positioning and remote sensing tools for disease management. Early warning and GIS based disease predictions.

VI. Suggested reading

- Norrgren L and Levensgood JM. eds., 2012. *Ecology and Animal Health* (No. 2). Baltic University Press.
- Waltner-Toews, David. 2007. *The Chickens Fight Back: Pandemic Panics and Deadly Diseases that Jump from Animals to Humans*. Vancouver: Greystone Books
- World Health Organization. 2013. "Zoonoses and Veterinary Public Health." WHO

- I. Course Title : Diagnostic Approaches in Epidemiology**
II. Course Code : VPE 711
III. Credit Hours : 2+1

IV. Aim of the course

Learning of recent advanced molecular techniques for establishing disease diagnosis.



V. Theory

Unit I

The concept of molecular basis of a disease, molecular determinants of pathogenicity of infectious agents and their transmissibility to susceptible populations of livestock and poultry.

Unit II

Laboratory biosafety, Antigenic, Genetic and Biological characterization of field isolates of pathogens incriminated in field outbreaks, Differentiation of field and Vaccine strains, the concept of Marker vaccines, and Correlation of pathotypes and genotypes of a pathogen.

Unit III

Immunological tests, immunoblotting techniques and use of monoclonal antibodies in different ELISAs for antigenic analysis. Application of nucleic acid-based assays, viz., polymerase chain reaction (PCR) assays, nucleotide sequencing, restriction endonuclease analysis and RFLP analysis for genomic characterization using the field material directly or after extraction of nucleic acid from small scale cultures, use of radio-actively labelled or non-radioactive oligo-nucleotide probes in dot-blot and Southern hybridizations.

VI. Practical

Finger printing of the nucleic acid obtained from field isolates and their comparative analysis. PCR and ELISA for screening of field samples.

VII. Assignment

Each student shall select at least two recent articles from journals related to the course and discuss the same in the class through presentation.

VIII. Suggested reading

- Boniolo G and Nathan MJ. eds., 2016. *Philosophy of molecular medicine: Foundational issues in research and practice*. Taylor and Francis.
- Pfeiffer D. 1998. *Veterinary Epidemiology. An Introduction*. Institute of Veterinary, Animal and Biomedical Sciences. Massey University, Palmerston, New Zealand.
- Stites DP, Stobo JD, Fundenberg HH and Wells JV. 1982. *Basic and Clinical Immunology*, 4th Edition. Lange Medical Publications, Los Altos, USA.
- Thrusfield M. 2018. *Veterinary Epidemiology*, John Wiley and Sons.

I. Course Title : Surveys, Surveillance and Data Management

II. Course Code : VPE-712

III. Credit Hours : 2+1

IV. Aim of the course

To demonstrate different methodologies and procedures involved in conducting survey and surveillance and collection of data, analysis and interpretation of data. Systematic data collection, analysis and management

V. Theory

Unit I

Robust survey: Planning, Statistical models for the same and Surveillance, Purpose and method of sampling, Size of sample, Questionnaires. State, National and



International agencies (OIE, CDC, etc.), their data bases and their management systems.

Unit II

Goals and types of surveillance, monitoring, mechanism of surveillance and surveillance network.

Unit III

Disease/ data recording and reporting, vet. recording schemes, vet. information system and data bases.

Unit IV

Emergence of new diseases and re-emergence of old diseases. Epidemiology of globally and nationally important emerging/ re-emerging diseases and designing of strategies for their prevention and control.

VI. Practical

Prepare questionnaires on selective topics, survey for livestock and poultry farmers to find out usefulness/ effectiveness of vaccination/ artificial insemination/ other practices, surveillance of important diseases in different parts of state, data analysis and presentation of data, development of suitable software.

VII. Assignment

Each student will select at least two recent articles from journals related to course and discuss the same in the class through presentation.

VIII. Suggested reading

- Hawker J, Begg N, Reintjes R, Ekdahl K, Edeghere O and Van Steenberg JE. 2018. *Communicable disease control and health protection handbook*. John Wiley and Sons.
- Salman M. ed., 2008. *Animal disease surveillance and survey systems: methods and applications*. John Wiley and Sons.
- Thrusfield M. *Veterinary epidemiology*. John Wiley and Sons; 2018 Apr 30.

I. Course Title : Special Problem

II. Course Code : VPE 790

III. Credit Hours : 0+1

IV. Aim of the course

To provide expertise in handling practical research problem(s).

V. Practical

Short research problem(s) involving contemporary issues and research techniques. Presentation and discussion of novel research papers on the disease or intervention strategies such disease pathogenesis, pathobiology, epidemiology, host-agent-environmental relationships, molecular mechanisms/ diagnostics, spatio-temporal trends, etc. Planning a short research problem or working on a published research paper or new developments.



Course Outline-cum-Lecture Schedule for Doctoral Degree Programme

I. Course Title	: Advances in Veterinary Public Health and Epidemiology
II. Course Code	: VPE 701
III. Credit Hours	: 2+1

Lecture(s)	Topic
Theory	
1-3	Contemporary status of Veterinary Public Health in India and abroad. Public Health in the Twenty first Century
4	Veterinary public health and its role in the society
5-6	Role of veterinary public health professionals in prevention and control of zoonoses.
7	Opportunities for veterinary public health professionals
8-9	Organization and administration of veterinary public health agencies structure and functions
10-11	Data analysis framework in healthcare and social sectors
12-15	Evidence-based information updates on current VPH topics
16-17	Global animal disease surveillance
18-19	Recent diagnostic tools used for emerging public health problems including zoonoses
20-21	Molecular surveillance of recent pandemics of zoonoses
22-23	Modes of evolutionary emergence of disease agents pertinent to VPH
24-27	Application of bioinformatics, biotechnological and computational tools for food hygiene. food safety quality assurance environmental health protection
28-29	Global pandemic threat preparedness
30-31	Emerging Disease Surveillance and Control
32	Biomedical models in veterinary public health
Practical	
1	Assessment of health status of an individual
2-3	Estimation of disease burdens in a population
4-5	Estimation of burden of food-borne and zoonotic diseases
6	Molecular epidemiology and genetic analysis of agents of VPH significance
7	Case study related to field investigations of outbreaks of food poisoning
8	Case study related to zoonotic diseases in a community
9	Application of recent analytical methods (<i>in-vitro</i> , <i>in-vivo</i> and <i>in silico</i> techniques) used for public health research
10	Visits to hospitals to acquaint the students about public health related problems.
11	Health hazards across food supply chain
12	Hygiene of production/ processing of foods of animal origin
13	Safety management at the large-scale production or processing units of foods of animal origin
14	Longitudinal and integrated food safety assurance
15-16	Assignment: Each student will select at least two recent articles from journals related to the course and discuss in the class through presentation



I. Course Title	: Emerging, Re-emerging Zoonoses and One Health
II. Course Code	: VPE 702
III. Credit Hours	: 2+1

Lecture(s)	Topic
Theory	
1	Definitions – emerging and re-emerging zoonoses. Public health risks of emerging and re-emerging zoonoses
2	Status of emerging and re-emerging zoonotic infections
3	National and international interests in emerging and re-emerging zoonoses
4	Measurement of emerging and re-emerging zoonoses
5	Economics of emerging and re-emerging zoonoses
6	Factors responsible for emergence and re-emergence of zoonotic diseases
7	Role of wildlife in emerging and re-emerging zoonoses
8	Current concepts in the diagnosis of emerging and re-emerging diseases
9	Epidemiology and combating of emerging and re-emerging zoonotic diseases
10	Latest diagnostics and management planning for emerging and re-emerging zoonoses
11-12	Health threats at the human- animal-ecosystems/ environment interface (HAEI) - tripartite (OIE, WHO and FAO) initiatives
13	Comparative medicine and VPH - horizons and perspectives in emerging and re-emerging zoonotic infections
14	Current challenges and strategies in the area of euzoonoses, Xenozoonoses, nosocomial zoonoses and newer zoonotic agents
15-16	Characteristics, host range, epidemiology and management of Cat-scratch disease, Rat bite fever, Ebola and Marburg
17-18	Characteristics, host range, epidemiology and management of Lassa, Nipah, and Menangle viruses
19-20	Characteristics, host range, epidemiology and management of SARS, Toro, ZIKA and MERS virus infections
21	Characteristics, host range, epidemiology and management of zoonotic influenza viruses
22	Characteristics, host range, epidemiology and management of herpes and hepatitis (A and E) viruses
23	Characteristics, host range, epidemiology and management of co-infections, super-infections and syndemics - Simian and human immunodeficiency viruses
24	Characteristics, host range, epidemiology and management of taeniasis/ cysticercosis
25	Characteristics, host range, epidemiology and management of Bovine spongiform encephalopathy
26	Characteristics, host range, epidemiology and management of Creutzfeldt-Jacob disease
27	Characteristics, host range, epidemiology and management of brucellosis, tuberculosis and other emerging bacterial zoonoses
28	Guillain-Barre Syndrome and related sequel due to emerging/ re-emerging zoonoses
29-30	Close collaborations with regional, national and international organizations in the control of emerging/ re-emerging pathogens
31-32	Case study on emerging/ re-emerging zoonotic disease
Practical	
1	Application of safety regulations in laboratories, hospitals and biological units for handling emerging/ re-emerging agents
2	Methods to elucidate epidemiology of emerging/ re-emerging zoonoses



Veterinary Para-Clinical Subjects: Veterinary Public Health and Epidemiology

Lecture(s)	Topic
3	Approach to establish role of wildlife in emerging/ re-emerging zoonoses
4	Epidemiology of drug resistant emerging/ re-emerging zoonotic agents
5	Establishing genetic basis of bacterial emerging/ re-emerging zoonoses
6	Establishing genetic basis of viral and prion emerging/ re-emerging zoonoses
7	Establishing genetic basis of fungal, rickettsial and chlamydial emerging/ re-emerging zoonoses
8	Recommended diagnostic testing (OIE) for emerging/ re-emerging zoonoses
9	Vaccination and other strategies for the prevention of emerging/ re-emerging zoonoses
10	Application of Novel molecular methods for the understanding of emerging/ re-emerging zoonoses
11	Study abundance, behaviour, profiling and dynamics of vectors associated with emerging/ re-emerging zoonoses
12	Institutional surveillance of emerging/ re-emerging zoonoses
13	Visits to health centre to study of zoonotic diseases and categorization of agents as emerging/ re-emerging zoonosis
14	Special problem related to emerging/ re-emerging or prevalent zoonotic diseases
15-16	Assignment: Each student will select at least two recent articles from journals related to course and discuss in the class through presentation

I. Course Title : Advances in Food Safety and Quality Control of Foods of Animal/ Aquatic Origin

II. Course Code : VPE 703

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Food supply chain dynamics
2	Food production, processing and handling practices
3	Food safety and quality assurance of foods of animal origin
4	New age voluntary and mandatory food standards
5	Types and evolution of food standards
6	Characteristics of food safety hazards
7-8	Quality control, assurance and food safety specifications for animal origin foods such as meat, milk, egg and fish
9-10	Recent innovations in shelf-life extension, preservation and packaging
11	Requirements for food testing and calibration Laboratory Mechanism of food spoilage (microbial and non-microbial)
12	Nature of major food-borne infections and intoxications
13	Elimination of food safety hazards from primary production systems
14	Rapid detection of food safety hazards
15	Impact of animal feed on food safety. Prevention and control of risks arising due to animal feeds
16	Coordination of surveillance policies in animal health and food safety
17	Food safety challenges in animal production systems affecting global markets
18	Quality assurance schemes applicable to foods of animal origin
19	Veterinary services for public health and consumer safety
20	Food safety risk assessment
21	National food control systems and its elements



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Lecture(s)	Topic
22	Genesis of food quality/ safety standard
23-24	Food quarantine and export guidelines, specifications and standards
25	National and international food safety compliances
26	Traceability system - Traceability of foods of animal origin
27	Global considerations and role of committees and agencies associated with food safety, quality control and quality assurance
28	Trends in green technologies in food production and processing
29	Waste reduction along the food supply chain
30	Impacts and performance of organic farming <i>vis-a-vis</i> conventional farming
31	Consumer perspectives of food quality and safety
32	Environmental impact assessment of production of foods of animal origin
Practical	
1-2	Detection, enumeration and identification of food safety hazards
3	Pre-requisite programs for ensuring food safety
4	Environmental impact assessment
5	Application of generic traceability system for foods of animal origin
6	Detection of allergens associated with foods of animal origin
7	Emerging technologies for microbial control in food processing
8-9	Methods of management of waste arising from production and processing units (foods of animal origin including aquaculture)
10	Rapid alert system for food and feed
11-12	Visit to food processing establishments
13-14	Special problems on quality and safety of foods of animal origin foods
15-16	Assignment: Each student will select at least two recent articles from journals related to course and discuss in the class through presentation

I. Course Title : Biosecurity and Occupational Health Safety

II. Course Code : VPE 704

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Definitions: Bio-safety, bio-security and bio-containment; physical, chemical and biological hazards
2	Elements of bio-security and bio-containment
3	Nature of physical, chemical and biological hazards at work places
4-5	Bio-security requirements, Containment Barriers
6-7	Laboratory and equipment safety
8	Risk assessment
9	Bio-safety levels
10-11	Bio-safety in microbiological and bio-medical laboratories
13	Risk groups, classification of organisms by risk groups
14	Classification of occupational groups
15	Laboratory designs - Biosafety Level 1/ Animal Biosafety Level 1
16	Laboratory designs - Biosafety Level 2/ Animal Biosafety Level 2
17	Laboratory designs - Biosafety Level 3/ Animal Biosafety Level 3
18	Laboratory designs - Biosafety Level 4/ Animal Biosafety Level 4
19-21	Transmission, spread, maintenance and control of diseases affecting various occupational groups in contact with animals and their public health significance



Veterinary Para-Clinical Subjects: Veterinary Public Health and Epidemiology

Lecture(s)	Topic
22-23	Diseases associated with various occupations
24	Occupational safety and health
25	Occupational Health and Safety (OHS) management system standard ISO 45001
26	Regulations pertaining to the Occupational safety and health
27	Occupational Safety and Health Administration
28	Risk group classification, Bio-risk Management
29	Classification of infective microorganisms by risk groups
30	Institutional Biosafety Committees (IBCs)
31	The Bio-medical Waste Management (Amendment) Rules, 2018
32	International Labour Organization and its occupational safety provisions, Research Ethics and Compliance

Practical

1	Standard laboratory practices
2	Handling of Bio-safety cabinets
3-4	Detection of occupational diseases of public health significance
5	Relation of risk group to biosafety levels, practices and equipment
6-7	Design of BSL-1 to BSL-4 laboratories
8	Survey of biosafety and biosecurity in biomedical laboratories
9-11	Transportation of dangerous pathogens/ samples – modes, guidelines and regulations
13	Activity spectrum of detergents and disinfectants
14	Personal protection, Bio-risk Assessment Sheet and Material Safety Data Sheet (MSDS)
15	Case study on occupational safety in specialized laboratories
16	Case study on biosafety level 3 or 4 laboratory

I. Course Title : Recent Concepts in Epidemiology and Disease Forecasting

II. Course Code : VPE 705

III. Credit Hours : 2+1

Lecture(s)	Topic
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Theory

1	Epidemiological concepts of disease occurrence in population
2	Variations in disease by time, place, and animal/ person
3	Recent epidemiological approaches for elucidating cause and effect
4	Variations: Role of error, bias, and confounding
5	The concept of risk/ risk factor in relation to the disease
6	Characterization and quantification of risk in epidemiology
7	Concepts in the measures of disease frequency
8	Analysis and integration of data for epidemiological methods/ techniques
9	Concepts in epidemiological study designs
10	Recent concepts in the epidemiology of economically important bacterial animal diseases of the region (haemorrhagic septicaemia, brucellosis, etc)
11-12	Recent concepts in the epidemiology of economically important viral animal diseases, viz., FMD, Swine fever, Avian Influenza, Sheep Pox, IBD, NCD and others of the region
13-14	Recent concepts in the epidemiology of economically important fungal, parasitic



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Lecture(s)	Topic
	and other animal diseases of the region
15	Geographical Information System (GIS)
16	Advancements in GIS technology for epidemiological application in Veterinary and Animal Sciences
17	Various expert systems and their role in epidemiology
18	Concepts in animal disease modelling, Animal disease modelling, Disease prediction models
19	Modelling of economically important animal diseases
20	Modelling of emerging zoonotic infections
21	Advances in disease forecasting
22	Application of advanced disease forecasting concepts for animal/ zoonotic diseases
23	Disease early warning systems
24	Global and national disease early warning systems
25	Epidemiological softwares and their applications related to animal/ zoonotic infections
26	Common software packages and databases used in veterinary practice
27	Epidemiological Concepts Regarding Disease Monitoring and Surveillance
28	Advances in the practice of Public Health Surveillance
29	Real-time animal tracking using global positioning systems (GPS)
30	Use of advanced computing and remote sensing/ satellite technology for the study of animal/ zoonotic diseases
31	Case study related to application of recent epidemiological tool
32	Case study related to disease forecasting
Practical	
1	Use of Geographical Information System to study epidemiology of disease
2	Disease expert systems for animal/ zoonotic diseases
3	Disease modelling for animal/ zoonotic diseases
4	Model designing for disease forecasting
5	Study of epidemiology of disease outbreaks using advanced epidemiological techniques
6	Investigation of animal/ zoonotic diseases using recent epidemiological tools
7	Advanced disease reporting system
8	Study of animal/ zoonotic diseases using advanced computing tools
9	Study of animal/ zoonotic diseases using remote sensing/ satellite technology
10	Risk mapping for animal/ zoonotic diseases
11-12	Epidemiological exercises of economically important diseases of the region
13	Use of artificial intelligence and neural networks in veterinary epidemiology
14	Integrated disease surveillance system – prototype development
15	Case study related to advanced epidemiological tool
16	Case study related to advanced disease forecasting/ modelling

I. Course Title : Risk Analysis and Predictive Modelling

II. Course Code : VPE 706

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Definitions, History of risk analysis
2	Relevance of risk analysis (RA) to food sector



Veterinary Para-Clinical Subjects: Veterinary Public Health and Epidemiology

Lecture(s)	Topic
3	Principles of risk analysis
4	Risk analysis components (risk assessment, management and communication)
5	Risk assessment
6	Risk management
7	Risk communication
8	Microbial Risk Assessment (MRA) involving hazard identification, exposure assessment, hazard characterization, and risk characterization
9	Hazard identification
10	Exposure assessment
11	Hazard characterization
12	Risk characterization
13	Methodologies used in risk analysis (RA)/ Microbial Risk Assessment MRA
14	Qualitative and quantitative risk analysis
15	Qualitative risk analysis
16	Quantitative Microbial Risk Assessment (QMRA) for foods of animal origin including water
17	Application of mathematical models to study propagation of microbial hazards from farm-to-fork
18	Risk-based decision-making
19	Variability and uncertainty inherent to biological data
20	Measurement and modelling of uncertainty and variability during risk assessment.
21	Integration of risk assessment/ risk analysis with HACCP and other quality management or assurance systems
22	Linking microbial food safety with risk assessment
23	Relevance of assumptions and observed data for predictive models
24	Study of software packages used for risk analysis
25	Mathematical modelling of microbial growth rate in food/ feeds
26	Predictive modelling tools for food safety management
27	Microbial modelling for the prediction of product shelf-life and safety
28	Applications of predictive modelling of microbial behaviour in foods
29	Meta-analysis in risk analysis of animal/ zoonotic diseases
30	Risk prediction models
31	Multivariate prediction models
32	Case study related to MRA of foods of animal origin
Practical	
1.	Microbial Risk Assessment (MRA)
2.	Risk assessment
3.	Risk management
4.	Risk communication
5.	Qualitative MRA
6.	Quantitative MRA
7.	Modelling of infectious diseases using computational and mathematical methods.
8.	Building and analyzing models of infectious diseases
9.	Study of population-level processes for infectious diseases of animals and humans
10.	Performing risk analysis for food safety hazards using microbial risk analysis tools
11.	Risk assessment using high throughput simulation modelling
12.	Investigation of uncertainty, variability and sensitivity analysis techniques using computer models
13.	Risk prediction models – study of prototype
14.	Meta-analysis – study of prototype



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Lecture(s)	Topic
15.	Multivariate prediction models – study of prototype
16.	Case study on MRA

I. Course Title : Advances in Environmental Hygiene
II. Course Code : VPE 707
III. Credit Hours : 2+1

Lecture(s)	Topic
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Theory

- 1 Current status of problems pertaining to environmental hygiene
- 2 Status, impact and management of air pollution
- 3 Status, impact and management of global warming
- 4 Status, impact and management of soil pollution
- 5 Status, impact and management of water pollution
- 6 Status, impact and management of environmental problems
- 7 Impact of pollution on the ecology of diseases
- 8 Environmental impact of intensive animal husbandry
- 9 Impact of intensive animal husbandry on the public health
- 10 Animal sector consequences of carbon footprints
- 11 Eco-philosophy, policy and advocacy of environmental hygiene with veterinary/ animal husbandry perspectives
- 12 Environmental economics
- 13 Environmental conflicts and cooperation
- 14 Ethics and compliance - sustainable animal husbandry and environmental safety
- 15 Disinfects and disinfection procedures
- 16 Environmental risk analysis (assessment and management)
- 17 Occupational health impact of animal farming
- 18 Occupational environmental hygiene and safety linked to animals
- 19 Health risk profiling and risk analysis of animal farming and trade
- 20 Epidemiology of chronic occupational disease induced by environmental pollution
- 21 Ecotoxicology of toxicants used in the farming
- 22 Bio-accumulation, concentration and bio-magnification of pollutants, toxicants and hazardous substances in the environment
- 23 Reporting of environmental issues and global informatics
- 24 Environmental hazard surveillance and monitoring systems
- 25 Decision making and public awareness
- 26 Role of VPH in National Sanitation Programmes (Swachh Bharat Abhiyan and other governmental programmes)
- 27 International environmental management efforts
- 28 International organizations and programmes
- 29 Legislations on environmental hygiene, safety and policy
- 30 Case study on ammonia as pollutant from animal sector
- 31 Case study on hydrogen sulphide as pollutant from animal sector
- 32 Case study on methane as pollutant from animal sector

Practical

- 1 Hygiene and sanitization of animals and animal premises
- 2 Detection and monitoring of pollutants emanating from animals to the air
- 3 Detection and monitoring of pollutants emanating from animals to the soil



Veterinary Para-Clinical Subjects: Veterinary Public Health and Epidemiology

Lecture(s)	Topic
4	Detection and monitoring of pollutants emanating from animals to the water
5	Detection and monitoring of pollutants emanating from animals to other environmental sources
6	Advanced environmental hazard measurement methods
7	Measurement of health effects of environmental toxicants
8	Environmental risk assessment methods
9	Risk analysis of animal contributed ammonia
10	Risk analysis of animal contributed hydrogen sulphide
11	Risk analysis of animal contributed methane
12	Risk analysis of animal contributed other environmental hazards
13-14	Visits to remediation unit, waste water treatment plant, sewage treatment plants, tannery, etc. to study characteristics, impact and mitigation of hazards and associated risks
15-16	Assignments: Each student will select at least two recent articles from journals related to course and discuss in the class through presentation

I. Course Title : Herd Health Management and Disease Economics

II. Course Code : VPE 708

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	General principles of herd health
2	Interaction between health and production
3	Health effects of animal and zoonotic infections at the farm level
4	Direct and indirect losses due to zoonotic diseases
5	Components of the economic impact of animal diseases
6	Herd health management and disease economics
7	Linking herd health with economics – margin of returns
8	Health effects of animal and zoonotic infections at the regional/ state/ national/ international level
9	Interactions between health, production and disease
10	General principles of enhancing herd immunity
11	Economic methods of disease control for decision support
12	Herd health management – intervention options and their economic assessment
13	Quantification of financial effects of animal disease
14	Methods for optimizing decisions at individual animal, herd and population levels
15	Determination of costs and benefits of disease control measures
16	Estimation of extent of the disease and potential spread
17	Economic aspects and impact of zoonotic diseases
18	Estimation of cost of animal/ zoonotic disease on livelihoods outcomes (income, health, and trade), including environmental impacts
19	Assessment of the cost-effectiveness of control strategies used to reduce the risk of animal/ zoonotic diseases
20	Identification of factors affecting adoption of zoonotic risk reduction strategies
21	Estimation of disability adjusted life years (DALYs) parameters
22	Herd health management and disease economics of diseases in cattle/ buffalo
23	Herd health management and disease economics of diseases in sheep/ goat
24	Herd health management and disease economics of diseases in swine



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Lecture(s)	Topic
25	Herd health management and disease economics of diseases in poultry
26	Herd health management and disease economics of diseases in other livestock
27	Preventive healthcare through vaccination
28	Preventive healthcare through bio-security practices
29	Economic benefits of prevention and control of diseases
30	Zoning and creation of disease-free area
31	Disease eradication and surveillance
32	Case study on eradication of disease–Economic perspectives

Practical

1	Study of framework of animal health management
2	Steps and methods for assessment of the economic impact of a disease
3	Assessing economic merit of interventions to control disease
4	Decision analysis and decision support systems for promoting animal health
5	Modelling animal health economics
6	Modelling the economics of Veterinary Services at the Farm Level
7	Modelling the economics of National Disease Control Programs
8	Economic modelling techniques (i.e. partial budgeting, cost-benefit analysis, decision analysis, and systems simulation) for veterinary decision making
9	Economic assessment of problems, programmes, prevention/ control measures, impact, etc.
10	Economic evaluation of hygienic practices in the animal house
11	Estimation of burden of animal/ zoonotic diseases
12	Estimation of DALY and other disease parameters
13	Case study on economic impact of zoonotic diseases
14	Visit to various livestock farms, assessment of their problems
15-16	Assignments: Each student shall select at least two recent articles from journals related to course and discuss in the class through presentation

I. Course Title : Epidemiology of Trans-boundary, Non-infectious and Chronic Diseases

II. Course Code : VPE 709

III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Definition and characteristics of trans-boundary diseases
2	Global trends in the occurrence of trans-boundary diseases
3	Role of wildlife in emergence of trans-boundary diseases
4	Prevention/ control of trans-boundary diseases
5	Important trans-boundary diseases categorized according to the aetiology
6	Important trans-boundary diseases categorized according to the animal species
7	New Technologies to fight transboundary animal diseases
8	Role of veterinary public health and veterinary services in the management of non-infectious and chronic diseases
9	Establishment of causality and associations in non-infectious and chronic diseases
10	Characteristics of Koch's/ Henle-Koch postulates and Evans' rules of disease causation
11	Unified principles of establishing causality for both infectious and non-infectious diseases



Veterinary Para-Clinical Subjects: Veterinary Public Health and Epidemiology

Lecture(s)	Topic
12	Infectious and chronic disease connections
13	Causal role of infectious agents in cancer (relating criteria)
14	Global status of non-communicable diseases
15	Establishment of trends of non-infectious and chronic disease occurrence
16	Epidemiology of non-infectious and chronic diseases affecting different species (livestock/ poultry) and production systems
17	Determinants of chronic and non-infectious diseases- reasons for emergence range of pathways and epidemiology
18	Study of characteristics of risk factors (genetic, physiological, environmental, behavioural, etc) associated with non-infectious and chronic diseases
19	Demographic, epidemiological and nutritional factors
20	Economic impact of chronic and non-communicable diseases
21	Social determinants of non-communicable diseases
22	Spatial and temporal epidemiology of nutritional and metabolic diseases
23	Spatial and temporal epidemiology of reproductive diseases
24	Spatial and temporal epidemiology of chemical poisonings and toxicities (pesticides, poisonous plants, etc)
25	Spatial and temporal epidemiology of neoplastic and other miscellaneous diseases
26	Modelling of non-infectious non –communicable diseases or chronic diseases
27	Trends in the prevention and control of non-infectious and chronic disease – current status and future perspectives
28	Early detection, notification and surveillance
29	Participatory surveillance
30	Case study on vector-borne trans-boundary diseases
31	Case study on non-infectious chronic livestock disease
32	Case study on emerging/ re-emerging zoonotic trans-boundary diseases
Practical	
1	Detection and characterization of trans-boundary diseases
2	Capacity building and training
3	Study of the role of wildlife in trans-boundary animal diseases
4	Wildlife disease surveillance
5	Study of wildlife–livestock interface and disease ecology
6	Disease investigation - data and information collection, collation and sharing
7	Surveillance for trans-boundary diseases
8	Measurement of burden of non-infectious and chronic diseases (mortality, morbidity, survival, risk factors, etc.)
9	Survey of non-infectious and chronic diseases
10	Animal models for the study of non-infectious and chronic diseases
11	Establishment of evidence/ proof of causation of non-infectious and chronic diseases
12	Study of risk factors associated with non-infectious and chronic diseases
13	Measurement of socioeconomic impacts associated with non-infectious and chronic diseases
14	Controlled trials involving contemporary non-infectious and chronic diseases
15	Undertaking short research problem(s)
16	Case study on trans-boundary/ chronic livestock disease



I. Course Title : Ecology and Animal/ Human Health
II. Course Code : VPE 710
III. Credit Hours : 2+0

Lecture(s)	Topic
Theory	
1	Definitions related to ecology and animal or human health
2	Linkage between human/ animal health and the ecosystem
3	Spill-over of diseases – elucidation of social and ecological basis of disease
4	Assessment of changing trends in the environments and its impact on the animal/ human health
5	Study of emerging public health threats linked to the changes in the environment
6	Study of landscape epidemiology of diseases
7	Study of contemporary issues centred on ecological and evolutionary perspectives of infectious diseases
8	Animal–human-ecosystem interface
9	Study of ecological/ environmental factors influencing spatio-temporal occurrence of disease such as temperature, rainfall and other environmental factors
10	Ecological conditions and evolutionary dynamics
11	Disease ecology based explanatory and predictive models
12	Elucidation of natural history and host-parasite interactions linked to the ecological factors
13	Ecology of vector borne diseases
14	Vector dynamics and ecology
15	Study extrinsic incubation period
16	Understanding of critical risk factors of disease spread – timing, distribution, and abundance of competent vectors
17	Study of cyclical patterns of disease
18	Mapping environmental conditions with disease
19	Establishing functional links between environmental modifications and disease
20	Linking climate change with disease occurrence
21	Impact of climate change on disease occurrence
22	Study of dynamics of ENSO with climate change and disease
23	El Niño/ Southern Oscillation (ENSO), influence on global climate variability and disease occurrence
24	Evolution of disease alert and forecasting systems
25	Use of global positioning and remote sensing tools for disease management
26	Early warning and GIS based disease predictions
27	Role of bio-security measures in curtailing transmissible diseases at the animal-animal, animal-human and human-human interface
28	Biology and ecology of vector-borne diseases – ecology of disease – the intersection of human and animal health
29	Impact of ecological/ environmental factors on the emergence of human/ animal diseases
30	Clusters of disease outbreaks
31	Environmental impact of antimicrobial resistance
32	Preparedness for combating the impacts of climate change



I. Course Title	: Diagnostic Approaches in Epidemiology
II. Course Code	: VPE 711
III. Credit Hours	: 2+1

Lecture(s)	Topic
Theory	
1	Concepts of molecular basis of a disease
2	Molecular epidemiology of diseases/ infections
3	Molecular determinants of pathogenicity and virulence amongst agents
4	Dynamics of disease transmissibility in populations of livestock and poultry
5-6	Epidemiology of antigenic, genetic and biological diversity amongst pathogens associated with disease/ outbreaks
7	Differentiation of field isolates (wild) from vaccine strains (markers, DIVA, etc).
8	Marker vaccine development
9	Detection and characterization of pathotypes, serotypes, biotypes and genotypes of pathogens
10	Understanding epidemiology of disease using immunological, immunoblotting and monoclonal antibody-based tests
11	Understanding epidemiology of disease using conventional and rapid enzyme immune assays. Use of monoclonal antibodies in different ELISAs for antigenic analysis
12	Understanding epidemiology of disease using pathogen typing methods, viz., polymerase chain reaction, sequencing, RFLP, etc.
13	Understanding epidemiology of disease using radio-actively labelled or non-radioactive oligo-nucleotide probes - dot-blot and Southern hybridizations
14	Evaluation of diagnostic tests/ assays using epidemiological approaches
15	Vaccine efficacy/ effectiveness trails
16	Epidemiology of screening and confirmatory diagnostic assays
17	Estimation of disease burden in populations
18	Estimation of frequency and pattern of health events in a population
19	Designing of epidemiological studies
20	Representation disease data/ information
21	Study of disease databases and online resources
22	Quantification of zoonotic agents using conventional and molecular tools
23	Rapid detection of foodborne and zoonotic agents
24	On-site, on-farm and animal-side detection systems- approaches and applications
25	Phylogenetic analysis of disease agents
26	Use of modern bio-informatics and disease informatics tools for the study of zoonotic and other determinants of public health significance
27	Source tracing of origin of infectious agents
28	Outbreak investigation and disease reporting including notifiable diseases
29	Traceability of livestock and its implications
30	Multi-centric molecular typing and validation of foodborne and zoonotic agents
31	Epidemiology of chronic disease makers
32	Case study on quantitative epidemiological analysis
Practical	
1	Molecular fingerprinting of pathogens
2	Molecular epidemiology of foodborne and zoonotic agents
3-4	Detection and characterization of pathogens using nucleic acid based techniques
5	Sero-epidemiology – methods and applications
6-7	Multi-locus sequence typing (MLST), pulsed-field gel electrophoresis (PFGE), and amplified fragment length polymorphism (AFLP) typing of pathogens



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Lecture(s)	Topic
8	Source tracing of outbreaks
9	Construction and characterization of epidemic curve
10	Spatio-temporal clustering of diseases
11	Mapping disease and risk factors
12	Calculation of variables and confounders using logistic regression analysis
13	Epidemiological analysis for the disease prediction, early warning and forecasting
14	Epidemiological analysis involving remote sensing, GIS and satellite technologies
15-16	Assignment: Each student shall select at least two recent articles from journals related to the course and discuss in the class through presentation

I. Course Title : Surveys, Surveillance and Data Management
II. Course Code : VPE 712
III. Credit Hours : 2+1

Lecture(s)	Topic
Theory	
1	Robust survey: planning, statistical models. Survey iceberg (tools and technologies).
2	Structured population-based surveys, types of surveys.
3	Survey design - Sampling, Sampling methods, Sample size, etc.
4	National surveys.
5	Surveillance – definition, goals and types of surveillance system.
6	Principles of surveillance.
7	Critical elements of surveillance.
8	Surveillance methods and approaches.
9	Surveillance for distribution and occurrence of infection.
10	Information architecture for surveillance.
11	Structured non-random surveillance.
12	Surveillance programmes. Designing an active surveillance program.
13	Surveillance to demonstrate freedom from disease or infection.
14	Epidemiological surveillance network.
15	Components of regional or national surveillance system.
16	Statistical models for surveillance.
17	Softwares used for surveillance.
18	State, National and International agencies (OIE, CDC, etc.), databases and management systems.
19-20	Surveillance of emerging and re-emerging diseases
21	Animal health surveillance
22	Data and database
23-24	Data acquisition - Sampling and questionnaires
25	Disease/ data recording and reporting
26	Veterinary data recording schemes and information system (databases)
27	National veterinary epidemiology and disease informatics
28-29	Epidemiology informatics on globally and nationally important emerging/ re-emerging diseases and designing of strategies for their prevention and control.
30	Analysis of disease data using software analysis
31	Study of veterinary epidemiology and disease informatics software (e.g. EpiInfo)
32	Case study on disease surveillance



Lecture(s)	Topic
Practical	
1	Data collection, storage and quality control
2	Sampling methods - confidence level, sample unit, sample size, etc.
3	Statistical methods for analysis of disease data
4	Preparation and analysis of questionnaires
5	Questionnaire survey for disease prevalence
6	Data analysis using computer software
7	Data analysis and representation of data pertaining to animal disease/ productivity
8	Survey for livestock and poultry diseases
9	Study/ development of computer software for animal disease/ productivity
10	Evaluation of veterinary/ animal husbandry interventions
11	Evaluation of animal disease surveillance systems
12	Study of national health surveys related to animal/ human disease
13	Surveillance of economically important disease of the region/ state
14	Usefulness/ efficacy/ effectiveness of vaccines/ vaccination
15-16	Assignment: Each student will select at least two recent articles from journals related to course and discuss in the class through presentation





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Veterinary Para-Clinical Subjects

– Veterinary Pharmacology and Toxicology





Course Title with Credit Load

M.V.Sc. in Veterinary Pharmacology and Toxicology

Course Code	Course Title	Credit	Hours
VPT 601	Concepts of Pharmacology, Drug Design and Development*	2+0	
VPT 602	Autonomic and Autacoid Pharmacology*	2+1	
VPT 603	CNS Pharmacology	2+1	
VPT 604	Digestive and Respiratory Pharmacology	2+1	
VPT 605	Cardiovascular and Urinary System Pharmacology	2+0	
VPT 606	Endocrine and Reproductive Pharmacology	2+1	
VPT 607	Chemotherapy*	2+1	
VPT 608	Toxicology of Xenobiotics*	2+1	
VPT 609	Toxinology	2+1	
VPT 610	Pharmacological Techniques*	0+2	
VPT 611	Techniques in Toxicology*	0+2	
VPT 612	Ethnopharmacology	1+1	
VPT 613	Fundamentals of Pharmacokinetics	1+1	
VPT 691	Master's Seminar*	1+0	
VPT 699	Master's Research		30

*Core courses



Course Contents

M.V.Sc. in Veterinary Pharmacology and Toxicology

- I. Course Title** : Concepts of Pharmacology, Drug Design and Development
- II. Course Code** : VPT 601
- III. Credit Hours** : 2+0

IV. Aim of the course

To study the basic concepts of drug actions, and drug design and development.

V. Theory

Unit I

Scope of pharmacology, Drugs and other therapeutic agents, Principles of biopharmaceutics and veterinary dosage forms, Dynamics of ADME; Principles of therapeutics; Rationale and Empirical, Various other types of therapeutics.

Unit II

Pharmacodynamics targets for drug actions (enzymes, ion channels, structural and transporter proteins) evidence of drug action through receptor, Signal transduction mechanisms (GPCR, enzyme linked receptor), Regulation and malfunctioning of diseases.

Unit III

Quantitation of drug-receptor interactions and elicited effects, Drug-drug interactions and adverse drug reactions.

Unit IV

Drug invention: Screening, Assaying, Designing and Development of drugs, Clinical trials, Drug safety, Regulations and standards; Gene based therapy and drug delivery system.

- I. Course Title** : Autonomic and Autacoid Pharmacology
- II. Course Code** : VPT 602
- III. Credit Hours** : 2+1

IV. Aim of the course

To study the pharmacological basis of the therapeutic uses of autonomic and autacoid drugs.

V. Theory

Unit I

Anatomical and physiological considerations of autonomic and somatic motor nervous system and Neurohumoral transmission.

Unit II

Agents modulating peripheral nervous system, Non-adrenergic-non cholinergic (NANC) transmission.



Unit III

Pharmacology of adrenergic agonists, Antagonists and Adrenergic neuron blockers.

Unit IV

Pharmacology of cholinergic agonists, Antagonists and cholinergic neuron blockers.

Unit V

Drugs acting at the Neuromuscular Junction and Autonomic Ganglia.

Unit VI

Autacoids: Introduction to immunity and inflammation, Immunostimulants, Immunosuppressants and Tolerogens, Pharmacological aspects of histamine, serotonin, kinins, eicosanoids and platelet activating factor, Angiotensins and other putative autacoids.

VI. Practicals

Pharmacological experiments on intact and isolated preparations for studying the effects of various prototype autonomic and autacoids drugs on vascular, intestinal, respiratory, urinary and reproductive smooth muscles, autonomic ganglia, skeletal muscles; blood pressure, ECG, heart, etc.

I. Course Title : CNS Pharmacology

II. Course Code : VPT 603

III. Credit Hours : 2+1

IV. Aim of the course

To study the pharmacology of drugs acting on central nervous system (CNS).

V. Theory

Unit I

Anatomical and physiological considerations and neurohumoral transmission in CNS.

Unit II

Historical development, theories, principles and stages of general anaesthesia.

Unit III

Recent advances in pharmacology of general anaesthetics and therapeutic gases, local anaesthetics, sedatives, hypnotics, neuroleptics, antiepileptics.

Unit IV

Pharmacology of CNS stimulants, analeptics, opioid agonists and antagonists; non-steroidal anti-inflammatory agents, central muscle relaxants, Pharmacology and regulations of euthanizing agents.

VI. Practicals

Study of pharmacodynamics of prototype drugs of each class of drugs in experimental animals.



- I. Course Title : Digestive and Respiratory Pharmacology**
II. Course Code : VPT 604
III. Credit Hours : 2+1

IV. Aim of the course

To study the pharmacological aspects of drugs acting on digestive and respiratory systems.

V. Theory

Unit I

Physiological considerations of GIT functions in ruminants and non-ruminants. Pharmacology of drugs acting on gastrointestinal tract. Appetite stimulants, emetics and anti-emetics.

Unit II

Pharmacology of anti-ulcer drugs, modulators of gastric and intestinal motility and secretions.

Unit III

Agents promoting digestive functions; bile acids and pancreatic enzymes, drugs affecting liver; rumen pharmacology.

Unit IV

Gastrointestinal protectant and adsorbents, laxatives and cathartics.

Unit V

Physiological considerations of respiratory functions in animals. Pharmacology of drugs acting on respiratory system: Bronchodilators, Antitussives, Mucolytics, Expectorants, Decongestants. Drugs used in treatment of asthma.

VI. Practicals

Study of effects of drugs on digestive and respiratory functions using different *in-vitro* and *in vivo* animal models.

- I. Course Title : Cardiovascular and Urinary System Pharmacology**
II. Course Code : VPT 605
III. Credit Hours : 2+0

IV. Aim of the course

To study the pharmacological aspects of drugs acting on CVS and kidneys.

V. Theory

Unit I

Cardiac electrophysiology consideration, Pharmacology of antiarrhythmic drugs, Cardiac glycosides, Myocardial stimulants.

Unit II

Antihypertensive, Antihypotensive and Antihyperlipidaemic drugs.

Unit III

Coagulants and anticoagulants, Thrombolytic agents, Plasma expanders, Drugs affecting haemopoietic system and antiplatelet drugs.



Unit IV

Pharmacology of drugs affecting renal functions and fluid-electrolyte balance: Diuretics, Antidiuretics, Urinary acidifiers, Urinary alkalizers, Urinary antiseptics and Uricosuric and other anti-gout drugs. Principles of acid-base balance, fluid and electrolyte therapy and blood substitutes.

I. Course Title : Endocrine and Reproductive Pharmacology

II. Course Code : VPT 606

III. Credit Hours : 2+1

IV. Aim of the course

To study the pharmacology of drugs affecting endocrine functions.

V. Theory

Unit I

Drugs affecting endocrine functions of hypothalamus, pituitary, thyroid, adrenals and pancreas.

Unit II

Drugs affecting calcium and phosphorus homeostasis.

Unit III

Drugs affecting male reproductive organs, spermatogenesis and erectile dysfunctions.

Unit IV

Drugs affecting female reproductive organs: ovulation, oestrus, conception, gestation and lactation.

Unit V

Oxytocic and other drugs affecting uterus.

VI. Practicals

To study the effects of various endocrine agonists and antagonists in animal models and isolated tissues.

I. Course Code : VPT 607

II. Course Title : Chemotherapy

III. Credit Hours : 2+1

IV. Aim of the course

To study the recent advances in chemotherapeutic agents with relevance to their molecular mechanisms and therapeutic aspects.

V. Theory

Unit I

General consideration and principles of Chemotherapy, Classification of chemotherapeutic agents; Molecular mechanism of Antimicrobial resistance-development and Prevention strategies; Combination therapy, Therapeutic failure.

Unit II

Systemic and gut acting sulphonamides, diaminopyrimidines, sulfones, quinolones, nitrofurans, nitroimidazoles.



Unit III

Penicillins, Cephalosporins, Carbapenems, Carbacephem, monobactam, beta lactamase inhibitors.

Unit IV

Aminoglycosides, Tetracyclines, Chloramphenicol and its congeners, macrolides, lincosamides.

Unit V

Antitubercular drugs, Glycopeptides, and Polypeptide antibiotics, Methenamine, Carbadox, Novobiocin, Virginiamycin, Spectinomycin, Oxazolidinones and newer agents.

Unit VI

Antiprotozoans, Anthelmintics, Ectoparasiticides

Unit VII

Antifungal agents, Antiviral and Anti-neoplastic drugs.

VI. Practicals

Assay of chemotherapeutic agents, Antibiotic sensitivity tests. Determination of minimum inhibitory concentration (MIC), Mutant Prevention Concentration (MPC), Minimum Bactericidal Concentration (MBC) and time kill kinetics. Molecular techniques for intervention of antimicrobial resistance. Determination of anthelmintic properties of drugs using *in-vitro* models.

I. Course Title : Toxicology of Xenobiotics

II. Course Code : VPT 608

III. Credit Hours : 2+1

IV. Aim of the course

To study the molecular basis of poisoning and antidotal therapy in animals.

V. Theory

Unit I

Principles and scope of toxicology.

Unit II

Molecular mechanism of action of poisons and their detoxification, rational approach for diagnosis and treatment of poisonings.

Unit III

Toxicology of metals, non-metals, agrochemicals, solvents and vapors, common salt, urea and other feed additives. Toxicity of drugs.

Unit IV

Genotoxic and other effects of radiations and radioactive chemicals; toxicogenomics and developmental toxicology; forensic and regulatory aspects of toxicology.

VI. Practicals

Extraction, separation and detection of common poisons in toxicological specimens, study of toxicity and antidotal treatment in animals, designing of animal toxicity experiments and general toxicity spot tests.



- I. Course Title : Toxicology**
II. Course Code : VPT 609
III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge of molecular basis of toxicity induced by toxins of plants, microbes and animals origin.

V. Theory

Unit I

Classification and identification of different types of toxins.

Unit II

Toxicity induced by abrin, strychnine, dhurin, amygdaline, sanguine, solamine, gossypol, beta-amino propionitryl, beta-oxolyl amino L-alanine, other Phytotoxins

Unit III

Toxin induced Teratogenicity, Thiamine deficiency and Phototoxicity.

Unit IV

Toxicology of mycotoxins: aflatoxins, rubratoxins, ochratoxins, sporidesmin, citrinin, F-2 toxin, trichothecenes, tremorgens and ergot alkaloids.

Unit V

Zootoxins: snake venom, scorpion, spider and insect stings and bufotoxins, Puffer fish and Shell fish toxins. Bacterial toxins (botulinum and tetanus toxins)

VI. Practicals

Detection of alkaloids, glycosides, cyanides, nitrate/ nitrite, tannins, saponins, resins and oxalates. Detection of mycotoxins in the samples of feed/ fodder and animal tissue. Identification of toxic weeds and plants of the state/ local area.

