

PONDICHERRY UNIVERSITY

PUDUCHERRY - 605 014



M.V.Sc. DEGREE PROGRAMME

(Master of Veterinary Science)

Revised Syllabi & Regulations

2022-23 ONWARDS



PONDICHERRY UNIVERSITY

PUDUCHERRY - 605 014

M.V.Sc . Degree Programme

Revised Syllabi & Regulations

(2022-23 onwards)

1. Short title, application, and commencement:

- 1.1 These regulations may be called Post-graduate Studies in M.V.Sc. Degree regulations 2022.
- 1.2. They shall govern the Postgraduate studies leading to the award of Degree of Master of Veterinary Science by Pondicherry University.
- 1.3. They shall come into force with effect from the academic year 2022-2023

2. Definitions:

In these regulations, unless the context otherwise requires

- 2.1 **University:** Pondicherry University.
- 2.2 **College:** Institutions offering Veterinary and Animal Sciences courses.
- 2.3 **Department:** A department in the Institute as notified by the competent authority / Dean
- 2.4 **Vice-Chancellor:** The Vice-Chancellor of Pondicherry University.
- 2.5 **Registrar:** The Registrar of Pondicherry University.
- 2.6 **Dean:** The Dean of the institution offering Veterinary and Animal Science Courses, affiliated with Pondicherry University.
- 2.7 **Head of the Department (HOD):** Head of the Academic Department of specialization in the institution.
- 2.8 **Teacher:** A teacher of the department.
- 2.9 **Academic year:** A period consisting of two consecutive semesters including an inter-semester break as announced by the Institute.
- 2.10 **Semester:** An academic term consisting of not less than 110 instructional days excluding the days of external examinations.

- 2.11 Credit hour, Semester Credit or Credit:** One hour of lecture or three hours of laboratory or field practicals or hospital each week in a semester.
- 2.12 Course:** A unit of instruction or segment of subject matter (as specified in the course catalogue) to be covered in a semester, having a specific number and credits.
- 2.13 Course Catalogue:** A list of approved courses for the M.V.Sc. degree programme wherein each course is identified with a specific number and credits giving outlines of the syllabus.
- 2.14 Grade Point (GP) of a course:** The value obtained by dividing the percentage of marks earned in a course by 10 and the grade point expressed on a 10-point scale up to one decimal place.
- 2.15 Credit Point of a course:** The product of grade points and credit hours in a course.
- 2.16 Grade Point Average (GPA):** The quotient of the total credit points obtained by a student in various courses at the end of each semester divided by the total credit hours completed by the student in that semester. The Research Credits are not to be included in the calculation of GPA. The GPA shall be corrected to the second decimal place.
- 2.17 Overall Grade Point Average (OGPA):** The quotient of cumulative credit points obtained by a student in all courses completed by a student from the beginning of the first semester of the P.G. degree course divided by completed credit hours up to the end of a specified semester and it determines the overall performance of a student in all the courses taken during the period covering more than one semester. The Research Credits are not to be included in the calculation of OGPA. The OGPA has to be corrected to the second decimal place.

3. Academic Departments referred to in these regulations:

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

4. Major Fields of study for M.V.Sc. degree:

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

5. Admission Procedure:

5.1. Eligibility for admission:

The candidate seeking admission to the Postgraduate programme leading to M.V.Sc. Degree shall possess:

- i. B.V.Sc. / B.V.Sc. & A.H. degree from an Institution recognized by the Veterinary Council of India (VCI) with a minimum OGPA of 6.0 on 10 point scale (5.0 for SC/ST candidates). In the other grading systems, OGPA / marks will be appropriately proportioned to the 10 point grading scale.
- ii. Shall secure a minimum of 50% (40% for SC/ST candidates) of cumulative marks obtained in the entrance examination (40%) and qualifying degree (60%).

5.1.1. Application for Admission: Application for admission shall be made in the prescribed form to be obtained from the office/website of the Institution after the notification is issued to this effect. The admissions shall be regulated and made by the regulations in force.

5.1.2 Number of Seats: The number of seats in each major field of study is three, out of which, two seats are allocated for resident candidates of Pondicherry and one seat to be filled under ICAR /Other States and Union Territories.