- I. Course Title : Pharmacological Techniques**
II. Course Code : VPT 610
III. Credit Hours : 0+2

IV. Aim of the course

To impart the knowledge of various pharmacological techniques and screening methods of drugs.

V. Practicals

Unit I

Principles of drug action and bioassay. Construction of dose-response plots and their significance. Determination of EC₅₀, median effective (ED₅₀), toxic (TD₅₀) or lethal doses (LD₅₀) from dose-response plots. Calculation of dissociation rate constants, therapeutic ratio, margin of safety, potency ratio, pA_x, pD_x and pD'_x values.

Unit II

Techniques for setting up isolated and intact preparations, recording of BP in hen/ rat, recording of ECG in rat/ other small animals.



Unit III

Organization of screening programme of drugs; multidimensional screening procedures and gross observational methods. Specific tests for evaluation of tranquillizing, hypnotic, analgesic, anticonvulsant, general and local anaesthetic, muscle relaxant, anti-inflammatory, antipyretic, antiarrhythmic, antihypertensive and antihyperglycemic activities.

Unit IV

Guidelines for safety studies on drugs.

- I. Course Title : Techniques in Toxicology**
- II. Course Code : VPT 611**
- III. Credit Hours : 0+2**
- IV. Aim of the course**

To understand the animal toxicity tests and assessment of various toxicants using specific tests.

V. Practicals

Unit I

Designing of animal models in toxicological studies. Introduction to different toxicological guidelines for *in-vitro* and *in vivo* studies (OECD, WHO, EPA, etc.). In silico toxicity prediction.

Unit II

Animal toxicity tests for acute, sub-acute and chronic toxicity.

Unit III

Specific toxicity tests for Neurotoxicity, Immunotoxicity, Behavioural, Reproductive and Developmental, Inhalation Toxicity, Mutagenicity, Carcinogenicity.

Unit IV

Toxicological tests for the study of metabolism, synergism and antagonism. Assay for marker enzymes, analysis of toxicant residues in biological materials.

- I. Course Title : Ethnopharmacology**
- II. Course Code : VPT 612**
- III. Credit Hours : 1+1**
- IV. Aim of the course**

To impart the knowledge and importance of traditional Indian medicine.

V. Theory

Unit I

Historical aspects of traditional Indian remedies. Alternate systems of medicine in animals. Scope of Ethnopharmacology.

Unit II

Classification and identification of medicinal plants. Classification, Metabolism and interactions of Phytoconstituents.



Unit III

Standardization and clinical validation of bioactive molecules from plant sources. Therapeutic and adverse effects of potential herbal drugs. Indigenous drugs used as galactagogues, carminatives, antiseptics, antidiarrhoeals, anthelmintics, Immunostimulants, antimicrobials, bioenhancers, analgesics, anti-inflammatory agents, etc.

VI. Practicals

Identification of medicinal plants. Preparation of plant extracts in various solvents using different techniques. Phytochemical screening of plant extracts. Evaluation of pharmacological activities of extracts using *in-vitro* and *in-vivo* methods.

I. Course Title : Fundamentals of Pharmacokinetics

II. Course Code : VPT 613

III. Credit Hours : 1+1

IV. Aim of the course

To study the disposition of drugs and dosage regimen.

V. Theory

Unit I

Routes of drug administration, ADME, plasma protein binding, factors modifying ADME

Unit II

Basic concept of pharmacokinetics, Order of pharmacokinetics processes (zero order, first order and mixed order), Models of pharmacokinetics analysis of drugs (compartmental, non-compartmental model)

Unit III

Compartmental models of drug distribution, determinants of absorption, distribution and elimination, rate constants (C_{max} , T_{max})

Unit IV

Calculation of pharmacokinetic parameters, dosage regimen and bioavailability based on compartmental analysis, Non-compartmental pharmacokinetic modelling.

VI. Practicals

Analysis of pharmacokinetic data and determination of different pharmacokinetic parameters and bioavailability of drugs in normal and diseased animal models.



Course Outline-cum-Lecture Schedule for Master Degree Programme

- I. Course Title** : Concepts of Pharmacology, Drug Design and Development
- II. Course Code** : VPT 601
- III. Credit Hours** : 2+0
- IV. Aim of the course**
To study the basic concepts of drug actions, and drug design and development.
- V. Lecture/ Practical schedule**

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Scope of pharmacology, nature and sources of drugs and other therapeutic agents	2
2.	Principles of biopharmaceutics and dosage forms of drugs	2
3.	Principles of Pharmacokinetics-Absorption, distribution, metabolism and excretion of drugs.	4
4.	Principles of drug action, rational, empirical and various other therapeutics	2
5.	Pharmacodynamics-targets for drug actions (enzymes, ion channels, structural and transporter proteins)	4
6.	Receptor mediated drug action, types of drug receptors, second messengers of drug action and signal transduction	4
7.	Regulation and malfunctioning of diseases.	1
8.	Quantitation of drug-receptor interactions and elicited effects	2
9.	Drug interactions and adverse drug reactions	2
10.	Drugs design and development, Screening and drug assay	3
11.	Clinical drug trials	2
12.	Drug safety, drug standards and regulations	2
13.	Gene therapy and novel drug delivery systems.	2

- I. Course Title** : Autonomic and Autacoid Pharmacology
- II. Course Code** : VPT 602
- III. Credit Hours** : 2 + 1
- IV. Aim of the course**

To study the pharmacological basis of therapeutic uses of autonomic and autacoid drugs.

**V. Lecture/ Practical schedule**

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction to autonomic nervous system (ANS), Anatomical and physiological considerations of autonomic and somatic motor nervous system	2
2.	Neurohumoral transmission	2
3.	Exceptions to generalization of ANS, Agents modulating peripheral nervous system, non adrenergic-non cholinergic (NANC) transmission	3
4.	Sympathetic nervous system, adrenergic agonists, antagonists and adrenergic neuron blockers	4
5.	Therapeutic uses of sympathetic drugs and blockers	1
6.	Parasympathetic nervous system, cholinergic agonists, antagonists and cholinergic neuron blockers	4
7.	Therapeutic uses of parasympathetic drugs and blockers	1
8.	Ganglion stimulating and blocking drugs	2
9.	Neuromuscular blocking drugs	1
10.	Introduction to immunity and inflammation	2
11.	Immunostimulants, immunosuppressants and tolerogens	1
12.	Histaminergic and antihistaminics	2
13.	Serotonin and antiserotonin agents	1
14.	Kinins as mediators of inflammation	2
15.	Eicosanoids and platelet activating factor	3
16.	Angiotensins and other putative autacoids	2
17.	Angiotensins and inhibitors of renin-angiotensin system	1
Practical		
1.	Effect of sympathetic agonists and antagonists on intact and isolated preparations through experiments/ simulation programmes.	5
2.	Effect of sympathetic agonists and antagonists on intact and isolated preparations through experiments/ simulation programmes.	5
3.	Effects of autonomic drugs on blood pressure, ECG, etc.	2
4.	Effect of autacoids on different systems	4

I. Course Title : CNS Pharmacology

II. Course Code : VPT 603

III. Credit Hours : 2 +1

IV. Aim of the course

To study the pharmacology of drugs acting on central nervous system (CNS)

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction to CNS – Physiological and anatomical considerations	1
2.	Drugs action on CNS	1
3.	Central neurotransmitters	2



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
4.	General anaesthesia – History, theories and stages of general anaesthesia	1
5.	Adjuvants to general anaesthetics	1
6.	Inhalant general anaesthetics	3
7.	Injectable general anaesthetics	3
8.	Local anaesthetics	2
9.	Hypnotics and sedatives	3
10.	Psychotropic drugs and drugs modifying abnormal behaviour of animals	3
11.	Anticonvulsants	2
12.	Opioid agonists (analgesics) and antagonists	3
13.	Non steroidal anti-inflammatory drugs (NSAIDs)	3
14.	CNS stimulants	1
15.	Central muscle relaxants	1
16.	Drugs of abuse	2
17.	Currents topics/ Discussion on library assignments	2
Practicals		
1.	Study on general anaesthetics	1
2.	Study on local anaesthetics	2
3.	Study on sedatives and hypnotics	2
4.	Study on anticonvulsants	1
5.	Study on antipyretics	1
6.	Study on analgesics	2
7.	Study on anti-inflammatory drugs	2
8.	Study on psychotropic drugs	2
9.	Study on CNS stimulants	1
10.	Study on central muscle relaxants.	1

I. Course Title : Digestive and Respiratory Pharmacology

II. Course Code : VPT 604

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the pharmacological aspects of drugs acting on digestive and respiratory systems.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Drugs affecting salivary secretions – Sialics and antisialics	1
2.	Drugs affecting gastric secretion – Stomachics, histamine and gastrin analogues	2
3.	Gastric antisecretory and antiulcer drugs – H ₂ -receptor antagonists and proton pump inhibitors	2
4.	Antacids	2
5.	Emetics	1
6.	Antiemetics	2
7.	Carminatives and antizymotics	1



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
8.	Appetizers and digestants	1
9.	Pro-kinetics	2
10.	Cathartics	2
11.	Antidiarrhoeic drugs	2
12.	Physiological basis of renal pharmacology	2
13.	Diuretics	3
14.	Drugs affecting fluid, electrolyte and acid-base balance	2
15.	Drugs affecting urinary pH and tubular transport	1
16.	Antitussives	1
17.	Expectorants	1
18.	Analeptics	1
19.	Bronchodilators and other drugs acting on respiratory system	1
20.	Drugs acting on skin and mucous membrane – Demulcents, emollients, protectants, counterirritants, caustics, keratolytics, and wound cleansing agents	2
21.	Current topics/ Discussion on library assignments.	2
Practicals		
1.	Effects of drugs on digestive functions using different <i>in-vitro</i> models	4
2.	Effects of drugs on digestive functions using <i>in vivo</i> animal models	4
3.	Effects of drugs on respiratory functions using different <i>in-vitro</i> models	4
4.	Effects of drugs on respiratory functions using different animal models	

I. Course Title : Cardiovascular and Urinary System Pharmacology

II. Course Code : VPT 605

III. Credit Hours : 2 + 0

IV. Aim of the course

To study the pharmacological aspects of drugs acting on CVS and kidneys.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	General considerations to cardiovascular system	2
2.	Myocardial stimulants – Cardiac glycosides and other myocardial stimulants	3
3.	Anti-arrhythmic drugs	3
4.	Vasodilators and antianginal drugs	2
5.	Antihypertensive agents	1
6.	Haemostatics and coagulants	2
7.	Anti-coagulants	2
8.	Fibrinolytic and anti-platelet drugs	1
9.	Haemtaopoietic drugs	2
10.	Blood components and blood substitutes	1
11.	Drugs used in treatment of shock	2
12.	Antihyperlipoproteinemics	1
13.	Physiological basis of renal pharmacology	2
14.	Diuretics	3



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
15.	Drugs affecting fluid, electrolyte and acid-base balance	3
16.	Drugs affecting urinary pH and tubular transport	2
17.	Current topics/ Discussion on library assignments	2

I. Course Title : Endocrine and Reproductive Pharmacology

II. Course Code : VPT 606

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the pharmacology of drugs affecting endocrine functions.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	General considerations to Endocrine and reproductive systems	2
2.	Pharmacology of drugs affecting endocrine functions of Pituitary gland	3
3.	Pharmacology of drugs affecting endocrine functions of thyroid gland	2
4.	Pharmacology of drugs affecting endocrine functions of adrenals	3
5.	Pharmacology of drugs affecting endocrine functions of the Pancreas	2
6.	Physiological basis of calcium and phosphorus homeostasis	2
7.	Hormonal regulation of calcium and phosphorus homeostasis.	2
8.	Pharmacology of drugs affecting male reproductive organs,	2
9.	Drugs affecting spermatogenesis	2
10.	Pharmacology of drugs affecting female reproductive organs	2
11.	Drugs affecting ovulation	2
12.	Drugs affecting oestrus	1
13.	Drugs affecting conception	2
14.	Drugs affecting gestation	2
15.	Drugs affecting lactation	2
16.	Current topics/ Discussion on library assignments	3
Practicals		
1.	Effects of various hormones in animal models and isolated tissues.	4
2.	Effects of various hormones in and isolated tissues	4
3.	Effects of different hormone antagonists in animal models	4
4.	Effects of different hormone antagonists in isolated tissues	4

I. Course Title : To study the recent advances in chemotherapeutic agents with relevance to their molecular mechanisms and therapeutic aspects.

II. Course Code : VPT 607

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the recent advances in chemotherapeutic agents with relevance to their molecular mechanisms and therapeutic aspects.

**V. Lecture/ Practical schedule**

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	General principles of antibacterial therapy, classification of antibacterial drugs, clinical use of antibiotics, antibiotic combinations. Bacterial resistance	2
2.	Sulfonamides	2
3.	Penicillins and Beta-lactamase inhibitors	2
4.	Cephalosporins	2
5.	Aminoglycosides and Aminocyclitols	2
6.	Chloramphenicol and Thiamphenicol	2
7.	Tetracyclines	2
8.	Macrolide antibiotics and Membrane antibiotics	2
9.	Quinolones – Spectrum, mechanism, kinetics and uses	2
10.	Antifungal agents	2
11.	Antiviral agents	2
12.	Anticancer agents – General principles, classification, mechanism, toxicity, uses	2
13.	Anthelmintics – Antinematodal drugs, Anticestodal drugs, Antitrematodal drugs	2
14.	Ectoparasiticides	2
15.	Antiprotozoan Drugs	2
16.	Antitubercular drugs	2
17.	Current discussions and assignments	2
Practical		
1.	General methods for assay of chemotherapeutic agents	2
2.	Estimation of sulfonamides in biological fluids	2
3.	Estimation of penicillins in biological fluids	3
4.	Estimation of oxytetracyclines in biological fluids	2
5.	Estimation of trimethoprim in biological fluids	2
6.	Estimation of nitrofurans in biological fluids	2
7.	Antibiotic sensitivity tests	2

I. Course Title : Toxicology of Xenobiotics

II. Course Code : VPT-608

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the molecular basis of poisoning and antidotal therapy in animals.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction, definitions and fields of toxicology	1
2.	History and scope of toxicology	1
3.	Sources and classification of toxicants	1
4.	General modes of action of poisons	1



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
5.	Detoxification of poisons	2
6.	Principles and fundamentals of toxicology	3
7.	Factors affecting toxicity	1
8.	Diagnosis of poisoning	2
9.	Treatment and management of poisonings	2
10.	Toxicology of metals – Arsenic, mercury, lead, copper, molybdenum, cadmium and iron	5
11.	Toxicology of agrochemicals – Insecticides, herbicides, fungicides and rodenticides	5
12.	Toxicology of solvents and vapours	2
13.	Feed additives – Growth and performance enhancers, non-protein nitrogen compounds, common salt	2
14.	Radiations and radioactive chemicals	2
15.	Genetic and developmental toxicology	2
16.	Regulatory and forensic toxicology	2
17.	Current topics/ Discussion of library assignments	2
Practical		
1.	Collection of material for toxicological investigations	2
2.	Dispatch and processing of samples for toxicological investigations	2
3.	Extraction and separation of poisons from toxicological specimens	2
4.	Identification and detection of common poisons	3
5.	Designing and experiments for acute, subacute and chronic toxicities	2
6.	Calculation of TD50 and LD50	2
7.	Antidotal treatment in animals	2

I. Course Title : Toxinology

II. Course Code : VPT 609

III. Credit Hours : 2 + 1

IV. Aim of the course

To impart knowledge of molecular basis of toxicity induced by toxins of plants, microbes and animals origin.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Classification, identification and chemical constituents of poisonous plants	2
2.	Nitrate/ nitrite poisoning: sources, mechanism of toxicity, clinical findings, diagnosis, treatment and control	2
3.	Cyanide poisoning – Causes, cyanogenetic plants: jowar, etc., mechanism of toxicity diagnosis and treatment	2
4.	Photosensitization – <i>Lantana camara</i> : mechanism of toxicity, clinical signs and treatment	2
5.	Bracken fern poisoning – Clinical signs, diagnosis and treatment	2
6.	Poisoning due to strychnos nux-vomica, Ricinus communis and	



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
	kaner – Mechanism of toxicity, clinical signs, diagnosis and treatment	2
7.	Toxicity due to dhatura, Abrus precatorius, Ipomoea carnea – Mechanism of toxicity, clinical signs and treatment	2
8.	Toxicity due to plants containing oxalate – Mechanism of toxicity, clinical signs and treatment	2
9.	Mycotoxins – Hepatotoxins (sporidesmin, aflatoxins and rubratoxins): mechanism of toxicity, symptoms and treatment	2
10.	Nephrotoxins (ochratoxin, citrinin) neurotoxins (penitren A and Patulin). Ergot alkaloids, estrogenism and Trichothecene toxins: clinical signs and treatment	3
11.	Bacterial toxins – Diphtheria toxins, Botulinum toxin, Cholera toxin, tetanus toxin, E.coli., Enterotoxin, Endotoxin	3
12.	Toxicity due to snake venom – Mechanism of toxicity, clinical signs and treatment	3
13.	Toxicity due to scorpion – Mechanism of toxicity, clinical signs and treatment	2
14.	Toxicity due to spider and insect stings and toad poisoning – Mechanism of toxicity, clinical signs and treatment	2
15.	Current topics/ Discussion of library assignments	3
Practicals		
1.	Detection of alkaloids, glycosides, cyanides, nitrate/ nitrite, tannins, saponins, resins and oxalates in toxic plants	8
2.	Phytochemical analysis of toxic plant extracts	2
3.	Detection of mycotoxins in the samples of feed/ fodder and animal tissue	2
4.	Identification of toxic weeds and plants of the state/ local area	2

I. Course Title : Pharmacological Techniques

II. Course Code : VPT 610

III. Credit Hours : 0 + 2

IV. Aim of the course

To impart the knowledge of various pharmacological techniques and screening methods of drugs.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Practicals		
1.	Principles of drug action	1
2.	Bioassay. Types of bioassay, bioassay techniques	3
3.	Setting up of an isolated tissue preparation and an intact preparation	2
4.	Study of dose response relationship	2
5.	Suprmaximal effect by cumulative dose response study	1
6.	Study on isolated organ assembly	3
7.	Intact frog heart perfusion	1
8.	Recording of blood pressure in animals	2
9.	Recording of ECG in animals	1



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
10.	Screening Programme of drugs: General and multidimensional	2
11.	Gross observational methods in Screening procedures	2
12.	Calculation of EC50, potency ratio, PDv, PDx PD values	1
13.	Screening of hypnotic activity	1
14.	Study of analgesic, antipyretic and anti-inflammatory activity in laboratory animals	2
15.	Study of general and local anaesthesia in experimental animals	1
16.	Study of anticonvulsant and muscle relaxant effect of drugs	2
17.	Study of antiarrhythmic and antihypertensive action of test compound	2
18.	Study of antihyperglycemic and anticholinesteric activity	1

I. Course Title : Techniques in Toxicology

II. Course Code : VPT 611

III. Credit Hours : 0 + 2

IV. Aim of the course

To understand the animal toxicity tests and assessment of various toxicants using specific tests.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Practicals		
1.	Animal models for toxicological studies	2
2.	Animal toxicity tests for acute, subacute, and chronic toxicity	2
3.	Specific toxicity test for neurotoxicity	1
4.	Specific toxicity test for immunotoxicity	1
5.	Specific toxicity test for developmental toxicity	1
6.	Specific toxicity test for behavioral toxicity	1
7.	Specific toxicity test for mutagenicity	1
8.	Specific toxicity test for reproductive toxicity	1
9.	Specific toxicity test for inhalation toxicity	1
10.	Study specific toxicity test for carcinogenicity	1
11.	Animal toxicological tests to study metabolism	1
12.	Animal toxicological tests for synergism	1
13.	Animal toxicological tests for study of antagonisms	1
14.	Good laboratory practices in toxicology	2
15.	Assays for marker enzymes: AchE, GPX, SOD, Catalase	3
16.	Biochemical analysis of suspected toxicity specimens	2
17.	Haematological evaluation of toxicological samples	2
18.	Determination of pesticide residues using Gas Chromatography	2
19.	Analysis of toxicant residues in biological materials	2
20.	Recent advances	1



I. Course Title : Ethnopharmacology

II. Course Code : VPT 612

III. Credit Hours : 1 + 1

IV. Aim of the course

To impart the knowledge and importance of traditional Indian medicine.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	History, traditional remedies and regional folklore in disease cure.	1
2.	Plant drugs with proven pharmacological and therapeutic efficacy	1
3.	Indigenous drugs used in treatment of various gastrointestinal ailments	1
4.	Indigenous drugs used as antimicrobials	1
5.	Indigenous drugs used as analgesics	1
6.	Indigenous drugs used in cardiovascular disorders	1
7.	Indigenous drugs used in CNS disorders	1
8.	Indigenous drugs used in behavioural disorders	1
9.	Indigenous drugs used in Renal and Urinary tract disorders	1
10.	Indigenous drugs used in eye, ear and skin disorders	1
11.	Therapeutic and adverse effects of potential herbal drugs	2
12.	Alternate systems of medicine in animals – Homeopathy	2
13.	Alternate systems of medicine in animals – Folklore medicine	2
14.	Current topics/ Discussion of library assignments	2
Practicals		
1.	Identification of medicinal plants	1
2.	Various processes used in purification and preparation of active constituents from medicinal plants	4
3.	Classification, identification and chemical constituents of medicinal plants	2
4.	Preparation of plant extracts in various solvents using different techniques	2
5.	Phytochemical screening of plant extracts	2
6.	Pharmacological screening of extracts using <i>in-vitro</i> methods	2
7.	Evaluation of pharmacological activities of extracts using in animals	2

I. Course Title : Fundamentals of Pharmacokinetics

II. Course Code : VPT 613

III. Credit Hours : 1 + 1

IV. Aim of the course

To study the disposition of drugs and dosage regimen.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Dosage forms of drugs	1
2.	Routes of drug administration	1



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
3.	Transfer of drugs across biological membranes	2
4.	Absorption of drugs	1
5.	Distribution of drugs	1
6.	Biotransformation of drugs	2
7.	Excretion of drugs	1
8.	Principles of pharmacokinetics	2
9.	Various Pharmacokinetics models	1
10.	Important pharmacokinetic parameters	2
11.	Dosage regiment	1
12.	<i>In-vitro</i> plasma protein binding of drugs	1
Practicals		
1.	Various methods of drug assay	2
2.	Microbiological assay for antimicrobial drugs	2
3.	HPLC techniques	4
4.	Bioavailability of drugs	1
5.	Pharmacokinetics in animal disease models	2
6.	<i>In-vitro</i> plasma protein binding of drugs	1
7.	Determination of different pharmacokinetic parameters	2
8.	Analysis of pharmacokinetic data	2
9.	PK-PD modelling and Time kill kinetics	1



Course Title with Credit Load

Ph.D. in Veterinary Pharmacology and Toxicology

Course Code	Course Title	Credit Hours
VPT 701	Molecular Pharmacology*	3+0
VPT 702	Advances in Autacoid Pharmacology	1+0
VPT 703	Pharmacology of Herbal Drugs	2+1
VPT 704	Biotransformation of Xenobiotics	2+0
VPT 705	Clinical Pharmacology and Pharmacokinetics*	2+1
VPT 706	Pharmacogenomics	2+0
VPT 707	Immunopharmacology and Immunotoxicology	2+0
VPT 708	Molecular Toxicology	3+0
VPT 709	Clinical Toxicology*	2+1
VPT 710	Ecotoxicology	3+0
VPT 711	Regulatory Toxicology	2+1
VPT 790	Special Problem	0+1
VPT 791	Doctoral Seminar I*	1+0
VPT 792	Doctoral Seminar II*	1+0
VPT 799	Doctoral Research	75

*Core courses



Course Contents

Ph.D. in Veterinary Pharmacology and Toxicology

- I. Course Title** : **Molecular Pharmacology**
II. Course Code : **VPT 701**
III. Credit Hours : **3+0**

IV. Aim of the course

To understand the identification and characterization of receptors and drug receptors interactions and underlying mechanisms of drug receptor interactions and its effects.

V. Theory

Unit I

Physicochemical properties of drugs, Forces involved in binding of drugs to receptors, Classification of receptors, Molecular structure of receptors, Properties and regulation of receptors, Receptors for physiological regulatory molecules.

Unit II

Receptor conformation and configuration. Structure activity relationship. Ligand binding study of receptors. Cellular mechanism of signal transduction and second messenger systems; Structures, Types and Functions of membrane ion channels.

Unit III

Theories of drug receptor interactions; Analysis of dose response Relationship and molecular mechanisms of drug actions, Quantitation of drug-receptor interactions and effects, receptors as pharmaceutical targets.

Unit IV

Calcium homeostasis within the cells, pharmacology of mitogen-activated protein (MAP) kinases/ extracellular signal-regulated kinases (ERK) and small G proteins. Methods of identification, isolation and characterization of receptors.

- I. Course Title** : **Advances in Autacoid Pharmacology**
II. Course Code : **VPT 702**
III. Credit Hours : **1+0**

IV. Aim of the course

To study the pharmacodynamics and clinical implications of autacoids.

V. Theory

Unit I

Histamine and antihistamines, serotonin and its antagonists.

Unit II

Kinins (Bradykinin, kallikrein, Neurokinin, Substance P, Atrial natriuretic peptides and others).



Unit III

Angiotensins, agonists and antagonists.

Unit IV

Eicosanoids, platelet-activating factors, slow reacting substances of anaphylaxis, Putative neurotransmitters (purine nucleotides, peptides, amino acids and nitric oxide).

Unit V

Pharmacotherapy of inflammation, fever, pain and gout; clinical manifestation of autacid imbalance.

I. Course Title : Pharmacology of Herbal Drugs

II. Course Code : VPT 703

III. Credit Hours : 2+1

IV. Aim of the course

To study the Pharmacological, Therapeutic and Toxicological aspects of potential medicinal plants.

V. Theory

Unit I

Historical aspect, Chemical constituents of medicinal plants and their classification.

Unit II

Identification, Collection, Preservation, Purification, Isolation, Standardization and Clinical validation of bioactive molecules from vegetable sources.

Unit III

Characterization of pharmacological, therapeutic and toxic effects of potential herbal drugs.

Unit IV

Strategies for development of herbal drugs.

VI. Practical

Extraction, detection, phytochemical analysis and fractionation of medicinal plant extracts. Screening of plant extracts for potential pharmacological activity; Pharmacological effects of herbal drugs on intact and isolated preparations.

I. Course Title : Biotransformation of Xenobiotics

II. Course Code : VPT 704

III. Credit Hours : 2+0

IV. Aim of the course

To study the molecular mechanisms of biotransformation of xenobiotics.

V. Theory

Unit I

Process of drug biotransformation phase I, phase II, and III, Microsomal and non-microsomal metabolizing enzyme systems.



Unit II

Mechanisms and processes of synthetic biotransformation

Unit III

Chemical, biological, genetic and environmental factors affecting drug biotransformation mechanisms.

Unit IV

Metabolic interactions, Enzyme induction and inhibition. Scope of biotransformation in drug development.

- I. Course Title : Clinical Pharmacology and Pharmacokinetics**
- II. Course Code : VPT 705**
- III. Credit Hours : 2+1**
- IV. Aim of the course**

To study the efficacy and disposition of drugs in clinical conditions.

V. Theory

Unit I

Scope of clinical pharmacology. Drug discovery and clinical trials. Pharmacovigilance, pharmacoepidemiology and pharmacoconomics.

Unit II

Various drug delivery systems-ruminal, intravaginal, intramammary, etc. Targeted drug delivery systems-liposomes, microparticles, nanoparticles, etc. Factors modifying drug delivery.

Unit III

Application of pharmacokinetic principles in therapeutics. PK-PD relationship and its applications.

Unit IV

Alterations in pharmacological behaviour of drugs in clinical conditions, neonates and pregnancy. Drug interactions and adverse drug reactions. Therapeutic drug monitoring. Rationale of drug use. Medication control programs in performance animals.

VI. Practicals

Analysis of pharmacokinetic data and determination of different pharmacokinetic parameters and drugs interactions in normal and diseased animal/ models.

- I. Course Title : Pharmacogenomics**
- II. Course Code : VPT 706**
- III. Credit Hours : 2+0**

IV. Aim of the course

To study the concepts of genomics in drug development.

V. Theory

Unit I

History, concepts and definitions of pharmacogenomics transcriptomics, proteomics and metabolomics. Genomic basis of species variations in drug response.



Unit II

Genetic polymorphism and its impact on pharmacokinetics, drug target receptors and disease-drug response.

Unit III

Pharmacogenomics and drug development, Pharmacogenomics in clinical practice, role of bioinformatics in pharmacogenomics.

Unit IV

Concept of gene therapy, gene therapy of inherited diseases, DNA repair and inactivation strategies. Synthesis of therapeutic proteins.

- I. Course Title : Immunopharmacology and Immunotoxicology**
II. Course Code : VPT 707
III. Credit Hours : 2+0
IV. Aim of the course

To study the pharmacological intervention of immune functions.

V. Theory

Unit I

General aspect of immune system and its interaction with nervous and endocrine systems. Chemical mediators of immune system.

Unit II

Immunomodulators; Immunostimulants, Immunosuppressant and Tolerogens; Immunological basis of drug allergy and drug tolerance.

Unit III

Immunotoxic effects of xenobiotics and environmental pollutants.

Unit IV

Immune deficiencies and autoimmune reactions. Immunotherapeutic applications in asthma, arthritis, cancer, dermatology, and organ transplant, etc.

- I. Course Title : Molecular Toxicology**
II. Course Code : VPT 708
III. Credit Hours : 3+0
IV. Aim of the course

To understand the mechanisms and targets of cellular/ molecular toxicity.

V. Theory

Unit I

Cellular, sub-cellular and molecular targets and mechanism of toxicity.

Unit II

Cellular dysfunctions and their consequences, Mechanism of cell death in toxicity, repair and disrepair of toxic damage.

Unit III

Molecular mechanisms of target organ directed toxicity of xenobiotics- brain,



hematopoietic system, GIT, liver, lungs, kidneys, reproductive system, skin,

Unit IV

Mechanism of chemical mutagenesis, carcinogenesis, teratogenesis and radiation toxicity.

- I. Course Title : Clinical Toxicology**
- II. Course Code : VPT 709**
- III. Credit Hours : 2+1**
- IV. Aim of the course**

To study the concepts of clinical toxicology and forensic toxicology.

V. Theory

Unit I

Scope of clinical and forensic toxicology. Toxicological investigation, management and antidotal therapy of poisonings.

Unit II

Clinical aspects of poisoning due metals, non-metals and pesticides.

Unit III

Clinical aspects of poisoning due to mycotoxins, animal and bacterial toxins, solvents and vapours, drugs and other food/ feed contaminants.

Unit IV

Forensic toxicology. GLP in toxicological evaluation.

VI. Practical

General screening of biological material for toxicants, analysis of clinical samples for poisons, use of biomarkers in the assessment of toxicity.

- I. Course Title : Ecotoxicology**
- II. Course Code : VPT 710**
- III. Credit Hours : 3+0**
- IV. Aim of the course**

To impart knowledge regarding ecotoxicology for conservation of healthy eco-system.

V. Theory

Unit I

Basic principles of ecotoxicology. Sources of contamination and effects of pollutants on eco-health.

Unit II

Chemical contamination of air, water, soil and food by major agricultural and industrial chemicals – pesticides, hydrocarbons and metals. Fate of chemicals in the environment and target species.

Unit III

Toxic effects of radiations. Marine and wildlife as monitors of environmental quality, Bioaccumulation and Biomagnifications of toxicants.



Unit IV

Biomarkers of monitoring the impact of environmental pollutants, Environmental hazard and Risk identification from Mixture of chemicals, Contamination control and approaches to rehabilitating damaged ecosystems, Nanoparticle toxicology, ecological emergencies.

- I. Course Title : Regulatory Toxicology**
II. Course Code : VPT 711
III. Credit Hours : 2+1
IV. Aim of the course

To study acts and regulations and risk assessment regarding use of drugs, chemicals and cosmetics.

V. Theory

Unit I

Principles of risk assessment. Test protocols for toxicity studies of various national and international regulatory agencies.

Unit II

Regulatory essential dose levels in chemical risk assessment (NOEL, NOAEL, LOEL, LOAEL and AOEL). Recommended acceptable levels of environmental pollutants.

Unit III

Risk assessment in practice. Classification and marking/ branding of chemicals. Monitoring/ surveillance of chemicals. Exposure assessment and modelling.

Unit IV

Quality control in safety research (GLP). Operation of product register.

VI. Practical

Good laboratory practice in toxicological research. Screening procedures in regulatory toxicology. Determination of MRL, ADI, NOEL, NOAEL, LOEL, LOAEL and AOEL. Visit to nearest industrial area.

- I. Course Title : Special Problem**
II. Course Code : VPT 790
III. Credit Hours : 0+1
IV. Aim of the course

To provide expertise in handling practical research problem(s).

V. Practical

Short research problem(s) involving contemporary issues and research techniques.



Course Outline-cum-Lecture Schedule for Doctoral Degree Programme

- I. Course Title** : **Molecular Pharmacology**
II. Course Code : **VPT 701**
III. Credit Hours : **3 + 0**
IV. Aim of the course

To understand the identification and characterization of receptors and drug receptors interactions and underlying mechanisms of drug receptor interactions and its effects.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Concept of receptors and forces involved in binding of drugs to receptors	2
2.	Methods of identification, isolation and characterization of receptors.	2
3.	Quantitative aspects and theories of drug-receptor interactions	2
4.	Signal transduction mechanisms: transducers, effectors and second messengers	2
5.	Classification and structures of receptors – Receptor conformation and configuration – Iono-receptors	2
6.	G-protein coupled receptors	2
7.	Enzymatic receptors	2
8.	Steroid receptors	2
9.	Molecular mechanisms of drug actions	2
10.	Receptors for physiological regulatory molecules	2
11.	Receptors as pharmaceutical targets.	2
12.	Hepatic and extra-hepatic metabolism of drugs	3
13.	Structures, types and functions of membrane ion channels.	3
14.	Role of cytochrome P450 isozymes in drug metabolism	2
15.	Metabolic enzyme induction and inhibition	2
16.	Factors affecting drug metabolism	2
17.	Mechanism of bioactivation and cytotoxicity – Electrophilic metabolites, free radicals and reactive oxygen species	3
18.	Drug induced mechanism of cell death – Necrosis and apoptosis	2
19.	Cytoprotective mechanisms against bioactive substances – Role of glutathione and other protectants	2
20.	Calcium homeostasis within the cells	2
21.	Pharmacology of mitogen-activated protein (MAP) kinases/ extracellular signal-regulated kinases (ERK) and small G proteins	3
22.	Current topics/ Discussion of library assignments	2



- I. Course Title : Advances in Autacoid Pharmacology**
II. Course Code : VPT 702
III. Credit Hours : 1 + 0

IV. Aim of the course

To study the pharmacodynamics and clinical implications of autacoids.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1	Histamine and antihistamines	2
2	5-Hydroxytryptamine and anti-5-HT drugs	2
3	Serotonin and its antagonists	2
4	Kinins	1
5	Angiotensins and inhibitors of renin-angiotensin system	2
6	Lipid-derived autacoids-prostaglandins and leukotrienes	2
7	Platelet activating factor	1
8	Cytokines and other autacoids	2
9	Neurohumoral transmission – purine nucleotides, peptides, amino acids and nitric oxide	2
10	Current topics/ Discussion on library assignments	1

- I. Course Title : Pharmacology of Herbal Drugs**
II. Course Code : VPT 703
III. Credit Hours : 2 + 1

IV. Aim of the course

To study the pharmacological, therapeutic and toxicological aspects of potential medicinal plants.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction to indigenous pharmacology – History, definitions and scope	1
2.	Basic requirements and classification of indigenous drugs	2
3.	Collection and preparations of indigenous drugs	1
4.	Extraction of drugs	2
5.	Purification of drugs by heat processes – Distillation, evaporation, sublimations,	2
6.	Filtration and clarification	1
7.	Plant drugs with proven pharmacological and therapeutic efficacy	1
8.	Indigenous drugs used in treatment of various gastrointestinal ailments	2
9.	Indigenous drugs used as antimicrobials	1
10.	Indigenous drugs used as analgesics	1
11.	Indigenous drugs used in cardiovascular and CNS disorders	2
12.	Indigenous drugs used in behavioural disorders	1
13.	Indigenous drugs used in Renal and Urinary tract disorders	2



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
14.	Indigenous drugs used in	1
15.	Indigenous drugs used in eye, ear and skin disorders	3
16.	Indigenous drugs used in reproductive disorders	1
17.	Therapeutic and adverse effects of potential herbal drugs	1
18.	Alternate systems of medicine in animals – Homeopathy	1
19.	Alternate systems of medicine in animals – Ayurvedic concepts	2
20.	Alternate systems of medicine in animals – Folklore medicine	1
21.	Alternate systems of medicine in animals – Unani medicine	1
22.	Discussion on few review articles on herbal drugs from journals	2
Practical		
1.	Fundamental techniques in indigenous pharmacology	2
2.	Extraction and purification of drugs from medicinal plants	4
3.	Bioassay of indigenous drugs	3
4.	Pharmacological screening of indigenous drugs – Effect on isolated smooth muscle of ileum	2
5.	Effect on skeletal muscle	1
6.	Effect on perfused heart	1
7.	Effect on uterus	1
8.	Effect on trachea	1

I. Course Title : Biotransformation of Xenobiotics

II. Course Code : VPT 704

III. Credit Hours : 2 + 0

IV. Aim of the course

To study the molecular mechanisms of biotransformation of xenobiotics.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1	Introduction, importance of drug metabolism. Mechanisms and processes of drug biotransformation	1
2	Synthetic and non-synthetic pathways of drug metabolism. Phase reactions- oxidative, reductive, and hydrolytic reactions	1
3	Phase II reactions- conjugation (glucuronidation, sulfation, methylation, acetylation), conjugation with glutathione, aminoacids and thiosulfates	1
4	Oxidation- molecular details, cytochrome P 450 system. Types of CYP enzymes with special reference to CYP 3A4, 1A2, 2D6, 2E1	1
5	Important drugs metabolized by different CYP isoforms- molecular mechanisms involved	1
6	Nuclear receptor mediated transcriptional regulation of cytochrome P 450 system- Nuclear receptors and their ligands	1
7	7-ethoxy-resorufin O-deethylation (EROD) and 7-methoxyresorufin O-demethylation (MROD) as markers of Cytochrome P450 1 activities in hepatic microsomes	1



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
8	Activity of liver enzymes during the acute and chronic phases of diseases- role of Total bilirubin, Aspartate transaminase (AST), AST/ ALT ratio, Alkaline phosphatase (ALP), Gamma glutamyl transpeptidase (GGT)	1
9	Use S9 liver fraction from animals for the prediction of <i>in vivo</i> drug metabolism, Chemical inhibition assays of S9 fraction	1
10	Xenobiotic response systems- AhR (aryl hydrocarbon receptor), ER (estrogen receptor), PPAR (peroxisome proliferator-activated receptor)	1
11	Response systems - VDR (Vitamin-D-Receptor), FXR (farnesoid-X-receptor), HNF4 (hepatocyte nuclear factor), Nrf2-Keap1.	1
12	Concept of orphan nuclear receptors in different phases of metabolism	1
13	Role of Pregnane-X-Receptor (PXR), Constitutive-Androstane-Receptor (CAR), Liver-X-Receptor (LXR) in metabolism of commonly used drugs. Cross-talk in metabolism pathways	1
14	Role of genetically modified animals in drug metabolism studies	1
15	Specific studies on PXR, CAR, LXR involving gene knockout mice, transgenic mice. Cholesterol and bile acid homeostasis. Search for new response elements	1
16	Reduction reactions- molecular details with specific reaction examples of drugs undergoing reduction: of hydrogenation, decarboxylation, amination	1
17	Hydrolysis- molecular details with specific reaction examples of drugs undergoing hydrolysis with enzymes like esterases, peptidases, and amidases	1
18	Glucuronidation- mechanism, sites, general influencing factors	1
19	Glucuronidation affected drugs – metabolism of morphine, oxazepam, carbamazepine, acetaminophen, testosterone, zidovudine, inhibitors and inducers of glucuronidation (barbiturates, ibuprofen, etc.	1
20	Sulfation-Tyrosine sulfation (function, Regulation, Posttranslational modification)	1
21	Acetylation- Ultrastructural Aspects of the Heterogeneous Acetylation	1
22	Phase II Biotransformation Reactions-Glutathione-S-Transferase, Glutathione S-conjugates as prodrugs to target drug-resistant tumors	1
23	Phase III – further modification and excretion- detoxification of endogenous reactive metabolites such as peroxides and reactive aldehydes, sites	1
24	Membrane transport – permeability barriers and detoxification, receptor mediated transcytosis, role of the solute carrier (SLC) and the ATP-binding Cassette (ABC) transporters; implications in drug resistance	1
25	Drug metabolism in organs other than liver- role of kidney, intestine and placenta	1
26	Drug metabolism in fetus and new born. <i>In-vitro</i> and <i>in-vivo</i> studies in drug metabolism; metabolic schemes of selected drugs	1
27	Factors influencing drug metabolism: Stereochemical, Physicochemical and biological factors	1
28	Strain difference in biotransformation, sex, age, environment factors, Genetic factors (pharmacogenetics) heritable factors recognized by use of drugs	1
29	Pathological states- Effect of liver dysfunction on the metabolism of drugs; effect on dosage regimens	1



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
30	Effect of renal dysfunction on the metabolism of different drugs	1
31	Chemical, biological, genetic and environmental factors. Species variations affecting drug biotransformation mechanisms	1
32	Biotechnology involved in drug metabolism studies- Electrophoretic Mobility Shift Assay (EMSA), northern, western/ southern blotting, PCR, real-time PCR	1
33	Preparation and Analysis of Total RNA Extracted from Hepatocytes for metabolism studies. Sulfation assay using P ³² , Site-directed Mutagenesis, etc.	1
34	Methods to determine glutathione in liver and blood. Importance of Gamma-glutamylcysteine (GGC) as the immediate precursor to GSH	1
35	Cell lines as tools for drug metabolism studies. Predicting <i>in-vivo</i> drug metabolism from <i>in-vitro</i> studies, Cultured hepatocytes (cryopreserved or fresh) for induction and down-regulation studies	1

I. Course Title : Clinical Pharmacology and Pharmacokinetics

II. Course Code : VPT 705

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the efficacy and disposition of drugs in clinical conditions.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction and general principles of pharmacokinetics including absorption, distribution, metabolism and excretion	3
2.	Graphical plotting and interpretation of kinetic data	2
3.	Calculation of pharmacokinetic constants	2
4.	Pharmacokinetic models and their application	2
5.	Determination of pharmacokinetic parameters and their significance	3
6.	Computation of dosage regimen	2
7.	Plasma protein binding of drugs	2
8.	Erythrocyte penetration of drugs	2
9.	Factors modifying pharmacokinetics of drugs	2
10.	Pharmacokinetics of drugs in diseased models	3
11.	Urinary excretion of drugs	1
12.	Kinetics following single and multiple doses	2
13.	Non-compartmental pharmacokinetic modelling	2
14.	Application of pharmacokinetics in clinical practice	2
15.	Drug therapy in neonate and geriatric animals	2
16.	Current topics/ Discussion on library assignments	2
Practical		
1.	Estimation of drugs by chemical and microbiological assays	3
2.	Graphical representation of plasma levels of drugs	1
3.	Determination of pharmacokinetic models	1



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
4.	Calculation of kinetic constants and parameters	2
5.	Calculation of dosage regimen	1
6.	Renal clearance studies of drugs	1
7.	<i>In-vitro</i> experiments on plasma protein binding	2
8.	Calculation of constants of plasma protein binding	1
9.	<i>In-vitro</i> erythrocytic penetration of drugs	1
10.	Pharmacokinetic parameters and adjustment of dosage regimen in diseased conditions	2

I. Course Title : Pharmacogenomics

II. Course Code : VPT 706

III. Credit Hours : 2 + 0

IV. Aim of the course

To study the concepts of genomics in drug development.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction- basic pharmacogenomic nomenclature and principle	1
2.	Pharmacogenomics and bioinformatics: past, present and future, species variations affecting drug responses	1
3.	Optimized drug development- Pharmacogenomics impacts on pharmacokinetics and pharmacodynamics	1
4.	Increased and decreased responsiveness to drug effects/ toxicities and novel drug effects- prediction through databases	1
5.	Personalized medicine using genotyping technologies- Optimized drug therapy	1
6.	Challenges of Pharmacogenomic Testing- access, feasibility, cost	1
7.	Genetic basis of disease – Impact of genetic variations on drug metabolism	1
8.	Ethical applications, social and economic implications	1
9.	Genetic polymorphism- Relevance to a drug, Relevance to a disease, Types of nomenclature- Star Nomenclature, Genotype Nomenclature, Haplotype Nomenclature	1
10.	Genetic polymorphism types-Single nucleotide polymorphism (SNP), Variable number tandem repeat, Gene deletion, Copy number variant	1
11.	Single Nucleotide Polymorphism (SNP)- Synonymous polymorphism, Non-synonymous polymorphism, Variable Number Tandem Repeat: UGT1A1	2
12.	Gene Deletions and Copy Number Variants- Ultra-rapid metabolizers, Extensive metabolizers, Intermediate metabolizers, Poor metabolizers	1
13.	Potential Roles for Healthcare Professionals- Implications for Clinical Practice	1
14.	Pharmacogenomic Resources- Centers for Disease Control and Prevention (CDC), Food and Drug Administration (FDA),	1
15.	Gene therapy: gene transfer technology, viral vectors, natural delivery strategies.	1



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
16.	Transient and Stable Transfection, Transfection Methods- Lipid-mediated method	1
17.	Calcium-phosphate mediated method of transfection, diethylaminoethyl-dextran mediated method of transfection	1
18.	Electroporation- Steps of the electroporation transfection, Biolistics (Gene gun/ microparticle bombardment), Laser transfection	1
19.	Drugs and gene therapy of inherited diseases- approaches, cell types, vectors	1
20.	Genetic inactivation strategies- key concepts. RNA interference (RNAi), Chemical modification on siRNA	1
21.	Engineered nucleases- zinc finger nucleases (ZFNs), transcription activator like effector nucleases (TALENs), clustered regularly interspaced short palindromic repeat associated (CRISPR associated) system	1
22.	DNA repair- Sources of damage –Nuclear versus mitochondrial, Senescence and apoptosis. Mechanisms- Direct reversal, Single-strand damage, Double-strand breaks, Translesion synthesis, Medicine and DNA repair modulation	2
23.	Cancer gene therapy- Immunotherapy, Oncolytic virotherapy- history, current clinical trials, future directions	1
24.	Boosting the immune response, Gene therapies to make cancer treatments effective	1
25.	Pro drug gene therapy, Blocking processes that protect cancer cells, Using altered viruses	1
26.	Role of bioinformatics in pharmacogenomic- Bioinformatics and drug discovery, Barriers to bioinformatics progress in drug design process	1
27.	Pharmacogenomics in drug discovery and development- Personalized/ effective medication.	1
28.	Reviving orphan drug, Barriers to pharmacogenomics progress in drug designing and development.	1
29.	Clinical applications of bioinformatics, genomics, and pharmacogenomics, Relationships and exchange of information with other resources	1
30.	Time dependent inhibition of genes involved in cytochrome P450 (CYP450) enzymes (single point, IC 50 shift)	1

I. Course Title : Immunopharmacology and Immunotoxicology

II. Course Code : VPT 707

III. Credit Hours : 2 + 0

IV. Aim of the course

To study the pharmacological intervention of immune functions.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction to immunology	1
2.	General aspect of Immune system	3



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
3.	Cellular components of immune system	2
4.	General principles of immunopharmacology	1
5.	Immunomodulators and their use in animals	2
6.	Immunostimulants and their role in animal health and diseases	2
7.	Immunosuppressants, and tolerogens – clinical applications	2
8.	Immunological basis of drug allergy and drug tolerance	2
9.	Neuroendocrine immune interactions	2
10.	Immunotoxic effects of environmental and other pollutants	3
11.	Molecular mechanisms of immunotoxicity	2
12.	Immunomodulatory effect of xenobiotics	2
13.	Implications of immune alterations in health and disease	2
14.	Immune deficiencies, autoimmune response to xenobiotics,	2
15.	Immunoregulants and their therapeutic applications in asthma, arthritis, cancer, dermatology and organ transplant etc	2
16.	Other immunological drugs	2
17.	Current discussions and assignments	2

I. Course Title : Molecular Toxicology

II. Course Code : VPT 708

III. Credit Hours : 3+0

IV. Aim of the course

To understand the mechanisms and targets of cellular/ molecular toxicity.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Cellular, sub-cellular and molecular targets and mechanism of toxicity	2
2.	Concept of receptors and forces involved in binding of xenobiotics to receptors	3
3.	Quantitative aspects and theories of xenobiotic-receptor interactions	3
4.	Signal transduction mechanisms: transducers, effectors and second messengers	2
5.	Classification and structures of receptors – Receptor conformation and configuration – Iono-receptors	2
6.	G-protein coupled receptors	2
7.	Enzymatic receptors	2
8.	Steroid receptors	2
9.	Biophysics of toxicants	2
10.	Hepatic and extra-hepatic metabolism of xenobiotics	3
11.	Metabolic enzyme induction and inhibition	3
12.	Mechanism of bioactivation and cytotoxicity – Electrophilic metabolites, free radicals and reactive oxygen species	3
13.	Molecular mechanisms of target organ directed toxicity of xenobiotics- brain, hematopoietic system, GIT, liver, lungs, kidneys, reproductive system, skin, etc.	4
14.	Cellular dysfunctions and their consequences	2
15.	Repair and disrepair of toxic damage	2



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S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
16.	Xenobiotic induced mechanism of cell death – Necrosis and apoptosis	3
17.	Risk Assessment	2
18.	Mechanism involved in carcinogenesis, mutagenesis, teratogenesis	2
19.	Radiation toxicity	2
20.	Current topics/ Discussion of library assignments	2

I. Course Title : Clinical Toxicology

II. Course Code : VPT 709

III. Credit Hours : 2 + 1

IV. Aim of the course

To study the concepts of clinical toxicology.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
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Theory

1.	Introduction, history, definition and scope of clinical toxicology	1
2.	Importance and processes of forensic toxicology	1
3.	Toxicological investigations	1
4.	Management and antidotal therapy of poisonings	1
5.	Toxicity of metals – Arsenic, lead, mercury, selenium, molybdenum, and other metals	3
6.	Toxicity of non-metals – Fluoride, nitrite/ nitrate, sodium chloride, phosphorus	3
7.	Toxicity of insecticides – Chlorinated hydrocarbons, organophosphates, carbamates, pyrethroids, and botanical and newer insecticides	3
8.	Toxicity of fumigants	1
9.	Toxicity of herbicides	2
10.	Toxicity of fungicides	1
11.	Toxicity of rodenticides	2
12.	Toxicity of fertilizers	2
13.	Toxicity of solvents and vapours	2
14.	Toxic plants – Plants causing cyanide poisoning, photosensitization, thiamine deficiency and oxalate poisoning	3
15.	Mycotoxins	2
16.	Venomous stings and bites – Snake, scorpion, spider, bees and wasps	2
17.	Toxicity of therapeutic agent	2
18.	GLP in toxicological evaluation	2

Practicals

1.	Extraction, separation and detection of various poisons in suspected materials	3
2.	Use of blood and tissue biomarker enzymes in assessment of toxicity, viz., acetylcholinesterase, carboxylesterase, etc.	3
3.	Demonstration of poisoning and their antidotal treatment	3
4.	Evaluation of antioxidant profile of toxicosed animals	2
5.	Analysis of poisons in biological samples	2



S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
6.	Use of biomarkers in the assessment of toxicity	1
7.	Good laboratory practices evaluation	1
8.	Identification and collection of poisonous plants	1

I. Course Title : Ecotoxicology

II. Course Code : VPT 710

III. Credit Hours : 3 + 0

IV. Aim of the course

To impart knowledge regarding ecotoxicology for conservation of healthy eco-system.

V. Lecture/ Practical schedule

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction and basic principles of ecotoxicology	2
2.	Sources of environmental contamination	2
3.	Effects of pollutants on eco-health	2
4.	Fate of chemicals in the environment and target species	2
5.	General aspects of hazards associated with Air and water pollutants	2
6.	Radiation and its hazards	2
7.	Toxicity of pesticides in relation to environmental contamination	3
8.	Toxicity of metals related to agriculture	3
9.	Nanoparticle toxicology	2
10.	Ecological emergencies	2
11.	Residues of agrochemicals in food and ecosystem	2
12.	Marine and wildlife as monitors of environmental quality	2
13.	Bioaccumulation and biomagnifications of toxicants	1
14.	Forensic and regulatory toxicology as related to agrochemicals	3
15.	Hazards of toxicants in domestic and wild life	3
16.	Biomarkers of monitoring the impact of environmental pollutants	3
17.	Environmental hazard and risk identification from mixture of chemicals	2
18.	Contamination control measures	3
19.	Approaches to rehabilitating damaged ecosystems	3
20.	Ethical, moral, and professional issues in toxicology	2

I. Course Title : Regulatory Toxicology

II. Course Code : VPT 711

III. Credit Hours : 2 + 1

IV. Aim of the course

To study acts and regulations and risk assessment regarding use of drugs, chemicals and cosmetics.

**V. Lecture/ Practical schedule**

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
Theory		
1.	Introduction to toxicology; scope and industrial application	1
2.	Drug and development in modern industry	1
3.	Regulatory toxicology and pre-clinical pharmaceutical testing services-linkage	2
4.	Principles of Hazard Identification	1
5.	Different guidelines for safety assessments	1
6.	Methods of toxic dose estimation	2
7.	Risk assessment and post marketing surveillance	2
8.	Procedure for acute, sub-acute and chronic toxicity study	3
9.	Toxicity test guidelines and different routes	2
10.	Guidelines for herbal safety risk assessment evaluation	1
11.	Working principle of FDA and Indian legislations	1
12.	Schedules of drugs and classification of industrial chemicals	1
13.	Approaches to hazard identification-carcinogenicity	2
14.	Modern concept tolerance: classification, evaluation	2
15.	Dose-response assessment LOEL, LOAEL and AOEL, NOEL, NOAEL, ADI, etc.	3
16.	Guidelines for registration of medicines	2
17.	Specific aspects of drug registration legislation abroad	1
18.	Central drugs standard control organization – CDSCO- India	2
19.	Concept of GLP India and abroad; Role of GLP in toxicological evaluation	2
Practical		
1.	Introduction to good laboratory practices in toxicology	2
2.	Screening procedures in regulatory toxicology	3
3.	Evaluation of acceptable daily intake	2
4.	Determination of No-observable effect level and NOAEL	2
5.	Determination of Low-observable effect level and LOAEL	2
6.	Determination of AOEL	2
7.	Mandatory toxicity testing protocols	2

Suggested Reading

- Baggot JD (Ed). 2001. *The Physiological Basis of Veterinary Clinical Pharmacology*. Blackwell Science.
- Barile FA (Ed). 2013. *Principles of Toxicology Testing*. CRC Press.
- Bisset NG (Ed). 1994. *Herbal Drugs and Phytopharmaceuticals*. CRC Press.
- Brunton LL (Ed). 2018. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 13th Ed. McGraw-Hill.
- Chopra SR, Badhwar RL and Ghosh S. 1984. *Poisonous Plants of India*. 1st Ed., Academic Publishers, Jaipur.
- Derelanko MJ and Holinger MA. (Eds). 2002. *CRC Hand Book of Toxicology*, 2nd Ed. CRC Press.
- Fowler BA (Ed). 2013. *Computational Toxicology: Methods and Applications for Risk Assessment*. Academic Press.
- Ghosh MN (Ed). 2015. *Fundamentals of Experimental Pharmacology*. 4th Ed. Hilton and Co.
- Gibaldi M and Perrier D (Eds). 1982. *Pharmacokinetics*, 2nd Ed. Taylor and Francis.



- Gibaldi M and Prescott LF (Eds). 1983. *Handbook of Clinical Pharmacokinetics*. ADIS Health Science Press.
- Hayes AW and Kruger CL (Eds). 2014. *Hayes' Principles and Methods of Toxicology*, 6th Ed. CRC Press.
- Klaassen CD and Watkins JB (Ed). 2015. *Casarett and Doull's Essentials of Toxicology*. 3rd Ed. McGraw-Hill.
- Klassen CD (Ed). 2018. *Casarett and Doull's Toxicology: Basic Sciences of Poisons*. 9th Ed., McGraw-Hill.
- Kulkarni SK (Ed). 2004. *Handbook of Experimental Pharmacology*. 3rd Ed. Vallabh Prakashan.
- Medhi B and Prakash A (Eds). 2010. *Practical Manual of Experimental and Clinical Pharmacology*. Jaypee Brothers.
- Riviere JE and Papich MG (Eds). 2018. *Veterinary Pharmacology and Therapeutics*. 10th Ed. Iowa State Univ. Press.
- Southwood R, Fleming VH and Huckaby G (Eds). 2018. *Concepts in Clinical Pharmacokinetics*. American Society of Health-System Pharmacists.
- Srivastava AK, Verma PK and Dumka VK (Eds). 2013. *Veterinary Toxicology*. Satish Serial Publishing House, New Delhi.
- Stine KE and Brown TM. (Eds). 2015. *Principles of Toxicology*. 3rd Ed. CRC Press.
- Vogel HG and Vogt WH (Eds). 1997. *Drug Discovery and Evaluation: Pharmacological Assays*. Springer.





VOLUME II D

Animal Production Sciences

Animal Genetics and Breeding
Animal Nutrition
Livestock Production and Management
Livestock Products Technology
Poultry Science



Suggested list of specified minor subjects (Departments)

Major Subjects	Minor Subjects
Animal Genetics and Breeding	Vety. Biotechnology, Statistics, Livestock Production Management, Vety. Gynecology & Obstetrics, Vety. Physiology, Vety. Biochemistry, Poultry Science, Animal Nutrition.
Animal Nutrition	Vety. Bio-chemistry, Veterinary Physiology, Livestock Production Management, Vety. Biotechnology, Livestock Product Technology, Poultry Science.
Livestock Production Management	Animal Nutrition, Animal Genetics & Breeding, Livestock Products Technology ,Veterinary and Animal Husbandry Extension Education.
Livestock Products Technology	Food Science and technology, Vety. Biochemistry, Vety. Microbiology, Vety. Public Health & Epidemiology, Poultry science, Livestock Production Management
Poultry Science	Animal Genetics & Breeding, Animal Nutrition, Livestock Product Technology, Livestock Production Management.





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Animal Production Sciences

– Animal Genetics and Breeding





Preamble

(Animal Genetics and Breeding)

Livestock plays an important role in Indian economy. About 20.5 million people depend upon livestock for their livelihood. Livestock contribute 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8 % of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP. The economy of farmer is greatly influenced by livestock keeping. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realize the resource efficiency. The livestock serve the farmers in four different ways: income, employment, food and social security. So the conservation and development of indigenous livestock is the need of the hour. The study of the subject of Animal Genetics and Breeding and its application for conservation and improvement of livestock is very important.

Genetic improvement in domesticated animal populations that are used for agricultural production mainly involves selection of males and females that, when mated, are expected to produce progeny that perform better than the average of the current generation. Performance usually includes a combination of multiple characteristics, or traits, most of which are quantitative in nature. Animal breeding involves the selective breeding of livestock with the intention to improve desirable (and heritable) qualities in the next generation. This course introduces the steps required to design a program for breeding animals and teaches the genetic and statistical concepts that are needed to build a solid breeding program. By following this course the students can learn the key aspects of improving and increasing productivity and learn what it takes to create and maintain a healthy strong population. Students will learn how an animal breeder balances the need for improving the desirable qualities of the animals with the need for genetic diversity and long-term sustainability of the breeding program. Also students will learn about the scientific concepts in genetics that are applied in animal breeding, as well as how to apply the genetic models and computational methods that are used in animal breeding. Professionals working with animals will be able to use the knowledge from this course to understand the impact of breeding on animal populations and use genetic principles to make their decisions. This course will allow an advanced starting point for further studies, such as M.Sc. level courses in breeding.

Although animal breeding was practiced long before the science of genetics and the relevant disciplines of population and quantitative genetics were known, breeding programs have mainly relied on simply selecting and mating the best individuals on their own or relatives' performance. This is based on sound quantitative genetic principles, developed and expounded by Lush, who attributed much of his understanding to Wright, and formalized in Fisher's infinitesimal model. Analysis at the level of individual loci and gene frequency distributions has had relatively little impact. Now with access to genomic data, a revolution in which molecular information is being used to enhance response with "genomic selection" is occurring. The predictions of breeding value still utilize multiple loci throughout the



genome and, indeed, are largely compatible with additive and specifically infinitesimal model assumptions.

The main goal in animal breeding is to select individuals that have high breeding values for traits of interest as parents to produce the next generation and, to do so, as quickly as possible. To date, most programs rely on statistical analysis of large data bases with phenotypes on breeding populations by linear mixed model methodology to estimate breeding values on selected candidates. However, there is a long history of research on the use of genetic markers to identify quantitative trait loci and their use in marker-assisted selection but with limited implementation in practical breeding programs. The advent of high-density SNP genotyping, combined with novel statistical methods for the use of this data to estimate breeding values, has resulted in the recent extensive application of genomic or whole-genome selection in dairy cattle and research to implement genomic selection in other livestock species is underway. The high-density SNP data also provides opportunities to detect QTL and to uncover the genetic architecture of quantitative traits, in terms of the distribution of the size of genetic effects that contribute to trait differences in a population. Experimental results show that this genetic architecture differs among traits but that for most traits, over 50% of the genetic variation resides in genomic regions with small effects that are of the order of magnitude expected under a highly polygenic model of inheritance.

In indigenous livestock breed improvement program and conservation of indigenous livestock courses, different schemes like Rastriya Krishi Vikash Yojana (RKVY), Rastriya Gokul Mission (RGM) and National Programme for Bovine Breeding and Dairy Development (NPBBDD) launched by GoI under Ministry of Agriculture, Animal Husbandry, Dairying and Fisheries are included.

Addition of Courses

In M.V.Sc. degree programme, six new courses are proposed namely AGB-611 (Swine Breeding), AGB-612 (Pet Animal Breeding- dogs and cats), AGB-613 (Wild Animal Genetics and Breeding), AGB-614 (Equine Breeding), AGB-615 (Camel Breeding), AGB-616 (Yak and Mithun Breeding) and AGB-617 (Statistical Methods in Animal Breeding).

In Ph.D. degree programme, one new course is proposed namely AGB-707 (Statistical Software in Animal Breeding) based on inputs of stakeholders and contemporary requirement.

The course contents have been decided and modified as per suggestions of all the stakeholders during four workshops held at Durg, Guwahati, Hyderabad and Srinagar. Assuming the priority day-by-day, the areas which need to be strengthened in Animal Genetics and Breeding are: Molecular Techniques in Animal Breeding, Biometrical Techniques in Animal Breeding, Bio-informatics in Animal Genetics and Breeding, Breeding for different species having regional importance, viz., Swine, Camel, Equine, Yak and Mithun Breeding. Pet Animal Breeding is important in the sense that majority of people are fond of keeping pets where pedigreed dog and cats are the choice. Wild Animal Genetics and Breeding is an essential part for conservation of wild life now-a- days.

Deletion of Courses

In Ph.D., one course has been deleted namely AGB-707 (Utilization of non-additive genetic variance in farm animals) which appears to be redundant and/ or contents included elsewhere.

**Changes of Name of Courses**

Title of five courses in M.V.Sc. and five courses in Ph.D. have been modified as per the following Table:

Course Code	Old Title/ Existing	Modified Title
AGB 601	Animal Cytogenetics and Immunogenetics	Animal Cytogenetics and Immunogenetics I
AGB 602	Molecular Genetics in Animal Breeding	Molecular Genetics I
AGB 605	Biometrical Techniques in Animal Breeding	Biometrical Genetics I
AGB 608	Small Farm Animal Breeding (sheep, goat, swine and rabbit)	Sheep and Goat Breeding
AGB 610	Laboratory Animal Breeding	Laboratory Animal and Rabbit Breeding
AGB 701	Recent Advances in Animal Genetics	Molecular Genetics II
AGB 702	Recent Trends in Animal Breeding	Trends in Animal Breeding
AGB 703	Advances in Biometrical Genetics	Biometrical Genetics II
AGB 705	Bioinformatics in Animal Genetics and Breeding	Bioinformatics in Animal Breeding
AGB 706	Advances in Molecular Cytogenetics	Animal Cytogenetics and Immunogenetics II

Change of Credit Hours

For AGB 604 and AGB 605, credit hours have been reduced from 3+1 to 2+1. For AGB 610, credit hour has been increased from 1+0 to 2+0 to accommodate rabbit breeding components. For AGB 705, credit hour has been modified from 2+0 to 1+1 to accommodate practical classes.

For M.V.Sc. degree programme, out of the total of 20 credit hours from major, 15 credits hours have been decided as core (compulsory) courses and five credit hours from optional major courses. For Ph.D. degree programme, out of the total 12 credit hours 10 credit hours have been decided as core (compulsory) courses and two credits from optional major courses.



Course Title with Credit Load M.V.Sc. in Animal Genetics and Breeding

Course Code	Course Title	Credit Hours
AGB 601*	Animal Cytogenetics and Immunogenetics I	2+1
AGB 602*	Molecular Genetics I	2+1
AGB 603*	Population and Quantitative Genetics	2+1
AGB 604*	Selection Method and Breeding System	2+1
AGB 605*	Biometrical Genetics I	2+1
AGB 606	Conservation of Animal Genetics Resources	2+0
AGB 607	Cattle and Buffalo Breeding	2+1
AGB 608	Sheep and Goat Breeding	2+0
AGB 609	Poultry Breeding	2+1
AGB 610*	Laboratory Animal and Rabbit Breeding	2+0
AGB 611	Swine Breeding	1+0
AGB 612	Pet Animal Breeding (Dogs and Cats)	1+0
AGB 613	Wild Animal Genetics and Breeding	1+0
AGB 614	Equine Breeding	1+0
AGB 615	Camel Breeding	1+0
AGB 616	Yak and Mithun Breeding	1+0
AGB 617	Statistical Methods in Animal Breeding	2+1
AGB 691	Seminar	1+0
AGB 699	Research	30

*Core courses



Course Contents

M.V.Sc. in Animal Genetics and Breeding

I. Course Title : Animal Cytogenetics and Immunogenetics I

II. Course Code : AGB 601

III. Credit Hours : 2+1

IV. Why this course?

To provide basic and advanced theoretical and practical training in animal cytogenetics and immunogenetics with an ulterior aim of enhancing animal production.

V. Aim of the course

This course is aimed to train students in identifying genetic/ chromosomal abnormalities and reviewing genetic mechanisms responsible for the generation of diversity in genes for immunoglobulin, TLR and MHC, etc., facilitating the better application of both classical and molecular cytogenetics and immunogenetics for animal improvement.

VI. Theory

Unit I (7 Lectures)

Physical and chemical basis of heredity; Development in animal cytogenetics and immunogenetics of farm animals; Inborn errors of metabolism and inherited disorders; immunoglobulin and their types; Antigen-antibody interactions; Immune response; ELISA.

Unit II (10 Lectures)

Chromatin structure of eukaryotes; Chromosome number and morphology in farm animals; Karyotyping and banding; Chromosomal abnormalities and genetic syndromes; DNA packing in chromosomes; Types of DNA; FISH chromosome painting and PRINS; SCH and RH panel mapping.

Unit III (10 Lectures)

Genetic variants in blood group systems of farm animals; Major histocompatibility complex: BoLA, BuLA; Genetics of biochemical variants and their applications; Immune response genes and concepts of disease resistance including major genes; Hybridoma and its significance; Concept of immunofertility; TLRs and interleukins.

Unit IV (3 Lectures)

Mutation and assays of mutagenesis; Sister chromatid exchanges.

VII. Practical (15 Classes)

Identification of Barr bodies; *In-vitro* and *in vivo* preparation of somatic metaphase chromosomes; Screening of chromosomal abnormalities; Microphotography and karyotyping; Banding procedures for comparing the chromosomal complement; FISH and PRINS; ELISA; Immunocompetence tests.

VIII. Teaching methods

Blackboard; PPT-animations; Hands-on practical training; application based practical



approach; Visit labs specialising in animal cytogenetics and immunogenetics; Research article discussion in the classroom.

IX. Learning outcome

Upon successful completion, the students will be able to understand the immune response (IR) and its role in disease resistance along with the role of allelic variations in IR genes in animal production in addition to the advances in the field of animal cytogenetics and immunogenetics.

X. Suggested Reading

- Gersen SL and Keagle MB. 2013. *The Principles of Clinical Cytogenetics*. Springer.
- Hare WCD and Singh EL. 1999. *Cytogenetics in Animal Reproduction*. CABI.
- Panayi GS and David CS. 1984. *Immunogenetics*. Elsevier.
- Roitt I. 1997. *Essential Immunology*. Blackwell.
- Summer AT and Chandley AC. 1993. *Chromosome Today*. Chapman and Hall.

I. Course Title : Molecular Genetics in Animal Breeding

II. Course Code : AGB 602

III. Credit Hours : 2+1

IV. Why this course?

To provide basic and advanced concepts of molecular genetics and their application to different species of animals

V. Aim of the course

This aim of this course is to study genes and their functions to understand their role in animal breeding and selection. Also aimed at the genetics of populations including quantitative genetics and its applications in animal breeding.

VI. Theory

Unit I (8 Lectures)

Basic concepts in molecular genetics; Concepts of proteomics and genomics; Genesis and importance of molecular techniques; Genome organization: physical and genetic map, current status of genome maps of livestock; Gene expression and control.

Unit II (8 Lectures)

Molecular markers and their applications; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting.

Unit III (7 Lectures)

DNA sequencing; Genome sequencing; Genomic Library; Polymerase Chain Reaction (PCR) and its types (PCR-RFLP, AS-PCR, etc.) and applications; Transgenesis and methods of gene transfer; Recombinant DNA technology and applications.

Unit IV (7 Lectures)

Analysis of molecular genetic data; Quantitative Trait Loci (QTL) mapping and its application in animal breeding; Genome scan, candidate gene approach.

VII. Practical (15 Classes)

Extraction and purification of genomic DNA; Gel electrophoresis; Restriction enzyme digestion of DNA and analysis; PCR-RFLP; PCR-SSCP; Bioinformatics tool for DNA sequence analysis; Isolation of RNA; cDNA synthesis; Statistical methods for analyzing molecular genetic data.



VIII. Teaching methods

Blackboard; PPT-animations; Web-courses (if available); Hands-on practical training; Application based practical skills; Visit labs specialising in molecular genetics critical discussion of articles in the area.

IX. Learning outcome

Upon successful completion, the students will have an understanding of how genes control biological functions from cellular activities to development, techniques used to manipulate gene functions in addition to genomics, proteomics and their applications in livestock improvement.

X. Suggested Reading

- Akano IE. 1992. *DNA Technology*. IAP Academic Press.
- Brown TA. 2006. *Genome 3*. Garland Science Publishers.
- Clark D and Pazdernik N. 2012. *Molecular Biology*, 2nd ed. Elsevier.
- Micklos DA, Fryer GA and Crotty DA. 2003. *DNA Science*. Cold Spring Harbor.
- Setlow JK. 2006. *Genetic Engineering – Principles and Methods*, Springer.

I. Course Title : Population and Quantitative Genetics

II. Course Code : AGB 603

III. Credit Hours : 2+1

IV. Why this course?

To study the genetic structure of the animal population and the importance of genetic variation and covariation among quantitative traits.

V. Aim of the course

To impart knowledge on the general structure of animal population and factors affecting it and estimation of genetic and phenotypic parameters of different quantitative traits.

VI. Theory

Unit I (15 Lectures)

Genetic structure of population; Hardy Weinberg Law; Idealized population; Factors affecting changes in gene and genotypic frequencies; Systematic processes; Approach to equilibrium under different situations: Single autosomal locus with two alleles, single sex-linked locus, two pairs of autosomal linked and unlinked loci; Linkage equilibrium and disequilibrium; Combined effect of all forces changing gene frequency.

Unit II (10 Lectures)

Dispersive process - small population: random genetic drift; Effective population size; Regular and irregular inbreeding systems; Founder effect and bottleneck; Effective number of founders and ancestors.

Unit III (10 Lectures)

Quantitative genetics: Gene effects, population mean, breeding value; Variance and its partitioning; Genotype-environment interaction and correlation; Resemblance between relatives.



Unit IV (10 Lectures)

Genetic and phenotypic parameters (heritability, repeatability, correlations): Methods of estimation, uses, possible biases, precision, optimal designs; Scale effects and threshold traits.

VII. Practical (15 Classes)

Estimation of gene and genotypic frequencies under different conditions; Estimation of inbreeding in regular and irregular systems; Estimation of effective population size; Computation of quantitative genetic effects; Estimation of variance components; Computation of heritability, repeatability, genetic, phenotypic and environmental correlations and their standard errors.

VIII. Teaching methods

Lectures; PPT-Presentations; MS-Excel for estimation of data.

IX. Learning outcome

Understanding the effect of gene and genotype frequencies on the genetic structure of populations, and estimation of genetic variation and covariation among different quantitative traits.

X. Suggested Reading

- Bulmer MG. 1980. *The Mathematical Theory of Quantitative Genetics*. Clarendon Press.
- Crow JF and Kimura M. 2009. *An Introduction to Population Genetics*. Harper and Row.
- Falconer DS and Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
- Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
- Pirchner F. 1983. *Population Genetics in Animal Breeding*. Springer.

I. Course Title : Selection Method and Breeding System

II. Course Code : AGB 604

III. Credit Hours : 2+1

IV. Why this course?

To explain the methodology of selection and breeding systems for improvement of livestock and poultry.

V. Aim of the course

To study different methods of selection and factors affecting it, various mating systems and their use in animal genetics and the concepts of recent selection techniques.

VI. Theory

Unit I (6 Lectures)

Types of selection and their genetic consequences; Response to selection: Prediction and improvement.

Unit II (12 Lectures)

Theoretical aspects of accuracy and efficiency of selection bases; Prediction of breeding value using different criteria; Combined selection; Correlated response and efficiency of indirect selection.

Unit III (12 Lectures)

Selection for several traits; Different types of selection indices; Evaluation of short



term and long term selection experiments: bidirectional selection, asymmetry of response, selection limit.

Unit IV (15 Lectures)

Different mating systems: assortative mating, inbreeding, out-breeding; Genetic and phenotypic consequences and applications of various mating systems in animal improvement; Heterosis; Selection for general and specific combining abilities; Genetic polymorphism and its application in genetic improvement: Basic concepts of marker-assisted selection (MAS) and genomic selection.

VII. Practical (15 Classes)

Prediction of direct and correlated response; Computation of realized heritability and genetic correlation; Computation of selection index; Estimation of breeding values from different sources of information; Determining the accuracy of selection; Estimation of heterosis for different types of crosses; Estimation of GCA and SCA.

VIII. Teaching methods

Blackboard; PPT-animations; Hands-on practical training; application based practical approach; Visit labs specialising in animal cytogenetics and immunogenetics; Research article discussion in the classroom.

IX. Learning outcome

Good knowledge of the application of selection methods and mating systems in animal improvement, and application of selection for combining abilities.

X. Suggested Reading

- Falconer DS and Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
- Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
- Tomar SS. 1996. *Text Book of Population Genetics*, vol. I. *Qualitative Inheritance*. Universal Publishers.
- Tomar SS. 2010. *Text Book of Animal Breeding*. Universal Publishers.
- Tomar SS. 2014. *Text Book of Population Genetics, . Quantitative Inheritance*. Universal Publishers.

I. Course Title : Biometrical Genetics I

II. Course Code : AGB 605

III. Credit Hours : 2+1

IV. Why this course?

To educate about the various biometrical techniques for data analysis and their applications

V. Aim of the course

To impart knowledge about common diseases and disorders of poultry, diagnosis, vaccination, prevention, control and treatment.

VI. Theory

Unit I (8 Lectures)

Nature and structure of animal breeding data; Source of variation; Adjustment of data; Outliers and their removal; Basic concepts in statistical inference and experimental designs.



Unit II (7 Lectures)

Introduction to matrix algebra; Types of matrices and their operations; Determinants and their properties; Matrix inversion and its applications.

Unit III (15 Lectures)

Multiple regression and correlations; Fisher's discriminant function and its application; D^2 statistics in divergent analysis; Cluster analysis; Fixation index; Genetic distance estimation and phylogeny construction; Linear models and their types; Least-squares (LS) analysis; Generalized LS and weighted LS; BLUE, BLUP; Methods of estimation of variance components: ANOVA, ML, REML, MINQUE, MIVQUE; Bayesian approach.

Unit IV (15 Lectures)

Animal model; Reduced animal model; Sire model; Maternal grandsire model; Maternal effects model; Repeatability model; Random regression model; Threshold model; Multidimensional scaling (MDS) and principal component analysis (PCA); Database management and use of software in animal breeding.

VII. Practical (15 Classes)

Collection, compilation, coding and transformation of animal breeding data; Matrix applications, determinant and inverse of matrices; Building of models for various types of data; Least-squares analysis of data; Estimation of BLUE and BLUP solutions; Formation of numerator relationship, dominance and identical by descent matrix; Estimation of variance components.

VIII. Teaching methods

Blackboard; PPT-Presentations; Application based practical approach; Research article discussion in the classroom.

IX. Learning outcome

Students will develop skills in analyzing breeding data using different biometrical techniques.

X. Suggested Reading

- Henderson CR. 1984. *Application of Linear Models in Animal Breeding*. University of Guelph Press.
- Mather K and Jinks JL. 1977. *Introduction to Biometrical Genetics*. Chapman and Hall.
- Searle SR. 2014. *Linear Models*. John Wiley and Sons.
- Singh RK and Chaudhary BD. 2012. *Biometrical Methods in Quantitative Genetic Analysis*. Kalyani Publishers.

I. Course Title : Conservation of Animal Genetics Resources

II. Course Code : AGB 606

III. Credit Hours : 2+0

IV. Why this course?

To study the concepts of conservation of animal genetic resources (AnGR)

V. Aim of the course

To impart knowledge on AnGR in India and their characterization, concepts and methods of conservation and national and international strategies for conservation of AnGR.



VI. Theory

Unit I (12 Lectures)

Domestic animal diversity in India: Origin, history and utilization; Present status and flow of AnGR and its contribution to livelihood security; Methodology for phenotypic and genotypic characterization of livestock and poultry breeds through systematic surveys; Management of breed; Physical, biochemical and performance traits and uniqueness of animals of a breed; Social, cultural and economic aspects of their owners/ communities rearing the breed.

Unit II (12 Lectures)

Methods for increasing effective population size of endangered breed/ species: Effective number of alleles, inbreeding effective size, variance effective size, minimum viable population size; Methodology for characterization of AnGR; nuDNA and mtDNA based diversity analysis and relationship among the breeds; Concept of conservation: *In-situ* and *ex-situ* (*in-vivo* and *in-vitro*); Models of conservation; Prioritization of breeds for conservation; Strategies for conservation of livestock and poultry genetics resources; Gene bank concept; Preservation of ecosystem.

Unit III (6 Lectures)

Status, opportunities and challenges in the conservation of AnGR; IPR issues on animal genetic resources/ animal products or by-products; Registration of livestock breeds and protection of livestock owner's rights in India; Breed societies and their role in conservation.

VII. Practical -

VIII. Teaching methods

Blackboard; PPT-Presentations; Application based practical approach; Research article discussion in the classroom

IX. Learning outcome

Conservation strategies of AnGR, their characterization and methods of conservation to protect biodiversity

X. Suggested Reading

- Nivsarkar AE, Vij RK and Tania MS. 2000. *Animal Genetic Resources of Indian Cattle and Buffaloes*. ICAR.
- Oldenbroek K. 2007. *Utilisation and Conservation of Farm Animal Genetic Resources*. WA Publishers.
- Sahai R and Vij RK. 1997. *Domestic Animal Diversity, Conservation and Sustainable Development*. SI Publishers.
- Van Vleck LD, Pollak E and Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

I. Course Title : Cattle and Buffalo Breeding

II. Course Code : AGB 607

III. Credit Hours : 2+1

IV. Why this course?

To educate the concept of cattle and buffalo breeding and improvement in dairy production

V. Aim of the course

To impart knowledge on different breeds of cattle and buffalo and their economic



traits, sire evaluation methods and breeding systems and different cattle and buffalo breeding programmes.

VI. Theory

Unit I (15 Lectures)

History of dairy cattle and buffalo breeding; Evolution of cattle and buffalo breeds and their characteristics; Population dynamics and production systems; Inheritance of important economic traits; Recording and handling of breeding data; Standardization of records; Computation of correction factors for the adjustment of the data; International Committee on Animal Recording (ICAR) and INAPH.

Unit II (12 Lectures)

Progeny testing under farm and field conditions; Evaluation of bulls by different models; Estimation of breeding values of the cows; Nucleus breeding system; Marker-assisted selection and genomic selection.

Unit III (12 Lectures)

Crossbreeding in cattle in India and abroad; Development of new breeds; Conservation of threatened breeds of cattle and buffaloes; Role of breed associations in dairy improvement; Breeding policy: national and state.

Unit IV (6 Lectures)

Import of exotic germplasm for breeding cattle in the tropics; Appraisal of buffalo and cattle breeding programme; Role of breed associations in dairy improvement.

VII. Practical (15 Classes)

Performance recording; Standardization of records; Estimation of economic traits; Computation of genetic parameters; Genetic gain; Sire evaluation methods; Estimation of heterosis; Culling and replacement.

VIII. Teaching methods

Blackboard; PPT-Presentations; Application based practical approach; Research article discussion in the classroom

IX. Learning outcome

After completion of the course, the students get good knowledge of different breeds of cattle and buffalo and breeding programmes

X. Suggested Reading

- Chakravarty AK and Vohra V. 2011. *Sustainable Breeding in Cattle and Buffalo*. Satish Serial Publications.
- Lasley JF. 1972. *Genetics of Livestock Improvement*. IBH.
- Oldenbroek K and van der Waaij L. 2014. *Text book of Animal Breeding and Genetics*. Wageningen University and Research Centre (Free Online).
- Schmidt GM, Van Vleck LD and Hutjens MF. 1988. *Principles of Dairy Science*. WH Freeman.
- Van Vleck LD, Pollak EJ and Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

I. Course Title : Sheep and Goat Breeding

II. Course Code : AGB 608

III. Credit Hours : 2+0

IV. Why this course?

To educate about sheep and goat breeding concepts and development in small ruminants



V. Aim of the course

To impart knowledge on different breeds of sheep and goat and their economic traits, breeding systems and selection strategies, and different sheep and goat breeding policies.

VI. Theory

Unit I (8 Lectures)

Breeds; Economic traits; Population dynamics and production systems; Prolificacy; Breeding records and standardization; Computation of correction factors.

Unit II (12 Lectures)

Genetic parameters; Selection of males and female; Selection indices for sheep and goat; Breeding systems; Breeding strategies for improvement of production (meat, milk and wool) and reproduction (fertility and fecundity); Inbreeding and its effects on production traits; Group breeding schemes; Development of new breeds; Strategies for introgression of genes (fecundity and growth).

Unit III (10 Lectures)

Breeding policy; Sheep and goat improvement programme in India; Conservation of breeds; Culling and replacement; Equivalent Animal Death Rate (EADR).

VII. Teaching methods

Blackboard; PPT-presentations

VIII. Learning outcome

After completion of the course, the students get a good knowledge of different breeds of sheep and goat and their breeding policies

IX. Suggested Reading

- Jindal SK. 2013. *Goat Production and Health Management*. New India Publishers.
- Karim SA. 2010. *Climate Change and Stress Management: Sheep and Goat Production*. Satish Serial Publications.
- Mulugeta A. 2016. *Sheep and Goat Production Text Book*. Lambert Academic Publishers.
- Prasad J. 2018. *Goat, Sheep and Pig, Production and Management*. Kalyani Publishers.
- Ross CV. 1988. *Sheep Production and Management*. Prentice-Hall.

I. Course Title : Poultry Breeding

II. Course Code : AGB 609

III. Credit Hours : 2+1

IV. Why this course?

To educate about advances in poultry breeding practices

V. Aim of the course

To impart knowledge on different species of poultry and their economic traits, selection criteria and selection indices, and conservation of poultry genetic resources.

VI. Theory

Unit I (10 Lectures)

Origin and history of poultry species: Chicken, turkey, duck and quail; Poultry classes and breeds; Important qualitative traits in poultry including lethal; Economic traits of egg and meat-type chicken and their standardization; Different mating systems.



Unit II (10 Lectures)

Selection criteria and selection indices; Response to selection; Genetic controls; Genotype and environment interaction; Inbreeding and its effects on production traits in egg and meat-type chickens; Development of inbred lines and strains; Strain and line crosses; Introduction to diallel cross; Utilisation of heterosis and reciprocal effect; Recurrent selection, reciprocal recurrent selection and modified RRS; Specialized sire and dam lines; Genetic improvement programs in poultry; Selection strategies for the improvement of layers and broilers; Performance testing of commercial strains; Backyard poultry.

Unit III (4 Lectures)

Industrial breeding; Artificial insemination in chicken; Auto-sexing; Random Sample Test.

Unit IV (6 Lectures)

Biochemical variants and immunogenetics of poultry; Use of molecular genetics in poultry breeding; Quantitative trait loci; Marker-assisted selection and genomic selection; Conservation of poultry genetic resources.

VII. Practical (15 Classes)

Inheritance of qualitative traits; Economic traits of egg-type and meat-type chicken; Procedures of standardization; Estimations of heritability, the correlation between various production traits; Inbreeding co-efficient and heterosis; Selection of sires and dams; Osborne index; Restricted selection index; Collection and evaluation of semen and insemination; Estimation of GCA and SCA.

VIII. Teaching methods

Blackboard; PPT-presentations

IX. Learning outcome

Students get acquainted with different poultry species, applications of selection methodology and molecular genetics in poultry for higher productivity.

X. Suggested Reading

- Brereton G and Roadnight S. 2000. *21st Century Poultry Breeding*. Gold Cockerel Books.
- Crawford RD. 1990. *Poultry Breeding and Genetics*. Elsevier.
- Hutt FB. 2003. *Genetics of Fowl*. Norton Greek Press.
- Muir WM and Aggrey SE. 2003. *Poultry Genetics, Breeding and Biotechnology*. CABI.
- Singh RP and Kumar J. 1994. *Biometrical Methods in Poultry Breeding*. Kalyani Publishers.

I. Course Title : Laboratory Animal and Rabbit Breeding

II. Course Code : AGB 610

III. Credit Hours : 2+0

IV. Why this course?

To educate about laboratory animal breeding principles and commercial rabbit breeding.

V. Aim of the course

To impart knowledge on different laboratory animals and their importance, selection and mating methods, and commercial rabbit production and management.



VI. Theory

Unit I (6 Lectures)

Introduction to laboratory animal genetics; Breeding colonies of mice, rats, hamsters, guinea pigs and rabbits and their maintenance; Use of primates in animal research.

Unit II (4 Lectures)

Selection methods and mating systems: Monogamous, polygamous and others.

Unit III (12 Lectures)

Development of genetically controlled laboratory animals; Rules for nomenclature: Inbred strains, outbred stocks, mutant stocks, recombinant inbred strains, transgenic strains; Gene targeting and production of 'gene knock-out' animals; Production and use of specific pathogen-free animals; Guidelines and SOPs for the establishment of lab animal house; Genetic control and monitoring; Record-keeping; Ethics of laboratory animal research: FELASA, CPCSEA and IAEA regulations.

Unit IV (8 Lectures)

Rabbit production and management systems; Rabbit breeds for meat and wool; Economic traits and their inheritance; Breeding records and standardisation; Selection methods and breeding systems.

VII. Teaching methods

Blackboard; PPT-presentations

VIII. Learning outcome

Students get a view on breeding importance of laboratory animals and their applications in animal genetics. Additionally, knowledge of commercial rabbit production will also be developed

IX. Suggested Reading

- Hafez ESE. 1970. *Reproduction and Breeding Techniques for Laboratory Animals*. Philadelphia.
- Peter RC, Nephi MP, Steven DL and James IM. 1987. *Rabbit Production*, 6th ed. Vero Media Inc.
- Shinde AK, Swarnkar CP and Naqvi SMK. 2013. *Sheep and Rabbit Production and Utilization Technologies*. CSWRI Publications.
- Sirosis M. 2004. *Laboratory Animal Breeding: Principles and Procedures*. Elsevier.
- Tuffery AA. 1995. *Laboratory Animals: An Introduction for Animal Experimenters*. J Wiley and Sons.
- USDA. 2014. *A Complete Hand Book of Backyard and Commercial Rabbit Production*. Peace Corps (Free Online).
- Van Vleck LD, Pollak EJ and Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.
- Weichbrod RH, Thompson GAH and Norton JN. 2018. *Management of Animal Care and Use Programs in Research, Education, and Testing*, 2nd ed. CRC Press.

I. Course Title : Swine Breeding

II. Course Code : AGB 611

III. Credit Hours : 1+0

IV. Why this course?

To educate about swine breeding principles and swine improvement programme in India



V. Aim of the course

To impart knowledge on different breeds of swine and their economic traits, breeding systems and selection methods, and breeding policies and conservation methods.

VI. Theory

Unit I (7 Lectures)

History and development of swine industry; Different breeds of pigs; Economic traits; Breeding records and standardization; Computation of correction factors; Culling and replacement; Equivalent Animal Death Rate (EADR).

Unit II (6 Lectures)

Genetic parameters; Bases and methods of selection; Selection of boars and sows; Breeding systems; Breeding strategies for improvement of indigenous and pure exotic breeds; Inbreeding and its effects on performance traits; Exploitation of heterosis; Development of synthetic varieties/ breeds.

Unit III (2 Lectures)

Swine breeding policy; National swine improvement programme; Conservation of breeds.

VII. Teaching methods

Blackboard: PPT-presentations: Research article discussion in the classroom

VIII. Learning outcome

Get acquainted with different breeds of swine, breeding methods and swine improvement programmes in India

IX. Suggested Reading

- ATARI. 2019. *Pig Farming: Promising Agri-business in Punjab*. ATARI-I Publication (Free Online).
- Board E. 2008. *Handbook of Pig Farming*, Engineers India Research Institute Publications.
- Das A, Tamuli AK, Mohan NH and Thomas R. 2013. *Handbook of Pig Husbandry*, Today and Tomorrow Printers.
- Das A, Tamuli, MK, Thomas R and Banik S. 2012. *Scientific Pig Production Practices*, NRC on Pig Publication.
- FAO. 2009. *Farmer's Hand Book on Pig Production*. FAO Publication.
- Oldenbroek K and van der Waaij L. 2014. *Text Book of Animal Breeding and Genetics*. Wageningen University and Research Centre (Free Online).

I. Course Title : Pet Animal Breeding (Dogs and Cats)

II. Course Code : AGB 612

III. Credit Hours : 1+0

IV. Why this course?

To educate about pet animal breeding principles which are contemporary in the defence establishment and affluent civic society

V. Aim of the course

To impart knowledge on different breeds of cats and dogs besides the principles of breeding management.



VI. Theory

Unit I (9 Lectures)

Breeds of dogs: Classification of breeds, important Indian and exotic breeds; Pedigree breeding and maintenance of breeding records; Kennel Club; Breed associations; Breeding management of dog.

Unit II (6 Lectures)

Breeds of cats: Classification of breeds, important Indian and exotic breeds; Pedigree breeding and maintenance of breeding records; Breeding management of cat.

VII. Teaching methods

Blackboard; PPT-animations; research article discussion in the classroom

VIII. Learning outcome

Different breeds of cats and dogs and their breeding management

IX. Suggested Reading

- Battaglia CL. 1990. *Dog Genetics: How to Breed Better Dogs*. TFH Publications.
- Harmer H. 1974. *Dogs and How to Breed Them*, 2nd ed. Gifford Publications.
- Hedberg K. 1992. *The Dog Owner's Manual on Selecting, Raising and Breeding Dogs*. Watermark Press.
- Moore AS. 1981. *Breeding Purebred Cats: A Guide for the Novice and Small Breeder*. AbraXes Publication.
- Robinson R. 1997. *Genetics of Cat Breeders*. Science Direct Publications.
- Vella CM and McGonagle JJ. 1997. *Breeding Pedigreed Cats*. Howell Book House.
- Vella C and Shelton L. 1999. *Genetics for Cat Breeders and Veterinarians*. Elsevier.
- Vine LL. 1977. *Breeding, Whelping and Natal Care of Dogs*. Acro Publication, NY.
- White K. 1980. *Dog Breeding: A Guide to Mating and Whelping*. Bartholomew Publications.

I. Course Title : Wild Animal Genetics and Breeding

II. Course Code : AGB 613

III. Credit Hours : 1+0

IV. Why this course?

To educate about wild animal breeding

V. Aim of the course

To impart knowledge on wildlife biodiversity in India, wild animal breeding in nature and captivity, and conservation of wild animals.

VI. Theory

Unit I (4 Lectures)

Wildlife biodiversity of India; Adaptation and natural selection; Species and speciation; Population dynamics; Variation; Loss of genetic variation; Hardy-Weinberg equilibrium.