5.2 Criteria for Residents of Pondicherry: Criteria prescribed by the Government of Puducherry from time to time for residents of Puducherry will be followed.

5.3 Reservation: Reservation of seats in different fields of study will be according to the reservation policy announced by the Government of Pondicherry from time to time for admission to Educational Institutions. The vacant seats, if any, will be filled based on the overall rank of the candidates without following any reservations. The details of reservations for different categories will be indicated in the Information Bulletin for the year of admission.

5.4 Selection: The Selection of candidates will be based on a merit list drawn on cumulative marks obtained in the B.V.Sc./B.V.Sc. & A.H. examination (60%) and the entrance examination (40%).

5.5 Entrance Examination: An entrance examination will be conducted by RIVER, Puducherry on a date and time to be notified. The syllabus for the entrance examination will be the syllabus prescribed by the VCI for B.V.Sc. & A.H. Degree. The details of the entrance examination will be furnished in the information bulletin for admission.

5.6. Registration of Courses: The candidates provisionally selected for admission have to pay the prescribed fee and deposit all the original certificates and transcripts at the time of admission and register for courses in the prescribed format (**Form I**) on the date specified for the purpose. For specific purposes and requirements, students may get their originals from the Institution by applying through the proper channel and return the documents by the specified time. Failure to pay the required fee and register for the courses will result in the cancellation of his/her offer of admission.

6. Courses and Credits:

6.1 Minimum Credit Requirements for M. V. Sc. Degree

Details	Credits
(i) Coursework	
Major courses	20
Minor courses	08
Supporting courses	06
Common courses	05
Seminar	01
(ii) Thesis Research	30
Total	70

Major courses: From the Discipline in which a student takes admission. Among the courses listed, the core courses compulsorily to be taken may be given an *mark.

Minor courses: From the subjects closely related to a student's major subject.

Supporting courses: The subject not related to the major subject. It could be any subject considered relevant for a student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

Common Courses: The following courses (**one credit each**) will be offered to all the students undergoing the Master's degree programme:

Code	Course Title	Credit Hours
PGS 601	Technical Writing and Communication skills	1+1
PGS 602	Agricultural Research, Research Ethics and Rural Development Programmes	1+0
PGS 603	Basic concepts in laboratory techniques	0+1
PGS 604	Intellectual Property and its Management	1+0
PGS 605	Library and Information Services	0+1

Some of these courses are already in the form of e-courses/ MOOCs (massive open online course). The students may be allowed to register for these courses/ similar courses on these aspects if available online on SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds) or any other platform. If a student has already completed any of these courses during UG, he/ she may be permitted to register for other related courses with the prior approval of the Head of Department (HoD)/Board of Studies (BoS). The above courses will be evaluated internally as detailed in Section 8.1

Supporting Courses

The following courses are being offered by various disciplines.

Code	Course Title	Credit Hours
STAT 502	Statistical Methods for Applied Sciences	3+1
STAT 522	Data Analysis Using Statistical Packages	2+1
BIOCHEM 501	Basic Biochemistry	3+1
BIOCHEM 505	Techniques in Biochemistry	2+2

6.2. Credit load: A candidate shall be allowed to register for a maximum of 18 credits.

6.3 Residential requirements: Minimum residential requirement for the M.V.Sc. degree programme is four semesters (two academic years) and the maximum limit for completion of M.V.Sc. programme is five academic years (ten semesters) (inclusive of the duration of discontinuation, if any). If a student fails to complete his/her Master's programme within the maximum time limit prescribed, his/her admission shall stand cancelled.

7. Attendance:

The student is required to have an attendance of at least 85 % of total classes separately for theory and practical in each course. If any student falls short of the required attendance the Dean may condone a shortage of up to 10% of attendance on valid grounds. If any student falls short of the required attendance he/she will not be permitted to appear in the University examinations and such candidates are required to re-register the course (s) in which he or she had fallen short of the required attendance.

8. Evaluation and Examinations:

Evaluation of a student in each course is based on Internal (50% weightage), external (50%) for theory and internal (100%) for practical. The weightage between theory and practical shall be as per the credits of the course.