Unit II (6 Lectures)

Inbreeding: Inbreeding depression, effective population size, demographic bottleneck; Genetic considerations in the translocation of wild animals; Wild animal breeding in nature and captivity; Captive breeding projects and principles; Concept of landscape genetics.



Unit III (5 Lectures)

Conservation of wild animals; Cryopreservation of semen and embryos of endangered species; Frozen zoo concept; Genetic markers; Application of molecular and cytogenetic techniques in wildlife breeding; Genetic defects in wild animals; Wildlife Protection Act.

VII. Teaching methods

Blackboard; PPT-animations; research article discussion in the classroom

VIII. Learning outcome

Breeding and conservation methods of wild animals

IX. Suggested Reading

- Devera GK, Katerina VT and Charlotte KB. 2012. *Wild Animals in Captivity: Principles and Techniques of Zoo Management*. University of Chicago Press.
- Kleiman DG, Allen ME, Thompson KV and Lumpkin S. 1997. *Wild Mammals in Captivity-Principles and Techniques*. Chicago Press.
- Linda JS. 2017. *A Field Guide of Tracking Mammals in North East*. Countryman Press.
- Nicholas FW. 1987. *Veterinary Genetics*. Oxford Science Publication.
- Parragon. 2006. *The Encyclopaedia of Wildlife*. Parragon Books Service Ltd.
- Ranjitsinh MK. 2017. *A Life with Wildlife: From Princely India to the Present*, Harper Collins Publications.
- Saha GK and Mazumdar S. 2017. *Wildlife Biology: An Indian Perspective*. PHI Learning Pvt Ltd.

I. Course Title : Equine Breeding

II. Course Code : AGB 614

III. Credit Hours : 1+0

IV. Why this course?

To educate about breeding practices in equines

V. Aim of the course

To impart knowledge on classification of light and work-horses, breeding management and selection strategies in equines, and biotechnology in equine breeding programmes requirements of poultry and factors influencing the same.

VI. Theory

Unit I (4 Lectures)

Equine population in India; Domestic diversity, its origin, history and utilization; Breeds of native and exotic horses; Types and classes of light and work-horses.

Unit II (6 Lectures)

Cytogenetics of horses and donkeys; Breeding of horses and donkeys and production of mules; Foaling and care of foal; Important quantitative and qualitative traits and their inheritance; Recording and handling of breeding data; Standardization of records.

Unit III (5 Lectures)

Stallion and mare complementation; Judging criteria for elite animals; Conservation strategies; Selecting the mare and the stallion for breeding; Ongoing breed improvement programmes; Biotechnology in equine breeding programmes.



VII. Teaching methods

Blackboard; PPT-presentations

VIII. Learning outcome

Breeding and conservation methods of equines

IX. Suggested Reading

- McKinnon AO, Squires EL, Vaala WE and Varner DD. 2011. *Equine Reproduction*. Wiley Blackwell.
- Morel MCGD. 2008. *Equine Reproductive Physiology, Breeding and Stud Management*. CABI.
- Samper JC. 2008. *Equine Breeding Management and Artificial Insemination*. Science Direct Publications.

I. Course Title : Camel Breeding

II. Course Code : AGB 615

III. Credit Hours : 1+0

IV. Why this course?

To educate about camel breeding, an emerging economically important species of livestock

V. Aim of the course

To impart knowledge on breeding management of camels, breed improvement programmes, and application of molecular genetic methods in camel breeding.

VI. Theory

Unit I (7 Lectures)

Population dynamics and economic importance; Breeds of the camel; Production systems and herd structure; Inheritance of important economic traits; Recording and handling of breeding data; Standardization of records; Cytogenetics of the camel; Behaviour and breeding management.

Unit II (5 Lectures)

Judging criteria for elite animals; Selection of breeding stock; Breeding seasons; Methods for detection of heat; Natural service and artificial insemination; Breed improvement programmes.

Unit III (3 Lectures)

Conservation strategies; Immune status of camel; Molecular genetics in camel breeding.

VII. Teaching methods

Blackboard; PPT-presentations; Research article discussion in the classroom

VIII. Learning outcome

Breeding and conservation methods of camels

IX. Suggested Reading

- Dmitriez NG and Ernst LK. 1989. *Animal Genetic Resources of the USSR*. FAO.
- Wilson RT. 1984. *The Camel*. Longman.
- Selected Research Articles



- I. Course Title : Yak and Mithun Breeding**
II. Course Code : AGB 616
III. Credit Hours : 1+0

IV. Why this course?

To educate about Yak and Mithun breeding

V. Aim of the course

To impart knowledge on breeds/ types of Yak and Mithun, production systems in Yaks and Mithun, their behaviour and breeding management including conservation strategies and molecular genetics in Yak and Mithun breeding.

VI. Theory

Unit I (7 Lectures)

Population dynamics and economic importance; Breeds/ types of yak and mithun; Production systems; Inheritance of important economic traits; Recording and handling of breeding data; Standardization of records; Cytogenetics of yak and mithun; Behaviour and breeding management.

Unit II (5 Lectures)

Judging criteria for elite animals; Selection of breeding stock; Breeding seasons; Methods for detection of heat; Natural service and artificial insemination; Breed improvement. programmes

Unit III (3 Lectures)

Conservation strategies; Molecular genetics in yak and mithun breeding.

VII. Teaching methods

Blackboard; PPT-presentations; Research article discussion in classroom

VIII. Learning outcome

Breeding and conservation methods of yak and mithun

IX. Suggested Reading

- Das PJ, Deori S and Deb SM. 2017. *Arunachali Yak*. NRC on Yak, Dirang, India.
- Gupta SC, Gupta N and Nivsarkar AE. 1996. *Mithun - A Bovine of Indian Origin*.
- Nivsarkar AE, Gupta SC and Gupta N. 1997. *Yak Production*. ICAR Publication.
- Pal RN. 2003. *The Yak*, 2nd ed. FAO; RAP Publication.
- *Selected Research Articles*

- I. Course Title : Statistical Methods in Animal Breeding**
II. Course Code : AGB 617
III. Credit Hours : 2+1

IV. Why this course?

To educate about Statistical Methods in Animal breeding

V. Aim of the course

To impart knowledge on the transformation of data, sampling, standard error and importance, basics of statistical inferences, and analysis of variance.



VI. Theory

Unit I (12 Lectures)

Measures of central tendency; Measures of dispersion; Correlation and regression; Probability; Theory of distributions; Transformation of data; Sampling: Theory, need and properties; Estimators: Concept, standard error and importance.

Unit II (8 Lectures)

Basics of statistical inferences; Parametric tests: Z , t and F distribution; Non-parametric test: c^2 sign test, run test and rank test; Confidence interval.

Unit III (10 Lectures)

Analysis of variance: One and two way; Experimental designs: CRD, RBD and LSD; Missing plot techniques; Analysis of covariance.

VII. Practical (15 Classes)

Measures of central tendency; Measures of dispersion; Correlation and regression; Transformation of data; Probability; Z , t , F and c^2 tests; CRD, RBD and LSD; Analysis of covariance

VIII. Teaching methods

Blackboard; PPT-presentations

IX. Learning outcome

Application of statistical methods in animal breeding

X. Suggested Reading

- Gianola D and Hammond K. 1990. *Advances in Statistical Methods for Genetic Improvement of Livestock*. Springer.
- Gupta SC and Kapur VK. 2014. *Fundamentals of applied statistics*. Sultan Chand and Sons.
- Gupta SC. 2016. *Fundamentals of Statistics*. Himalaya Publishing House Pvt Ltd.
- Pillai SK and Sinha HC. 1968. *Statistical Methods for Biological Workers*. Ram Prasad and Sons.
- Snedecor GW and Cochran WG. 1989. *Statistical Methods*. Wiley India Publications.



Course Title with Credit Load Ph.D. in Animal Genetics and Breeding

Course Code	Course Title	Credit Hours
AGB 701*	Molecular Genetics II	2+0
AGB 702*	Trends in Animal Breeding	2+0
AGB 703*	Biometrical Genetics II	2+1
AGB 704*	Advances in Selection Methodology	2+1
AGB 705	Bioinformatics in Animal Breeding	1+1
AGB 706	Animal Cytogenetics and Immunogenetics II	2+0
AGB 707	Statistical Software in Animal Breeding	1+1
AGB 791	Seminar I	1+0
AGB 792	Seminar II	1+0
AGB 799	Research	75

*Core courses



Course Contents

Ph.D. in Animal Genetics and Breeding

I. Course Title : Molecular Genetics II

II. Course Code : AGB 701

III. Credit Hours : 2+0

IV. Why this course?

To educate about the latest tools and techniques of animal genetics and their uses in animal sciences

V. Aim of the course

To impart knowledge on the eukaryotic genome, gene editing, gene knock-out and silencing, transgenic animals their benefits in livestock production, and genomic selection.

VI. Theory

Unit I (10 Lectures)

Eukaryotic genome: Gene families, pseudogenes, SnRNPs; Types of RNA including miRNA; Gene conversion; Tandem repeats; Minisatellites and microsatellites; Sequencing of EST.

Unit II (10 Lectures)

Transposable elements; Transcription and RNA processing; Translation; Regulation of gene expression; Differential expression analysis; Serial analysis of gene expression; Selective gene amplification; The proteasome and longevity of proteins; Gene editing; Gene targeting; Gene knock-out and silencing.

Unit III (10 Lectures)

Transgenic animals: Application, ethical issues; Gene therapy; Bio-pharming; Cloning; Genome imprinting; Epigenetic modification; Creation of SNP chips and microarray technology; Next-generation sequencing; Genomic selection.

VII. Teaching methods

Blackboard; PPT-animations; Research article discussion in classroom

VIII. Learning outcome

Epigenetic Modification and transgenic animal production

IX. Suggested Reading

- Brown TA. 2006. *Genome 3*. Garland Science Publishers
- Clark DP. 2012. *Molecular Biology*. Academic Cell
- Hugo van den Berg. 2015. *Cell Biology and Molecular Genetics*. IPO Publishers
- Pasternak JJ. 2005. An Introduction to Human Molecular Genetics: *Mechanisms of Inherited Diseases*. Wiley
- Puehler A and Timmis KN. 1984. *Advanced Molecular Genetics*. Springer
- Watson, JD, Tania AB, Bell SP, Gann A, Levine A and Losick R. 2017. *Molecular Biology of the Gene*. Pearson Education Publication



- I. Course Title : Trends in Animal Breeding**
II. Course Code : AGB 702
III. Credit Hours : 2+0

IV. Why this course?

To acquaint with recent trends in animal breeding and designing of need-based breeding strategies

V. Aim of the course

To impart knowledge on identification of novel traits and their role in breed improvement programme, development of mixed model equations, formulation of detailed breeding plans and advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

VI. Theory

Unit I (12 Lectures)

Identification of novel traits and their role in breed improvement programme; Development of mixed model equations; Advancement in biometrical methods including artificial neural network and Bayesian approach; Detection of QTL; Ancestry informative markers for admixture analysis.

Unit II (10 Lectures)

Formulation of detailed breeding plans; Breeding for disease resistance and functional traits; Breeding for climate resilience; Inheritance of animal behavior traits; Breeding for animal welfare; Impact analysis of different breed improvement programme in various livestock species.

Unit III (8 Lectures)

Advanced techniques in genetic manipulation for multiplication and improvement of livestock species: Use of sexed semen, gene introgression, and cloning, etc.

VII. Teaching methods

Blackboard; PPTs; Research article discussion in the classroom

VIII. Learning outcome

Breeding for disease resistance and functional traits; Breeding for climate resilience

IX. Suggested Reading

- Brah GS. 2016. *Animal Breeding: Principles and Applications*. Kalyani Publishers.
- Lynch M and Walsh B. 1998. *Genetics and Analysis of Quantitative Traits*. Oxford University Press.
- Morde RA and Thompson R. 2014. *Linear Models for the Prediction of Animal Breeding Values*. CABI.
- Oldenbroek K and van der Waaij L. 2014. *Text book of Animal Breeding and Genetics*. Wageningen University and Research Centre (Free Online).
- Tomar SS. 2010. *Textbook of Animal Breeding*. Universal Publishers.
- Zeggini E and Morris A. 2010. *Analysis of Complex Disease Association Studies*. Academic Press.



- I. Course Title : Biometrical Genetics II**
II. Course Code : AGB 703
III. Credit Hours : 2+1

IV. Why this course?

To impart knowledge about recent advances in population genetic theory and application in animal breeding.

V. Aim of the course

To impart knowledge on multivariate analysis, QTL gene mapping, mating designs and other advanced biometrical techniques pertaining to animal breeding.

VI. Theory

Unit I (8 Lectures)

Multivariate analysis; Discriminant function; D^2 analysis; Principal component analysis; Path analysis.

Unit II (8 Lectures)

Mating designs: Basis, diallel, partial diallel, NCD-1, 2, 3 for reciprocal and maternal effects.

Unit III (5 Lectures)

Prediction of recombinant inbred lines using genetic parameters; Advances in genotype-environment interaction and selection indices.

Unit IV (9 Lectures)

QTL mapping; Analysis of SNP data for genomic selection; Advances in the estimation of variance component and prediction of breeding value: Threshold, dominance, random regression and survival models.

VII. Practical (15 Classes)

Discriminant function; D^2 analysis; Principal component analysis; Path analysis; Estimation of GCA and SCA through diallel, partial diallel, NCD-1, 2, 3; Advances in construction of selection indices; QTL mapping; Analysis of SNP data for genomic selection; Advances in estimation of variance components.

VIII. Teaching methods

Blackboard; PPTs; Research article discussion in the classroom

IX. Learning outcome

Students can analyze data on Animal Genetics using different Biometrical Techniques

X. Suggested Reading

- Choudhuri S. 2014. *Bioinformatics for Beginners*. Academic Press.
- Daniel S and Daniel G. 2012. *Likelihood, Bayesian, and MCMC Methods in Quantitative Genetics*. Springer.
- Kute N and Shinde G. 2016. *Principles of Biometrical Genetics*. Daya Publications.
- Marther K. 1997. *Biometrical Genetics*. Springer.
- Michael JK and Harpal SP. 1996. *The Genetical Analysis of Quantitative Traits*. Springer.
- Pawar IS and Singh S. 2010. *Theory and Application of Biometrical Genetics*. CBS Publications.
- Weller JI. 2016. *Genomic Selection in Animals*. John Wiley and Sons.
- Womack JE. 2012. *Bovine Genomics*. John Wiley and Sons.



- I. Course Title : Advances in Selection Methodology**
II. Course Code : AGB 704
III. Credit Hours : 2+1

IV. Why this course?

To educate about the latest advances in selection theory and their application in animal breeding

V. Aim of the course

To impart knowledge on design of selection experiments, information on single and multiple trait animal models, construction of various selection indices and their relationship with BLUP including the fundamentals of MAS and gBLUP.

VI. Theory

Unit I (8 Lectures)

Fundamental theorem of natural selection; Selection in finite populations; Effect on genetic structure and variance; Design of selection experiments for testing selection theory.

Unit II (6 Lectures)

Measurement of genetic and environmental trends; Advances in selection indices: Multistage, restricted and retrospective selection indices.

Unit III (6 Lectures)

Empirical evaluation of selection theory: genetic slippage, limits to the selection, asymmetry of response, selection experiments, the effect of selection on variance.

Unit IV (10 Lectures)

Selection for threshold traits; Selection under single and multiple trait animal models; Direct and correlated response through various selection indices; Relationship between BLUP and selection index; Selection using markers and entire genome; Methods for analysing GS data like RR-BLUP, Bayes-1, 2 and 3, etc.

VII. Practical (15 Classes)

Determination of culling levels and selection intensity; Estimation of direct and correlated response; Estimation of relative economic values; Construction of various selection indices; Prediction of breeding value using advance methods; QTL analysis using LDMS and LEMAS.

VIII. Teaching methods

Blackboard; PPT; Research article discussion in classroom

IX. Learning outcome

They will be acquainted with all the theoretical techniques of the advanced selection methodology

X. Suggested Reading

- Balakrishnan N, Nagaraja HN and Kannan N. 2007. *Advances in Ranking, Multiple Comparisons and Reliability*. Springer.
- Cameron ND. 1997. *Selection Indices and Prediction of Genetic Merit in Animal Breeding*. CABI.
- Daniel S and Daniel G. 2012. *Likelihood, Bayesian and MCMC Methods in Quantitative*



- Genetics. Springer.
- Draper NR and Smith H. 1998. *Applied Regression Analysis*. J Wiley and Sons.
 - Henderson CR. 1984. *Applications of Linear Models in Animal Breeding*. CABI.
 - Legarra A, Lourenco DAL and Vitezica ZG. 2018. *Bases for Genomic Prediction*. INRA (Free Online).
 - Morde RA and Thompson R. 2014. *Linear Models for the Prediction of Animal Breeding Values*, CABI.

- I. Course Title : Bioinformatics in Animal Breeding**
II. Course Code : AGB 705
III. Credit Hours : 1+1

IV. Why this course?

To educate about basic concepts of bioinformatics and their applications in animal breeding

V. Aim of the course

To impart knowledge on the concepts of bioinformatics, information resources for protein and genome databases, genetic characterization and selection using bioinformatic tools, and modern bioinformatic tools like GWAS.

VI. Theory

Unit I (4 Lectures)

Overview of bioinformatics; Database concepts; Algorithms; Information resources for protein and genome databases: GenBank, EMBL, SWISSPROT, PROSITE.

Unit II (5 Lectures)

Nucleotide and protein sequence analysis; Pair-wise and multiple sequence alignments; Phylogeny; Big SNP data analysis methods; Micro-array processing; Clustering; Software for secondary database search and analysis.

Unit III (6 Lectures)

Genetic characterization; Use of bioinformatics tools for identifying QTL and selection of elite germplasm; GWAS; Development of DNA chips; NGS data analysis.

VII. Practical (15 Classes)

Database development; Algorithms; Nucleotide and protein sequence analysis; Pair-wise and multiple sequence alignments; Phylogeny and dendrogram; Micro-array processing; Clustering; Secondary database search and analysis; Genetic characterization; Identification of QTL; GWAS; NGS data analysis.

VIII. Teaching methods

Blackboard; PPT-animations; Research article discussion in the classroom

IX. Learning outcome

Nucleotide and protein sequence analysis and phylogenetic analysis

X. Suggested Reading

- Attwood TK and Parry-Smith DJ. 2001. *Introduction to Bioinformatics*. Benjamin-Cummings Publishing Company.
- Bishop M. 1999. *Genetics Databases*. Elsevier.
- Jiang R, Zhang X and Zhang MQ. 2013. *Basics of Bioinformatics*. Springer.



- Luke A. 1997. *DNA Sequencing: From Experimental Methods to Bioinformatics*. BIOS Scientific Publishers.
- Ramsden J. 2009. *Bioinformatics: An Introduction*. Springer.
- Stekel D. 2003. *Microarray Bioinformatics*. Cambridge University Press.
- Wu CH and McLarty JW. 2000. *Neural Networks and Genome Informatics*. Elsevier Science.
- Xiong J. 2006. *Essential Bioinformatics*. Cambridge University Press.

I. Course Title : Animal Cytogenetics and Immunogenetics II

II. Course Code : AGB 706

III. Credit Hours : 1+1

IV. Why this course?

To educate about the advances in cytogenetics and their application in animal genetics and breeding

V. Aim of the course

To impart knowledge on somatic cell genetics, stem cell genetics, image analysis of advanced karyotyping techniques, and molecular cytogenetics and gene mapping techniques.

VI. Theory

Unit I (8 Lectures)

Structure of eukaryotic chromosomes; Evolution of karyotype; Various *in-vitro* cell culture techniques; Cell lines and utility; Genotoxicity

Unit II (10 Lectures)

Somatic cell genetics; Stem cell genetics; Molecular cytogenetics and gene mapping; Linkage mapping; ISH; FISH; Radiation hybrid mapping; Fibre-FISH; PRINS; Positional cloning; Spectral karyotyping

Unit III (12 Lectures)

Image analysis; Chromosome painting; Chromosome walking; Micro-dissection of chromosomes; Structure and functions of major histocompatibility complex; T Cell receptor; CD4; Interleukins; Toll-like receptors and their functions

VII. Teaching methods

Blackboard; PPT-animations; Research article discussion in the classroom

VIII. Learning outcome

Students get a good grip on different gene mapping techniques and image analysis

X. Suggested Reading

- Agarwal S and Naik S. 2008. *Fundamentals of Immunogenetics Principles and Practices*. IBD Publisher.
- Christiansen FT and Tait BD. 2012. *Immunogenetics: Methods and Applications in Clinical Practice*. Springer.
- Gersen SL and Keagle MB. 2013. *The Principles of Clinical Cytogenetics*. Springer.
- Litwin SD. 1989. *Human Immunogenetics*. CRC Press.
- Tyagi R. 2009. *Textbook of Cytogenetics*. Discovery Publishers.



- I. Course Title : Statistical Software in Animal Breeding**
II. Course Code : AGB 707
III. Credit Hours : 1+1

IV. Why this course?

To educate about the standard statistical software packages in animal breeding

V. Aim of the course

To impart knowledge on the use of software for computation of different statistical data

VI. Theory

Unit I (4 Lectures)

Data preparation and job control commands for statistical analysis of data; Introduction to statistical and standard software packages.

Unit II (6 Lectures)

Use of software for t-test, Chi-squares test, F-test, ANOVA (CRD, RBD and LSD), correlation and regression (simple, multiple, curvilinear, stepwise) and discriminant analysis.

Unit III (5 Lectures)

Graphic features of the software packages; Linear programming using appropriate software package; Least-squares analysis; Data mining techniques such as neural networks, genetic algorithms and fuzzy logic for predictive modelling.

VII. Practical (15 Classes)

Data preparation and generation; Import and export of data from spreadsheet and database packages; Use of software for t-test, Chi-squares test, F-test, ANOVA (CRD, RBD and LSD), correlation and regression (simple, multiple, curvilinear, stepwise) and discriminant analysis; Graphic features of the software packages; Use of software for linear programming problem; Least-squares analysis; Use of software for neural networks and fuzzy logic models for prediction.

VIII. Teaching methods

Blackboard; PPTs; Research article discussion in the classroom

IX. Learning outcome

Students get an idea on the availability of different statistical and standard software packages and their application in Animal Breeding.

X. Suggested Reading

- Balding DJ, Bishop M and Cannings C. 2001. *Handbook of Statistical Genetics*. J Wiley and Sons.
- Boldman K, Kriese LA, Van Vleck LD, Van Tassell CP and Kachman SD. 1995. *Manual for Use of MTDFREML*. ARS, USDA (Free online).
- Dempfle L. 1990. *Statistical Aspects of Design of Animal Breeding Programs*. Springer.
- Freund RJ, Mohr D and William WJ. 2010. *Statistical Methods*. Academic Press.
- Henderson CR. 1984. *Applications of Linear Models in Animal Breeding*. University Guelph Press.
- Isik F, Holland J and Maltecca C. 2017. *Genetic Data Analysis for Plant and Animal Breeding*. Springer.
- Lynch M and Walsh B. 1990. *Genetics and Analysis of Quantitative Traits*. Oxford.





SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Animal Production Sciences

– Animal Nutrition





Preamble

(Animal Nutrition)

As is true for all branches of science, the science of nutrition has seen a lot of progress during the last decade or so in understanding underlying metabolic processes and the application. Accordingly, it has become imperative to update the course curricula of Animal Nutrition to make a student of Animal Nutrition conversant with the latest development in the field. Therefore, a consorted effort was made by the Committee to gather inputs from all concerned, including experts from academics and industry and incorporate the same after thorough deliberations. The followings are the aspects that were taken into consideration while revising the Animal Nutrition syllabi to make it up to date with the aim of making it knowledge-based while at the same time making it rewarding from a career point of view:

- Latest developments in the science of nutrition and food bioscience and integrating the newer concepts from human and laboratory animal nutrition into the curriculum of animal nutrition
- A particular focus was given to the use of molecular biology (nutrigenomics), which has become a key to understanding the outcome of various nutritional interventions in health and more so in diseases including the rumen metabolism.
- Because of the changing perspectives of livestock and environment, greater thrust on the role of feeding and nutrition on minimizing and/ or mitigating the (adverse) environmental impacts of rearing various classes of farm animals
- Sound feeding practices and evolving nutritional concepts for ensuring safe food production for consumers
- The potential use of nutrition (involving specific nutrients and emerging nutraceuticals) for promotion of health: both for preventive and prophylactic use of clinical nutrition for farm, companion and captive and zoo animals
- Greater focus on the industrial application of nutritional concepts in order to make the students more industry-ready. It also aimed to inculcate a sense of entrepreneurship among animal nutrition students.
- Continued focus on making better use of local and alternate feed resources strategically to make livestock production economic and rewarding while maintaining the sustainability for various classes of livestock farmers.

**Summary of Changes Made**

Course	Title	Remarks
M.V.Sc. Courses		
ANN 601	Energy and Protein Nutrition	Contents updated
ANN 602	Minerals and Vitamin Nutrition and Feed Additives	Contents updated
ANN 603	Feed and Fodder Technology	Merging of ANN 603 and ANN 604
ANN 604	Ruminant Nutrition	Contents updated
ANN 605	Non-Ruminant Nutrition	Contents updated
ANN 606	Companion Animal Nutrition	ANN 607 split into two courses (ANN 606 and ANN 607)
ANN 607	Nutrition of Laboratory, Wild and Zoo Animals	
ANN 608	Research Methodology in Animal Nutrition	Contents updated
ANN 609	Non-Conventional Feed Resources	Contents updated
ANN 610	Nutritional Biochemistry	New Course
ANN 611	Clinical Nutrition	New Course
ANN 612	Rumen Biotechnology	New Course
Ph.D. Courses		
ANN 701	Modern Concepts in Feeding of Ruminants	ANN 701 split into two courses (ANN 701 and ANN 702)
ANN 702	Forages in Animal Nutrition	
ANN 703	Modern Concepts in Feeding of Non-Ruminants	Contents updated
ANN 704	Emerging Concepts in Rumen Metabolism	Contents updated
ANN 705	Advances in Mineral and Vitamin Nutrition	Contents updated
ANN 706	Advanced Techniques in Nutritional Research	Contents updated
ANN 707	Recent Trends in Feed Technology	Contents updated
ANN 708	Clinical Nutrition of Farm and Pet Animals	Merging of two courses: ANN 707 and ANN 708
ANN 709	Toxicants and Antimetabolites in Animal Nutrition	Contents updated
ANN 710*	Nutrigenomics in Animal Nutrition	New Course
ANN 711	Equine Nutrition	New Course



Course Title with Credit Load M.V.Sc. in Animal Nutrition

Course Code	Course Title	Credit Hours
ANN 601*	Nutritional Biochemistry	1+0
ANN 602*	Energy and Protein Nutrition	2+0
ANN 603*	Minerals and Vitamin Nutrition and Feed Additives	2+1
ANN 604*	Feed and Fodder Technology	1+1
ANN 605*	Ruminant Nutrition	2+1
ANN 606*	Non-Ruminant Nutrition	2+1
ANN 607*	Research Methodology in Animal Nutrition	0+2
ANN 608	Companion Animal Nutrition	1+0
ANN 609	Nutrition of Laboratory, Wild and Zoo Animals	2+1
ANN 610	Non-Conventional Feed Resources	1+1
ANN 611	Introductory Clinical Nutrition	1+0
ANN 612	Rumen Biotechnology	1+0
ANN 691	Seminar	1+0
ANN 699	Research	30

*Core Courses



Course Contents

M.V.Sc. in Animal Nutrition

I. Course Title : Nutritional Biochemistry

II. Course Code : ANN 601

III. Credit Hours : 1+0

IV. Why this course?

Biochemistry is the mother of all sciences. To understand the mechanism of nutrient metabolism a clear understanding of the various biochemical events is essential for a student specialising in animal nutrition.

V. Aim of the course

To help to develop the concepts of biochemical pathways involving nutrient metabolism.

VI. Theory

Unit I (12 Lectures)

Classification of carbohydrates and their functions. Digestion and metabolism of carbohydrate in ruminants and non-ruminants. Carbohydrate synthesis.

Unit II (8 Lectures)

Classification and properties of fats and their functions. Digestion and metabolism of fat in ruminants and non-ruminants. Fat synthesis

Unit III (12 Lectures)

Classification, structure, properties and function of proteins, amino acids and nucleic acids. Digestion and metabolism of proteins and other nitrogenous compounds in ruminants and non-ruminants. Protein synthesis. Control of metabolism

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Understanding of biochemical basis of nutrient metabolism.

IX. Suggested Reading

- Cheeke PR and Dierenfeld E. 2010. *Comparative Animal Nutrition and Metabolism*. CAB International.
- D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
- Leeson S and Summers JD. 2001. *Scott's Nutrition of The Chicken*, 4th ed. University Books.
- Maynard LA, Loosli JK, Hintz HF and Warner RG. 1987. *Animal Nutrition*. Tata McGraw-Hill.
- McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.
- Nelson DL and Cox MM. 2017. *Lehninger Principles of Biochemistry*, 7th ed. Macmillan Learning.



- I. Course Title : Energy and Protein Nutrition**
II. Course Code : ANN 602
III. Credit Hours : 2+0

IV. Why this course?

Energy and protein constitute the major nutrients driving the maintenance and production in farm animals. A clear understanding of underlying concepts is key to the application of the same under practical feeding situation.

V. Aim of the course

To understand the metabolic pathways involved in energy and protein utilization including their requirements for various classes of animals for different physiological functions.

VI. Theory

Unit I (8 Lectures)

Measures of feed energy. Partitioning of feed energy. Energy balance, Fasting catabolism. Direct and indirect calorimetry. Efficiency of energy and protein utilization.

Unit II (12 Lectures)

Rumen degradable protein (RDP), and rumen undegradable protein (UDP) and fermentation kinetics. Protein turnover. Quantification of microbial protein synthesis. Protein quality determination in ruminants and monogastrics. Supplementary value of amino acids. NPN metabolism, urea fermentation potential and metabolizable protein. Amino acids imbalance, antagonism and toxicity.

Unit III (12 Lectures)

Feeding standards: comparative appraisal and limitations. Determination of energy and protein requirements. Nutrients metabolism with special reference to milk, meat and wool production. Energy and protein requirement for maintenance, growth, pregnancy and lactation in farm animals.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Development of comprehensive knowledge of basic nutrition involving energy and protein.

IX. Suggested Reading

- Blaxter K. 1989. *Energy Metabolism in Animal and Man*. Cambridge University Press.
- Bondi A. 1987. *Animal Nutrition*. Wiley InterScience.
- Cheeke PR and Dierenfeld E. 2010. *Comparative Animal Nutrition and Metabolism*. CAB International.
- Crampton EW and Harris LE. 1969. *Applied Animal Nutrition*. WH Freeman.
- Dryden GM. 2008. *Animal Nutrition Science*, 1st ed. CAB International.
- Maynard LA, Loosli JK, Hintz HF and Warner RG. 1987. *Animal Nutrition*. Tata McGraw-Hill.
- McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.



- Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. *Basic Animal Nutrition and Feeding*, 5th ed. Wiley.
- Singh UB. 1987. *Advanced Animal Nutrition for Developing Countries*. Indo-Vision.

I. Course Title : Minerals and Vitamin Nutrition and Feed Additives

II. Course Code : ANN 603

III. Credit Hours : 2+1

IV. Why this course?

Mineral and vitamins are key drivers of intermediary metabolism besides playing an important role in health and production

V. Aim of the course

To impart knowledge on sources, functions, analysis, signs of deficiency and signs of toxicity of various minerals and vitamins

VI. Theory

Unit I (12 Lectures)

General role of minerals, factors affecting mineral requirements. Macro-minerals and micro-minerals, their, distribution, metabolism, physiological functions, deficiencies and excesses, and sources and requirements. Probable essential minerals.

Unit II (6 Lectures)

Mineral interactions. Chelated minerals and concept of nano-minerals. Bioavailability studies in minerals. Impact of minerals on reproduction, fertility, and immunity. Soil-plant-animal-human relationship, development of area-specific minerals. Toxic minerals; their role in health and production of farm animals. Newly recognized trace minerals.

Unit III (10 Lectures)

Definition, history, classification, chemistry, functions, deficiencies and excesses, requirements and sources of water-soluble and fat-soluble vitamins. Role of vitamins in energy metabolism. Vitamin-mineral interrelationship. Vitamin toxicosis. Role of vitamins in reproduction, fertility and immunity.

Unit IV (4 Lectures)

Feed additives and nutraceuticals. Probiotics, prebiotics and synbiotics; eubiotics. Feed enzymes. Phytochemical feed additives; polyphenols and essential oils; organic acids and acidifiers.

VII. Practical (16 Classes)

General principles of mineral estimation. Sampling and processing techniques. Use of atomic absorption spectrometry and ICP in mineral estimation. Estimation of macro- and micro-minerals. Formulation of mineral mixture for various species. Estimation of some important vitamins (vitamin A, E and C). Purified diets for mineral and vitamin studies. Calculation of mineral and vitamin requirements.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions



- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

- Comprehensive knowledge about mineral and vitamin metabolism and their requirements for farm animals
- Capacity for estimation of various minerals and vitamins using advanced analytical techniques

X. Suggested Reading

- McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.
- McDowell RL. 1989. *Vitamins in Animal Nutrition*. Academic Press.
- McDowell RL. 2003. *Minerals in Animal and Human Nutrition*, 2nd ed. Elsevier Science.
- Suttle NF. 2010. *Mineral Nutrition of Livestock*, 4th ed. CAB International.

I. Course Title : Feed and Fodder Technology

II. Course Code : ANN 604

III. Credit Hours : 1+1

IV. Why this course?

Processing of feed and fodder are important means to augment the utilization for efficient animal production.

V. Aim of the course

To understand various technological options available for processing of classes of food, feeds and fodders and their potential application in feeding management of farm animals.

VI. Theory

Unit I (4 Lectures)

Various feed mill equipment and their handling; layout and operations in feed mill (small, medium and large feed plants); automated feed mill: merits and demerits. Procurement of feed ingredients: specification and guidelines. Quality control of feed ingredients and finished feeds. BIS standard.

Unit II (4 Lectures)

Principles and process of material handling, weighing, grinding, mixing, pelleting, packaging and other major processing operations. Crumbling, flaking, popping and extrusion. Premixes. Codex Alimentarius, HACCP.

Unit III (4 Lectures)

Feed and fodder processing and preservation techniques. Densification, chemical and biological treatment of feeds/ fodders. Fodder conservation through hay and silages; Microbiological evaluation of processed and preserved feeds; Effect of preservation on the nutritional value of feed.

Unit IV (4 Lectures)

Feed storage and godown management; goods sanitation and hygiene of go-down. Traditional and modern farm-level storage structures. Factors affecting feedstuffs during storage. Liquid feed ingredients. Storage losses; insect pests and rodents control measures; Mycotoxins in feedstuffs and its control measures.



VII. Practical (16 Classes)

Quality control and inspection of feed materials. Qualitative tests for adulterants urea, urease, thiram. Identification of insect pests and fungi in stored products. Feed microscopy. Formulation and preparation premixes. Quality evaluation of silage and hay, Laboratory preparation of silage. Visit to feed plant: Hands-on training on preparation of feed and mineral mixture. Preparation of project report on plant layout and design, problems related to feasibility, record-keeping in different sections of a feed mill.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

Practical understanding and application of feed processing technologies

X. Suggested Reading

- Dryden G. 2008. *Animal Nutrition Science*. CAB International.
- Kundu SS, Mahanta SK, Singh S and Pathak PS. 2016. *Animal Feed Technology*. Satish Publishers
- Perry TW, Cullison AE and Lowrey RS. 2003. *Feeds and Feeding*, 6th ed. Pearson.
- Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. *Basic Animal Nutrition and Feeding*, 5th ed. Wiley.
- Schofield EK (Ed.). 2005. *Feed Manufacturing Technology V*. American Feed Industry Association, Arlington.

I. Course Title : Ruminant Nutrition

II. Course Code : ANN 605

III. Credit Hours : 2+1

IV. Why this course?

Ruminants possess unique digestive capabilities involving rumen microbes that utilize diverse feed resources which are otherwise not fit for monogastric animals.

V. Aim of the course

To develop an understanding of the rumen metabolism and its manipulation for improving nutrient utilization for enhancing ruminant production.

VI. Theory

Unit I (6 Lectures)

Functional anatomy of the digestive system of ruminants. Introduction to rumen microflora and fauna. Development of rumen. Feeds and fodders for ruminant feeding.

Unit II (12 Lectures)

Water requirements. Nutrient requirements and feeding of calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat. Peculiarities of digestive physiology, nutrition and feeding management of camels.



Unit III (6 Lectures)

Voluntary feed intake. Determination of digestibility, factors affecting digestibility. Manipulation of rumen fermentation.

Unit IV (12 Lectures)

Concept of complete feed and total mixed ration. Precision feeding. Phase feeding. Limiting nutrients and strategic feeding of high yielding ruminants. Concept of by-pass nutrients and their impact on production, reproduction and immune status.

Unit V (12 Lectures)

Nutritional approaches for increasing the functional properties of milk: role of CLA, omega fatty acids. Different systems of feeding buffalo for beef production. Feeding during stress and natural calamities. Feeding management of migratory/nomadic small ruminants.

VII. Practical (16 Classes)

Design and planning of feeding experiments. Identification of feed and fodder based on its composition. Ration formulation for large and small ruminants for different physiological stages. Estimation of digestibility and nutritive value of feeds and fodders by metabolism trial in dairy cattle. Determination of nutritive value of pastures by the use of range techniques. Collection and processing of rumen liquor. Estimation of rumen metabolic profile (pH, ammonia, lactate, and TVFA, etc.). Estimation of purine derivatives.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

In-depth knowledge of feeding ruminants in light of their metabolic peculiarities. Feed evaluation based on an assessment of various rumen functions

X. Suggested Reading

- Church DC. 1988. *The Ruminant Animal: Digestive Physiology and Nutrition*, 2nd ed. Prentice-Hall.
- Dehority BA. 2003. *Rumen Microbiology*. Nottingham University Press.
- D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
- Givens D, Axford R and Owen E. (Ed.). 2000. *Forage Evaluation in Ruminant Nutrition*. CAB International.
- Hynd PI. 2019. *Animal Nutrition: From Theory to Practice*. CAB International.
- McDowell RL. 2012. *Nutrition of Grazing Ruminants in Warm Climates*. Academic Press.
- Moran J. 2005. *Tropical Dairy Farming: Feeding Management for Small Holder Dairy Farmers in the Humid Tropics*. Landlinks Press
- NRC. 2001. *Nutrient Requirements of Dairy Cattle*, 7th rev. ed. National Research Council. National Academies Press.
- NRC. 2016. *Nutrient Requirements of Beef Cattle*, 8th rev. ed. National Academies of Sciences, Engineering, and Medicine. National Academies Press.
- NRC. 2007. *Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids*. National Research Council. National Academy Press.
- Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. *Basic Animal Nutrition and Feeding*, 5th ed. Wiley.
- Shirley RL. 2012. *Nitrogen and Energy Nutrition of Ruminants*. Academic Press.
- Van Soest PJ. 1994. *Nutritional Ecology of the Ruminant*. Cornell University Press.



- I. Course Title : Non-Ruminant Nutrition**
II. Course Code : ANN 606
III. Credit Hours : 2+1

IV. Why this course?

The nutritional attributes of non-ruminants differ among various species as well as their characteristic digestive physiology.

V. Aim of the course

To impart knowledge on the nutrient metabolism of various classes of monogastric animals involving poultry, swine, equines and rabbits under different physiological stages.

VI. Theory

Unit I (20 Lectures)

Feeding of poultry for meat and egg production. Ideal protein concept. Standard ileal digestible amino acids. Nutrient requirements for broilers and layers. Feeding of breeder hens; nutritional factors affecting hatchability. Feeding systems for poultry. Feed additives for poultry. Nutritional approaches for designer egg and meat production. Nutritional disorders in poultry and the role of nutrition in diseases prevention. Water intake and quality in poultry production.

Unit II (16 Lectures)

Nutrition and feeding of swine in different stages of growth and production. Nutritional factors affecting the quality of the products: lean meat production. Water intake and quality in pig production.

Unit III (12 Lectures)

Feeding of equines. Feeding of rabbits. Hindgut fermentation and its importance. Nutrient requirements of equines. Special features of equine feeding management. Nutritional management of colic and other health disorders. Nutrient requirements of rabbits for wool and meat production. Nutrition-related disorders in rabbits.

VII. Practical (16 Classes)

Design and planning for poultry and swine feeding experiments. Calculation of nutrient requirements for broilers and layers. Formulation and compounding of general and least-cost rations, determination of the nutritive value of poultry and swine feeds by balance experiments. Formulation of rations for horses and rabbits. Visit poultry and pigery units, feed and fodder stores. Calculation of different measures of protein quality.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

Knowledge of practical feeding management of various classes of non-ruminant species.



X. Suggested Reading

- Adamo G and Costanza A (Eds.). *Rabbits Biology, Diet and Eating Habits and Disorders*. Nova Biomedical.
- Cheeke PR. 1987. *Rabbit Feeding and Nutrition*. Academic Press, Inc.
- Chiba LI (Ed.). 2012. *Sustainable Swine Nutrition*. Wiley-Blackwell.
- de Blas C and Wiseman J. (Eds.). 2010. *Nutrition of the Rabbit*, 2nd ed. CAB International.
- D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
- Frape D. 2010. *Equine Nutrition and Feeding*, 4th ed. Wiley-Blackwell.
- Hynd PI. 2019. *Animal Nutrition: From Theory to Practice*. CAB International.
- Leeson S and Summers JD. 2009. *Commercial Poultry Nutrition*, 3rd ed. Nottingham University Press.
- Leeson S and Summers JD. 2019. *Scott's Nutrition of The Chicken*, 4th ed. CBS Publishers and Distributors.
- NRC. 2007. *Nutrient Requirements of Horses*, 6th Rev. ed. National Research Council. National Academy Press.
- NRC. 1994. *Nutrient Requirements of Poultry*, 9th Rev. ed. National Research Council. National Academy Press.
- NRC. 2012. *Nutrient Requirements of Swine*, 11th Rev. ed. National Research Council. National Academy Press.
- Varga M. 2013. *Textbook of Rabbit Medicine*, 2nd ed. Butterworth-Heinemann.

I. Course Title : Research Methodology in Animal Nutrition

II. Course Code : ANN 607

III. Credit Hours : 0+2

IV. Why this course?

Nutritional evaluation involving feed analysis and nutrient metabolism is vital in the interpretation of the outcomes of nutritional studies.

V. Aim of the course

Preparedness in part of the students to understand the basics of various analytical techniques and their application in nutritional research.

VI. Practical

Unit I (6 Classes)

Principles of animal experimentation. Common statistical tools for nutritional research.

Unit II (20 Classes)

Preparation of standard solutions. Proximate analysis of feeds and fodders. Cell-wall partitioning using Van Soest methods. Markers in digestibility determination. *In-vitro/ in sacco* determination of digestibility and digestion kinetics. Determination of energy content of feed, faeces and urine using bomb calorimeter. Determination of blood metabolic profile. Unit III (6 Classes) Introduction and principles of GC, HPLC, AAS, ICP, tracer technique, flame photometer, NIR, SF₆, rumen-simulation technique, and amino acid analyzer.

VII. Teaching methods/ activities

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on training of laboratory techniques



VIII. Learning outcome

Capacity building of the students to undertake animal nutrition research.

IX. Suggested Reading

- Bate ST and Clark RA. 2014. *The Design and Statistical Analysis of Animal Experiments*. Cambridge University Press.
- Hofmann A and Clokie S (Eds.). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*, 8th ed. Cambridge University Press.
- Maynard LA, Loosli JK, Hintz HF and Warner RG. 1987. *Animal Nutrition*. Tata McGraw-Hill.
- McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.
- Pounis G. 2018. *Analysis in Nutrition Research*. Academic Press.

I. Course Title : Companion Animal Nutrition

II. Course Code : ANN 608

III. Credit Hours : 1+0

IV. Why this course?

The philosophy of companion animal nutrition is altogether different from that of the farm animals.

V. Aim of the course

To impart knowledge in the fundamental and applied aspects of the nutrient metabolism for ensuring health and wellbeing of companion animals.

VI. Theory

Unit I (4 Lectures)

Philosophy of companion animal nutrition. Digestion and absorption of nutrients in dogs and cats. Nutrient requirements for dogs and cats during different life stages: energy, protein, fat, minerals and vitamins. Critical nutrients for cats.

Unit II (4 Lectures)

Common feed ingredients and supplements for pets. Homemade diets. Commercial pet foods: types and nutritional profile. Processing techniques in pet food manufacturing. Pet food evaluation and quality control.

Unit III (4 Lectures)

Feeding management for dogs and cats of different age groups, viz., pregnancy, lactation, neonatal puppies and kitten, growth, adult maintenance, stress and geriatrics including feeding behaviour. Water requirements.

Unit IV (4 Lectures)

Deficiencies and excesses of nutrients. Nutritionally responsive disorders: inherited disorders of nutrient metabolism, diabetes mellitus, obesity, urinary tract health and kidney diseases. Parenteral nutrition for hospitalized pets.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments



VIII. Learning outcome

Understanding of the nutritional concepts for feeding management of companion animals.

IX. Suggested Reading

- Buffington C, Holloway C, Abood S. 2004. *Manual of Veterinary Dietetics*. Elsevier.
- Case LP, Daristotle L, Hayek MG, Raasch MF. 2010. *Canine and Feline Nutrition: A Resource for Companion Animal Professionals*, 3rd ed. Elsevier.
- Case LP. 2005. *The Dog: Its Behavior, Nutrition, and Health*, 2nd ed. Blackwell Publishing.
- McNamara JP. 2013. *Principles of Companion Animal Nutrition*, 2nd ed. Pearson.
- NRC. 2006. *Nutrient Requirements of Dogs and Cats*. National Research Council. National Academy Press.

I. Course Title : Nutrition of Laboratory, Wild and Zoo Animals

II. Course Code : ANN 609

III. Credit Hours : 2+1

IV. Why this course?

The nutrition of laboratory animals is important to ensure their health performance making them ready for use in biomedical research. On the contrary, wild and zoo animals as a part of the ecosystem call for an entirely different approach in terms of their nutritional management.

V. Aim of the course

To understand the mechanism involved in the nutrient metabolism in laboratory and wild animals and their diverse applications for effective health management and wellness.

VI. Theory

Unit I (12 Lectures)

Digestive structure and functions of laboratory animals: rats, mice, and guinea pigs. Nutritional requirements of various species of laboratory animals. Feeding of laboratory animals. Concept of purified diets in laboratory animals. Nutrition of non-human primates.