8.1 Internal Examinations:

It shall be the responsibility of the concerned Dean / Head of the Department to ensure proper conduct of all internal evaluations in all the courses offered by that Department. The internal marks scored by the student will be communicated by the Dean at the end of the semester to Pondicherry University for the declaration of the result. The answer scripts of all the internal examinations will be shown to the students after evaluation. The concerned HOD will retain the answer scripts for a minimum period of two years after the student completes the degree programme.

8.1.1. The theory internal assessment is conducted for 100 marks as two internal tests of 40 marks each (one after 45% (Mid-Term) and another at the end of 90% (End-Term) of instructional days) and an assignment of 20 marks. The internal test will be of a subjective type and would be the responsibility of the concerned course teacher to conduct the internal test as per the schedule. The total marks obtained will be reduced to 50% and submitted to Pondicherry University.

8.1.2. After the completion of the Semester board examination, in theory, the practical examination shall be conducted by an Internal board of examiners as approved by the Pondicherry University for 100 marks comprising of 70 marks for practicals, 20 for practical based assignments/Case Study/Record (any two) and 10 marks for viva-voce. Submission of assignments/cases study/records and attendance in the viva-voce examination are compulsory, failing which the candidate will be treated as absent for the examination. The marks obtained are to be submitted to the University as it is.

8.1.3. The Internal Board of examiners shall consist of the Head of the Department of the concerned subject as the Chairman and the Course teacher as approved by the University. In case HoD is the course teacher, senior faculty members (Professors/ Associate Professors/Assistant Professors who possess a Ph.D. Degree with five years of Teaching/Research/Extension experience in the concerned subject area) from the same department can be nominated as a member of the board. The Dean may nominate any one of the faculty members of the Institute as an Observer.

8.2. External Examinations:

The external examination in each course will be conducted for the theory component after the end of the semester by the Pondicherry University. The external examination for each theory course will consist of one paper for 100 marks comprising subjective questions for a 3-hour duration. The marks obtained will be reduced to 50% and added to internal marks (50%) for the final declaration of results. An External examiner in the subject area will be invited to evaluate the theory papers of all the courses (major and minor courses) offered by the department.

9. External Examiners:

All the Professors, Associate Professors and those Assistant Professors who possess Ph.D. Degree with five years of Teaching/Research/Extension experience in the concerned field

of specialization and working in veterinary colleges and academic institutions are eligible for appointment as external examiners including thesis evaluation and paper setters. The retired experts with the above criteria below the age of 65 years can also be appointed as external examiners.

9.1. Panel of examiners: The HOD will submit a panel of 10 External examiners to the University, through the Dean of the institute, to be nominated as an External examiner and the List of Internal Examiners to evaluate the Semester Theory answer scripts for the approval of the University. The practical examination shall be dealt internally by a board of examiners consisting of the concerned HOD , course teacher and representative of the Dean (Clause 8.1.2 and 8.1.3).

9.2 Evaluation:

The Semester External Examination answer scripts will be evaluated by the External Examiner and also by the concerned course teacher. The average of marks obtained in double evaluation will be the marks obtained by the candidate. If the difference between the two evaluations is 15 or more, the answer script will be subjected to a third evaluation. Internal Board of Examiners as detailed in the section 8.1.3 will evaluate the practical examination.

10. Minimum Marks for Pass:

The candidate has to score a minimum of 50% in Theory (internal and external examinations, separately) and also a minimum of 50% in the Practical examination for a given course. In addition, if a candidate scores less than a GP of 6.00 in aggregate of Theory and Practical in a given course, he/she should reappear for all the examinations in Theory (internal and external) and Practical in that course conducted in the ensuing semester. The Pondicherry University will declare the results of the examinations and the results will be communicated to the Institute

11. Advisory Committee:

The HOD shall allot a Major advisor / Chairman of the advisory committee for each student registered for M.V.Sc. programme in his/ her department in the first semester. The major advisor in consultation with the HOD will propose an advisory committee for approval by the Dean in the second semester. The committee shall consist of at least three members, two from the major field of study and one from the minor field.