Unit II (10 Lectures)

Natural dietary habits of zoo animals. Feeding schedules of various classes captive and zoo animals and birds. Feeding orphan and neonates. Role of nutrition in the management of health disorders in zoo animals. Feeding of sick and old animals: parenteral nutrition.

Unit III (10 Lectures)

Feeding habits, and behaviour of wild animals. General aspects of digestive physiology of herbivores and carnivores. Nutrition of semi-wild animals like mithun and yak. Nutritive characteristics of forages for wild animals. Adequacy of forage plants for wild and zoo animals.

VII. Practical (16 Classes)

Formulation and preparation of hygienic, balanced diets and feeding of laboratory animals. Characteristics of ration formulation and feeding schedules wild and zoo animals. Visit zoological parks and wildlife sanctuary, and collection of information on the feeding schedule of different categories of captive animals.



VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

Understanding of nutritional management of the laboratory, wild and zoo animals

X. Suggested Reading

- Barboza PS, Parker KL and Hume ID. 2008. *Integrative Wildlife Nutrition*. Springer.
- Clemons DJ and Seeman JL. 2011. *The Laboratory Guinea Pig*, 2nd ed. CRC Press/ Taylor and Francis.
- Gordon IJ and Prins HHT. 2008. *The Ecology of Browsing and Grazing*. Springer.
- Lane-Patter W and Pearson AEG. 1971. *The Laboratory Animal: Principles and Practice*, 2nd ed. Academic Press.
- NRC. 1995. *Nutrient Requirements of Laboratory Animals*, 4th rev. ed. National Research Council. National Academy Press.
- NRC. 2003. *Nutrient Requirements of Nonhuman Primates*. National Research Council. National Academy Press.
- NRC. 2011. *Guide for the Care and Use of Laboratory Animals*, 8th ed. National Research Council. National Academy Press.
- Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. *Basic Animal Nutrition and Feeding*, 5th ed. Wiley.
- Robbins C. 1993. *Wildlife Feeding and Nutrition*, 2nd ed. Elsevier.
- Weichbrod RH, Thompson GAH and Norton JN (Eds.). 2018. *Management of Animal Care and Use Programs in Research, Education, and Testing*, 2nd ed. CRC Press/ Taylor and Francis.

I. Course Title : Non-Conventional Feed Resources

II. Course Code : ANN 610

III. Credit Hours : 1+1

IV. Why this course?

Exploration of alternative feed resources for farm animals is a continuous process considering the scarcity of quality feeds and fodders for efficient livestock production.

V. Aim of the course

To build-up concepts involving the availability and potential use of various classes of non-conventional feed resources including ameliorative measures to ensure feed and food safety.

VI. Theory

Unit I (8 Lectures)

Present and future feed requirements and current availability for livestock and poultry. Use of non-conventional feeds; By-products of agricultural, industrial, food processing units and forest by-products. Slaughterhouse by-products, aquatic weeds. Permissible levels of inclusion of various non-conventional feeds in the ration of different kinds of livestock. Formulation of economical rations using the non-conventional feed.



Unit II (5 Lectures)

Classification of toxic principles in animal feedstuffs. Chemico-physical properties of various anti-nutritional factors (ANFs). Rumen microbial adaptation to various ANFs. Effect of anti-nutritional factors on health and production indifferent species of livestock.

Unit III (3 Lectures)

Detoxification of toxin principles by various physical, chemical and biological techniques. Insecticide and pesticide residues, heavy metals residues in feeds and fodders.

VII. Practical (16 Classes)

Qualitative methods for the presence/ detection of ANFs in feedstuffs. Estimation of mycotoxins in various feeds and fodders. Estimation nitrates, HCN, oxalates, protease inhibitors, tannins, saponins, gossypol, mimosine and heavy metals.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

Comprehensive knowledge on the integration of alternative feed resources in practical farm animal production.

X. Suggested Reading

- Devendra C. 1985. *Non-conventional Feed Resources in Asia and the Pacific*, 2nd ed. APHCA, FAO.
- FAO. 1995. *Tropical Feeds and Feeding Systems*. Proceedings of the First FAO Electronic Conference. Food and Agriculture Organization of the United Nations, Rome.
- FAO. 2004. *Assessing Quality and Safety of Animal Feeds*. Food and Agriculture Organization of the United Nations, Rome.
- Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*, 2nd ed. Academic Press.
- Singh UB. 1987. *Advanced Animal Nutrition for Developing Countries*. Indo-Vision.
- Speedy A and Sansoucy R. 1991. *Feeding Dairy Cows in the Tropics*. Food and Agriculture Organization of the United Nations, Rome.
- *Select articles from journals*

I. Course Title : Introductory Clinical Nutrition

II. Course Code : ANN 611

III. Credit Hours : 1+0

IV. Why this course?

Nutrition forms the basis of health and therefore could be strategically used for prevention and/ or therapeutic management of various diseases.

V. Aim of the course

To understand the role of nutrients in the development of various disease processes To elucidate the potential of various nutrients and nutraceuticals in amelioration and management of disease of diverse nature.



VI. Theory

Unit I (8 Lectures)

Metabolic disorders and peri-parturient diseases: milk fever, ketosis, downer cow syndrome, retained placenta, sub-acute ruminal acidosis, laminitis, abomasal displacement, mastitis. Nutrient parasite interaction. Enterotoxaemia

Unit II (8 Lectures)

Nutritional amelioration of biotic and abiotic stress: heat and cold stress, transportation stress. Potential plant toxicity to grazing animals. Toxicity of grazing animals: signs of poisoning. Nitrite poisoning, toxic effects of goitrogens, glucosinolates. Nutritional management of reproductive disorders.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Understanding of nutritional management of health disorders.

IX. Suggested Reading

- Constable P, Hinchcliff KW, Done S and Gruenberg W. 2016. *Veterinary Medicine*, 11th ed. Saunders Ltd.
- Knight AP and Walter R. 2001. *A Guide to Plant Poisoning of Animals in North America*. Teton NewMedia.
- McDowell RL. 2012. *Nutrition of Grazing Ruminants in Warm Climates*. Academic Press.
- Select articles from Journals

I. Course Title : Rumen Biotechnology

II. Course Code : ANN 612

III. Credit Hours : 1+0

IV. Why this course?

Rumen being a distinctive digestive organ typical to ruminants harbouring diverse microbial communities offers opportunities for their manipulation using molecular biological approaches.

V. Aim of the course

To understand the basics of rumen metabolism employing molecular biology tools

VI. Theory

Unit I (8 Lectures)

Rumen ecology. Manipulation of rumen fermentation for better utilization of fibrous feeds and reduction in methane production. Biotechnological applications for lignin degradation. Role of feed additives, chemicals, antibiotics and probiotics and their effect on rumen metabolism. Degradation of anti-nutritional factors in the rumen.

Unit II (8 Lectures)

Genetic manipulation, DNA recombinant technology for improvement in rumen fermentation. Factors influencing the fate of introduced microbes. Metagenomics for microbial diversity: concept and application.



VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Basic knowledge of molecular biology as applicable to rumen functions.

IX. Suggested Reading

- Dehority BA. 2003. *Rumen Microbiology*. Nottingham University Press.
- Dijkstra J, Forbes J and France J. 2005. *Quantitative Aspects of Ruminant Digestion and Metabolism*. CAB International.
- Kebreab E, Dijkstra J, Bannink A, Gerrits W and France J. 2006. *Nutrient Digestion and Utilization in Farm Animals*. CAB International.
- Millen DD, Arrigoni MDB and Pacheco RDL. (Eds.). 2016. *Rumenology*. Springer Nature.
- Van Soest PJ. 1994. *Nutritional Ecology of the Ruminant*. Cornell University Press.



Course Title with Credit Load Ph.D. in Animal Nutrition

Course Code	Course Title	Credit Hours
ANN 701*	Modern Concepts in Feeding of Ruminants	2+0
ANN 702*	Forages in Animal Nutrition	1+0
ANN 703*	Recent Concepts in Feeding of Non-Ruminants	1+0
ANN 704*	Advances in Rumen Metabolism	1+1
ANN 705*	Advances in Mineral and Vitamin Nutrition	2+0
ANN 706*	Advanced Clinical Nutrition	1+1
ANN 707	Advanced Techniques in Nutritional Research	1+1
ANN 708	Advances in Feed Technology	1+0
ANN 709	Toxicants and Anti-Metabolites in Animal Nutrition	1+0
ANN 710	Nutrigenomics in Animal Nutrition	1+0
ANN 711	Equine Nutrition	1+0
ANN 791	Seminar-I	1+0
ANN 792	Seminar-II	1+0
ANN 799	Research	75

*Core courses



Course Contents

Ph.D. in Animal Nutrition

- I. Course Title** : Modern Concepts in Feeding of Ruminants
II. Course Code : ANN 701
III. Credit Hours : 2+0
IV. Why this course?

The feeding management of ruminants is undergoing rapid changes because of scientific and technological advances to augment productivity.

V. Aim of the course

To understand the emerging concepts involving feeding management of high producing ruminant animals.

VI. Theory

Unit I (20 Lectures)

Developments in ruminant digestive physiology. Advanced concepts in the determination of energy and protein requirements. Importance of energy and protein quality for milk and meat production. Recent concepts in protein and energy systems like CNCPS, net energy, metabolizable and available protein. Methods of estimation of energy and protein values of feeds for different physiological functions of livestock. Kinetics of nutrient metabolism. Hindgut fermentation. Efficiency of nutrient utilization for different production purposes. Hormonal regulation of nutrient partitioning.

Unit II (12 Lectures)

Concept of limiting amino acids for high yielders. Strategic feeding of high yielding dairy cows and meat-producing ruminants. Concept of phase feeding and precision feeding. Feeding during the transition period. Bypass nutrient technology. Rumen manipulation to optimize productivity and reduce methanogenesis.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Knowledge of the newer concepts for its application in the feeding management of ruminants.

IX. Suggested Reading

- D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
- McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.
- McDowell RL. 2012. *Nutrition of Grazing Ruminants in Warm Climates*. Academic Press.
- NRC. 2001. *Nutrient Requirements of Dairy Cattle*, 7th rev. ed. National Research Council. National Academies Press.



- NRC. 2016. *Nutrient Requirements of Beef Cattle*, 8th rev. ed. National Academies of Sciences, Engineering, and Medicine. National Academies Press.

- I. Course Title : Forages in Animal Nutrition**
II. Course Code : ANN 702
III. Credit Hours : 1+0
IV. Why this course?

Forages are the principal component of the animal feeding system and therefore their effective utilization is the key for efficient animal production.

V. Aim of the course

To impart knowledge on the fodder management including different forage production systems and their utilization.

VI. Theory

Unit I (10 Lectures)

Forages in ruminant production. Improvement in productivity of fodders and pasture: feed-food crops, silvi-pasture, horti-pasture, shrubs. Use of conserved forages in ruminant feeding. Factors affecting the nutritive value of cultivated and conserved forages. Hydroponics as an alternate to green fodder production. Top feeds, fodder trees and their effective utilization. Tree leaves as a source of condensed tannins: role in protein protection and GI parasite control.

Unit II (6 Lectures)

Methods in forage evaluation: calculated *in-vitro* DOMD and ME by using *in-vitro* gas production technique. Pasture consumption and evaluation studies.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Understanding of various aspects of forage production, fodder evaluation and their integration into the different animal production system.

IX. Suggested Reading

- Givens D, Axford R and Owen E. (Ed.). 2000. *Forage Evaluation in Ruminant Nutrition*. CAB International.
- McDowell RL. 2012. *Nutrition of Grazing Ruminants in Warm Climates*. Academic Press.
- Minson D. 1990. *Forage in Ruminant Nutrition*. Academic Press.
- Shirley RL. 2012. *Nitrogen and Energy Nutrition of Ruminants*. Academic Press.

- I. Course Title : Recent Concepts in Feeding of Non-Ruminants**
II. Course Code : ANN 703
III. Credit Hours : 1+0
IV. Why this course?

Increased consumer awareness has necessitated a relook into the feeding management of food animals leading to the production of safe and healthy food.



V. Aim of the course

To derive knowledge regarding the nutritional manipulation of food animals for the production of quality food for human consumption.

VI. Theory

Unit I (18 Lectures)

Latest concepts in nutrition and feeding in different phases of broiler, layer and breeder stocks. In-ovo and early chick nutrition. Nutritional disorders in modern poultry production and their amelioration. Nutritional factors affecting egg quality and hatchability in poultry. Feeding strategies for the production of designer eggs and meat. Omega fatty acids. Recent trends in amino acid nutrition. Advances in new generation feed and feed additives.

Unit II (14 Lectures)

Nutrition and feeding of pigs in various stages of production. Modern concepts in amino acids nutrition in swine production. Emerging concepts in feeds and feed additive for pigs. Role of vitamins and minerals in health and disease. Nutritional manipulation for lean meat and designer pork production. Carcass modifiers.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Comprehensive knowledge on the scope of nutritional management of non-ruminant animals for the production of healthy food.

IX. Suggested Reading

- Chiba LI (Ed.). 2012. *Sustainable Swine Nutrition*. Wiley-Blackwell.
- D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
- Hendriks WH, Verstegen MWA and Babinszky L. (Eds.). 2019. *Poultry and Pig Nutrition: Challenges of the 21st Century*. Wageningen Academic Publishers.
- Leeson S and Summers JD. 2001. *Scott's Nutrition of The Chicken*, 4th ed. University Books.
- Lewis AJ and Southern LL. 2000. *Swine Nutrition*, 2nd ed. CRC Press.

I. Course Title : Advances in Rumen Metabolism

II. Course Code : ANN 704

III. Credit Hours : 1+1

IV. Why this course?

An in-depth of the understanding of the rumen function is key to devise strategies for augmenting the efficiency of production besides ensuring environmental sustainability.

V. Aim of the course

To understand the metabolic aspects of rumen function and its application for eco-friendly ruminant production.

VI. Theory

Unit I (8 Lectures)

Rumen development. Rumen microflora: classification and their role in fermentation



and digestion, microbial interactions, rumen kinetics, the nutrient requirement of rumen microbes. Dynamics of nitrogen metabolism in the rumen.

Unit II (8 Lectures)

Manipulation of rumen fermentation: physical, chemical and biological approaches. Trans-faunation and defaunation. Concept of metagenomics in rumen manipulation. Green-house gas production from rumen and mitigation strategies

VII. Practical (16 Classes)

Rumen microbial and protozoal count. Estimation of rumen microbial protein. Estimation of nitrogen-fractions in rumen liquor. Volatile fatty acid fractionations. Rumen enzymes assay. Extraction of nucleic acids and quantification of rumen microbes by PCR.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

Comprehensive knowledge of various concepts of rumen metabolism for efficient ruminant production.

X. Suggested Reading

- Dehority BA. 2003. *Rumen Microbiology*. Nottingham University Press.
- Dijkstra J, Forbes J and France J. 2005. *Quantitative Aspects of Ruminant Digestion and Metabolism*. CAB International.
- Kebreab E, Dijkstra J, Bannink A, Gerrits W and France J. 2006. *Nutrient Digestion and Utilization in Farm Animals*. CAB International.
- Millen DD, Arrigoni MDB and Pacheco RDL. (Eds.). 2016. *Rumenology*. Springer Nature.
- Van Soest PJ. 1994. *Nutritional Ecology of the Ruminant*. Cornell University Press.

I. Course Title : Advances in Mineral and Vitamin Nutrition

II. Course Code : ANN 705

III. Credit Hours : 2+0

IV. Why this course?

Molecular mechanisms driving the metabolism of minerals and vitamins have opened up a new vista in the nutrition of farm animals.

V. Aim of the course

To understand advances in mineral and vitamin metabolism for its application in ensuring optimized health and efficient production in farm animals.

VI. Theory

Unit I (18 Lectures)

Role of minerals in nutrient metabolism. Mineral absorption, transport, metabolism and its regulation. Bio-availability of macro and micro minerals: factors affecting the bioavailability; bio-markers for mineral status. Mineral interactions. Dietary cation-anion difference (DCAD). Identification and correction of deficiencies and toxicities of minerals. Mineral tolerance in animals. Mineral requirements for growth,



reproduction and lactation. Mineral toxicities concerning livestock feeding and their amelioration. Methods of mineral supplementation.

Unit II (14 Lectures)

Chemical nature of fat-soluble and water-soluble vitamins. Role of vitamins in nutrient metabolism. Advances in physiological functions and metabolism of vitamins. Vitamin deficiency: clinical signs and their management. Antimetabolites to vitamins. Hypervitaminosis. Vitamins as antioxidants. Role of vitamins in immunity and stress. Dietary supplementation of vitamins: forms, storage and stability.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Knowledge on the latest understanding of mineral and vitamins and its application in practical feeding conditions.

IX. Suggested Reading

- McDowell RL. 1989. *Vitamins in Animal Nutrition*. Academic Press.
- McDowell LR. 2003. *Minerals in Animal and Human Nutrition*, 2nd ed. Elsevier Science B.V.
- Suttle N. 2010. *The Mineral Nutrition of Livestock*, 4th ed. CAB International.

I. Course Title : Advanced Clinical Nutrition

II. Course Code : ANN 706

III. Credit Hours : 1+1

IV. Why this course?

Approaches involving preventive, therapeutic and convalescent nutrition have been recognized as a sustainable means of ensuring health and wellbeing of animals besides the production of safe and healthy food.

V. Aim of the course

To understand the disease-induced alterations in nutrient metabolism and the potential of select nutrients to prevent and/ or support disease management in prone animals.

VI. Theory

Unit I (12 Lectures)

Metabolic disorders in farm animals. Modern concepts in the metabolic alterations leading to production diseases, viz., milk fever, ketosis, downer cow syndrome, retained placenta, sub-acute ruminal acidosis, laminitis, abomasal displacement and mastitis Optimum nutrition for peri-parturient dairy animals.

Unit II (10 Lectures)

Metabolic effects of infection: metabolism of carbohydrates, fats, protein and amino acids and minerals during various infection and inflammatory diseases. Role of cytokines in nutrient homeorrhesis. Nutrition-immunity interaction: Role of nutrients (fats, amino acids, minerals and vitamins) in the immune response. Metabolic



alterations during abiotic stress and feeding management during stress

Unit III (10 Lectures)

Nutritional manipulation and feeding of sick and hospitalized animals. Preventive and therapeutic nutrition. Optimum nutrition for the management of diseases of the hepatic, renal and gastrointestinal system. Convalescence diet. Feeding management of pre- and post-operated animals.

VII. Practical (16 Classes)

Assessment of immunity: humoral immune response, cell-mediated immune response. Assessment of antioxidant status: Superoxide dismutase, Catalase, Glutathione peroxidase, reduced glutathione (GSH), lipid peroxides. Formulation of diet for sick and diseased animals.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

IX. Learning outcome

Understanding the potential of nutrition for prophylaxis and therapeutic purposes.

X. Suggested Reading

- Cheeke PR and Dierenfeld E. 2010. *Comparative Animal Nutrition and Metabolism*. CAB International.
- Constable P, Hinchcliff KW, Done S and Gruenberg W. 2016. *Veterinary Medicine*, 11th ed. Saunders Ltd.
- Naylor JM and Ralston SL. 1991. *Large Animal Clinical Nutrition*. Mosby Inc.
- Walker S, Beckett G, Rae P and Ashby P. 201. *Clinical Biochemistry: Lecture Notes*, 9th ed. Wiley-Blackwell

I. Course Title : Advanced Techniques in Nutritional Research

II. Course Code : ANN 707

III. Credit Hours : 1+1

IV. Why this course?

Cutting edge technologies in analytical science have revolutionized food science research.

V. Aim of the course

To become conversant with the use of advanced techniques in nutritional research.

VI. Theory

Unit I (16 Lectures)

Good laboratory practices. Analytical equipment in animal nutrition research. Estimation of minerals using atomic absorption spectrophotometer and ICP. Principles and applications and of GC, HPLC, amino acid analyzer, SF6, and electron microscopy. Remote sensing and geographic information system (GIS) in animal nutrition research. Analysis of feeds and fodders using NIR. Faecal inoculum as an alternative to rumen liquor for *in-vitro* studies.



VII. Practical (16 Classes)

RUSITEC. Estimation of minerals by atomic absorption spectrophotometer. Estimation of mycotoxins, oxalate, nitrates and tannin. Fatty acid analysis. Vitamin estimation.

VIII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

VIII. Learning outcome

Skill development in terms of efficient use of modern analytical techniques related to animal nutrition research.

IX. Suggested Reading

- Kaneko J, Harvey J, Bruss M.(Eds.) 2008. *Clinical Biochemistry of Domestic Animals*, 6th ed. Academic Press.
- Krishna 2012. *Livestock Nutrition- Analytical Techniques*. New India Publishing Agency.

I. Course Title : Advances in Feed Technology

II. Course Code : ANN 708

III. Credit Hours : 1+0

IV. Why this course?

The translation of nutritional knowledge for its wider application involves industrial-scale technological adaptations.

V. Aim of the course

To understand the basic as well as applied aspects of various feed processing technologies.

VI. Theory

Unit I (10 Lectures)

Good manufacturer practices (GMP) in feed plants. Planning and designing of feed plants of different capacities. Recent developments in feed processing: particle size reduction, pelleting, extrusion, expanding, conditioning, micronizing. Post pelleting applications. Automation in feed processing. Flow charts for preparation of feeds for various species. Mixer efficiency test, pellet durability test. Densification of bulk feeds. Silos of various capacity, silage preparation and silage additives. Laws and regulations of the feed manufacturing industry. Introduction to labour laws and standards, planning and production programme. Record-keeping.

Unit II (6 Lectures)

Roughage processing. Whole plant processing. Solid-state fermentation technology. Preparation of complete feeds and its processing. Formulation of premixes. Carriers and diluents. Liquid feed handling. Latest concepts in feed microscopy. Qualitative tests for rancidity.

VII. Teaching methods

- Classroom lectures using audio-visual aids



- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Skill development in terms of increased employment and entrepreneurship

IX. Suggested Reading

- Langham J. 2013. *Recent Advances in Animal Feed Technology*. Random Exports.
- Moughan PJ and Hendricks WH. (Eds.). 2018. *Feed Evaluation Science*. Academic publishers.
- Perry TW, Cullison AE and Lowrey RS. 2003. *Feeds and Feeding*, 6th ed. Pearson.
- Schofield EK (Ed.). 2005. *Feed Manufacturing Technology V*. American Feed Industry Association, Arlington.

I. Course Title : Toxicants and Anti-Metabolites in Animal Nutrition

II. Course Code : ANN 709

III. Credit Hours : 1+0

IV. Why this course?

In-feed anti-metabolites in incriminating factor poses a threat not only to the animal health but also for human health and safe food production.

V. Aim of the course

To impart knowledge on the various toxicants and anti-metabolites in the feeding system and their amelioration.

VI. Theory

Unit I (12 Lectures)

Classification of toxicants in animal feeds. Plant origin toxicants, microbial origin toxicants, acquired toxicants (heavy metals, pesticide residues, drug residues), and their effects on animal health and production. Ameliorative measures. Detoxification of plant origin toxicants. Residual effects on animal products and the environment.

Unit II (4 Lectures)

Anti-metabolites in animal feedstuffs. Effects of anti-metabolites on animal health and production. Anti-vitamins

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Safe use of animal feed resources for ensuring food safety.

IX. Suggested Reading

- Cheeke PR and Shull LR. 1985. *Natural Toxicants in Feeds And Poisonous Plants*. AVI Publishing Company Inc.
- FAO. 2004. *Assessing Quality and Safety of Animal Feeds*. Food and Agriculture Organization of the United Nations, Rome.
- Gremmels JF (Ed.). 2010. *Animal Feed Contamination Effects on Livestock and Food Safety*. Woodhead Publishing Ltd.
- Keeler RF, Van Kampen KR and James LF. 1978. *Effects of Poisonous Plants on Livestock*. Academic Press.



- Knight AP and Walter R. 2001. *A Guide to Plant Poisoning of Animals in North America*. Teton NewMedia.
- Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*, 2nd ed. Academic Press.
- Osweiler G. (Ed.) 2011. *Ruminant Toxicology. An issue of Veterinary Clinics: Food Animal Practice*. Elsevier.

I. Course Title : Nutrigenomics in Animal Nutrition

II. Course Code : ANN 710

III. Credit Hours : 1+0

IV. Why this course?

The establishment of a functional relationship between nutrition and gene expression has become recognized as a tool to unravel the mechanisms involving the role of nutrition in health and disease.

V. Aim of the course

To impart the knowledge on the basics of nutrigenomics and its application in nutrition.

VI. Theory

Unit I (4 Lectures)

Basic concepts of genetics and molecular biology. Nucleic acid structure and replication, transcription and translation.

Unit II (8 Lectures)

Introduction to nutrigenomics and nutrigenetics. Nutritional regulation of gene expression. Introduction to epigenetics, and its influence on early life nutrition and health.

Unit III (4 Lectures)

Concepts of proteomics and metabolomics. Microbiome and diseases of nutritional importance. Dietary influences on the microbiome.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

Development of concepts on nutrigenomics.

IX. Suggested Reading

- Carlberg C, Ulven SM and Molnár F. 2016. *Nutrigenomics*. Springer
- Caterina RDE, Martinez, JA and Kohlmeier M.(Eds.) 2020. *Principles of Nutrigenetics and Nutrigenomics*. Elsevier Inc.
- Dodds JW and Laverdure DR. 2015. *Canine Nutrigenomics - The New Science of Feeding Your Dog for Optimum Health*. Dogwise Publishing.
- Select articles from Journals



- I. Course Title : Equine Nutrition**
II. Course Code : ANN 711
III. Credit Hours : 1+0

IV. Why this course?

Nutrition of equines calls for special attention considering their use for mankind.

V. Aim of the course

To impart a comprehensive knowledge on the nutrition of horses and other equids.

VI. Theory

Unit I (8 Lectures)

Digestive function and metabolism of nutrients. Nutrient requirements of equines in different physiological stages. Feed ingredient for horses. Digestive disorders.

Unit II (8 Lectures)

Feeding foal, yearlings, mares and stallions for production and reproduction. Feeding for performance and nutrient metabolism during exercise. Nutritional management of race-horses. Diet formulation for all classes of horses.

VII. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments

VIII. Learning outcome

In-depth knowledge of equine nutrition including its application.

IX. Suggested Reading

- Frape D. 2010. *Equine Nutrition and Feeding*, 4th ed. Wiley-Blackwell.
- Geor R, Harris P and Coenen M (Eds). 2013. *Equine Applied and Clinical Nutrition*. Saunders, Elsevier.
- NRC. 2007. *Nutrient Requirements of Horses*, 6th Rev. ed. National Research Council. National Academy Press.
- Pagan JD. (Ed.). 2009. *Advances in Equine Nutrition IV*. Kentucky Nutrition Research.



SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Animal Production Sciences

Livestock Production and Management





Preamble **(Livestock Production and Management)**

Veterinarians with higher qualifications are increasingly being involved in devising means and methods of production. Temporal aspirations of knowledge seekers ought to be addressed through building knowledge and skill portfolio suiting the job market and thus enhancing the marketability of the veterinary post graduates.

At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in-depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance.

In this perspective the proposed course curriculum and syllabus in Livestock Production Management have been developed. There have been unprecedented advancements in all the branches of veterinary sciences including Livestock Production Management. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. The new and restructured Post-Graduate syllabus in respect of LPM contain several innovative and practically applicable courses and extensively revamped course contents, viz., production aspects, business and entrepreneurship skills, environment and climate change issues, behaviour and welfare aspects of animals, wildlife management and recycling of waste or wealth from waste, etc.

Apart from the existing syllabus 3 new PG course have been incorporated keeping in view of the demand

1. LPM-607 Companion animal production management
2. LPM-613 Livestock farm machinery management
3. LPM-615 Regional animal production management

Salient features of the M.V.Sc. courses

- To acquaint students on basic aspects of dairying in India comparing with developed countries, problems and prospects of dairying, detailed aspects of care and management of different categories of dairy cattle and buffaloes.
- To impart knowledge on various aspects of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of growth and economic pig production systems.
- To familiarize students on climate, weather, various climatic factors and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and assessing the heat tolerance of bovines.
- To acquaint students on principles of farm animal behaviour with regard to environmental influence, group formation, social behaviour and behavioural adaptations under domestication.
- To acquaint with dog and cat breeds their feeding, breeding, health management and socialization.
- To acquaint students with the principles and concepts of wild life sanctuaries and national parks, classification of wild animals, role of authorities in conservation and



management of wild animals in captivity

- To familiarize students on principles of air and water hygiene with reference to impurities and inclusions of water, collection and disposal of waste from the animal house, modern techniques in manure disposal and biosecurity measures to be adapted for hygienic production of livestock products.
- To familiarize students on various aspects, viz., scope and limitations of integrated livestock farming system, recent approach and economic feasibility of different integration models for sustainable production
- To familiarize the students with various aspects of lab animals, problems and prospectus, principles of housing, breeding, feeding and health care of rabbits, rats, mice and guinea pigs, measures to reduce the mortality in young ones at different seasons.
- To acquaint students with knowledge in principles, planning, technical approach and preparing financial statement in Livestock Business Management and preparing projects for financing.
- To familiarize the students with different farm machines and milking machine, different parts and their functions for better utilization

New Ph.D. Courses

1. LPM-704 Livestock and Environment
2. LPM-705 Organic livestock production
3. LPM-706 Recent developments in welfare of farm animals
4. LPM-707 Entrepreneurship in livestock production
5. LPM-708 Precision livestock farming

Salient features of Ph.D. Courses

- To impart knowledge related to application of technologies that improve the efficiency of land use and feed use can mitigate the negative effects of livestock production on biodiversity, ecosystems and global warming. Technologies that increase livestock efficiency include improved breeds, improved grazing-land management, improved herd-health management, etc.
- To impart knowledge on key considerations, organic farming standards, certifying agencies, role of organic livestock farming in environmental protection and biodiversity enhancement and economics of organic livestock products.
- To familiarize students with the concept and practice of ethical livestock production and production from content ended animals - Animal Welfare Management
- To understand livestock entrepreneurship, concept, incubation centre, PPP prospective in animal husbandry sector, business communication, inter-personnel skills for establishing an enterprise.
- To educate the students with a concept of precision in livestock farming, implementation of sensor system, automation, use of software and analysis



Course Title with Credit Load

M.V.Sc. in Livestock Production and Management

Course Code	Course Title	Credit Hours
LPM 601*	Cattle and Buffalo Production Management	2+1
LPM 602*	Sheep and Goat Production Management	2+1
LPM 603*	Swine Production Management	1+1
LPM 604*	Climatology and Livestock Production	1+1
LPM 605*	Behaviour and Welfare of Farm Animals	1+1
LPM 606*	Equine Production Management	1+1
LPM 607*	Companion Animal Production Management	1+1
LPM 608	Farm Hygiene and Waste Management	1+1
LPM 609	Integrated Livestock Farming Systems	1+1
LPM 610	Management and Conservation of Wild and Zoo Animals	1+1
LPM 611	Laboratory Animal Production Management	1+1
LPM 612	Livestock Business Management	1+1
LPM 613	Livestock Farm Machinery Management	0+2
LPM 614	Poultry Farm and Hatchery Management	1+1
LPM 615	Regional Animal Production Management	1+1
LPM 691	Seminar	1+0
LPM 699	Research	30

*Core courses



Course Contents

M.V.Sc. in Livestock Production and Management

- I. Course Title : Cattle and Buffalo Production Management**
II. Course Code : LPM 601
III. Credit Hours : 2+1

IV. Why this course?

Important species of livestock are a source of employment and cater to nutritional demands and socio-economic upliftment of people.

V. Aim of the course

To acquaint students with basic aspects of dairying in India comparing with developed countries, problems and prospects of dairying, detailed aspects of care and management of different categories of dairy cattle and buffaloes.

VI. Theory

Unit I (2 Lectures)

Development of dairy industry in India and the world. Present status and future prospects of dairying in India and the world. SWOT analysis of the dairy sector in different agro-climatic zones. Production systems in vogue under Indian conditions. Breeds of cattle and buffalo with more emphasis on breeds of economic importance.

Unit II (6 Lectures)

Housing/ Shelter management. Housing and equipment requirements for different classes of cattle and buffaloes. Layout plans and construction details for different sized farms in different climatic zones of India. Ventilation and lighting systems in dairy farms.

Unit III (8 Lectures)

Feed and fodder resources used for feeding cattle and buffaloes. Scientific technique and regimen of feeding and watering of different categories of cattle and buffaloes. Feed and fodder requirements of different categories of cattle and buffaloes. Supply of green fodder round the year. Enrichment of poor quality roughages. Non-conventional feeding resources. Pasture management.

Unit IV (8 Lectures)

Traits of economic importance and their inter-relationships. Selection and methods of breeding. Reproduction management - Pre-natal and post-natal care and management of dams. Care of neonates and young calves. Management strategies for reducing mortality in calves, optimizing age at first calving and calving interval. Improving breeding efficiency of dairy animals.

Unit V (8 Lectures)

Farm management - Routine management practices and farm labour management. Milking management - Machine milking and hand milking. Clean milk production- Techniques of harvesting clean milk, cooling and transportation. Different laws



and practices governing the dairy sector to produce quality products on par with international standards. Health management of dairy animals. Summer and winter management of dairy animals. Draughtability and management of draught animals.

VII. Practical (14 Classes)

Visits to different sized dairy farms and assessment of routine managerial practices. Analysis of various farm records for economic evaluation:- Computation of practical and economical rations. Layout plans and housing details. Housing, milking, calf, heifer and adult management. Dairy Cattle and Buffalo judging and body condition scoring (BCS). Project preparation for commercial farms.

VIII. Teaching methods

Blackboard, ICTs, success stories, group discussions and farm visits

IX. Learning outcome

By the end of this course, the student will come out with practical knowledge of cattle and buffalo production management aspects, entrepreneurship skills.

X. Suggested Reading

- Arora SP. 1997. *Feeding of Dairy Cattle and Buffaloes*. Kalyani Publication.
- Dutta G. 1994. *Care and Management of Dairy Cattle and Buffaloes*, 3rd ed. ICAR.
- Flanders F and Gillespie J. 2015. *Modern Livestock and Poultry Production*, 9th ed. Delmar Cengage Learning Edition.
- Gupta PR. 2017. *Dairy India-2017*, 7th ed. Dairy India Yearbook, Thomson Press Ltd.
- ICAR. *Livestock Production and Management* - ICAR eCourse PDF eBook (online free).
- Phillips CJC. 2011. *Principles of Cattle Production*. CABI Publishing.
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.
- Thomas CK, Sastry NSR and Ravikiran G. 2012. *Dairy Bovine Production*, 2nd ed. Kalyani Publishers.
- Tyler HD and Ensminger ME. 2006. *Dairy Cattle Science*, Pearson Prentice Hall Publishing.
- Selected articles from journals.

I. Course Title : Sheep and Goat Production Management

II. Course Code : LPM 602

III. Credit Hours : 2+1

IV. Why this course?

To know the production and management of small ruminants. Important species of livestock provide employment and supplementary income besides meeting the nutritional demands and are of commercial importance.

V. Aim of the course

To acquaint students on the status of sheep and goat farming in India, principles of housing and feeding, breeding management to improve the reproductive efficiency and detailed account on care and management of different classes of sheep and goat.

VI. Theory

Unit I (2 Lectures)

Population structure and importance. Sheep farming under different systems of management. Advantages and limitations of sheep and goat farming. Genetic resources of sheep and goats with special emphasis on breeds of economic importance.



Unit II (6 Lectures)

Shelter management. Housing and equipment requirements for different classes of sheep and goats. Designing feeders and waterers. Layout plans and construction details for different size farms in different agro-climatic zones of India.

Unit III (8 Lectures)

Feed and fodder resources for small ruminants. Common property resources (CPR's) and their management. Principles and systems of feeding and watering different categories of sheep and goat. Pasture utilization and improvement.

Unit IV (8 Lectures)

Breeding Management, Traits of economic importance and their inter-relationship. Breeding seasons. Selection of breeding animals. Methods of detection of heat, use of teaser, flushing, tugging. Estrous synchronization, Natural Service, artificial insemination and off-season breeding in small ruminants. Care and management of pregnant animals and breeding stock. Culling.

Unit V (4 Lectures)

Disease Management. Prevention and control measures including vaccination, deworming, dipping and spraying, etc. Transportation of small ruminants.

Unit VI (4 Lectures)

Meat, Methods of slaughter, dressing percentage. Wool: Shearing methods. Importance of wool, wool quality. Goat fibers: mohair, pashmina - Marketing of goat fibers/ wool. Milk, Milking, avoidance of goaty odour in milk, clean milk production and its therapeutic uses.

VII. Practical (14 Classes)

Visits to modern sheep and goat farms and critical analysis of various managerial practices under different conditions. Study of practical housing management. Diseases control management. Shearing management. Record keeping and economics of sheep and goat farming for mutton/ chevon, wool/ fibre and milk. Preparation of project for commercial farming. Daily and periodical farm operations. Dipping and vaccination.

VIII. Teaching methods

Blackboard, ICTs, success stories, group discussions and farm visits

IX. Learning outcome

By the end of this course, the students get practical exposure to different aspects of sheep rearing, production and management.

X. Suggested Reading

- Bhat PN and Khan BU. 2009. *Goat Production*. Studium Press (India) Pvt. Ltd.
- Bhatt PN and Arora CL. 2009. *Sheep Production*. Studium Press (India) Pvt. Ltd.
- Devendra C and McLeroy GB. 1982. *Goat and Sheep Production in Tropics*. Longman.
- Devendra C and Burns M. 1983. *Goat Production in the Tropics*. CABI Publishing.
- Gupta JL. 2006. *Sheep Production and Management*. BS Publ.
- ICAR. 2014. *Handbook of Animal Husbandry*, 3rd ed. ICAR.
- Jindal SK. 2013. *Goat Production and Health Management*. New India Publishing Agency.
- Kaushik SK. 2017. *Sheep Production*. ICAR Publ.
- Peacock CP. 1996. *Improving Goat Production in the Tropics: A Manual for Development Workers*, OXFam, UK.
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.



- Solaiman SG. 2010. *Goat Science and Production*. Wiley-Blackwell.
- *Selected articles from journals.*

I. Course Title : Swine Production Management

II. Course Code : LPM 603

III. Credit Hours : 1+1

IV. Why this course?

Majority of people are rearing pigs under traditional and small scale production.

V. Aim of the course

To impart knowledge on various aspects of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of growth and economic pig production systems.

VI. Theory

Unit I (2 Lectures)

Population dynamic, Economic contribution of pigs, Advantages and limitations of swine rearing, Systems of management. Breeds of economic importance.

Unit II (2 Lectures)

Housing and rearing systems. Housing and equipment requirements for different classes of swine, layout plans and construction for different sized farms.

Unit III (3 Lectures)

Feeding principles and nutritional requirement of different classes of swine. Feeding schedule for different classes of swine. Traditional and scientific methods of swine feeding.

Unit IV (4 Lectures)

Traits of economic importance and their interrelationship. Selection of breeding stock. Reproductive parameters of swine. Methods for detection of heat. Mating systems. Care and management of pregnant sows, piglets, growers and boar. Summer management in swine.

Unit V (3 Lectures)

Health Management, Prevention and control measures including sanitation, vaccination, deworming, etc. Piglet anaemia and its management.

Unit VI (2 Lectures)

Methods of slaughter, dressing percentage, Methods of marketing and transportation. Use of by-products from the swine industry

VII. Practical (14 Classes)

Visit modern piggeries and critical analysis of various types of managerial practices. Practical feeding and breeding management, disease control measures, Judging. Record-keeping. Economics of pig production. Formulation of economic rations for different classes of swine. Project formulation of commercial swine production.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits



IX. Learning outcome

The students will come up with scientific principles, production and management techniques in swine production.

X. Suggested Reading

- Acharya RM and Puneet Kumar. 2017. *Pig Production*. Satish Serial Publishing, Delhi
- Beyno N. 2014. *Pigs: A Guide to Management*, 2nd ed. Replika Press Ltd.
- Boden E. 1995. *Swine Practice*. WB London.
- ICAR. 2014. *Hand Book of Animal Husbandry*, 3rd ed. ICAR
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.
- Sharda DP. 2000. *Swine Production*. ICAR publication
- *Selected articles from journals.*

I. Course Title : Climatology and Livestock Production

II. Course Code : LPM 604

III. Credit Hours : 1+1

IV. Why this course?

This course is important to know the climatic changes that affect the health and production of livestock and vice versa.

V. Aim of the course

To familiarize students on climate, weather, various climatic factors and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of the animal house and assessing the heat tolerance of bovines.

VI. Theory

Unit I (4 Lectures)

Climatology and agro-climatic regions of India. Study of climatic factors and their measurement. Climatic stress in livestock (heat stress/ cold stress): effects, measurement and amelioration. Temperature-humidity index and thermo-neutral zone. Adaptation and acclimatization.

Unit II (4 Lectures)

Light: natural and artificial, photoperiod, mechanism of light action and responses. Application in livestock production.

Unit III (4 Lectures)

Performance of livestock introduced in different climates. Micro-climate modification in animal houses. Livestock and global warming.

Unit IV (4 Lectures)

Climate-resilient livestock production systems. Natural disasters-effects on livestock and mitigation measures.

VII. Practical (14 Classes)

Visit modern weather forecast stations. Assessment of climate: Microclimatic conditions within the animal house, Measurement of Temperature, Relative humidity, wind velocity and intensity of light. Ambient temperature. Construction of climographs and hythergraphs. Heat tolerance test in bovines.



VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits.

IX. Learning outcome

The student is expected to know the different climatic conditions and adaptations for better production and managing livestock.

X. Suggested Reading

- Collier RJ and Collier JL. 2012. *Environment Physiology of Livestock*. Wiley-Blackwell Co.
- Lal DS. 1998. *Climatology*. Sharda Pustak Bhavan, Allahabad.
- McDowell RE. 1972. *Improvement of Livestock Production in Warm Climates*. WH Freeman.
- Payne WJ and Wilson RT. 1999. *An Introduction to Animal Husbandry in the Tropics*. Blackwell Publishing, USA.
- Rainwater MCF. 1962. *Animal Climatology*. Indian Veterinary Research Institute, Izatnagar.
- Sejian V, Gaughan J, Baumgard L and Prasad C. 2015. *Climate Change Impact on Livestock: Adaptation and Mitigation*, 5th ed. Springer.
- Siddhartha K and Roger B. 1996. *Atmosphere, Weather and Climate*. ELBS.
- *Selected articles from journals*.

I. Course Title : Behaviour and Welfare of Farm Animals

II. Course Code : LPM 605

III. Credit Hours : 1+1

IV. Why this course?

Improving the behaviour of livestock for better productivity and welfare.

V. Aim of the course

To acquaint students on principles of farm animal behaviour concerning environmental influence, group formation, social behaviour and behavioural adaptations under domestication.

VI. Theory

Unit I (4 Lectures)

Introduction to Animal behaviour. Evolution of animal behaviour: Theories of animal behaviour. Importance of animal behaviour studies. Physiological basis of behaviour. Natural selection, proximate and ultimate causes, fitness, optimality theory, selfish genes, kin selection, and game theory. Influence of genetic, environmental and physiological influence. Daily and seasonal cycles of behaviour. Patterns of behaviour. Favourable and unfavourable behaviours of domestication.

Unit II (4 Lectures)

Ethogram construction for general behaviour management – interpretation - behaviour assisted animal management - flight zone, Animal learning and training- conditioning- operant and classical, animal behaviour based housing designs – Methods of studying animal behaviour- Vices – causes and prevention.

Unit III (2 Lectures)

Group formation. Social relationships like hierarchy and aggression, the process of socialization, locality and behaviour. Behavioural characters for management practices.

Unit IV (6 Lectures)

Animal welfare – concepts – animal rights – animal freedoms – animal welfare



organizations Measurement of animal welfare: - indicators of animal welfare- improvement of animal welfare through selection- the welfare of livestock in commercial farms and captivity, environmental enrichment- Welfare of livestock during various management activities such as handling, transportation, etc., Legislation and regulations of animal welfare – welfare and economics.

VII. Practical (14 Classes)

Behavioural characters for managerial practices. Behavioural adaptations under domestication. Analysis of behaviour in relation to climate. Analysis of social behaviour. Preparation of ethogram (time budgeting).

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

The student will apply the understanding of animal behaviour to draw conclusions about animal welfare, Consider how common management practices for livestock influence behaviour and welfare, Interpret and critically evaluate scientific literature in the field of animal behaviour

X. Suggested Reading

- Agarwal VK. 2013. *Animal Behaviour* (Ethology) S. Chand and Company
- Albright JL and Arave CW. 1997. *The Behaviour of Cattle*. CAB International.
- Arora MP. 1995. *Animal Behaviour*. WB London.
- Benson BJ and Rollin BE. 2004. *The Well-being of Farm Animals: Challenges and Solutions*. Blackwell Publishing, USA.
- Bouenger EG. 1994. *Animal Behaviour*. WB London.
- Broom DM and Fraser AF. 2007 *Domestic Animal Behaviour and Welfare*, 4th ed. CABI.
- Fraser AF and Broom DM. 1990. *Farm Animal Behaviour and Welfare*. CAB international
- Hafez ESE. 1969. *The Behaviour of Domestic Animals*, 2nd ed. Balliere, Tindall and Cassell.
- Houpt KA. 2018. *Domestic Animal Behavior for Veterinarians and Animal Scientists*. 6th ed. Wiley Blackwell.
- Kumar V. 1996. *Animal Behaviour*. WB London.
- Selected articles from journals.

I. Course Title : Equine Production Management

II. Course Code : LPM 606

III. Credit Hours : 1+1

IV. Why this course?

Equines are important sports and pack animals

V. Aim of the course

To make the students become familiarize with principles of housing, breeding, feeding and health care of different classes of horse, stable routines and measures to reduce the mortality in young ones at different seasons.

VI. Theory

Unit I (2 Lectures)

Scope of equine husbandry in India. Equine population dynamics. Types and classes in equines. Breeds of economic importance.

Unit II (2 Lectures)

Housing and stable management, behaviour, stable vices and their management



Unit III (4 Lectures)

Feeding and breeding of equines. Care and management of stallion, broodmare, pregnant mare and foal.

Unit IV (2 Lectures)

Stud farms, Race clubs, Race-horses and their care, training, exercising, doping and horsemanship.

Unit V (4 Lectures)

Foot care and dental care in equines. General health management and diseases control. Colic, equine azoturia - prevention and management. Regulatory acts in equine disease control and welfare.