The following teachers are eligible to be appointed as **Chairman** of the Student Advisory committee:

- i. Professors and Associate Professors
- ii. Assistant Professors who possess Ph.D. Degree with five years of Teaching/ Research/ Extension experience in the concerned field of specialization
- iii. Assistant Professors who do not possess Ph.D Degree but have eight years of Teaching/Research/Extension experience in the concerned field of specialization. However, Assistant Professors who do not possess Ph.D. Degree but have at least five years of experience in Teaching /Research

/Extension in the concerned field of specialization are also eligible to be appointed as members of the advisory committee.

11.1 Advisor/ Co-guide/ Member, Advisory Committee from other collaborating University/ Institute/ Organization

- In order to promote quality Post-graduate research and training in cutting edge areas, the University may enter into Memorandum of Understanding (MOU) with other Universities/ Institutions for conducting research. While constituting an Advisory Committee of a student, if the Chairperson, Advisory Committee feels the requirement of involving of a faculty member/ scientist of such partnering university/ Institute/ Organization, he/ she may send a proposal to this effect to Director (Education)/ Dean PGS along with the proposal for consideration of Student's Advisory Committee (SAC).
- The proposed faculty member from the partnering institution can be allowed to act as Chairperson/ Co-guide/ Member of SAC, by mutual consent, primarily on the basis of intellectual input and time devoted to carrying out the research work at the particular institution.

11.2. Allotment of students to the retiring persons

Normally, retiring person may not be allotted M. V. Sc. student if he/ she is left with less than 2 years of service. However, in special circumstances, permission may be obtained from the Director (Education)/ Dean PGS, after due recommendation by the concerned Head of the Department.

11.3. Changes in the Advisory Committee:

- (i) Change of the Chairperson or any member of the Advisory Committee is not ordinarily permissible. However, in exceptional cases, the change may be effected with due approval of the Director of Education/ Dean PGS.
- (ii) Normally, staff members of the university on extra ordinary leave or on study leave or who leave the University service will cease to continue to serve as advisors of the Post-graduate students of the University. However, the Director (Education)/ Dean PGS may permit them to continue to serve as advisor subject to the following conditions:
 - (a) The concerned staff member must be resident in India and if he/ she agrees to guide research and must be available for occasional consultations.
 - (b) An application is made by the student concerned duly supported by the Advisory Committee.
 - (c) The Head of the Department and the Dean of the College concerned agree to the proposal.
 - (d) The staff member, after leaving the University service is granted the status of honorary faculty's membership by the Vice-Chancellor on the recommendation of the Director (Education)/ Dean PGS for guiding as Chairperson or Member, Advisory Committee the thesis/ theses of the student(s) concerned only.
- (iii) In case the Chairperson/ member of a Student's Advisory Committee retires, he/ she

shall be allowed to continue provided that the student has completed his course work and minimum of 10 research credits and the retiring Chairperson/ member stays at the Headquarters of the College, till the thesis is submitted.

(iv) If the Chairperson/ member proceeds on deputation to another organization, he/ she may be permitted to guide the student provided his/ her new organization is at the Headquarters of the College and his/ her organization is willing for the same.

(v) The change shall be communicated to all concerned by the Head of Department.

12. Research Project formulation and Supervision:

On successful completion of 75% of the Course work in the Major Subject, the student can register eligible research credits in the subsequent semester in the second year of the study. The Chairman in consultation with the members of the advisory committee shall identify the topic of research project and submit the ORW of the proposed Research Project in prescribed format to the Dean for approval. He/she will also present a seminar on the outline of proposed research work (ORW) to the faculty and PG students of the institute including the members of the PG coordination Committee (PGCC) of the institute. Based on the recommendations of the PGCC, the Dean will accord the approval to the synopsis. Subsequent change(s) if any in the synopsis needs to be approved by the Dean on the recommendation of the SAC. The student will carry out the research work as per the approved synopsis under the supervision and guidance of the Advisory Committee.

12.1. Approval of the ORW: The ORW approval must be accomplished in the third semester and the time between submission of ORW and thesis shall be at least one semester.