Unit VI (2 Lectures)

Transportation, Laws governing the import and export of equines, Horse passport and trading

VII. Practical (14 Classes)

Visit institutional stables. Identification, ageing, soundness and selection. Passing of nasogastric tube, Shoeing and covering. Saddle fitting, Gaits of horses and horse colours.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of the course, the student gains knowledge on management practices of equine production

X. Suggested Reading

- Blanchard T, Varner D, Love C, Brinsko S, Rigby R and Schumacher J. 2002. *Manual of Equine Reproduction*. Mosby.
- Brown JH and Powell-Smith V. 1984. *Horse and Stable Management*. Blackwell Science.
- Frape D. 1986. *Equine Nutrition and Feeding*. Blackwell.
- Kacker RN and Panwar BS. 1996. *Text Book of Equine Husbandry*. Vikas Publ.
- Mills DS and Nankervis KJ. 1998. *Equine Behaviour: Principles and Practice*. Blackwell.
- Panwar BS and Yadav KN. 2010. *Equine Husbandry and Equestrian Sports*. IBDC Publishers.
- Pilliner S. 1994. *Care of the Competition Horse*. BT Batsford.
- Rose RJ and Hodgson DR. 2000. *Manual of Equine Practice*. WB Saunders.

I. Course Title : Companion Animal Production Management

II. Course Code : LPM 607

III. Credit Hours : 1+1

IV. Why this course?

To know the different practices of dog and cats

V. Aim of the course

To acquaint with dog and cat breeds their feeding, breeding, health management and socialization.



VI. Theory

Unit I (4 Lectures)

Various companion animals, evolutionary history, the process of domestication of dog and cat. Breeds of dogs and cats. Ownership. Selection of dog, cat and other companion animals. Dogs/ cat body: structure, movement and special senses.

Unit II (4 Lectures)

Reproduction and breeding management, care of newborn, weaning, reproductive problems of bitch/ queen, Socialization.

Unit III (4 Lectures)

Principles of the feeding of dog and cat, Feeding during different life stages and disease conditions, feeding behaviour, common nutritional problems and their preventive measures.

Unit IV (4 Lectures)

Basic Kennel and health management. Principles of training of dogs/ cats. Dog shows. Preparation for the shows, kennel clubs, important characters for judgment. Vaccination/ deworming schedules.

VII. Practical (14 Classes)

Recognizing various breeds. Handling and Restraining of dogs/ cats, Routine management practices of dogs/ cats. Detection of oestrus, mating, whelping/ kitting (through demonstration). Kennel/ cattery design and management. Hygiene of kennel/ pens. Licensing and identification of companion animals. Visit dog hostels and dog park/ shows.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and visits to kennels

IX. Learning outcome

By the end of the course, the student will be able to gain knowledge on different aspects of breeds and management of companion animals.

IX. Suggested Reading

- Case LP, Daristotle L, Hayek MG and Raasch MF. 2011. *Canine and Feline Nutrition: A Resource for Companion Animal Professionals*. 3rd ed. Mosby Elsevier Publishing.
- Chakrabarti A. 2006. *Train Your Dog: At Work and Show*, 2nd ed. Kalyani Publishers.
- Chakrabarti A. 2014. *Dogs their Care and Treatment*, 4th ed. Kalyani Publishers.
- Sharma MC, Pathak NN and Bhat PN. 1993. *Dogs, Breeding, Nutrition, Diagnosis, and Health Management*. CBS Publishers and Distributors.
- Smith FWK. 2012. *Veterinary Medical Guide to Dog and Cat Breeds*. Teton New Media, NY.
- Selected articles from journals.

I. Course Title : Farm Hygiene and Waste Management

II. Course Code : LPM 608

III. Credit Hours : 1+1

IV. Why this course?

Maintenance of farm hygiene and proper waste management promotes animal health



V. Aim of the course

To familiarize students on principles of air and water hygiene concerning impurities and inclusions of water, collection and disposal of waste from the animal house, modern techniques in manure disposal and biosecurity measures to be adapted for hygienic production of livestock products.

VI. Theory

Unit I (4 Lectures)

Animal air hygiene. Measure air pollutants and their sources. Factors affecting outdoor and indoor pollution. Methods to control these factors.

Unit II (4 Lectures)

Water Hygiene. Sources of drinking water-Impurities and inclusions. Hygienic requirements and standards for drinking water. Purification of water. Water conservation.

Unit III (4 Lectures)

Manure, Quantity of manure voided by domestic animals. Animal excreta a factor in the spread of disease. Hygienic and economic disposal of farm wastes. Drainage in livestock farms. Lagoons, Sewers, septic tanks, drains and traps.

Unit IV (2 Lectures)

Environmental protection act: Air (Prevention and control of pollution) act and water (Prevention and control of pollution) act.

Unit V (2 Lectures)

Factors affecting environmental pollution and their effect on livestock and livestock products for human consumption. Controlling measures thereof.

VII. Practical (14 Classes)

Assessment of air pollutants on animal health and production. Collection of water samples: Physical, chemical, bacteriological and microscopic examination. Bio-security measures. Modern techniques used in the disposal of farm wastes. Value-added products from farm wastes. Visit water filtration plants and study of filtration systems (rapid and slow-sand, etc.). Testing of drains in livestock farms.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of the course, the students know the practical knowledge and experiences in hygiene and waste management and control methods.

X. Suggested Reading

- Baba MD. 2007. *Environmental Changes and Natural Disasters*. New India Publ.
- Overcash MR. 1983. *Livestock Waste Management*. CRC Press.
- Thapliyal DC and Misra DS. 1996. *Fundamentals of Animal Hygiene and Epidemiology*. International Book Distr. Co.



- I. Course Title : Integrated Livestock Farming Systems**
II. Course Code : LPM 609
III. Credit Hours : 1+1

IV. Why this course?

To know the Integration of livestock farming systems which in turn helps improves the overall profitability of the livestock system.

V. Aim of the course

To familiarize students on various aspects, viz., scope and limitations of integrated livestock farming system, recent approach and economic feasibility of different integration models for sustainable production

VI. Theory

Unit I (4 Lectures)

Classification of livestock-based farming systems. Principles, Scope, drivers and tradeoffs in integrated livestock farming systems. Sustainability and ecological advantages of integrated livestock farming systems and their economic importance.

Unit II (4 Lectures)

Integration of various components of farming systems. Livestock-fish, arable farming, plantation crops and different livestock enterprises (cattle, buffalo, sheep, goat, pig, rabbit, poultry, beekeeping, silkworm, etc.) along with the bio-gas plant, FYM, vermicompost, solar and wind energy utilization

Unit III (4 Lectures)

New approach for changing farming systems in the light of global warming, carbon sequestration and mitigation of GHGs (reducing carbon and water footprints)

Unit IV (4 Lectures)

Project formulation and evaluation of various integrated livestock enterprises in light of reducing poverty, livelihood diversification, environmental sustainability and resource conservation.

VII. Practical (14 Classes)

Visit modern integrated livestock farming units. Critical analysis of different subunits, economic analysis and preparation of feasibility reports

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of the course, the students are expected to know with different integrated farming systems and their application in the field of their study.

X. Suggested Reading

- Ghosh B. 2007. *Integrating Crops and Livestock*, 1st ed. Gene-Tech Books.
- Little DC and Edwards P. 2003. *Integrated Livestock-fish Farming Systems*. FAO.
- Mukherjee TK, Moi PS, Panandam JM and Yang YS. (Eds.) 1992. *Integrated Livestock Fish Production Systems*. FAO/ IPT Workshop on Integrated Livestock-Fish Production Systems, University of Malaya, Kuala Lumpur.
- Raman KV and Balaguru T. (Eds.). 1992. *Farming Systems Research in India: Strategies for Implementation*. NAARM, Hyderabad.



- Rana SS. 2015. *Recent Advances in Integrated Farming Systems*. CSK HPKV, Palampur.
- Rangasamy A and Annadurai K. 2002. *Farming System in the Tropics*. Kalyani Publishers.
- Renard C. (Ed.). 1997. *Crop Residues in Sustainable Mixed Crop/ Livestock Farming Systems*. CABI.
- Speirs M and Opsen O. 1992. *Indigenous Integrated Farming System in the Sahel*. World Bank.
- Sunil Kumar and DR Palsaniya DR and Kiran Kumar T. 2017. *Farming systems: Issues and Strategies*. Satish Serial Publishing, New Delhi.
- Selected articles from journals.

I. Course Title : Management and Conservation of Wild and Zoo Animals

II. Course Code : LPM 610

III. Credit Hours : 1+1

IV. Why this course?

The course is useful to know about the zoo, wild animals and their biodiversity conservation

V. Aim of the course

To acquaint students with the principles and concepts of wildlife sanctuaries and national parks, classification of wild animals, the role of authorities in conservation and management of wild animals in captivity.

VI. Theory

Unit I (2 Lectures)

Taxonomy and distribution of important Indian wild animals and birds – Ecology of wildlife sanctuaries and National parks - Principles and concepts of Zoo and captive wild animals- Status of forest in India - Biological and ecological basis of management of wildlife

Unit II (2 Lectures)

Rules and regulations of Zoo Authority of India - Wildlife protection act - Conservation of wild animals – feeding of captive animals and birds- Habitat Components-Cover, food, water, space and their development and conservation

Unit III (6 Lectures)

Wildlife health control - Population dynamics- and its manipulation Movements – Corridors, – Mortality - Predator and prey relationship - Human-animal conflict - Refuge rehabilitation

Unit IV (6 Lectures)

Principles for the protection of wild and zoo animals - Breeding seasons - Breeding characteristics – puberty - pregnancy - parturition - postnatal survival of the young. Social factors among various species. Miscellaneous management procedures. Wildlife Census methods- captive animal breeding

VII. Practical (14 Classes)

Visit wildlife sanctuary/ national park/ biosphere reserves/ conservation breeding centre and zoo. Restraining methods. Funding agencies for wildlife research and preparation of project proposals, Habitat analysis and design.



VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of the course, the students gain knowledge in zoo animals and wildlife management and conservation methods.

X. Suggested Reading

- Agrawal KC. 2000. *Wildlife of India: Conservation and Management*. Nidhi Publishers.
- Berwick SH and Saharia VB. (Eds.). 1995. *The Development of International Principles and Practices of Wildlife Research and Management*. Oxford University Press.
- Bobbins CT. 1983. *Wildlife Feeding and Nutrition*. Daya Publ. House.
- Giles RH, Jr. 1978. *Wildlife Management*. WH Freeman.
- Giles RH, Jr. 1984. *Wildlife Management Techniques*, 3rd ed. Wildlife Society, Washington, DC.
- Hosetti BB. 2005. *Concepts in Wildlife Management*, 2nd ed. Daya Publ. House.
- Saha GK and Mazumdar S. 2017. *Wildlife Biology: an Indian Perspective*. PHI Learning Pvt. Ltd.
- Santra AK. 2008. *Handbook on Wild and Zoo Animals: A Treatise for Students of Veterinary, Zoology, Forestry and Environmental Science*. International Book Distributing Co.
- Sinclair ARE, Fryxel JM and Caughley G. 2006. *Wildlife Ecology, Conservation and Management*, 2nd ed. Blackwell.
- Singh SK. 2005. *Text Book of Wildlife Management*. International Book Distributing Co.
- Wildlife (Protection) Act 1972 (as amended up to 1991). Natraj Publ.
- *Selected articles from journals*.

I. Course Title : Laboratory Animal Production Management

II. Course Code : LPM 611

III. Credit Hours : 1+1

IV. Why this course?

Laboratory animals are important components of research for conducting animal experiments.

V. Aim of the course

To familiarize the students with various aspects of lab animals, problems and prospectus, principles of housing, breeding, feeding and health care of rabbits, rats, mice and guinea pigs, measures to reduce the mortality in young ones at different seasons.

VI. Theory

Unit I (2 Lectures)

Importance of rabbit, rats, mice, hamster and guinea pigs as laboratory animals.

Unit II (4 Lectures)

Systems of housing, layout and design for laboratory animals house. Feeding management of laboratory animals. Feeding regimen, Types of diets.

Unit III (6 Lectures)

Production of laboratory animal models for various experiments. Management of specific pathogen-free, gnotobiotic and germ-free animals. Concepts related to the welfare of laboratory animals. Sanitary and hygienic measures. Common diseases and their control measures. Biosecurity measures. Transportation.



Unit IV (4 Lectures)

Breeding, growth, sexual maturity, mating, gestation, parturition, litter size, weaning. Selection of breeding stock for replacement.

VII. Practical (14 Classes)

Visit to laboratory animal house and critical analysis of various types of managerial practices. Handling and restraining of laboratory animals. Practical breeding methods. Disease control and special management. Ageing and identification. Economics of production.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and experimental lab visits

IX. Learning outcome

By the end of the course, the students get practical exposure on different experimental laboratory animals, their production and management.

X. Suggested Reading

- Anonymous.1993. *Rabbit Management*. IBH and Oxford
- Banday MT, Shrivastava HP and Hamdani H. 2014. *Rabbit Production and Management*. New India Publishing Agency.
- Chakrabarti A and Biswas S. 2014. *Rabbit Health and Production*. Kalyani Publishers.
- Hau J and Van Hoosier GL, Jr. 2002. *Handbook of Laboratory Animal Science*, 2nd ed. CRC Press.
- ICAR. 2014. *Hand Book of Animal Husbandry*, 3rd ed. ICAR, New Delhi.
- NRC. 2011. *Committee for the Update of the Guide for the Care and Use of Laboratory Animals. Guide for the Care and Use of Laboratory Animals*, 8th ed. National Research Council, National Academy Press, Washington, DC.
- Rao TKS, Chauhan IS and Chauhan A. 2018. *Handbook of Laboratory Animal Production Management*. Kalyani Publishers.
- Reddy DV. 2007. *Applied Nutrition: (Livestock, Poultry, Human, Pet, Rabbit and Laboratory Animal Nutrition)*. IBH and Oxford.
- Ronald N and Penman S. 1991. *A Manual for Small Scale Rabbit Production*. South Asia Publ.
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.
- Selected articles from journals.

I. Course Title : Livestock Business Management

II. Course Code : LPM 612

III. Credit Hours : 1+1

IV. Why this course?

Study of livestock business management will improve marketing of livestock and livestock products and enhance the profitability

V. Aim of the course

To acquaint students with knowledge in principles, planning, technical approach and preparing financial statement in Livestock Business Management and preparing projects for financing.



VI. Theory

Unit I (3 Lectures)

Management principles, Planning Techniques, strategic planning, organization structure, co-ordination and controlling techniques, Approaches to management.

Unit II (5 Lectures)

Key economic concepts, factors of production, farm enterprises, cost of production, opportunity cost, value of production, gross margin, farm profit, net farm family income, substitution, and efficiency: return to scarce resources, risk. SWOT analysis for different livestock species and products, Livestock production economics, theory of supply and demand, production relationships, production function, cost input variables, profit maximization.

Unit III (4 Lectures)

Economics and the market, market intelligence, newer concepts in marketing, market research and opinion polling, advertising research, market surveillance, etc.

Unit IV (3 Lectures)

Marketing channels, Marketing of livestock and livestock products and laws governing them, Pricing strategies, supply chain management, marketing agencies.

VII. Practical (14 Classes)

Accounting records, fund flow statement, Cost and benefit analysis. Budgeting and control. Preparation of financial statements, depreciation accounting methods, trend and variance analysis, cost-volume profit analysis. Financial planning and forecasting. Estimation of working capital requirement. Break even analysis. Visit to livestock business firms and banks. Preparing projects for financing.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of course the students gain knowledge in planning and handling business records.

X. Suggested Reading

- Acharya RM and Kumar P. 2013. *Dairy Production and Business Management*. Satish Serial Publishing, New Delhi.
- Bardhan D. 2013. *Textbook on Livestock Economics, Marketing and Business*. Satish Serial Publishing House.
- Bhaskaran S and Mohanty S. 2007. *Marketing of Livestock and Livestock Products in India*. ICFAI University Press.
- Das N. 2009. *Forage for Sustainable Livestock*. Satish Serial Publishing House.
- Gangadhar KS. 2009. *Livestock Economics: Marketing, Business Management and Accountancy*. New India Publishing Agency.
- George RP and Raj Kamal PJ. 2015. *Farm Economics, Entrepreneurship and Marketing*. Satish Serial Publishing, New Delhi.
- Kahan D. 2008. *Economics for Farm Management Extension*. FAO, Rome.
- Koontz H and O'Donnel C. 1999. *Essentials of Management*. Tata McGraw Hill.
- Kotler P. 2000. *Marketing Management - Analysis, Planning and Control*. Prentice Hall of India.
- Maheswari SN. 1998. *Management Accounting*. Tata McGraw Hill.
- Massie JL. 1995. *Essential of Management*. Prentice Hall of India.



- Moran J. 2009. *Business Management for Tropical Dairy Farmers*. Land Links Publishing.
- Srinivasan NP. 1998. *Management Accounting*. Sterling Publications.
- Selected articles from journals.

I. Course Title : Livestock Farm Machinery Management

II. Course Code : LPM 613

III. Credit Hours : 0+2

IV. Why this course?

The course will facilitate effective utilization and maintenance of farm machinery with their practical knowledge.

V. Aim of the course

To familiarize the students with different farm machines and milking machine, different parts and their functions for better utilization

VI. Theory

Unit I (2 Lectures)

Visit to Instructional Livestock Farm Complex, Identification of various livestock farm machineries

Unit II (2 Lectures)

Familiarization with different parts and their functions of tractor and power tiller (for tillage implements for fodder land development).

Unit III (2 Lectures)

Irrigation of fodder field. Familiarization with different electric motors and diesel engines, use of sprinkler for irrigation.

Unit IV (2 Lectures)

Non-conventional energy source-Wind energy and its utilization in livestock farm.

Unit V (2 Lectures)

Post-harvest equipment/ machineries. Common terms used in harvesting of fodder crops; hay and forage harvesting equipment, mowers, field choppers, chaff cutters for silage making, different types of silos, forage harvesters, mechanical hay driers, conventional balers, hay stackers, straw combine.

Unit VI (2 Lectures)

Familiarization with different parts of milking/ shearing machines, handling, operation and cleaning after use, instruments used for milk packaging. Automatic feeders and waterers

Unit VII (2 Lectures)

Milk storing equipment, pasteurization equipment and transportation of milk, handling of equipment for preparation traditional milk products.

Unit VIII (2 Lectures)

Forage densifying machine/ Feed block machine and its use- preparation of complete feed block (CFB).

Unit IX (2 Lectures)

Visit to feed mill- use and maintenance of feed grinder and mixture machines in



the farms. Visit milk processing unit

VII. Teaching methods

Practical demonstration of prescribed machinery in different farms/ processing plants

VIII. Learning outcome

By the end of course the students get knowledge on different farm machineries including milking machine.

IX. Suggested Reading

- Kutz M. 2007. *Handbook of Farm, Dairy, and Food Machinery*. William Andrew Inc.
- Malhotra K. 2012. *Handbook of Farm, Dairy, and Food Machinery*. Centrum Press.
- Selected articles from journals.

I. Course Title : Poultry Farm and Hatchery Management

II. Course Code : LPM 614

III. Credit Hours : 1+1

IV. Why this course?

Poultry rearing provides employment opportunities and is an important component of food security

V. Aim of the course

To impart knowledge on housing, flooring and management of poultry. They also learn incubation and hatching of eggs.

VI. Theory

Unit I (4 Lectures)

Poultry housing systems - cage vs floor system, litter management and lighting for poultry, rearing turkey, duck and quails, backyard poultry.

Unit II (4 Lectures)

Management of chicks, growing, laying and breeding flocks, broiler production, selection and culling of laying flocks. Health management. Management of birds during disease outbreaks.

Unit III (3 Lectures)

Procuring, care and pre-incubation storage of hatching eggs - Method of incubation, sanitation disinfection and management of hatchery. Biosecurity in poultry farms

Unit IV (2 Lectures)

Embryonic development and factors affecting fertility and hatchability of eggs.

Unit V (3 Lectures)

Chick sexing, packing and hatchery business - Transporting management of farm and hatchery waste.

VII. Practical (14 Classes)

Observation and recording of Poultry Farm management - Brooding of chicks; selection of laying flocks - Disease preventive measures - Selection and care of hatching eggs; incubator operation, fumigation and candling setting and hatching, packaging of chicks - Waste management - Marketing of products.



VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of the course, the students gain knowledge on poultry farm management, brooding and hatching management including health.

X. Suggested Reading

- Ensminger ME. 1992. *Poultry Science*. International Book Distr. Co.
- Hued LM. 2003. *Modern Poultry Farming*. Greenworld.
- Powell-Owen W. 2008. *Poultry Farming and Keeping*. Daya Books.
- Prasad J. 2005. *Poultry Production and Management*. Kalyani Publication
- Singh RA. 1996. *Poultry Production*. 3rd ed. Kalyani Publication

I. Course Title : Regional Animal Production Management

II. Course Code : LPM 615

III. Credit Hours : 1+1

The course content will be developed as per the need of the university



Course Title with Credit Load

Ph.D. in Livestock Production and Management

Course No.	Course Title	Credits
LPM 701*	Recent Developments in Large Ruminants Production Management	2+1
LPM 702*	Recent Developments in Small Ruminants Production Management	2+1
LPM 703*	Recent Developments in Swine Production Management	1+1
LPM 704*	Livestock and Environment	1+0
LPM 705*	Organic Livestock Production	1+0
LPM 706	Recent Developments in Welfare of Farm Animals	1+0
LPM 707	Entrepreneurship in Livestock Production	1+1
LPM 708	Precision Livestock Farming	1+1
LPM 709	Recent Developments in Poultry Production Management	2+1
LPM 791	Seminar-I	1+0
LPM 792	Seminar-II	1+0
LPM 799	Research	75

*Core courses



Course Contents

Ph.D. in Livestock Production and Management

- I. Course Title** : **Recent Developments in Large Ruminants Production Management**
- II. Course Code** : **LPM 701**
- III. Credit Hours** : **2+1**

IV. Why this course?

Large ruminants are a source of employment and cater to nutritional demands and socio-economic upliftment of people.

V. Aim of the course

To know modern trends on housing, feeding, health and milking management in dairy bovines.

VI. Theory

Unit I (2 Lectures)

Present status of dairying in India *vis-à-vis* Global and south Asian scenarios, Production dynamics, Recent policy initiatives in dairy development. Conservation of indigenous germplasm

Unit II (4 Lectures)

Advances in housing management, viz., design, layout, construction materials, cost of construction suits to various agro-climatic zones of India. Low-cost houses for large ruminants. Ideal shelter management practices for better productivity, Advances in manure and waste disposal.

Unit III (6 Lectures)

Recent approaches in breeding and reproductive Management of dairy animals, Optimization of reproductive traits, Estrus synchronization, MOET, Sexed semen, Cloning and IVF.

Unit IV (4 Lectures)

Recent approaches in Feeding, Phased feeding, Transition period, Hydroponic fodder, Eco-feeding, standards for drinking water and water hygiene.

Unit V (4 Lectures)

Advances in health management of dairy animals, preventive measures for production-related diseases, bio-security measures, etc.

Unit VI (4 Lectures)

Milking management, automation, Sanitary and phytosanitary standards for the production of quality milk, post-harvest processing.

Unit VII (4 Lectures)

Establishing a Dairy Enterprise suitable for various economic strata with different sizes, SWOT analysis. Computerization of dairy enterprises, Best management practices.



Unit VIII (4 Lectures)

Advances in herd management and data analysis, Advances in the management aspects of buffaloes, salvaging of buffalo calves, Advances in work animal management.

VII. Practical (14 Classes)

Critical analysis of various types of managerial practices at farms. Preparation of layout and designs for construction of sheds of various sizes in different agro-climatic zones. Cost analysis of dairy bovine housing. Organization of milking machines. Dairy Cattle and Buffalo judging – BCS. Farm record analysis. Project report preparation for commercial dairy farms.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of the course, the student gain knowledge and experience in different aspects of advanced methods of large ruminants management in different fields of housing, feeding, breeding and milking of dairy animals.

X. Suggested Reading

- Clarence HE. 2007. *Dairy Cattle and Milk Production*. Daya Publ. House.
- Moran J and Chamberlain P. 2017. *Blueprints For Tropical Dairy Farming: Milk Production in Developing Countries*. CSIRPO Publishing.
- Moran J. 2013. *Tropical Dairy Farming: Feeding Management for Small Holder Dairy Farmers in the Humid Tropics*. Landlinks Press.
- Singh U, Kumar S, Kumar A, Deb R and Sharma A. 2013. *Advances in Cattle Research*. Satish Serial Publishing House, New Delhi.
- Thomas CK, Sastry NSR and Ravi Kiran. 2012. *Dairy Bovine Production*, 2nd ed. Kalyani Publishers.

I. Course Title : Recent Developments in Small Ruminants Production Management

II. Course Code : LPM 702

III. Credit Hours : 2+1

IV. Why this course?

Small ruminants are an important source of livelihood security to rural masses and study/ application of recent advances will improve the profitability of small ruminant rearing.

V. Aim of the course?

To familiarize the students with advanced methods of housing, feeding, breeding, reproduction and health management.

VI. Theory

Unit I (4 Lectures)

Relevance of small ruminants in the Indian economy. Population and production dynamics of small ruminants. Systems of rearing. Needs and possibilities for research in future.

Unit II (8 Lectures)

Recent approaches in breeding and reproductive management. Management during



the breeding season, Mating seasons and their control. Recent approaches in reproductive biotechnologies, MOET, Cloning, transgenic, genomics and accelerated lambing.

Unit III (6 Lectures)

Recent approaches in feeding management, Pasture and grazing management, Phase feeding, Feed resources and feeding techniques under different systems.

Unit IV (6 Lectures)

Recent approaches in housing systems with reference to different agro-climatic zones and rearing systems.

Unit V (6 Lectures)

Prospects of management under stall-fed conditions, management of small ruminates during scarcity periods, Migratory pattern and flock management. Recent approaches in exploiting goat's, milk quality, safety and production aspects of dairy goats. Wool/ fibre production and its quality.

Unit VI (2 Lectures)

Recent approaches in health care management, Parasitic control in present ecological and environmental changes.

VII. Practical (14 Classes)

Critical analysis of various farm practices, Preparation of layout and designs for construction of sheds of various sizes in different agro-climatic zones. Cost analysis of housing. Organization of shearing. Sheep and goat judging – BCS. Farm record analysis. Disease control management. Scorecard and grading of wool. Project report preparation for commercial sheep and goat units.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

The students gain knowledge and experience on different advance management aspects of small ruminants.

X. Suggested Reading

- Devendra C and McLeroy GB. 1983. *Goat and Sheep Production in the Tropics*. Agrodok.
- Gupta JL. 2006. *Sheep Production and Management*. CBS.
- Jansen C and van den Burg K. 2004. *Goat Production in the Tropics*. 4th ed. © Agromisa Foundation, Wageningen.
- Karim SA. 2008. *Small Ruminant Production in India*. Satish Serial Publishing, New Delhi.
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.
- Selected articles from journals

I. Course Title : Recent Developments in Swine Production Management

II. Course Code : LPM 703

III. Credit Hours : 1+1

IV. Why this course?

Study of recent developments will facilitate their application for better growth of the swine industry



V. Aim of the course

To impart knowledge on recent advances in the improvement of swine housing, feeding, reproduction and health management.

VI. Theory

Unit I (2 Lectures)

Trends in population and production in India and world, Production systems followed in developed countries.

Unit II (6 Lectures)

Recent approaches in improvement of economic traits, Prenatal and postnatal development, care of newborn, Growth, breeding and reproduction, analysis of mating systems, Farrowing and lactation.

Unit III (3 Lectures)

Strategic management measures in feeding, Phase feeding, Split sex feeding and individual feeding. Automatic feeding and watering techniques, Feed resources and feeding systems.

Unit IV (2 Lectures)

Recent approaches in housing, environmental physiology, summer management, approaches in manure management.

Unit V (2 Lectures)

Strategies to reduce mortality in different classes, common diseases, health management, Biosecurity measures.

VII. Practical (14 Classes)

Critical analysis of various types of managerial practices at farms. Preparation of layout and designs for construction of sties for the backyard and commercial piggeries. Judging and BCS, Farm record analysis. Preparation of Project report for commercial and backyard piggeries. Marketing Analysis

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of the course, the students will gain knowledge on modern aspects swine practices and management including health.

X. Suggested Reading

- Katingi E. 2012. *Raising Pigs – Manuals and Other Useful Resources*. ICARDA and ILRI Publications.
<https://livestockfish.cgiar.org/2012/06/13/raising-pigs-manuals-and-other-useful-resources/>
- Selected articles from journals.

I. Course Title : Livestock and Environment

II. Course Code : LPM 704

III. Credit Hours : 1+0

IV. Why this course?

There is an urgent need for governments and institutions to develop and enact appropriate policies, at the national and international levels, that focus more on



and account for livestock–environment interactions.

V. Aim of the course

To impart knowledge related to the application of technologies that improve the efficiency of land use and feed use can mitigate the negative effects of livestock production on biodiversity, ecosystems and global warming. Technologies that increase livestock efficiency include improved breeds, improved grazing-land management, improved herd-health management, etc.,

VI. Theory

Unit I (4 Lectures)

Effect of livestock on the environment- Role of ruminants in global warming, Slaughterhouse waste, Tannery waste, Stray and fallen animal impact. Strategies for mitigation of methane emission from the livestock sector, animal waste management. A life cycle assessment of the environmental impacts of livestock in different production systems.

Unit II (4 Lectures)

Effect of environment on livestock and quality of products: Heat and cold stress, Pollution, Heavy metals, Pesticide residues, etc., Management of micro and macro-environment with respect to animal well-being,

Unit III (4 Lectures)

Concept of Water, Carbon footprints and carbon sequestration of farm animals and products. Thermal load indices, Livestock comfort zones. Carbon trading, mechanisms and opportunities in the livestock sector.

Unit IV (4 Lectures)

Selection of breeds of livestock for hot climate. Recent advances in shelter management practices under the impending climate change scenario. Climate and reproduction. Environment and diseases.

VII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions.

VIII. Learning outcome

By the end of the course, the students gain knowledge about the interaction between livestock and the environment. They also acquire knowledge of the greenhouse effect and mitigation.

IX. Suggested Reading

- Cheeke PR. 1993. *Impacts of Livestock Production on Society, Diet/ health, and the Environment*. Interstate Publishers.
- FAO. 2009. *Livestock in the Balance*, FAO, Rome.
- ICAR. 2014. *Handbook of Animal Husbandry*. ICAR, New Delhi.
- Mudgal VD, Singhal KK and Sharma DD. 2003. *Advances in Dairy Animal Production*, 2nd ed. International Book Distributing Co.
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.
- Sejain V, Naqvi SMK, Ezeji T, Lakritz J and Lal R. 2012. *Environmental Stress and Amelioration in Livestock Production*. Springer
- Sirohi SK, Walli TK, Singh B and Singh N. 2013. *Livestock Greenhouse Gas: Emissions and Options For Mitigation*. Satish Serial Publishing, New Delhi.
- Selected articles from journals



- I. Course Title : Organic Livestock Production**
II. Course Code : LPM 705
III. Credit Hours : 1+0
IV. Why this course?

Organic livestock production offers an effective means of satisfying consumer demand for healthy and safe foods and reducing the environmental pressure of agricultural production. There is a need to know the organic production of livestock products and by-products.

V. Aim of the course

To impart knowledge on key considerations, organic farming standards, certifying agencies, the role of organic livestock farming in environmental protection and biodiversity enhancement and economics of organic livestock products.

VI. Theory

Unit I (2 Lectures)

Historical background and origin, Organic livestock farming vis-a-vis conventional livestock farming, the current status of organic farming in India and world- objectives and importance of organic livestock farming. Opportunities and Problems of organic livestock farming in India.

Unit II (6 Lectures)

Key consideration, selection of animals, housing, feeding, breeding, health care, record keeping, processing and labelling and marketing. Conversion of livestock farm into an organic farm. ITKs used in organic livestock production.

Unit III (4 Lectures)

Organic farming standards in India and the world. IFOAM basic standards, WHO/FAO Codex Alimentarius, NSOP of India, etc. Role of organic livestock farming in environmental Protection and biodiversity enhancement.

Unit IV (4 Lectures)

Accreditation of inspection and certification agencies. Organic certification mark. Guidelines for organic certification of livestock modalities in the certification of organic products. The economic value of organic livestock products, pricing strategy and marketing of organic products.

VII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions

VIII. Learning outcome

By the end of the course, the student will be acquainted with organic livestock production, economics and marketing of organic products.

IX. Suggested Reading

- Balasubramaniam R, Balakrishnan K and Sivasubramaniam K. 2013. *Principles and Practices of Organic Farming*. Satish Serial Publishing House, New Delhi.
- ICAR. 2014. *Handbook of Animal Husbandry*. ICAR, New Delhi.
- Paajanen T. 2011. *The Complete Guide to Organic Livestock Farming*. Atlantic Publishing Group Inc.
- Katherine M. 2009 *The Organic Dairy Handbook*. Northeast Organic Farming Association.
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.



- Singh M, Sharma DK and Mishra UK. 2011. *Organic Dairy Farming*. Satish Serial Publishing House, New Delhi.
- Selected articles from journals

I. Course Title : Recent Developments in Welfare of Farm Animals

II. Course Code : LPM 706

III. Credit Hours : 1+0

IV. Why this course?

Now there are big movements on ethical animal production all over the World. Hence a doctoral student of LPM has to be prepared on this issue too.

V. Aim of the course

To familiarize students with the concept and practice of ethical livestock production and production from content ended animals - Animal Welfare Management;

VI. Theory

Unit I (2 Lectures)

Ethology: species-specific behaviour, changing with the season, physiological condition of animals, as a guide to animal welfare; not driving animals beyond their natural capacity, for better performance;

Unit II (6 Lectures)

Amelioration of climatic stress and avoidance of unnecessary injury, pain and stress to animals in animal houses, during handling, before and during slaughter, carting bullocks, feeding, milking, shearing, transportation, etc., including deprivation of quality feeds and water; this being a common feature;

Unit III (4 Lectures)

Providing safety, healthcare, feed and water to unproductive animals let off to free roam and injured or orphaned pets, birds and others; monkeys being common – Good management of goshalas and safe shelters for such animals – Conversion of their wastes into VAP to meet part costs of running shelters; Education of the general public, especially children to avoid wanton harm to animals via *Lectures* in schools, TV and radio talks, leaflets, etc.

Unit IV (4 Lectures)

Evaluation of animal welfare measures as an ‘instrument’ of good animal husbandry, production of quality products and enhanced income to farmers.

VII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

VIII. Learning outcome

By the end of this course, the student will be familiarized with species-specific behaviour, amelioration of climatic stress and evaluation of animal welfare measures.

IX. Suggested Reading

- *Animal Rights and Animal Welfare Publications* 1896-2009. <https://www.lib.ncsu.edu/findingaids/mc00440>
- Appleby MC, Mench JA, Anna Olsson I and Hughes BO. 2018. *Animal Welfare*. CABI.
- AWBI. Animal Protection Laws, Newsletters, etc. of Animal Welfare Board of India; <http://www.awbi.org/section/4/publications/2>



- GoI Gazzete. *Order on Animal Welfare* - <http://www.moef.nic.in/legis/awbi/awbi18.html>
- Phillips C. 2009. *The Welfare of Animals: The Silent Majority*. Springer.
- Webster J. 2005. *Animal Welfare: Limping Towards Eden*. Blackwell Publishing.
- Selected articles from journals.

- I. Course Title : Entrepreneurship in Livestock Production**
- II. Course Code : LPM 707**
- III. Credit Hours : 1+1**

IV. Why this course?

Livestock production has huge scope vis a vis income generation. Study of concepts of entrepreneurship will ensure awareness towards the possibilities of taking livestock production as a business unit.

I. Aim of the course

To understand livestock entrepreneurship, concept, incubation centre, PPP perspective in the animal husbandry sector, business communication, inter-personnel skills for establishing an enterprise.

II. Theory

Unit I (2 Lectures)

Understanding livestock entrepreneurship, Concept and characteristics of Entrepreneurship, Role of entrepreneur in relation to enterprise, Functions of the entrepreneur in the economy,

Unit II (4 Lectures)

Process of entrepreneurship development. Barriers in entrepreneurship. The institutional interface in the development of entrepreneurship, incubation centres, startups, PPP Prospective in the animal husbandry sector.

Unit III (6 Lectures)

Essential criteria for the development of entrepreneurship in livestock sector - basic requirements for entrepreneurship initiatives in livestock and allied sectors (i.e. techno-economic feasibility of the enterprises under different conditions, training and management skills, business acumen, business communication, inter-personnel skills for establishing an enterprise, etc.).

Unit IV (4 Lectures)

Entrepreneurial training/ development programmes at the State and National level, Livestock Insurance, Bank and Government support for entrepreneurship, Financial credit and financial management: general principles and practices, analyzing project appraisals and reports, capital, expenditure decisions, reinvestment and payback.

Unit V (2 Lectures)

Preparing projects for bank appraisal, banking requirements, Assessing project profits, Procurement management quality issues, standardisation, grading and packaging.

III. Practical (14 Classes)

Visit incubation centres, extrapolation of existing financial models in livestock entrepreneurship, Approach to the preparation of Entrepreneurial Project on livestock, Bankable project for a dairy enterprise (small/ large dairy unit), Bankable



project for a sheep/ goat/ Ram lamb enterprise, Bankable project for a pig-enterprise, Bankable project for a Broiler enterprise (small/ medium/ large unit), Bankable project for a layer-enterprise

IV. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

V. Learning outcome

The student acquires knowledge in entrepreneurship initiatives in livestock and allied sectors, financial management and assessment of project profit.

VI. Suggested Reading

- George RP and Raj Kamal PJ. 2015. *Farm Economics, Entrepreneurship and Marketing*. Satish Serial Publishing, New Delhi.
- Kahan D. 2012. *Entrepreneurship in Farming*. FAO, Rome.
- Zama MMS, Rashid M and Kumar S. 2014. *Handbook of Livestock Entrepreneurship*. Narendra Publishing House.
- *Selected articles from journals.*

I. Course Title : Precision Livestock Farming

II. Course Code : LPM 708

III. Credit Hours : 1+1

IV. Why this course?

Precision Livestock Farming is a combination of developing animal sensing (sensors) tools and decision-making process at the farm level. This information is very much needed for the students in the present technology of the world.

V. Aim of the course

To educate the students with a concept of precision in livestock farming, implementation of the sensor system, automation, use of software and analysis

VI. Theory

Unit I (2 Lectures)

Concepts of Precision Livestock Farming-Scope and limitations. Utilities of Precision tools in Livestock Farming, the present level of usage of precision tools in India

Unit II (6 Lectures)

Implementation of sensor systems and ICTs in animal health, productivity and welfare, Animal identification and tracking- Radio frequency identification (RFID), Livestock identification and traceback system (LITS), etc. Geo-tagging, Virtual fencing, GPS and GIS in the exploration of feeding resources and grasslands.

Unit III (6 Lectures)

Automation in water resource management. Development and evaluation of early warning and disease support systems for animal health and welfare.

Unit IV (2 Lectures)

Use of software's for database creation of the livestock farms, computation and analysis.

VII. Practical (14 Classes)

GPS/ GIS Application in the exploration of breeding tracts of livestock, forage and



grassland profiles. Exposure visit to precision livestock farms with automation, use of tools in reproduction and health care, use of different software in farm routines.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits

IX. Learning outcome

By the end of this course, the students will gain knowledge in precision livestock farming.

X. Suggested Reading

- Halachmi I. 2015. *Precision Livestock Farming Applications*. Wageningen Academic Pub.
- Sastry NSR. 2016. *Livestock Production Under Diverse Constraints - Indian Experience in its Management*. ISAPM Publication.
- *Selected articles from journals.*

I. Course Title : Recent Developments in Poultry Production Management

II. Course Code : LPM 709

III. Credit Hours : 2+1

IV. Why this course?

The poultry industry is growing at a very fast rate. Students have to remain aware of the recent developments in the sector

V. Aim of the course

To educate the students on recent developments on the management of farms and hatcheries, egg, meat and policy developments in poultry.

VI. Theory

Unit I (8 Lectures)

Planning, organization, executive and management of poultry farms and hatcheries of various sizes - an alternative in poultry production

Unit II (4 Lectures)

Demand, supply, the present status of poultry production in India.

Unit III (10 Lectures)

Problems and new management techniques in poultry for egg and meat in India vis-à-vis in other countries of the world - Automation in poultry houses, management of specific pathogen-free flocks.

Unit IV (10 Lectures)

Poultry development policies and planning for higher production constraints in development and solutions, Ethology in relation to avian welfare in intensive poultry production.

VII. Practical (14 Classes)

Planning and preparation of research and commercial projects on broiler and layer production management.

VIII. Teaching methods

Blackboard, power point presentations, ICT, Group discussions and farm visits



IX. Learning outcome

By the end of this course, the student acquires knowledge in advances of modern poultry farm and hatchery management

X. Suggested Reading

- DAHD. 2015. *Poultry Farm Manual: A Reference Guide for Central and State Poultry Farms*. 2014-15. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.
- FAO. 2003. Live bird marketing. In: *Egg Marketing - A Guide for the Production and Sale of Eggs*. <http://www.fao.org/3/Y4628E/y4628e09.htm#bm9>
- Sreenivasaiah PV. 2006. *Scientific Poultry Production: A Unique Encyclopaedia*. International Book Distribution Co.
- *Selected articles from journals*.





SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Animal Production Sciences – Livestock Products Technology





Preamble

(Livestock Products Technology)

Salient features of revised courses

- Changed course numbers to bring desired sequence in the courses for better understanding. Revised and updated all courses to ensure practical and latest knowledge covering processing quality control and other aspects of livestock products.
- To give more emphasis on processing, packaging, quality control and marketing of livestock products, separate courses have been developed for processing, packaging and marketing, and quality control (earlier course no. was LPT 602, Now LPT 603, LPT 605, LPT 606). Many latest topics have been included in the revised courses.
- Topics related to poultry meat (earlier course no. LPT 603) are included along with other meat topic in LPT 601, LPT 603, LPT 605 and LPT 606). Separate course has been developed for Fish and Fish Products (LPT 613, optional).
- In abattoir course (LPT 605), contents related to meat plant operations are included as per requirement of industry, so that students get practical knowledge. Course number is changed to LPT 601 to bring desired change in sequence.
- In slaughter house byproducts course (earlier course no. was LPT 606, now LPT 607), all updated/ latest technologies/ processes have been included.
- Courses specifically related to milk, are re-casted. Separate course (LPT 604) is developed on Milk and milk products processing (after deleting processing content from old course - LPT 610). This ensures more emphasis on Market milk and dairy plant operations (LPT 610).
- Updated, revised and changed In-plant training course (LPT 612) to Industrial and Entrepreneurial Training course (LPT 608) and made it as a credit course.
- Advances in Fresh and Processed Meat Products Technology (LPT 702), is divided into two courses (LPT 702 and 703). Topics related to Meat production are also included in LPT 702.
- Contents of these two related courses (LPT 705 and 706, quality control and biotechnological tools) are merged and given in new course LPT 705. Topics are revised, updated and rearranged in other courses.
- Considering the entrepreneurship importance, changing trends of consumer preference for novel animal food products and requirement of the industry, and also to provide practical exposure and training to students, following new courses are proposed:
 1. LPT 706- Ethnic and Organic Meat and Milk Products (1+1)
 2. LPT 707- Industrial and Entrepreneurial Training (0+2)
 3. LPT 708- Current trends in Disposal and Utilization of Waste from Meat and Dairy Industry (1+1)
 4. LPT 709 Advances in Egg and Egg Products Technology (1+1)



Course Title with Credit Load

M.V.Sc. in Livestock Products Technology

Course No.	Course Title	Credits Hours
LPT 601*	Abattoir Practices and Meat Plant Operations	2+1
LPT 602*	Fresh Meat Technology	1+1
LPT 603*	Processing and Preservation of Meat	2+1
LPT 604*	Processing of Milk and Milk Products	1+1
LPT 605*	Packaging and Marketing of Livestock Products	1+1
LPT 606*	Microbiology and Quality Control of Livestock Products	1+1
LPT 607*	Slaughterhouse By-products Technology	1+1
LPT 608	In-Plant Training	0+2
LPT 609	Egg and Egg Products Technology	1+1
LPT 610	Market Milk Processing and Dairy Plant Practices	1+1
LPT 611	Processing and Marketing of Wool	1+1
LPT 612	Biotechnology of Foods of Animal Origin	1+1
LPT 613	Fish and Fish Products Technology	1+1
LPT 691	Seminar	1+0
LPT 699	Research	30

*Core courses



Course Contents

M.V.Sc. in Livestock Products Technology

I. Course Title : Abattoir Practices and Meat Plant Operations

II. Course Code : LPT 601

III. Credit Hours : 2+1

IV. Why this course?

Human Resource Development (Manager, Supervisor, Meat inspector and other Technocrats) for Slaughterhouses and Meat processing plants.

V. Aim of the Course

To impart knowledge about the handling of meat animals, layout and design of abattoir, sanitation and basics of slaughterhouse practices and meat plant operations.

VI. Theory

Unit I (12 Lectures)

Handling and transportation of meat animals including poultry - Pre-slaughter handling and care of food animals - Ante-mortem inspection - Humane slaughter - Principles and methods of stunning - Ritual methods of the slaughter of food animals and poultry - Machinery for slaughter and dressing of food animals - Post-mortem inspection - Handling, disposal and condemnation of unfit materials.

Unit II (11 Lectures)

Abattoir - layout, designing, organization and operation - Maintenance of meat and poultry processing plants - Record keeping - Legislations and regulations for establishment and operation of slaughterhouses and meat processing plants.

Unit III (11 Lectures)

Sanitation of slaughterhouse - Sanitary practices in meat plant and its benefits - Solid and liquid waste management of slaughterhouse - Different methods of effluent treatment and designs of effluent treatment plants - State and Central Pollution Control Board norms.

VII. Practical (17 classes)

Design and outlay of modern abattoir including poultry processing and effluent treatment plants for different capacities - Judging and grading of food animals - Procedure for the slaughter of food animals and poultry - Ante-mortem and post-mortem inspection - Recording of carcass data - carcass yield, meat bone ratio, etc. - Measurement of effluent characteristics - pH, BOD, COD, suspended solids, etc. - Visit slaughterhouse, poultry processing and effluent treatment plants - DPR for the establishment of an abattoir.

VIII. Teaching methods

- Classroom teaching, practical demonstration in Divisional laboratory/ slaughter unit.
- Visit municipal slaughterhouse and meat plants.
- Demonstration of charts, video films and models.



IX. Learning Outcome

Gaining knowledge of abattoir practices and operations to be carried out in meat plants.

X. Suggested Reading

- Collins DS and Huey RJ. 2015. *Gracey's Meat Hygiene*, 11th Ed. John Wiley and Sons Ltd., UK.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences* Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing- Improving Quality*. Woodhead Publishing Ltd., UK.
- Sahoo J, Sharma DK and Chatli M. 2011. *Practical Handbook on Meat Science and Technology*, 1st ed., Daya Publishing House.
- Swatland HJ. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.
- Warriss P. 2010. *Meat Science: An Introductory Text*, 2nd ed. Oxford Press.

I. Course Title : Fresh Meat Technology

II. Course Code : LPT 602

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development for Meat processing Sector

V. Aim of the Course

To impart knowledge about the status of the meat industry, muscle structure and composition, carcass handling, grading and fabrication.

VI. Theory

Unit I (10 Lectures)

History, current development and prospects of meat and poultry industry in India – Skeletal muscle development – pre- and post-natal- Structure and chemistry of muscle including poultry – Muscle Proteins - sarcoplasmic and myofibrillar proteins – Stromal proteins – Types of muscle fibres - Post mortem changes – Rigor mortis - Conversion of Muscle to meat - Pre and post-slaughter factors affecting meat quality – Defects during the conversion of muscle to meat – PSE/ DFD/ Cold Shortening – Off odour development.

Unit II (7 Lectures)

Composition and nutritive value of meat and poultry - Qualities of fresh meat – pH, WHC, colour, odour, juiciness, texture/ tenderness and firmness - Chilling, ageing and conditioning of meat - Electrical stimulation - Carcass evaluation, grading and fabrication- Tenderization of meat.

VII. Practical (17 Classes)

Evaluation/ estimation of physicochemical properties of fresh meat pH, colour, water holding capacity, ERV, shear force value, glycogen, R-value and myoglobin - Proximate analysis of meat - Estimation of drip loss - Determination of sarcomere length, fibre diameter and myofibrillar fragmentation index - Fractionation of sarcoplasmic, myofibrillar and stromal proteins - Carcass evaluation and grading - Meat cutting, retail and wholesale cuts.



VIII. Teaching methods

- Classroom teaching, practical demonstration and analysis in Divisional laboratory/ slaughter unit.
- Visit slaughterhouses, meat plants and retail units
- Use of Audio-visual Capsules.

IX. Learning Outcome

Acquiring knowledge on quality attributes of fresh meat, factors affecting these attributes, composition and nutritive value of meat.

X. Suggested Reading

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. *Principles of Meat Science*, 5th ed., Kend All/ Hunt Publishing Company, IOWA.
- Bender A. 1992. *Meat and Meat Products in Human Nutrition in Developing Countries*. FAO, Rome.
- Carlson CW, Greaser ML and Jones KW. 2001. *The Meat We Eat*, 14th ed. Interstate Publishers, INC.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences* Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Lawrie RA and Ledward DA. 2006. *Lawrie's Meat Science*, 7th ed. Woodhead Publishing Limited, Cambridge, England.
- Pearson AM. 1994. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Springer, New York.
- Swatland HJ. 2004. *Meat Cuts and Muscle Foods*. Nottingham University Press.

I. Course Title : Processing and Preservation of Meat

II. Course Code : LPT 603

III. Credit Hours : 2+1

IV. Why this course?

Human Resource Development for Meat and Poultry Processing Industry and Entrepreneurship development

V. Aim of the Course

To impart knowledge about processing and preservation of meat including poultry meat, fundamentals of sensory evaluation and techniques for sensory evaluation of meat products.

VI. Theory

Unit I (8 Lectures)

Basic principles of meat preservation – dehydration, chilling, freezing, freeze-drying, thermal processing, direct microbial inhibition, irradiation, use of chemicals and antimicrobials - Curing and smoking - Hurdle technology concept.

Unit II (17 Lectures)

Principles of Meat Processing - Meat and non-meat ingredients and their roles - Additives - Processing techniques - comminution, chopping, blending, marination, massaging, tumbling, etc. - Cooking methods including microwaving – Development of meat products including ham, bacon, tandoori and barbeque - Emulsion formation – factors affecting emulsion formation - Emulsion based meat products - sausages, nuggets and patties - Enrobed, restructured, fermented and intermediate moisture meat products – Ready-to-cook, ready-to-eat and shelf-stable meat products - Canned



and retort meat products – Traditional and ethnic meat products - Functional meat products.

Unit III (9 Lectures)

Sensory evaluation – Sensory physiology, types, methods, quality attributes - Factors influencing sensory measurements - Types of sensory panels - Selection of sensory panellists- Sensory evaluation tests- Layout and designing of sensory evaluation laboratory.

VII. Practicals (17 Classes)

Estimation of tyrosine value, nitrite content, TBARS value, peroxide value - Preparation of Meat Products - Minced meat products - Emulsion based meat products – sausages, nuggets and patties - Ham and Bacon - Meat Pickles – Enrobed, restructured, fermented and shelf-stable meat products - Canned/ retorted Meat Products - Traditional and ethnic Meat Products - Kebabs - Sensory evaluation of meat products - Subjective and objective method of sensory evaluation - differential, descriptive, training tests, etc. – Test practices and training in the sensory lab - Determination of emulsion stability - Cooking yield - Texture Profile Analysis.

VIII. Teaching methods

- Classroom teaching, practical performance in Divisional Pilot Processing Plant.
- Visit of Meat and Poultry Processing Unit.
- Demonstration videos

IX. Learning Outcome

Theoretical and practical understanding of meat preservation, processing and sensory evaluation of the meat products.

X. Suggested Reading

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Amerine MA, Pangborn RM and Roessler EB. 1965. *Principles of Sensory Evaluation of Food*. Academic Press, New York.
- Barbut S. 2005. *Poultry Products Technology*. CRC Press.
- Carlson CW, Greaser ML and Jones KW. 2001. *The Meat We Eat*, 14th ed. Interstate Publishers, INC.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing- Improving Quality*. Woodhead Publishing Ltd., UK.
- Lawless HT and Heymann H. 2010. *Sensory Evaluation of Food - Principles and Practices*, 2nd ed, Springer-Verlag, New York Inc.
- Mountney GJ and Parkhurst CR. 2017. *Poultry Products Technology*, 3rd ed. Food Products Press, New York.
- Pearson AM and Gillett TA. 1996. *Processed Meats*, 3rd ed. Chapman and Hall, Inc, New York.
- Sharma BD, Wani S and Sharma N. 1997. *Sensory Evaluation Manual for Meat and Meat Products*. IVRI Publication.
- Toldrá F. 2010. *Handbook of Meat Processing*. Wiley-Blackwell.



- I. Course Title : Processing of Milk and Milk Products**
II. Course Code : LPT 604
III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for Milk Processing Industry, Cooperatives, etc.

V. Aim of the Course

To impart knowledge about the organization of dairy plants, basic milk operations, cleaning and sanitization of milk processing plants, milk products processing and applications of membrane technologies in dairy industries.

VI. Theory

Unit I (6 Lectures)

Basic concepts of dairy plant organization and operation - collection, chilling, transportation - Heat treatments of Milk - Cleaning and sanitization of Dairy plants - Composition, nutritional, physico-chemical and functional properties of milk - Standards for milk and milk products.

Unit II (7 Lectures)

Manufacture of milk products - Flavoured Milk - Drying of milk and milk products - Evaporated and condensed milk - Milk powders - Butter - Ice cream and other frozen desserts - Manufacture of different fermented milk products - Manufacture of cheddar, mozzarella, cottage and processed cheese - Manufacture of indigenous milk products - paneer, channa, khoa, ghee, dahi and shrikhand - Rheology of milk products - Dairy by-products.

Unit III (4 Lectures)

Membrane filtration technology- principles and concepts - Manufacturing and functional properties of casein - Caseinates- Co-precipitates - Whey protein concentrates (WPC) - Lactose- Dairy whiteners.

VII. Practical (17 Classes)

Platform tests - Determination of fat, SNF, TS, protein, lactose and ash contents of milk - Preparation of butter, ice cream, cheese - cheddar, mozzarella and cottage cheese, khoa, paneer, channa, ghee, dahi, yoghurt, casein, caseinate, co-precipitate, flavoured milk - Determination of degree of browning - Measurement of rheological properties of different milk products - Evaluation of sensory quality of milk and milk products - Visit dairy plants.

VIII. Teaching methods

- Classroom teaching and laboratory practical.
- Visit the milk processing plant.
- Use of Audio-visual Capsules

IX. Learning Outcome

Gaining knowledge of handling and processing of milk and milk products.

X. Suggested Reading

- Aneja RP, Mathur BN, Banerjee AK and Chandan RC. 2002. *Technology of Indian Milk Products*. Dairy India.



- Chandan RC, Kilara A and Shah NP. 2008. *Dairy Processing and Quality Assurance*, 1st ed. Willey–Blackwell.
- Davis JG. 2010. *Milk Testing: A Laboratory Control of Milk*. Agribios.
- MIF. 2005. *Analysis of Milk and its Products: A lab Manual*, 2nd ed. Milk Industries Foundation. Biotech Books, Delhi
- Singh S. 2014. *Dairy Technology*, Vol. 1 and 2. New India Publishing Agency.
- Spreer E. 1993. *Milk and Dairy Products*. Marcel Dekker.
- Varnam AH and Sutherland JP. 1994. *Milk and Milk Products Technology*. Chapman and Hall, UK.
- Walstra P, Wouters JTM and Geurts, TJ. 2006. *Dairy Science and Technology*, 2nd ed. Taylor and Francis Group.
- Web BH, Johnson AH and Alford JA. 1987. *Fundamental of Dairy Chemistry*, 3rd ed. Westport AVI Publ.

I. Course Title : Packaging and Marketing of Livestock Products

II. Course Code : LPT 605

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor, Marketing Executives and other Technocrats) for Packaging Industry and Business Planning.

V. Aim of the Course

To impart knowledge about properties of different packaging material, techniques used in packaging of different livestock products, marketing channels and value chain of processed products.

VI. Theory

Unit I (10 Lectures)

Principles of packaging - objectives and functions - Product characteristics affecting packaging requirements - Packaging materials and their characteristics - Different packaging systems for fresh, cured, dehydrated, freeze-dried and shelf-stable products of milk, meat and chicken - Aseptic packaging of milk - UHT milk - Vacuum packaging – MAP and role of different gases - Retort pouch processing - Active and intelligent/ smart (biosensors) packaging - Edible and biodegradable packaging - Nanotechnology for food packaging - Recycling of packaging materials - Labelling requirements – Barcoding and its importance - Packaging standards and regulations – Economics of different packaging systems.

Unit II (7 Lectures)

Marketing of Livestock Products - Types of markets - Marketing channels of live meat animals and Poultry - Existing systems - constraints and possible solutions - Value Chain of meat, poultry and processed products - strategies and interventions for better profitability – Meat retailing and establishment of retail outlets for meat and poultry - FSSAI, APEDA, EIA, GOI/ WTO regulations for the domestic market, import and export of livestock products.

VII. Practical (17 Classes)

Different packaging materials and their properties - Determination of thickness, bursting strength, piercing strength, water vapour transmission rate, gas transmission rate, headspace gas analysis - Vacuum, shrink, MAP and retort



packaging of meat and milk products - Visit milk and meat processing plants - Study of the value chain of livestock products including online marketing.

VIII. Teaching methods

- Classroom teaching, Practical demonstration in the laboratory.
- Visit market and packaging units.
- Demonstration using video films and models.

IX. Learning Outcome

Developing an understanding of packaging and marketing of livestock products.

X. Suggested Reading

- Aberle ED, Forrest JC, Gerrard DE and Mills EW. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Fuquay JW, Fox PF and McSweeney PLH. 2011. *Encyclopaedia of Dairy Sciences*, 2nd ed. Elsevier Academic Press, UK.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed., Elsevier Academic Press, UK.
- Robertson GC. 2012. *Food Packaging- Principles and Practices*, 3rd ed. CRC Press.
- *Selected Articles from Journals*.

I. Course Title : Microbiology and Quality Control of Livestock Products

II. Course Code : LPT 606

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development for Quality Control of Livestock Products

V. Aim of the Course

To develop an understanding about microbial spoilage of different livestock products, quality control and legal standards.

VI. Theory

Unit I (9 Lectures)

Microorganisms associated with spoilage of livestock products - Factors affecting microbial growth - Contamination of livestock products - Microbial spoilage of meat, poultry, eggs, milk and their products - Physical and chemical changes produced by microbes in milk, meat, eggs and their products - Meat and milk-borne infections and intoxications - Control of microbial growth in livestock products - Antimicrobial resistance (AMR).

Unit II (8 Lectures)

Introduction to Good Laboratory Practices (GLP), Good Hygienic practices (GHP) and Good Manufacturing Practices (GMP), Sanitary and Phytosanitary measures (SPS) and Food Safety System Certification (FSSC) - Quality Control – Quality Assurance - principles and practices - Quality Management Systems – Food Safety and Standards Act (FSSAI, 2006 Act) - Codex regulation for food products safety - ISO 9001 - ISO 22000 - HACCP concepts - Risk-based quality assessment - Microbial quality control - FSSAI/ BIS standards for milk, meat and poultry, Chemical residues in livestock products and their effects on the health of the consumer.



VII. Practical (17 Classes)

Basic requirements for setting up of quality control laboratory - Sampling methods for the microbiological examination of different processing plants, products and equipment - Development of HACCP plan for milk and meat processing plants - Microbial evaluation of market samples of milk, meat and egg – Total Viable Count, coliform, etc. - Pathogens of Public Health importance - *E. coli*, *Salmonella*, *Staphylococcus aureus*, *Campylobacter* - Rapid detection methods of food pathogens.

VIII. Teaching methods

- Classroom teaching with laboratory analysis.
- Sampling and survey of market, butchers shop, milk and meat processing plants.
- Visits to units having HACCP and ISO certification.

IX. Learning Outcome

Acquiring knowledge on microbiology, quality control and legal standards for different livestock products.

X. Suggested Reading

- Aberle ED, Forrest JC, Gerrard DE and Mills EW. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Bell C, Neaves P and Williams AP. 2005. *Food Microbiology and Laboratory Practices*, 1st ed. Blackwell Publishing.
- Collins DS and Huey RJ. 2015. *Gracey's Meat Hygiene*, 11th ed. John Wiley and Sons Ltd., UK.
- Frazier WC and Westhoff DC. 2013. *Food Microbiology*, 5th ed. McGraw Hill Publication.
- Fuquay JW, Fox PF and McSweeney PLH. 2011. *Encyclopaedia of Dairy Sciences*, 2nd ed. Elsevier Academic Press, UK.
- Jay JM, Loessner MJ and Golden DA. 2006. *Modern Food Microbiology*, 7th ed. Springer.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed., Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.
- Pearson AM and Dutson TR. 1995. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.

I. Course Title : Slaughterhouse By-products Technology

II. Course Code : LPT 607

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development for better utilization of animal by-products and pollution control

V. Aim of the Course

To impart knowledge about the utilization and processing of animal by-products.

VI. Theory

Unit I (6 Lectures)

Status and scope of slaughterhouse by-products utilization - Trade practices - Planning, design and layout of by-products plant - Classification of by-products - edible and inedible - Rendering methods and products - Yield and characteristics of rendered fat and meat cum bone meal.



Unit II (6 Lectures)

Utilization of blood, horns and hooves, intestine, bones, feathers, bristles, glandular by-products and ruminal contents - Value-added by-products from slaughterhouse and poultry processing plants - Processing of animal by-products for pet foods - High-value low volume by-products – collagen sheets, scaffolds, bone morphogenic proteins, biopeptides, biodiesel, etc.- Legislation and regulations related to animal by-products.

Unit III (5 Lectures)

Flaying - Classification and factors affecting the quality of hides and skin - Physical and chemical characteristics of hide and skin - Grading and processing of hide and skin for the manufacture of leather - Preparation and quality control of gelatine and glue.

VII. Practical (17 Classes)

Preparation of casing, neatsfoot oil, gelatin and glue - Demonstration of preparation of carcass meal, meat meal, bone meal, blood meal, feather meal, slime meal - Grading of casings - Collection and preservation of glandular by-products - Preparation of pet foods -Visit local by-products processing units - Quality evaluation of rendered animal fat.

VIII. Teaching methods

- Classroom teaching, practical demonstration of different by-products preparation in the Divisional laboratory/ slaughter unit
- Visit of municipal slaughterhouse and tanneries.
- Use of Audio-visual Capsules.

IX. Learning Outcome

Gaining knowledge on proper utilization of slaughterhouse by-products

X. Suggested Reading

- Aberle ED, Forrest JC, Gerrard DE and Mills EW. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed., Elsevier Academic Press, UK.
- Mann I. 1962. *Animal By-products: Processing and Utilization*. FAO, Rome. Ockerman HW and Hansen CL. 1999. *Animal By-product Processing and Utilization*. CRC Press.

I. Course Title : In-Plant Training

II. Course Code : LPT 608

III. Credit Hours : 0+2

IV. Why this course?

Development of Entrepreneurial Skill and Human Resources for Meat and Milk Industry

V. Aim of the Course

To impart industrial exposure and develop entrepreneurial skill among postgraduate students.

VI. Practical (34 sessions/ Hours equivalent to 34 credit hours of practical)

LPT students shall undergo in-plant training in any one of the specialized area of



Livestock Products Technology in an institute/ industry – private or public sector. After completion of the training, the student will submit a training report. The evaluation will be based on attendance, report submission and viva-voce examination.

VII. Teaching methods

- Deputation to slaughterhouse/ meat/ milk processing plants
- Use of Audio-visual Capsules.

VIII. Learning Outcome

Students after undergoing training will have a good understanding of the functioning of the industry and capable of starting their own enterprises.

IX. Suggested Reading

- Interaction with Industry Persons.
- *Selected articles from Journals.*

I. Course Title : Egg and Egg Products Technology

II. Course Code : LPT 609

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development for Egg Processing Industry/ Plants

V. Aim of the Course

To impart knowledge about the status of egg production, composition, nutritive value, preservation, grading, processing packaging and marketing of eggs and egg products.

VI. Theory

Unit I (9 Lectures)

Status of egg production and processing in India - Structure, composition, nutritive value and functional properties of eggs - Grading, preservation, packaging and marketing of shell eggs - Quality evaluation of shell eggs and factors influencing egg quality - Defects and Spoilage of eggs.

Unit II (8 Lectures)

Layout and design of egg processing Unit - Principles and procedures involved in pasteurization, chilling, freezing, desugarization and drying of egg products - Quality standards of egg products - Packaging of egg products - Designer egg products.

VII. Practical (17 Classes)

Evaluation of physical, chemical, functional and microbial quality of egg and egg products - Preservation of eggs - Preparation of value-added egg products - Visit egg-processing plant.

VIII. Teaching methods

- Classroom teaching, practical demonstration in Divisional laboratory.
- Visit egg processing plant.

IX. Learning Outcome

Gaining knowledge on composition, nutritive value, preservation and marketing of eggs. Quality maintenance and development of designer egg products.



X. Suggested Reading

- Romanoff AL and Romanoff AJ. 1949. *Avian Egg*. John Wiley and Sons.
- Stadelman WL and Cotterill OJ. 2002. *Egg Science and Technology*, 4th ed. CBS.
- *Selected articles from Journals*.

I. Course Title : Market Milk Processing and Dairy Plant Practices

II. Course Code : LPT 610

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for Milk Processing Industry and Dairy Plants.

V. Aim of the course

To impart knowledge about procurement of milk, assessment of milk quality, legislation for quality control, milk processing techniques, the layout of milk processing and dairy effluent plants and preparation of special milk.

VI. Theory

Unit I (5 Lectures)

Organization of procurement and pricing plans of raw milk - Operation of automatic milk collection stations - Reception of milk at Raw Milk Reception Dock (RMRD) - Assessing raw milk quality - Sanitary handling of milk - Milk standards and legislations.

Unit II (6 Lectures)

Unit operations in milk processing plants - Clarification – Bactofugation - Different chilling methods - Standardization - Homogenization (theories, methods and effects) - Heat treatments (thermization, boiling, pasteurization, sterilization (UHT and In-container) - Separation technologies (Microfiltration, Ultrafiltration, reverse osmosis, diafiltration, nanofiltration etc).

Unit III (2 Lectures)

Distribution methods for liquid milk - Consumer pricing - Traceability - Handling of unsold and returned milk- - Adulteration of milk and detection - Residues in milk and preventive steps

Unit IV (4 Lectures)

Fortified, special and functional market milk - A1 and A2 milk Design and layout of dairy plants of different capacities - Dairy by-products - Treatment of Dairy Effluents.

VII. Practical (17 Classes)

Platform tests - Principles of rapid milk analyzers including milko-tester and operation of automatic milk collection stations - Raw milk quality, somatic cell count, bacteriological count - Estimation of homogenization efficiency - Assessment of efficiency of pasteurization, sterilization and boiling- Detection of adulterants.

VIII. Teaching methods

- Classroom teaching and laboratory analysis.
- Visit milk processing plants.



IX. Learning Outcome

Acquaintance with the processing of market milk and other dairy plant practices.

X. Suggested Reading

- FAO. 2013. *Milk and Dairy Products in Human Nutrition*. FAO, Rome.
- Fuquay JW, Fox PF and McSweeney PLH. 2011. *Encyclopaedia of Dairy Sciences*, 2nd ed. Elsevier Academic Press, UK.
- Walstra P, Wouters JTM and Geurts, TJ. 2006. *Dairy Science and Technology*, 2nd ed., Taylor and Francis Group.

I. Course Title : Processing and Marketing of Wool

II. Course Code : LPT 611

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for Wool Processing Industry

V. Aim of the Course

To impart knowledge about the growth and structure of wool and fibres and their use. Grading, processing, marketing and specifications of wool and speciality fibres.

VI. Theory

Unit I (10 Lectures)

Status and prospects of wool industry - Wool types and their uses - Growth and molecular structure of wool fibre - physical and chemical properties of wool - Grading of wool, Characteristics of speciality hair fibres and their uses- factors influencing the quality of wool and speciality hair fibres - principles and steps involved in the processing of wool and speciality hair fibres, Impurities in wool and their removal, Defects in wool.

Unit II (7 Lectures)

Physical, chemical and mechanical testing of wool - by-products of wool industry - Trade and Marketing of wool, specification and regulation for quality control - Characteristics of natural and synthetic fibres

VII. Practical (17 Classes)

Physical, chemical and mechanical testing of wool and speciality hair fibres - Characterization of wool - grading of wool - Identification of natural and synthetic fibres - Visit the wool processing industry and acquaintance with various steps in the processing of wool and speciality hair fibres.

VIII. Teaching methods

- Classroom teaching and laboratory analysis.
- Visit wool processing units.

IX. Learning Outcome

Gaining knowledge on the quality and processing of wool.

X. Suggested Reading

- Bergen WV. 1963. *Wool Hand Book*, Vols. I and II. Interscience.
- Houck MM. 2009. *Identification of Textile Fibres*. Woodhead Publishing Limited, Cambridge, England.



- Johnson NAG and Russell IM. 2009. *Advances in Wool Technology*. Woodhead Publishing Limited, Cambridge, England.

- I. Course Title : Biotechnology of Foods of Animal Origin**
II. Course Code : LPT 612
III. Credit Hours : 1+1
IV. Why this course?

Human Resource Development for meat and milk processing Industry with understanding of the latest biological techniques

V. Aim of the Course

To impart knowledge about new biotechnological techniques and tools for improving livestock productivity, quality control and food value.

VI. Theory

Unit I (10 Lectures)

Role of Biotechnology in improving productivity and quality of Meat, Milk and their products - Application of biotechnological tools in food preservation and packaging - Transgenic meat animal production - techniques - Genes influencing meat quality traits – Production of meat and milk with the desired composition - Application of enzymes in dairy and meat industry - Genetically modified enzymes - Biotechnologically produced food flavours and colours for animal products.

Unit II (7 Lectures)

Starter cultures in Meat and milk - Pre and probiotics, and their supplementation in animal origin foods - Biopreservation- Bacteriocin - Fermentation technology - Upstream and Downstream processing - Biosensors - Antimicrobial Peptides - Meat Species Identification- Molecular tools.

VII. Practical (17 Classes)

Introduction of basic biotechnological techniques such as western blotting, enzyme isolation and identification, DNA extraction, amplification, different types of PCR, Acquaintance with RT-PCR, Multiplex PCR, gene identification and characterization - Biotechnological techniques for meat species identification and meat quality - Electrophoresis, Chromatography for fatty acids- Operation of Fermenters.

VIII. Teaching methods

- Classroom teaching.
- Use of Audio-visual capsules.

IX. Learning Outcome

Gaining knowledge on utilization of biotechnology as a tool to improve production, shelf life and nutritive value of livestock products.

X. Suggested Reading

- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing - Improving Quality*. Woodhead Publishing Ltd., UK.
- Kowale BN, Kulkarni VV and Keshava Rao V. 2008. *Methods in Meat Science*. Jaypee Brothers Medical Publishers, New Delhi.
- Sahoo J, Sharma DK and Chatli MK. 2011. *Practical Handbook on Meat Science and Technology*, Daya Publishing House, New Delhi.



- Toldra F. (Ed). 2008. *Meat Biotechnology*, Springer Science, New York
- Webb BH, Johnson AH and Alford JA. 2005 *Fundamentals of Dairy Chemistry*, 2nd ed. CBS Publishers and Distributors Pvt. Ltd.
- Selected articles from Journals.

I. Course Title : Fish and Fish Products Technology

II. Course Code : LPT 613

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for Fish Processing Industry

V. Aim of the Course

To impart knowledge about fish resources, structure and composition of fish muscles, preservation and processing of fish, marketing of fish products, deterioration of quality and legislations for quality control.

VI. Theory

Unit I (9 Lectures)

Fishery resources, marine and freshwater fishes- Transportation and hygienic handling of fish - Fish Muscle structure, composition and nutritive value - Processing of fish - gutting, filleting, beheading, peeling, deveining, etc. - Preservation - chilling, freezing, etc. - Principles and procedure of canning, curing, smoking, dehydration - Surimi and other Fish based products.

Unit II (8 Lectures)

Quality control- identification of freshness of fish - Chemical and Microbial spoilage of fish, labelling and marketing of fish and fish products, utilization of fish processing waste. National and international regulations, standards, quality control and marketing of fish and fish products.

VII. Practical (17 Classes)

Visit fish processing plant - Grading of live fish for freshness - Filleting and other techniques for the processing of fish - Proximate Composition of Fish - Physico-chemical and Microbial evaluation of fish quality - Preparation of Value added fish products.

VIII. Teaching methods

- Classroom teaching.
- Practical demonstration in the laboratory.

IX. Learning Outcome

Acquiring knowledge on the structure of fish muscle, preservation, processing and quality control of fish and fish products.

X. Suggested Reading

- Pearson AM. 1994. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Springer, New York.
- Suzuki T. 1981. *Fish and Krill: Protein Processing Technology*. Applied Science Publ.
- *Selected articles from Journals*.



Course Title with Credit Load

Ph.D. in Livestock Products Technology

Course No.	Course Title	Credits
LPT 701*	Modern Abattoir Practices and Animal By-Products Technology	1+1
LPT 702*	Advances in Meat Production and Fresh Meat Technology	1+1
LPT 703*	Developments in Processed Meat Technology	1+1
LPT 704*	Current Trends in Processing of Milk And Milk Products	1+1
LPT 705	Biotechnological Techniques and Quality Control of Livestock Products	1+1
LPT 706	Ethnic and Organic Meat and Milk Products	1+1
LPT 707	Industrial and Entrepreneurial Training	0+2
LPT 708	Current Trends in Disposal and Utilization of Waste From Meat and Dairy Industry	1+1
LPT 709	Advances in Egg and Egg Products Technology	1+1
LPT 791	Seminar I	1+0
LPT 792	Seminar II	1+0
LPT 799	Research	75

*Core courses



Course Contents

Ph.D. in Livestock Products Technology

I. Course Title : **Modern Abattoir Practices and Animal By-Products Technology**

II. Course Code : **LPT 701**

III. Credit Hours : **1+1**

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for Slaughterhouses, Tanneries and other by-products industries.

V. Aim of the Course

To impart knowledge about advances in abattoir practices and animal by-products utilization.

VI. Theory

Unit I (5 Lectures)

Current scenario of slaughterhouses and processing plants in India - Establishment and operation of a modern abattoir - Basic machinery and tools of slaughterhouse - Automation/ Robotics in meat and by-product processing – Latest developments in the evaluation of carcass quality – Chilling and freezing of carcass - Maintenance of cold storages.

Unit II (8 Lectures)

Latest machinery and tools used in by-products processing plant - New technologies for utilization of animal by-products as food, feed, pharmaceuticals and other miscellaneous products - Leather chemistry and processing technology - Latest Techniques in handling, preservation, tannery procedure, manufacture and testing of leather - Value addition in leather processing - Developments in gelatin, glue and natural casings production - Characterization, processing, yield and quality control of rendered fat and meat cum bone meal.

Unit III (4 Lectures)

Organization, layout and operation of dry and wet rendering plants. Latest trends in the disposal of slaughterhouse effluents and control of environmental pollution. Designs and function of effluent treatment plants.

VII. Practical (17 Classes)

Plan and outlay of various components of a modern abattoir. Designs of ETP. Estimation of TS (suspended and dissolved) BOD and COD from abattoir effluents. Ante-mortem inspection of food animals, methods of stunning, stunning instruments. Slaughter and dressing of food animals. Electrical stimulation of carcasses. Post mortem inspection of carcasses of food animals - Visit municipal slaughterhouse, by-product processing plant, Effluent treatment plant and tanneries.



VIII. Teaching methods

- Classroom teaching, practical demonstration in laboratory/ slaughter unit.
- Visit municipal slaughterhouse and tanneries.
- Demonstration through charts, video films and models.

IX. Learning Outcome

Understanding of latest techniques employed in abattoir practices and slaughterhouse by-products utilization.

X. Suggested Reading

- Biswas A and Kondaiah N. 2014. *Meat Science and Technology*, 1st ed. Jaya Publishing House.
- Collins DS and Huey RJ. 2015. *Gracey's Meat Hygiene*, 11th ed. John Wiley and Sons Ltd., UK.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing- Improving Quality*. Woodhead Publishing Ltd., UK.
- Swatland HJ. 2004. *Meat Cuts and Muscle Foods*. Nottingham University Press.
- Warriss P. 2010. *Meat Science: An Introductory Text*, 2nd ed. Oxford Press.
- *Selected articles from Journals*.

I. Course Title : Advances in Meat Production and Fresh Meat Technology

II. Course Code : LPT 702

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for Meat Industry

V. Aim of the Course

To impart knowledge about the latest trends in meat production, the ultrastructure of muscle fibres, strategies for improving meat production and traceability of meat products.

VI. Theory

Unit I (7 Lectures)

Current status of meat production trends in India - Government policies - economics and viability – Traceability in the meat industry – Strategies for augmenting meat production - Salvaging male buffalo calf - Non-conventional meat resources.

Unit II (10 Lectures)

Pre- and Post-natal development of Muscle fibres - Genetic, nutritional and physiological aspects of muscle development - Ultrastructure of skeletal muscle - Modern tools for fibre typing of muscle - Chemical and biochemical aspects of rigor mortis and fresh meat quality – Odour, colour, water holding capacity - Texture profile - Artificial tenderization - Myofibrillar, sarcoplasmic and connective tissue proteins - Cytoskeletal proteins - Lipid profile - Meat in human nutrition - Meat and health issues.



VII. Practical (17 Classes)

Economics of establishing commercial meat animal production Unit - Extraction of sarcoplasmic and myofibrillar proteins and their fractionation - Estimation of Collagen content of Meat - Histochemistry of muscle tissues - Muscle fibre typing - Meat tenderization techniques.

VIII. Teaching methods

- Classroom teaching, practical demonstration in laboratory/ slaughter unit
- Visit municipal slaughterhouse and meat plants
- Use of Audio-visual capsules.

IX. Learning Outcome

Knowledge of latest trends in meat production and fresh meat technology.

X. Suggested Reading

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Carlson CW, Greaser ML and Jones KW. 2001. *The Meat We Eat*, 14th ed. Interstate Publishers, Inc.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Lawrie RA and Ledward DA. 2006. *Lawrie’s Meat Science*, 7th ed. Woodhead Publishing Limited, Cambridge, England.
- Pearson AM and Dutson TR. 1997. *Advances in Meat Research. Healthy Production and Processing of Meat, Poultry and Fish Products*, Vol. 11. Springer.
- Swatland HJ. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.
- *Selected articles from Journals.*

I. Course Title : Developments in Processed Meat Technology

II. Course Code : LPT 703

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for Meat Processing Industry

V. Aim of the Course

To impart knowledge about the advances in the technology for processing of meat and development of value-added meat products.

VI. Theory

Unit I (5 Lectures)

Current trends in meat processing techniques - Functional properties of the tissue component in meat processing - Approaches for new product development - Latest equipment used for processing of meat products - Indigenous and heritage meat products - Curing and smoking - purpose, composition and methods of smoking - Liquid smoke - Processing of Ham, bacon, sausages, patties, meatloaves and tandoori chicken- Novel meat products - Non-thermal processing - Irradiation techniques - Canning/ retorting.

Unit II (8 Lectures)

Marination, massaging, tumbling and flaking techniques - Restructured/ reformed,



intermediate moisture, fermented, enrobed, shelf-stable and dried meat products - Meat analogues and substitutes - Thermal processing of meat- Enzymatic and non-enzymatic browning reactions - Protein changes in processed meat products - Lipid changes - Protein and lipid interaction - Protein and carbohydrate interaction - Bioactive peptides.

Unit III (4 Lectures)

Functional and designer meat products - Role of omega-3 fatty acids in animal foods - Role of n-3 in PUFA enriched and CLA enriched meat and eggs - Packaging of meat and meat products - smart, active, intelligent packaging - Developments in sensory evaluation of meat products.

VII. Practical (17 Classes)

Evaluation of textural characteristics of meat products – Estimation of emulsifying capacity, emulsion stability- Estimation of Nitrosamines and PAHs - Preparation of emulsion-based, restructured, enrobed, cured and smoked, dried, fermented, intermediate moisture, ready to eat, and shelf-stable meat products-objective and subjective evaluation of meat products.

VIII. Teaching methods

- Classroom teaching, practical performance in Divisional Pilot Processing Plant.
- Visit Meat Processing Unit.
- Demonstration by videos.

IX. Learning Outcome

Acquaintance with the knowledge of the latest techniques used in meat processing and packaging and development of functional meat products.

X. Suggested Reading

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. *Principles of Meat Science*, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Barbut S. 2005. *Poultry Products Technology*. CRC Press.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing- Improving Quality*. Woodhead Publishing Ltd., UK.
- Pearson AM and Gillett TA. 1996. *Processed Meats*, 3rd ed. Chapman and Hall, Inc, New York.
- Toldrá F. 2010. *Handbook of Meat Processing*. Wiley-Blackwell.
- *Selected articles from Journals*.

I. Course Title : Current Trends in Processing of Milk And Milk Products

II. Course Code : LPT 704

III. Credit Hours : 1+1

IV. Why this course?

Human resource development (Manager, Supervisor and other Technocrats) for the milk processing industry

V. Aim of the Course

To impart knowledge about current trends in the processing of milk and milk products and their effect on physico-chemical and nutritional quality of milk, the



scope of mechanization in the production of indigenous milk products and advances in the utilization of dairy by-products.

VI. Theory

Unit I (8 Lectures)

Principles and practices of production of quality raw milk - Advances in methods of chilling of milk - Thermal processing of milk – Principles and methods - types of UHT processing plants - Advances in the packaging of milk and milk products - Rheology of milk products - Preservatives, antioxidants, antibiotics and different toxic residues in milk - Advances in bacteriological and physico-chemical analysis of milk and milk product – Different legal and voluntary standards for milk and milk products - A1 and A2 milk and their significance.

Unit II (4 Lectures)

Bacteriological, physical, chemical and nutritional effects of processing on milk - New concepts in milk processing – radiation, microwave processing and conduction heating of milk – By-products from the dairy industry and their utilization.

Unit III (5 Lectures)

Innovative mechanization in the manufacture of Indigenous dairy products - Advances in the utilization of dairy by-products - preservation of milk products - Application of immobilized enzymes in dairy products – Latest trends in cleaning and sanitation of dairy plant

VII. Practical (17 Classes)

Quality evaluation of milk and milk products - Preparation of novel and indigenous milk products and their economics of production, quality and sensory evaluation - Use of Starter cultures - Maintenance of cultures - Demonstration of membrane processing technology - Preparation of DPR for Dairy plants of different capacities.

VIII. Teaching methods

- Classroom teaching and laboratory analysis.
- Visit the milk processing plant.
- Use of Audio-visual Capsules.

IX. Learning Outcome

Gaining knowledge of advances in the processing of milk and milk products.

X. Suggested Reading

- Fuquay JW, Fox PF and McSweeney PLH. 2011. *Encyclopaedia of Dairy Sciences*, 2nd ed. Elsevier Academic Press, UK.
- Herrington BL. 2000. *Milk and Milk Processing*. Green World Publishers.
- Walstra P, Wouters JTM and Geurts, TJ. 2006. *Dairy Science and Technology*, 2nd ed. Taylor and Francis Group.
- *Selected articles from Journals*.

I. Course Title : Biotechnological Techniques and Quality Control of Livestock Products

II. Course Code : LPT 705

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor and other Technocrats) for



production of high-quality livestock products and their quality assurance.

V. Aim of the Course

To impart knowledge about advances in the application of biotechnological techniques for improving the production and quality of livestock products. To familiarize with the agencies responsible for maintaining the quality of livestock products, quality standards and legislations

VI. Theory

Unit I (10 Lectures)

Biotechnological tools for microbial testing of food - Industrial cell culture - Bioreactor types and design - Upstream and downstream processing - Bacterial food additives and supplements - Characteristics and application of microbial starters in milk and meat fermentation - Biotechnology in production of designer livestock products - Bio-production of flavours and colour and their application in dairy products - Enzyme applications in dairy technology. - Utilization of nanotechnology in livestock products - Biotechnology for food safety - Cultured meat - Biotechnology in meat species identification.

Unit II (7 Lectures)

Importance of quality control for livestock products - Concept and application of HACCP - BIS, FSSAI and AGMARK standards - GMP and total quality management in the processing of livestock products - ISO-9000, ISO-14000 and ISO-22000 - Codex regulations of food product safety.

VII. Practical (17 Classes)

Demonstration of the latest biotechnological techniques including DNA and protein-based techniques. Operation of bioreactors - Gene identification and characterization. Visit Milk/ Meat processing plants for an understanding of HACCP and other quality management systems.

VIII. Teaching methods

- Laboratory analysis.
- Visit of ISO and HACCP certified food processing plant.
- Use of Audio-visual Capsules.

IX. Learning Outcome

Gaining knowledge on the application of biotechnology for augmenting production and quality assurance.

X. Suggested Reading

- Fuquay JW, Fox PF and McSweeney PLH. 2011. *Encyclopaedia of Dairy Sciences*, 2nd ed. Elsevier Academic Press, UK.
- Jensen WK, Devine C and Dikeman M. 2004. *Encyclopaedia of Meat Sciences*, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.
- *Selected articles from Journals*.



- I. Course Title : Ethnic and Organic Meat and Milk Products**
II. Course Code : LPT 706
III. Credit Hours : 1+1

IV. Why this course?

Improving the production, processing and marketing of ethnic and organic meat and milk and their products.

V. Aim of the Course

To impart knowledge about the production of ethnic and organic meat and milk products.

VI. Theory

Unit I (9 Lectures)

Historical developments, present scenario and prospects of ethnic meat and milk products in various parts of India - Ethnic meat products - haleem, biryani, chettinad recipe, pork vindaloo, Kebab, Goan sausages, Kashmiri wazwan and meat products of North Eastern Region (NER) - Ethnic milk products – churpi, kalari, kunda, etc. - Constraints in promoting ethnic meat products - Approaches for development and commercialization of ethnic meat products - Fermented and non-fermented ethnic milk and meat foods – Impact of Globalization and role of WTO in promoting ethnic meat and milk products from India.

Unit II (5 Lectures)

Entrepreneurship Development for Ethnic meat and milk Products – Formulation, composition, quality, safety and shelf life of ethnic meat and milk products of India - Geographical indicators for recognition of ethnic meat and milk products.

Unit III (3 Lectures)

Organic meat and milk products - introduction, registration, certification, marketing and scope.

VII. Practical (17 Classes)

Preparation of ethnic meat products - haleem, biryani, chettinad recipe, pork vindaloo, Kebab, Goan sausages, Kashmiri wazwan and meat products of NER/ local region, Preparation of Ethnic milk products – churpi, kalari, Kunda, etc. - Composition, physico-chemical and microbial quality of ethnic milk and meat products - Packaging and marketing of ethnic milk and meat products.

VIII. Teaching methods

- Classroom teaching, practical demonstration in the laboratory
- Through the study of reports published by Govt. agencies time to time

IX. Learning Outcome

To acquaint with the knowledge for the production of ethnic and organic meat and milk products.

X. Suggested Reading

- Books on Indian Food.
- *Selected articles from Journals*



- I. Course Title : Industrial and Entrepreneurial Training**
II. Course Code : LPT 707
III. Credit Hours : 0+2

IV. Why this course?

Human Resource Development for catering to livestock products and related industry.

V. Aim of the Course

To prepare students to venture into various start-ups for self-reliant enterprises.

VI. Practical (34 Classes)

Preparation of basic feasibility report including raw material availability, marketing potential, economic viability and regulatory requirements for different livestock products related industry. Entrepreneurial training in an industrial establishment related to livestock products (17 sessions/ Hours equivalent to 17 credit hours of practical). Preparation of Detailed project reports (DPR) for the establishment of livestock products enterprises, viz. slaughterhouses, milk and meat processing plants, effluent treatment and byproducts utilization plants, etc..

VII. Teaching methods

- Visiting processing units
- Web surfing

VIII. Learning Outcome

Students envisioned having adequate knowledge and skills for setting up livestock products enterprises.

IX. Suggested Reading

- *Selected articles from Journals.* Through Interaction with Industry personnel.

- I. Course Title : Current Trends in Disposal and Utilization of Waste From Meat and Dairy Industry**
II. Course Code : LPT 708
III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development (Manager, Supervisor, Meat inspector and other Technocrats) for better utilization of animal wastes and effluent treatments.

V. Aim of the Course

To impart knowledge about disposal and handling of wastes from the meat and dairy industry, Agencies involved and their norms for pollution control from meat and dairy industries.

VI. Theory

Unit I (8 Lectures)

Terminologies used in solid and liquid waste management systems - Public health significance - Classification, composition, functional elements and sources of solid waste from Meat and Dairy Processing plants and their management - Aerobic and anaerobic systems of liquid waste management.



Unit II (9 Lectures)

Waste handling, separation, storage, processing and utilization of Solid waste - Common solid waste disposal methods like rendering, composting, deep burial and incineration - Scope for zero waste management - Properties of dried sludge and its utilisation as manure - Economical aspects of waste treatment and disposal - Utilization of meat and dairy processing wastes - Application of nanotechnology in waste management - State and Central Pollution Control Board norms.

VII. Practical (17 Classes)

Visit Sewage and Effluent Treatment Plants - Estimation of pH, dissolved oxygen, TSS, BOD and COD - Estimation of micronutrients in treated effluents - Design and schematic layout of various solid and liquid waste treatment plants.

VIII. Teaching methods

- Classroom teaching
- Visit Sewage Treatment Plant

IX. Learning Outcome

Gaining knowledge on advances in the utilization of wastes from the meat and dairy industry.

X. Suggested Reading

- *Selected articles from Journals.* Through Interaction with personnel of Municipal Corporation and Pollution Control Board.

I. Course Title : Advances in Egg and Egg Products Technology

II. Course Code : LPT 709

III. Credit Hours : 1+1

IV. Why this course?

Human Resource Development for Egg Processing Industry and Egg Processing Plants

V. Aim of the Course

To impart knowledge about the status of egg production, composition, nutritive value, preservation, grading, processing packaging and marketing of eggs and egg products.

VI. Theory

Unit I (5 Lectures)

Advanced preservation techniques for egg and egg products - Maintenance of quality of eggs - Microbiology of egg - Spoilage of eggs and its prevention.

Unit II (8 Lectures)

Preparation of fast foods and role of egg in fast foods chains - Egg breaking and processing plants - lay-out and organization Preservation methods viz pasteurization, desugarization, freezing, dehydration, etc. – process and methods - Quality estimation of egg and egg products - Designer egg and egg products.

Unit III (4 Lectures)

Specifications, Standards and marketing of egg and egg products - Quality control of egg products.



VII. Practical (17 Classes)

Evaluation of physical, chemical and functional quality of egg and egg products -
Detection of egg rots - Evaluation of microbiological quality of egg and egg products -
Preservation techniques of eggs - Preparation of convenient, dehydrated and value-added egg products -Visit a modern egg processing plant

VIII. Teaching methods

- Classroom teaching, practical demonstration in the laboratory.
- Visit the egg processing plant.

IX. Learning Outcome

Gaining knowledge on composition, nutritive value, preservation and marketing of eggs. Quality maintenance and development of designer egg products.

X. Suggested Reading

- Romanoff AL and Romanoff AJ. 1949. *Avian Egg*. John Wiley and Sons.
- Stadelman WL and Cotterill OJ. 2002. *Egg Science and Technology*, 4th ed. CBS.
- *Selected articles from Journals*.





SVVU POST-GRADUATE STUDIES REGULATIONS 2021

Animal Production Sciences

– Poultry Science





Preamble **(Poultry Science)**

Poultry industry in India has made a remarkable growth ever since its inception and is presently emerging as a sunrise sector with a growth rate of 8.51 and 7.52 percent in egg and broiler production respectively (BAHS, 2019) as against 2.5 percent for agricultural crops. Within the poultry sector, broiler and layer segment constitutes about 65.3 and 34.7 percent with the monthly turnover of 400 million chicks and 8400 million eggs, respectively (ICRA, 2020). In poultry farming activities around one million farmers are engaged with 85 percent of them having less than 2 ha of land or the landless. With the annual poultry production of 851.8 million, poultry in India has emerged as the most dynamic and diversified subsector with third largest egg producing and fourth largest broiler producing country in the world with an estimated production of 103.3 billion eggs and 4.1 million metric tons (MMT) of broiler meat (BAHS, 2019).

Indian poultry industry has witnessed a radical and robust transformation from backyard poultry farming in villages to environmental controlled house coupled with high end automation. Industry is continuously updating with the evolvement and enrichment of newer technologies for achieving maximum efficiency in poultry at production and post-harvest levels. These developments demand the requirement of poultry veterinarians experts and managers for optimized production practices. In order to keep pace in the race of advancing poultry farming technology, a realistic update at academic level in poultry science is highly mandatory and demands of the hour. Hence, an academic curriculum of poultry science involving the industrial visits, automation in poultry farms, market research skills and winning bankable project reports for poultry startups can shape and equip poultry veterinarians so as to cater the needs of the poultry industry. The current designed syllabus provides the students regarding working knowledge in farms, decision making and troubleshooting analytical skills at different stages of poultry production.

Recently, waste disposal from poultry farms is emerged as an alarming issue for which knowledge on efficient wealth from waste technological intervention is required to pave a way for Go Green Poultry and the current syllabus has been designed to include the course on this emerging and much needed requirement to train veterinary post graduates to tackle this problem. Since waste recycling is very important to address environmental concerns and also to reduce use of energy sources used in disposal of waste. Hence, the course on waste recycling has also been designed so as to teach newer and innovative techniques of waste recycling for production of useful end products with concept of waste to wealth.

As changing environmental scenario is also posing problems in disease incidence and survivability of pathogens leading to constant threat of emerging and re-emerging diseases in poultry, the contents has been designed in such a way to impart knowledge on the sensitive and precise aspects of disease detection and also the segment has been incorporated to gain an knowledge on disease preventive measure including designing vaccination programme. Since biosecurity measures remains the cheap and effective means of disease preventive measures and it becomes essential to teach the basic concept of disease prevention so the poultry industry is helped with trained veterinarians with knowledge and skills in prevention of disease incidence.



The syllabus has also been designed in such a way so that the students can get practical exposure with farm/ lab/ field visits to the advanced environmentally controlled houses, feed manufacturing units, processing plants, advanced disease diagnostic labs on-filed poultry farms so that they can learn the practices being followed in these units so that they can think and plan to get more knowledge in the problems faced in the field conditions and can think of devising mechanisms to solve the problems.

Emphasis has been given to include the courses on commercial poultry nutrition. As nutrition in poultry production remains important segment and constitutes around 60-70% costs of production. Hence, emphasis has been laid to teach more basic aspects related to commercial aspects so that the cost of production can be minimized with knowledge in estimating the precise nutrient requirements in different poultry species, commercial uses of feed ingredients and use of non-conventional feed ingredients in poultry. Further practical emphasis has also been given to standardize the seasonal changes in feeding practices, use of advanced analytical techniques for estimating the feed nutrient content and also to learn other feeding practices for better poultry production and profitability.

Since diversified poultry species like quails, duck, guinea fowl, geese, ostrich and emu which are also important poultry species and these contribute to the economy of our country. In some segment of the country the diversified poultry species remains important for poor farmers due to geographical conditions of those regions. So it becomes imperative to train the veterinarians on all aspects of these species for optimum production and profitability. As breeding, feeding, health requirement are different chickens and thus, the contents of newly added course have been focused on different aspects related breeding, feeding, housing and health care management.

Emphasis has also been given on new scientific techniques, value-addition, post-harvest management, methods of organic poultry production, formulation of bankable projects with minimal expenditure in poultry production and also on utilizing the by-products from poultry processing and waste. Overall the course has been designed in such a way so as to focus to enhance skills for tackling emerging problems in this sector, increase employment and also focus has been given to cope up the post-covid-19 challenges. The newly designed syllabus will greatly enhance the capacity of the veterinarians in the areas of emerging nature and will meet new education policy requirement



Summary of changes in syllabus

Old courses	New course title	Changes
M.V.Sc. courses		
1. PSC-603: Commercial layer production 2+1 PSC-604: Commercial broiler production 2+1	PSC-603: Commercial layer and broiler management [2+1]	Two courses (PSC-603 and PSC-604) merged
2. PSC-605: Breeder stock, flock health and hatchery management	PSC-605: Poultry health and biosecurity	Health aspect delinked from old PSC-605 and title modified
3. PSC-607: Poultry products technology and marketing	PSC-607: Poultry products technology	Title changed
4.	PSC-610: Commercial poultry nutrition	New course added
5.	PSC-611: Poultry welfare and waste management	New course added
Ph.D. courses		
1. PSC-703: Developments in poultry products technology	PSC-703: Developments in poultry processing and products technology	Title modified
2. PSC-704: Emerging diseases of poultry and flock health	PSC-704: Emerging and re-emerging diseases of poultry and health management	Title modified
3. PSC-705: Advanced poultry breeding methods	PSC-705: Applied poultry breeding	Title merged
4.	PSC-707 Diversified poultry production	New course added



Course Title with Credit Load M.V.Sc. in Poultry Science

Course Code	Course Title	Credit Hours
PSC 601*	Poultry Breeding and Genetics	2+1
PSC 602*	Poultry Nutrition and Feeding	2+1
PSC 603*	Commercial Layer and Broiler Management	2+1
PSC 604*	Breeder Stock and Hatchery Management	2+1
PSC 605	Poultry Health and Biosecurity	2+1
PSC 606	Management of Other Avian Species	3+1
PSC 607*	Poultry Products Technology	2+1
PSC 608	Poultry Economics, Project Formulation and Marketing	2+1
PSC 609*	Physiology of Poultry Production	1+1
PSC 610	Commercial Poultry Nutrition	1+1
PSC 611	Poultry Welfare and Waste Management	2+0
PSC 691	Seminar	1+0
PSC 699	Research	30

*Core courses



Course Contents

M.V.Sc. in Poultry Science

- I. Course Title** : Poultry Breeding and Genetics
II. Course Code : PSC 601
III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge on different systems of breeding, selection methods, design and implementation of the breeding programme in developing egg-type and meat-type birds. Modern tools in poultry breeding.

V. Theory

Unit I (12 Lectures)

Genetic classification of Poultry – Origin and breed characteristics of poultry- Mendel's laws of inheritance related to poultry - Qualitative and Quantitative traits in Poultry breeding – Additive and Non-additive – Dominance, Incomplete dominance, Epistasis and complementary gene actions – Lethals and mutations in poultry – Sex-linked, Sex limited and Sex influenced traits – Economic traits – Partitioning of variance - Heritability – Quantitative inheritance – Phenotype, Genotype and environment interactions.

Unit II (10 Lectures)

Systems of Breeding – Systems of Mating – Selection methods – Breeding programme for developing egg-type, meat type and rural poultry strains - Developing hybrids - Breeding and management of other species of Poultry- Formation and Management of inbred pure lines, grandparent and parent stock - Industrial breeding.

Unit III (12 Lectures)

Artificial insemination in chicken –Autosexing–Random Sample Test - Use of molecular genetics in poultry breeding-Quantitative trait loci and marker-assisted selection- Conservation of poultry genetic resources.

VI. Practical (17 Classes)

Breeds of poultry – Estimation of qualitative and quantitative traits in poultry – Exercises on individual and family selection – Constructing multi-traits selection index and Osborne index-Estimating heritability – Breeding program for developing commercial hybrid layers, broilers and Japanese quail– Breeding programmes for rural poultry - Semen collection, evaluation, dilution and insemination in chicken and turkey – Breeding records –Use of computers to maintain breeding records and for selection– Estimation of effective population size, rate of inbreeding, response to selection and genetic and phenotypic responses.

VII. Teaching methods

- Classroom teaching with laboratory support and farm visits
- Use of computers for quantitative genetic analysis



VIII. Learning outcome

Gaining knowledge on poultry breeding and genetics

IX. Suggested Reading

- Crawford RD. 1990. *Poultry Breeding and Genetics*. Elsevier.
- Falconer DS. 1997. *Introduction to Quantitative Genetics*. Benjamin Cummings.
- Hutt FB. 1949. *Genetics of the Fowl*. McGraw-Hill
- Muir WM and Aggrey SE. 2003. *Poultry Genetics, Breeding and Biotechnology*. CABI.
- Singh RP and Kumar J. 1994. *Biometrical Methods in Poultry Breeding*. Kalyani Publications

I. Course Title : Poultry Nutrition and Feeding

II. Course Code : PSC 602

III. Credit Hours : 2+1

IV. Aim of the course

Teaching about nutrients and their functions, nutrient requirements of poultry and factors influencing the same. Imparting knowledge of different types of feeds and feeding methods.

V. Theory

Unit I (8 Lectures)

Digestive system, digestion, metabolism and absorption of nutrients in poultry – Factors influencing the feed consumption in birds – Macro and micro-nutrients – Protein and amino acids - Nutrient requirements for various species of poultry – Factors influencing the nutrient requirements - Partitioning of energy - Calorie: protein ratio – Nutrient interrelationships.

Unit II (12 Lectures)

Feed ingredients composition - Feed storage techniques - Milling and quality control- Processing of feed – Types and forms of feeds and feeding methods - Commonly occurring antinutrients and toxicants in poultry feed ingredients – Mycotoxins and their prevention – Feeding chicks, growers, layers, broilers and breeders – Principles of computing feed – Balanced feeds - Least cost feed formulation and programming – Feeding in different seasons and stress conditions - Nutritional and metabolic disorders in poultry.

Unit III (8 Lectures)

Systems of feeding – restricted, forced, controlled and phase feeding -Use of Additives and Non-additives- enzymes, probiotics, prebiotics, antibiotics, herbs and other performance enhancers – Utilization of non-conventional feedstuff - Feeding of ducks, turkeys, Japanese quails and Guinea fowls.

Unit IV (6 Lectures)

Organic, functional, designer and SPF feed production - Production of feeds free from drug residue, pesticide residue and toxins – Regulations for Import and Export of feed and feed supplements.

VI. Practical (17 Classes)

Physical and sensory evaluation of feed ingredients- sampling techniques for ingredients and compounded feed-Estimation of proximate principles of feed and feed ingredients – Computing various poultry feed formulae based on commonly



available feed ingredients – Computer applications in feed formulations - Estimation of Aflatoxin, Calcium, Phosphorus, Sand, Silica and Salt – Mash, pellet and crumble feed preparation – Feeding procedures. Visit to feed mills –Hands-on training in feed analytical lab.

VII. Teaching methods

- Classroom teaching with laboratory support and feed mill visits
- Use of computers in feed formulations

VIII. Learning outcome

Gaining knowledge on poultry nutrition and feeding

IX. Suggested Reading

- Bell DD and Weaver WD JR. 2002. *Commercial Chicken Meat and Egg Production*, 5th ed. Kluwer Academic Publishers.
- ICAR. 2013. *Nutrient Requirements of Poultry*. ICAR Publication.
- Leeson S and Summers JD. 2001. *Scott's Nutrition of the Chicken*. University Books.
- Leeson S and Summers JD. 2008. *Commercial Poultry Nutrition*, 3rd ed. University Books.
- Singh RA and Panda B. 1992. *Poultry Nutrition*. Kalyani Publishers.

I. Course Title : Commercial Layer and Broiler Management

II. Course Code : PSC 603

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge on different systems of rearing and management of commercial layer and broilers for maximum egg and meat production

V. Theory

Unit I (10 Lectures)

Development of Poultry Industry in India and the World – Systems of layer and broiler farming – Location and layout of the farm – Systems, types and design of houses – Poultry farm equipment - Automation in poultry houses and its maintenance - Environmentally controlled houses and their management -Deep litter and cage system of management- Litter materials -All in All out and Multiple batch systems of rearing layers and broilers –Brooding management - Lighting programme for egg-type and meat-type birds- Water quality standards, watering and water sanitation - Biosecurity and health management – Production indices for broilers and layers – Integration in broiler and layer production.

Unit II (12 Lectures)

Cages and modified cages for egg-type birds – Feeding management in layers - Medication and vaccination schedules and procedure for layers –Brooder, grower, pre-layer, layer and cockerel management – Management of layers during peak egg production and maintaining the persistency in production – Strategies to prolong the egg production beyond 72 weeks of age - Factors causing uneven growth and low egg production - Monitoring egg production curve - Culling of unproductive birds – Record keeping –Management during different seasons – Induced moulting.

Unit III (10 Lectures)

Management of broilers during different seasons -Mash, crumble and pellet feeding of Broilers – Weekly growth rate, feed conversion and livability in broilers- Sex



separate feeding – Feeding broilers for optimum growth rate and feed efficiency – Broiler farm records - Broiler farm routine, medication and vaccination schedule – Transport of broilers - Regulations and specifications for the production of export quality broilers.

VI. Practical (17 Classes)

Layer farm layout– Design of different chick, grower and layer houses, their specifications – Selection and culling of layers, debeaking, dubbing, deworming, delicing, vaccination and other farm routines and operations – Farm sanitation, disinfection and waste disposal – Visit commercial layer farms including environmental controlled houses – Record keeping – Calculating Hen day egg production, Hen housed egg production and other economic traits – Calculating the cost of production of eggs and meat and economics–Location and layout for a broiler farm – Broiler house design – Visit to commercial broiler farms including environmental controlled houses – Broiler brooding, Medication, vaccination, transportation and farm routines - Record keeping - Calculating the cost of production of broilers – Feeding of broilers at different ages – Working-out feed efficiency.

VII. Teaching methods

- Classroom teaching with farm visits
- Using different housing models
- Using Audio-visual capsules
- Demonstration of different management practices at farms

VIII. Learning outcome

Gaining knowledge of commercial broiler and layer production

IX. Suggested Reading

- Bell DD and Weaver WD, Jr. 2002. *Commercial Chicken Meat and Egg Production*, 5th ed. Kluwer Academic Publishers.
- Narahari D. 1997. *Commercial Broiler Production*. Emkay Publishers.
- Rajini RA. 2012. *Simply Poultry Science*. Alpha Publishers.
- Sapkota D, Narahari D and Mahanta JD. 2017. *Avian Poultry Production*, 2nd rev ed. New India Publishing Agency.
- Scanes CG, Brant G and Ensminger ME. 2003. *Poultry Science*, 4th ed. Prentice-Hall.
- Sreenivasaiah PV. 2015. *Textbook of Poultry Science*. Write and Print Publications.

I. Course Title : Breeder Stock and Hatchery Management

II. Course Code : PSC 604

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge about care and management of breeders and hatchery operations.

V. Theory

Unit I (9 Lectures)

Different types of commercial breeder flocks –Special care of breeder chicks – Breeder male and female management – Feeding the breeder flocks: Separate sex feeding, feed restriction in broiler breeders. Management for improving fertility



and hatchability, Management of parent and grandparent farms - Management of pure lines – Artificial Insemination - Care and management of Hatching eggs.

Unit II (4 Lectures)

Vaccination of layer and broiler parents - Nutrient supplementation – Seasonal management of breeders – Lighting management in breeder farms - Flock testing and culling.

Unit III (12 Lectures)

Natural and Artificial incubation –Stages of embryonic development -Incubation principles – Location of hatchery – Layout and design of hatchery - hatchery equipment– Hatchery management - Ventilation and temperature control –Pre-incubation storage, Fumigation and sanitation – Hatchery operations, routine and schedule – Egg candling -Packaging and transportation of hatching eggs and chicks, hatchery troubleshooting- Factors affecting fertility and hatchability - Biosecurity and hatchery waste disposal – Control of vertically transmissible and hatchery borne diseases – Special incubator management during hot summer – Hatch analysis.

Unit IV (9 Lectures)

SPF egg production - Import and export regulations – Maintaining Salmonella and Mycoplasma free breeding flock –Application of HACCP and Good Management Practices (GMP) in hatchery management for better chick quality.

VI. Practical (17 Classes)

Layout and blueprints for breeder farm and hatchery –Incubator management – Candling - Hatchery sanitation, fumigation procedures and hatchery hygiene – Pedigree hatching – Hatchery waste disposal and recycling – Calculating the cost of production of hatching eggs and day-old-chicks, management of bangers–Attending breeder farm routines and operation – Flock testing and culling of reactors – Analyzing hatchability results – Use of computers in hatchery operations - Economics of setting up of layer and broiler hatchery. Vaccinating day-old chicks and concept of in-ovo vaccination, visit to commercial breeder farm and hatchery.

VII. Teaching methods

- Classroom teaching with breeder farm and hatchery visits
- Using Audio-visual capsules

VIII. Learning outcome

Gaining knowledge of breeder flock and hatchery management

IX. Suggested Reading

- Bell DD and Weaver WD, Jr. 2002. *Commercial Chicken Meat and Egg Production*, 5th ed. Kluwer Academic Publishers.
- Leeson S and Summers JD. 2009. *Broiler Breeder Production*. Context Products.
- Sreenivasaiah PV. 2006. *Scientific Poultry Production: A Unique Encyclopaedia*. International Book Distributing Co.
- Taylor LW. 2003. *Fertility and Hatchability of Chicken and Turkey*. John Wiley and Sons.



- I. Course Title : Poultry Health and Biosecurity**
II. Course Code : PSC 605
III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge about common diseases and disorders of poultry, diagnosis, vaccination, prevention, control and treatment. Biosecurity measures in the control of common poultry diseases.

V. Theory

Unit I (7 Lectures)

Common bacterial diseases: *Salmonella*, *Pasteurella*, *E.coli*, Fowl typhoid, *Mycoplasma*, Infectious *Coryza*, *Gallibacterium*, *Clostridium*

Unit II (9 Lectures)

Common Viral diseases: Newcastle, Infectious bronchitis, Infectious laryngeotracheitis, Marek's, Fowl pox, Infectious Bursal disease, Egg drop syndrome-76, Avian Encephalomyelitis, Avian influenza, Duck viral hepatitis, Chicken Infectious Anaemia, etc.

Unit III (8 Lectures)

Common Fungal, parasitic and metabolic diseases: Aspergillosis, Mycotoxicosis, Fatty liver haemorrhagic syndrome (FLHS), Gout, Ascites, leg weakness - Coccidiosis, Ecto- and endo-parasitic infestation of poultry, etc.

Unit IV (5 Lectures)

Diagnosis, vaccination, prevention, treatment and control of various poultry diseases.

Unit V (5 Lectures)

Principles of biosecurity - Locational, structural and operational biosecurity in Poultry farms – Water sanitation and control of water-borne diseases – Quarantine of poultry - Farm sanitation and disinfection procedures.

VI. Practical (17 Classes)

Ante-mortem and Post-mortem examination of birds – Sample collection – Despatch of samples – Processing of samples and detection of pathogens/ etiological agents -Different sanitizers and disinfectants available and their uses. Care and contraindication of using different products. Personal hygiene and isolation – Different vaccines and routes of administration – Methods of medication – Water quality analysis, Field visit to poultry diagnostic lab.

VII. Teaching methods

- Classroom teaching with laboratory diagnosis
- Post-mortem examination
- Using Audio-visual capsules

VIII. Learning outcome

Gaining knowledge on poultry health and bio-security

IX. Suggested Reading

- Gordon RF and Jordan FTW. 1982. *Poultry Diseases*. ELBS
- Pattison M, McMullin P, Bradbury JM and Alexander D. 2008. *Poultry Diseases*, 6th ed. Elsevier.



- Saif YM. 2008. *Diseases of Poultry*. Blackwell Publishing House.
- Thyagarajan D. 2011. *Diseases of Poultry*, Satish Serial Publishing House.
- Vegad JL. 2015. *Poultry Diseases Farmers. A Guide for Farmers and Poultry Professionals*. International Book Distributing Co.

I. Course Title : Management of Other Avian Species

II. Course Code : PSC 606

III. Credit Hours : 3+1

IV. Aim of the course

Care and management of different breeds, varieties of poultry other than chicken, methods of rearing and common diseases affecting them and their control measures.

V. Theory

Unit I (15 Lectures)

Breeds and varieties of Turkey, Duck, Goose, Guinea fowl, Japanese quail, Emu and Ostrich – Incubation periods and incubation procedure for different species – Production standards - Housing, cage and equipment for other avian species under different systems of rearing.

Unit II (15 Lectures)

Management and rearing of Turkey, duck, goose, Guinea fowl, Japanese quail, emu and ostrich- Feeding standards and feeding, watering and rearing systems and procedure for different species of poultry - Breeding programmes for egg and meat production in different species.

Unit III (10 Lectures)

Different types of pet birds - Management and rearing of pet birds of regional importance (Pigeon, budgerigar, parakeets, love birds, macaws, doves, parrots, etc.) – Housing for pet birds, their habitat, feeding and breeding under captivity.

Unit IV (8 Lectures)

Common diseases affecting other avian species and their control – Regulations for import and export of different species of poultry – Prevention of exotic diseases through the import of live birds.

Unit V (3 Lectures)

Concept and definition of organic poultry – status, certification and guidelines for organic poultry production – Government policies on organic poultry farming.

VI. Practical (17 Classes)

Layout and design of housing and cages for other species of poultry. Visit commercial Japanese quail, turkey and duck farms. Incubation and care of hatching eggs and young ones – Rearing practices followed by duck, quails and turkey farmers under field conditions - Sexing of pet birds – Preparing project reports for different species and calculating the cost of production – Feeding pet birds and their chicks.

VII. Teaching methods

- Classroom teaching with farm visits
- Visit pet bird farms
- Using Audio-visual capsules



VIII. Learning outcome

Gaining knowledge on rearing different poultry species other than chicken

IX. Suggested Reading

- Cherry P and Morris T. 2011. *Domestic Duck Production: Science and Practice*. CABI
- CPDO. *Duck – Management Guide*. Central Poultry Development Organization Publication (online resource)
- CPDO. *Turkey – Management Guide*. Central Poultry Development Organization Publication (online resource)
- Mayer J and Donnelly TM. 2012. *Clinical Veterinary Advisor: Birds and Exotic Pets*. Elsevier.
- Pathak N. 2013. *Poultry and Ratite Nutrition*. Narendra Publishing House.
- Sapkota D, Narahari D and Mahanta JD. 2017. *Avian Poultry Production*, 2nd rev ed. New India Publishing Agency.
- Scanes CG, Brant G and Ensminger ME. 2003. *Poultry Science*, 4th ed. Prentice-Hall.

I. Course Title : Poultry Products Technology

II. Course Code : PSC 607

III. Credit Hours : 2+1

IV. Why this course?

V. Aim of the course

Composition and nutritive value of eggs and chicken meat, grading and preservation methods of eggs and meat, functional and value-added poultry products.

VI. Theory

Unit I (15 Lectures)

Physical and chemical composition and nutritive value of eggs and meat – Grading of eggs and meat by different standards - Egg quality deterioration - Factors affecting egg quality – Handling, processing, packaging materials, packaging, transport and marketing of eggs.

Unit II (8 Lectures)

Quality control of poultry meat – Preservation of egg and meat-Functional and value-added egg and meat products – Further processing of eggs and meat – Various egg and meat fast foods.

Unit III (11 Lectures)

Sanitary and phytosanitary measures to ensure food safety – Pre and Post oviposition value addition to the eggs and Post-processing value addition to the meat for export– Microbial safety of poultry products – Import and export of poultry products – Further processing of poultry for export – Implementation of GMP and HACCP procedures for food safety – Codex regulations for poultry products safety – Traceability and branding of poultry products.

VII. Practical (17 Classes)

Measuring internal and external egg qualities – Measurement of meat quality - Preservation of table eggs, grading of eggs – Processing of chicken – Further processing of poultry – Preservation of poultry meat – Preparation of various eggs and poultry meat products and fast foods – Preservation, packaging and transport – Quality control of value-added poultry products – Measures of microbial safety of poultry products for export, visit to poultry processing plant.



VIII. Teaching methods

- Classroom teaching with laboratory analysis
- Visit egg and meat processing plants
- Using Audio-visual capsules

IX. Learning outcome

Gaining knowledge of poultry products technology

X. Suggested Reading

- Biswas A and Kondaiah N. 2014. *Meat Science and Technology*. Jaya Publishing House.
- Mead G. 2004. *Poultry Meat Processing and Quality*. Elsevier
- Mountney GJ and Parkhairst CR. 1995. *Poultry Products Technology*, 3rd ed. AVI Publ.
- Romanoff AL and Romanoff AJ. 1949. *The Avian Egg*. CAB international
- Sim JS and Nakai S. 1994. *Egg Use and Processing Technologies: New Developments*. CAB International.
- Stadelman WJ and Cotterill OJ. 1995. *Egg Science and Technology*, 4th ed. CRC Press.

I. Course Title : Poultry Economics, Project Formulation and Marketing

II. Course Code : PSC 608

III. Credit Hours : 2+1

IV. Aim of the course

To study about measures of performance efficiency in poultry farms and its allied sector, components of project reports and preparation of viable projects related to poultry Industry.

V. Theory

Unit I (10 Lectures)

Glossary of terms used in poultry economics and projects – Measures of performance efficiency in the broiler, layer, breeder and other poultry species, hatcheries and other poultry-related operations – Production standards and goals for layer, broiler and breeders.

Unit II (12 Lectures)

Planning poultry enterprise – Minimum viable units - Bank norms for poultry projects – Poultry insurance– Methods to improve the production efficiency and reduce the production cost - Components of project reports and preparing projects and return on investment.

Unit III (12 Lectures)

Integration in Poultry production and marketing – Marketing channels for eggs and meat - Cost of production of the egg, broiler, hatching egg, day-old chick and compounded feed –New regulations on cage rearing of layers. Traceability and branding of poultry products. Export norms for poultry products.

VI. Practical (17 Classes)

Preparing different poultry projects for bank finance – Calculating the cost of production of various products under various systems-case study – Preparation of Balance sheet, break-even points, Cost: Benefit ratio and other farm economic indices- Preparation of feasibility and viability reports.



VII. Teaching methods

- Classroom teaching with calculations
- Using Audio-visual capsules

IX. Learning outcome

Gaining knowledge of poultry marketing and project preparations.

X. Suggested Reading

- Bell DD and Weaver WD, Jr. 2002. *Commercial Chicken Meat and Egg Production*, 5th ed. Kluwer Academic Publishers.
- Narahari D and Asha Rajini R. 2005. *Poultry Economics and Projects*. Pixie Publication India (P) Ltd.

I. Course Title : Physiology of Poultry Production

II. Course Code : PSC 609

III. Credit Hours : 1+1

IV. Why this course?

V. Aim of the course

To study the basic principles of physiology of poultry production in relation to egg production, incubation, stress and role of environment.

VI. Theory

Unit I (7 Lectures)

Skeletal system of poultry – Comb pattern and plumage - Physiology of poultry digestive system- Digestion, metabolism and absorption of feed and water – Role of enzymes – Poultry circulatory system – Respiratory system – Physiology of growth.

Unit II (7 Lectures)

Poultry nervous system and its function – Excretory system – Male and female reproductive system - Semen production-semen characteristics- Semen extenders – Egg formation- Egg laying pattern-photo periodic responses – Role of endocrine glands and their functions - Neuroendocrine control of egg production - Ovulation and Oviposition – Clutch and Pause.

Unit III (3 Lectures)

Thermoregulatory mechanism – Stress due to adverse environmental factors – Acid-base balance

VII. Practical (17 Classes)

Demonstration of various systems of birds – the structure of feather - Identification of endocrine glands and demonstration of hormones estimation in poultry production and reproduction - Haematology of poultry species - SGOT, SGPT, free fatty acids - Morphology of Poultry spermatozoa. Demonstration of artificial insemination in poultry.

VIII. Teaching methods

- Classroom teaching with laboratory techniques
- Using Audio-visual capsules

IX. Learning outcome

Gaining knowledge on the physiology of poultry production



X. Suggested Reading

- Etches RJ. 1995. *Reproduction in Poultry*. CAB International.
- Scanes CG. 2014. *Sturkie's Avian Physiology*. Elsevier.

I. Course Title : Commercial Poultry Nutrition

II. Course Code : PSC 610

III. Credit Hours : 1+1

V. Aim of the course

To impart knowledge on advanced poultry nutrition with respect to commercial egg and meat production

VI. Theory

Unit I (7 Lectures)

Breed specific nutrient requirements. Factors influencing the digestibility of nutrients – Reasons to assist the birds for digestion – Gut health management.

Unit II (4 Lectures)

Commercial use of feed ingredients by the industry – their drawbacks - Use of different feed additives and supplements: Enzymes, prebiotics, probiotics, postbiotics, phytobiotics, nucleotides, acidifiers, emulsifiers, and essential oils, etc. – Trace minerals: organic, inorganic and nanoparticles – Pre-digested proteins.

Unit III (6 Lectures)

Unconventional feed ingredients: Merits and demerits – Measures to counteract the demerits – Responsible use of them for reducing the cost of production – Least cost feed formulation – Phase feeding for layers and broilers – Juvenile nutrition.

VII. Practical (17 Classes)

Analytical methods for quick estimation of proximate principles and other nutrients – Use of latest technologies like NIR – Force-feeding, Challenge feeding – Factors preventing the birds from optimum feeding: Particle size, feed milling technologies, etc.– Seasonal variations in feeding practices, in-ovo feeding, visit to commercial poultry nutrition lab and feed mill.

VIII. Teaching methods/ activities

- Classroom teaching with laboratory support and feed mill visits
- Use of computers in feed formulations

IX. Learning outcome

Gaining knowledge on advances in poultry nutrition

X. Suggested Reading

- ICAR. 2013. *Nutrient Requirements of Poultry*. ICAR Publication.
- Leeson S and Summers JD. 2001. *Scott's Nutrition of the Chicken*. University Books.
- Leeson S and Summers JD. 2008. *Commercial Poultry Nutrition*, 3rd ed. University Books.
- Singh RA and Panda B. 1992. *Poultry Nutrition*. Kalyani Publishers.



- I. Course Title : Poultry Welfare and Waste Management**
II. Course Code : PSC 611
III. Credit Hours : 2+0

IV. Aim of the course

To provide knowledge on the concept of poultry welfare and safe disposal of wastes generated from poultry farms

V. Theory

Unit I (14 Lectures)

Concept of poultry welfare – Different freedoms to the birds – Present housing systems with relation to the welfare – Welfare and productivity – Feed restriction – Economics - Welfare cages – Welfare in relation to country's requirement. Precautions and requirements before, during and after transport of birds from one place and another, thermal imaging, assessment of welfare in poultry

Unit II (20 Lectures)

Waste generated from poultry farms and hatcheries – Male chicks disposal - Hazards of waste for humans and environment – Spread of diseases – Fly problems – Leaching of toxic substances in groundwater – Emission of gases – Dust and smell problem – Disposal of carcasses – Means to mitigate the hazardous effects of wastes – Composting of manure and dead birds - Generation of biogas, electricity, rendering plant products for feeding other species – Wastewater recycling – Usage of slurry – Preparation of bio-fuel pellets, methods of recycling poultry feathers.

VI. Teaching methods

- Classroom teaching
- Visit various waste disposal units

VII. Learning outcome

Gaining knowledge on the welfare of poultry and methods for safe disposal of poultry wastes

VIII. Suggested Reading

- Collins E (Ed.). 1999. *Poultry Waste Management Handbook*. NARES Series 132. Natural Resources.
- DAHD. 2015. *Poultry Farm Manual*. Department of Animal Husbandry, Dairy and Fisheries, GOI.
- Mench JA. 2017. *Advances in Poultry Welfare*. Woodhead Publishing
- Overcash MR, Humenik FJ and Miner RJ. 1983. *Livestock Waste Management*. CRS Press.



Course Title with Credit Load Ph.D. in Poultry Science

Course Code	Course Title	Credits	Hours
PSC 701*	Applied Poultry Nutrition	2+1	2+1
PSC 702*	Recent Trends in Commercial Poultry Production	2+1	2+1
PSC 703	Developments in Poultry Processing and Products Technology	2+1	2+1
PSC 704	Emerging Diseases of Poultry and Health Management	2+1	2+1
PSC 705	Applied Poultry Breeding	1+1	1+1
PSC 706	Poultry Economics, Marketing and Integration	2+1	2+1
PSC 707	Diversified Poultry Production	2+1	2+1
PSC 791	Seminar I	1+0	1+0
PSC 792	Seminar II	1+0	1+0
PSC 799	Research		75

*Core courses



Course Contents

Ph.D. in Poultry Science

- I. Course Title** : Applied Poultry Nutrition
II. Course Code : PSC 701
III. Credit Hours : 2+1

IV. Aim of the course

Teaching about nutrients and their functions, nutrient requirements of poultry and factors influencing the same. Different methods and forms of feeds and feeding of poultry.

V. Theory

Unit I (10 Lectures)

Developments in the nutrient requirement for egg and meat-type chicken - Concepts in various poultry feeding procedures and methods for optimal production - Factors influencing the nutrient requirements, feed intake and feed efficiency in poultry - Nutritional deficiencies - Protein and energy utilization - Digestibility of nutrients - Ileal digestibility of amino acids - Vitamins, minerals and their interactions in poultry rations.

Unit II (10 Lectures)

In ovo - juvenile nutrition for optimal growth rate and feed efficiency - Care in grower and pre-layer feeding - Nutrition and feeding of layers/ breeders during peak egg production - Nutritional requirements for higher egg production, broiler meat production, fertility and hatchability and other special purposes.

Unit III (10 Lectures)

Feeding of broilers for uniform growth and feed efficiency - Feeding to enhance egg quality and nutrients - Nutritive and non-nutritive feed additives in feed production - organic, functional and designer feed. Advances in feed milling technology - Specialty feed production to produce microbial safe foods, SPF eggs and organic foods.

Unit IV (4 Lectures)

HACCP implementation in feed quality control - Production of feed free from antibiotics, mycotoxins and pesticide residues.

VI. Practical

Computation of specific and functional feeds - Estimation of available carbohydrate/ Metabolizable energy, Aflatoxin, anti-nutritional factors and other toxins in the feed. Evaluation of various feeds for its quality - Field methods of feed quality control including feed microscopy - Estimation of carotenes, cholesterol and peroxides. Quality control of functional poultry feeds - Maintaining the feed quality from production to consumption.

VIII. Teaching methods

- Classroom teaching with laboratory support and feed mill visits
- Use of computers in feed formulations



IX. Learning outcome

Gaining advanced knowledge in poultry nutrition.

X. Suggested Reading

- Bell DD and Weaver WD, Jr. 2002. *Commercial Chicken Meat and Egg Production*, 5th ed. Kluwer Academic Publishers.
- ICAR. 2013. *Nutrient Requirements of Poultry*. ICAR Publication.
- Leeson S and Summers JD. 2001. *Scott's Nutrition of the Chicken*. University Books.
- Leeson S and Summers JD. 2008. *Commercial Poultry Nutrition*, 3rd ed. University Books. Nutrient
- Singh RA and Panda B. 1992. *Poultry Production*. Kalyani Publishers.
- *Selected articles from journals*.

I. Course Title : Recent Trends in Commercial Poultry Production

II. Course Code : PSC 702

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge on different systems of poultry rearing, care and management of commercial layers/ broilers for optimal egg and meat production.

V. Theory

Unit I (7 Lectures)

Global trends in poultry production - Advances in broiler production in India – concepts in egg production – Latest concepts in breeder management – advances in hatchery operations for higher hatchability and chick quality – Use of artificial intelligence in poultry production.

Unit II (8 Lectures)

Optimal microclimatic condition in poultry houses and cages for higher production – Management of poultry in environmentally controlled houses – Management of poultry under adverse climatic conditions – advances in the management of other species of poultry - Behavioural patterns of poultry in different growing systems.

Unit III (7 Lectures)

Advanced management techniques for egg and meat production - advances in lighting management, feeding management, litter management and manure management.

Unit IV (5 Lectures)

Factors influencing egg production in different species of poultry – Factors influencing growth rate and egg production - Automation in poultry production.

Unit V (7 Lectures)

Regulations for cage-free egg production and organic chicken production – Functional feeds for functional foods – Production of HACCP and GMP certified table eggs, meat, chicks, hatching eggs and other value-added products for export. Advances in Biosecurity, welfare and waste management - Role of integration in poultry production.

VI. Practical (17 Classes)

Performance study in the commercial layer, broiler, Japanese quail, duck, turkey and other species of poultry farms by Interpretation of the farm records - Management



routines of different species of poultry - calculating the cost of production – Estimation of microclimatic conditions and comparing the productive traits– Modern poultry house and cage design for optimal efficiency and cost reduction.

VII. Teaching methods

- Classroom teaching with farm visits
- Use of Audio-visual capsules

VIII. Learning outcome

Gaining knowledge of advanced commercial poultry production practices

IX. Suggested Reading

- Bell DD and Weaver WD, Jr. 2002. *Commercial Chicken Meat and Egg Production*, 5th ed. Kluwer Academic Publishers.
- Sreenivasaiah PV. 2006. *Scientific Poultry Production: A Unique Encyclopaedia*. International Book Distributing Co.
- Online sources of equipment manufacturers
- *Selected articles from journals.*

I. Course Title : Developments in Poultry Processing and Products Technology

II. Course Code : PSC 703

III. Credit Hours : 2+1

IV. Aim of the course

Composition and nutritive value of eggs and chicken meat, grading, packaging and preservation methods of eggs and meat, functional and value-added poultry products, marketing of eggs and poultry meat.

V. Theory

Unit I (9 Lectures)

Global trends in egg and poultry processing -Indian scenario of poultry processing industry - Nutrients and Non-nutrient components in regular and value-added poultry products – various measures of egg and meat quality control – advances in value addition to poultry products.

Unit II (12 Lectures)

Concepts in poultry meat and egg preservation – Newer concepts in meat tenderization, canning, dehydration, curing, irradiation, etc. - Modified atmosphere packaging and other packaging techniques – Other processed products - Room temperature preservation of poultry fast foods by multi hurdle technology – Further processing to produce ready to eat products.

Unit III (5 Lectures)

Egg powder production - Egg desugarization - pasteurization – Functional properties of eggs – Industrial uses of eggs – Marketing trends in poultry meat and eggs.

Unit IV (8 Lectures)

Improving the product quality to meet Codex and European standards – Standards for the egg, meat and their products -Production of immunoglobulins, lecithin, lysozyme, sialic acid and other pharmaceutical products from eggs – Sanitary and phytosanitary measures for food safety.



VII. Practical (17 Classes)

Preparation of value-added products suitable for preservation at room temperature – Further processing – Barbecuing and Tandoori preparation – preparation of local specific poultry meat and egg products – Meatballs, meat patties, etc. - Quality estimation of egg, meat and their products - Preservation of meat and eggs - Measuring the microbial quality of poultry foods.

VIII. Teaching methods

- Classroom teaching with laboratory analysis
- Preparation of value-added meat and egg products
- Use of Audio-visual capsules

IX. Learning outcome

Gaining knowledge of advanced poultry products and processing technology.

X. Suggested Reading

- Biswas A and Kondaiah N. 2014. *Meat Science and Technology*. Jaya Publishing House.
- Mead G. 2004. *Poultry Meat Processing and Quality*. Elsevier.
- Mountney GJ and Parkhairst CR. 1995. *Poultry Products Technology*, 3rd ed. AVI Publ.
- Owens CM. 2010. *Poultry Meat Processing*. CRC Press.
- Stadelman WJ and Cotteril OJ. 1995. *Egg Science and Technology*, 4th ed. CRC Press.
- *Selected articles from journals.*

I. Course Title : Emerging and Reemerging Diseases of Poultry and Health Management

II. Course Code : PSC 704

III. Credit Hours : 2+1

IV. Aim of the course

To study about common diseases and disorders of poultry, their diagnosis, vaccination, prevention and treatment, emphasis on control of emerging poultry diseases of zoonotic importance, disease diagnostic techniques.

V. Theory

Unit I (6 Lectures)

Concepts of disease prevention in poultry – Emerging and re-emerging avian diseases -Factors influencing immunosuppression/ immunity – Enhancing immunity in poultry.

Unit II (10 Lectures)

Water sanitation, hatchery sanitation procedures - Control of vertically transmissible diseases, hatchery borne diseases – non-infectious, metabolic and parasitic diseases in poultry and their control –Mycotoxins and their control.

Unit III (12 Lectures)

Stress alleviation – prevention and control of bacterial and viral diseases in poultry – Biosecurity measures – Control measures of problematic re-emerging diseases of poultry like Ranikhet, Avian influenza, Marek's disease, Infectious bursal disease, Infectious Bronchitis, Infectious laryngotracheitis, etc.

Unit IV (6 Lectures)

Flock management for Specific pathogen-free egg production – Maintaining the



HACCP standards in poultry farms – developments in the EXIM policies for flock health – Concept of compartmentalization and zoning as per terrestrial code, geographical information system in disease control.

VI. Practical (17 Classes)

Studying the Immune status of birds – Egg inoculation techniques in laboratory diagnosis – differential diagnosis of various poultry diseases by post-mortem, and laboratory techniques – Molecular diagnosis of diseases - Antibiotic sensitivity test – Designing Vaccination schedule for different poultry species – Disinfection and sanitation - Ectoparasite control, medication procedures.

VII. Teaching methods

- Classroom teaching with laboratory techniques
- Post-mortem examination and sample collection
- Use of Audio-visual capsules

VIII. Learning outcome

Gaining knowledge of the emerging disease of poultry and health management.

IX. Suggested Reading

- Davison F, Kaspers B and Schat KA. 2008. *Avian Immunology*. Elsevier
- Pattison M, McMullin P, Bradbury JM and Alexander D. 2008. *Poultry Diseases*, 6th ed. Elsevier.
- Thyagarajan D. 2011. *Diseases of Poultry*. Satish Serial Publishing House.
- Vegad JL. 2015. *Poultry Diseases Farmers. A Guide for Farmers and Poultry Professionals*. International Book Distributing Co.
- *Selected articles from journals*.

I. Course Title : Applied Poultry Breeding

II. Course Code : PSC 705

III. Credit Hours : 1+1

IV. Aim of the course

To impart knowledge about different systems of breeding, selection methods and implementation of the breeding programme in developing egg and meat type hybrids. Modern tools in poultry breeding.

V. Theory

Unit I (7 Lectures)

Gene and genotypic frequency - Sex-linked, limited and influenced traits-Auto sexing- Qualitative and quantitative traits and its inheritance in poultry- methods of selection – family selection – selection for multi characteristics and construction of selection indices –Reciprocal recurrent selection – Recurrent selection, Marker assisted selection – Random bred control populations - Selection limit - Osborne’s index – construction of selection index for multiple traits - Use of molecular genetics in poultry breeding.

Unit II (5 Lectures)

Exploitation of additive and non-additive gene action for commercial poultry production - Heterosis – Exploitation of hybrid vigour for commercial production of layers and broilers - Formation of synthetic lines – Development of strains in poultry - Comparative efficiency of different selection methods in poultry.



Unit III (5 Lectures)

Modern methods in commercial layer and broiler breeding, performance testing – Pure line-breeding – Inbreeding and hybridization - Diallele mating. Pedigree hatching. Genotype × Environment interaction.

VI. Practical (17 Classes)

Construction of selection index – Analysis of breeding data collected from breeding records – Estimation of qualitative and quantitative inheritance - Estimation of variance, heritability and standard error of heritability by different methods – Repeatability - analysis of heritability for different traits – Estimation of inbreeding coefficient – Artificial insemination in poultry.

VII. Teaching methods

- Classroom teaching with breeding farm visits
- Utilizing computer for quantitative genetic analysis
- Use of Audio-visual capsules

VIII. Learning outcome

Gaining knowledge on applied poultry breeding methods

IX. Suggested Reading

- Crawford RD. 1990. *Poultry Breeding and Genetics*. Elsevier.
- Muir WM and Aggrey SE. 2003. *Poultry Genetics, Breeding and Biotechnology*. CAB International.
- Singh R and Kumar J. 1994. *Biometrical Methods in Poultry Breeding*. Kalyani Publishers.
- *Selected articles from journals*.

I. Course Title : Poultry Economics, Marketing and Integration

II. Course Code : PSC 706

III. Credit Hours : 2+1

IV. Aim of the course

To study about measures of performance efficiency in poultry farms and its allied sectors, hatcheries and developing poultry projects.

V. Theory

Unit I (11 Lectures)

Present practices and future trends in the production of egg and meat – Present trends in consumption – Demand and supply - Seasonal variations in production and consumption. Marketing channels- procedures of marketing for eggs and meat - Market intelligence -Advertising and branding of poultry products.

Unit II (14 Lectures)

Various poultry enterprises – choice of production size of business – input and output analysis – calculating cost of various inputs – calculating cost of production – Break-even point analysis - Price determination – Role of NECC, BroMark and other marketing agencies - Least demand and supply indices of performance – Performance targets and achievements - marketing and business management - market managerial skills and human resource development - cost and financial management.

Unit III (9 Lectures)

Future trends in broiler and egg production – Factors influencing the profit margin



in poultry enterprises – Role of integration in Poultry business – Different types of integration.

VI. Practical (17 Classes)

Study of marketing channels of egg and meat, calculating the cost of production of eggs, meat, day-old chick and feed – Calculating marketing costs - Preparing other related poultry projects. Use of social media in popularizing poultry and poultry products – Study of successful business models in the poultry sector.

VII. Teaching methods

- Classroom teaching and interaction with the poultry industry
- Use of Audio-visual capsules

VIII. Learning outcome

Gaining knowledge of market intelligence and marketing techniques

IX. Suggested Reading

- Narahari D and Asha Rajini R. 2005. *Poultry Economics and Projects*. PIXIE Publications India (P) Ltd.
- Vashisht K. 2006. *Practical Approach to Marketing Management*. Atlantic.
- Online sources of NABARD website4. *Selected articles from journals*.

I. Course Title : Diversified Poultry Production

II. Course Code : PSC 707

III. Credit Hours : 2+1

IV. Aim of the course

To provide knowledge on care and management of different breeds, varieties of poultry other than chicken, methods of rearing and common diseases affecting them and their control measures.

V. Theory

Unit I (9 Lectures)

Commercial hybrid strains of ducks for egg and meat production – Feeding and management – Housing – Specific diseases of ducks, prevention and their control – Slaughter and processing of ducks – Economics of production of ducks, indigenous duck production system including polythene duck pond.

Unit II (8 Lectures)

Varieties of Japanese quail for meat and egg production – Cage and deep litter system of rearing of quails – Feeding and management – Housing – Emerging diseases affecting Japanese quail – Nutritive value of Japanese quail meat and egg - Economics of production of Japanese quail.

Unit III (9 Lectures)

Varieties/ breeds of Turkey, Guinea fowl, Geese, Emu and Ostriches – System of rearing – Feeding and management – Housing – Emerging diseases and their prevention – Nutritive value of Turkey, Geese and Guinea fowl – By-products of Geese, Emu and Ostriches.

Unit IV (8 Lectures)

Scope and constraints in the marketing of diversified poultry products – Rearing



and management of common pet birds and other birds of regional importance – Common diseases affecting pet birds and their prevention and treatment - Economics of production of different pet birds.

Learning outcome

Gaining advanced knowledge of diversified poultry production

VI. Practical (17 Classes)

Layout and design of housing for other species of poultry. Visit commercial Japanese quail, turkey and duck farms. Incubation and care of hatching eggs and young ones – Rearing practices followed for duck, quails and turkey farmers under field conditions – Designing of aviaries for pet birds - Different types of feed prepared for pet birds – Vaccination and medication for diversified poultry species - Preparing project reports for different species and calculating the cost of production.

VII. Teaching methods

- Classroom teaching and visit to other avian species farms
- Use of Audio-visual capsules

VIII. Suggested Reading

- Cherry P and Morris T. 2011. *Domestic Duck Production: Science and Practice*. CAB International.
- CPDO. *Duck – Management Guide*. Central Poultry Development Organization Publication (online resource)
- CPDO. *Turkey – Management Guide*. Central Poultry Development Organization Publication (online resource)
- Pathak N. 2013. *Poultry and Ratite Nutrition*. Narendra Publishing House.
- Thiyagarajan D. 2012. *Scientific Turkey Farming*. SSPH, New Delhi.