13. Preparation and submission of thesis:

On successful completion of the research credits and research work to the satisfaction of the advisory committee, the candidate will present a seminar on the research work before the faculty members. After incorporating the necessary suggestions in consultation with the Advisory Committee, the candidate will submit three draft copies of the thesis and the approved ORW to the Dean along with a certificate in the prescribed proforma (**Form II**) duly signed by the advisory committee. The student is permitted to submit his or her thesis within 30 calendar days after the closure of the semester failing which he/she has to register in the concerned semester by paying a registration fee of Rs. 5000/- with 0 credits. If he/she fails to submit the thesis in that semester too, the student has to register in the subsequent semester by paying the balance amount of the Annual fee with 0 credits.

13.1 Prevention of plagiarism

An institutional mechanism should be in place to check plagiarism. The students must be made aware that manipulation of the data/ plagiarism is punishable with serious consequences.

14. Internship for Development of Entrepreneurship in Agriculture (IDEA)

Currently, a provision of 30 credits for Research work in M.V.Sc. programme helps practically only those students who aspire to pursue their career in academic/ research. There is hardly any opportunity/ provision under this system to enhance the entrepreneurship skills of those students who could start their own enterprise or have adequate skills to join the industry. Therefore, in order to overcome this gap, an optional internship/ in-plant training (called as IDEA) in lieu of thesis/ research work has been recommended by ICAR (2021) which would give the students an opportunity to have a real-time hands-on experience in the industry.

It is envisaged that the internship/ in-plant training would enhance the interactions between academic organizations and the relevant industry. It would not only enable the development of highly learned and skilled manpower to start their-own enterprises but also the industry would also be benefitted through this process. This pragmatic approach would definitely result in enhanced partnership between academia and industry.

The main objectives of the programme:

1. To promote the linkages between academia and industry
2. To establish newer University – Cooperative R&D together with industry for knowledge creation, research and commercialization
3. Collaboration between Universities and industries through pilot projects
4. To develop methods for knowledge transfer, innovation and networking potential
5. To enhance skill, career development and employability

The following criteria for IDEA will be taken into consideration:

- At any point of time there will not be more than 50% of students who can opt under IDEA.
- Major Advisor will be from Academia and Co-advisor (or Advisory Committee member) from industry.
- Total credits (30) will be divided into 20 for internship/ in-plant training and 10 for writing the report followed by viva-voce similar to dissertation.
- Workplace will be industry; however, academic/ research support would be provided by the University or both. MoU may be developed accordingly
- The IPR, if any, would be as per the University policy.

15. Evaluation of the thesis:

The Head of the Department in consultation with the Chairman of the Advisory Committee shall submit a panel of five external examiners in the field of specialization to the Dean for forwarding to the University. The thesis will be sent to one of the examiners from the panel who shall be required to send the detailed evaluation report with the specific recommendation in a prescribed proforma (**Form III**) to the University within the stipulated time.

15.1 Recommendation of the Examiner: In case the external examiner recommends the acceptance of the thesis with remarks such as “HIGHLY COMMENDED OR COMMENDED,” the report will be forwarded to the concerned Head of the Department through the Dean by the university for the conduct of the Viva-voce examination. The student shall submit five final bound copies of the thesis after incorporating the suggested corrections of the external examiner in consultation with the Advisory Committee to the HOD who in turn will arrange for the conduct of the final viva-voce examination by inviting the external examiner who evaluated the thesis. The viva-voce will be conducted by the HOD, the external examiner and the members of the Advisory Committee. A certificate regarding the performance of the candidate in the final viva-voce examination on the thesis in the prescribed form (Form IV), duly signed by all the members of the Advisory Committee and the external examiner shall be forwarded to the Dean by the concerned HOD. The result of the examination should clearly indicate the performance of the student either as “SATISFACTORY” or “UNSATISFACTORY” and the same will be communicated to the University for the Declaration of the result.

15.1.1. If the performance of the candidate in the viva voce examination is “UNSATISFACTORY”, he/she may be asked to take the viva voce examination after a lapse of at least 30 days after the declaration of the result of the final viva voce examination.

15.1.2. If the external examiner does not recommend the award of the degree with the comments to revise and resubmit the thesis, the concerned HOD in consultation with the members of the Student Advisory Committee may arrange for incorporating the suggestions given by the external examiner and resubmit the thesis to the University to arrange for an evaluation by the same examiner.

15.1.3. If the external examiner rejects the thesis, the University may send the thesis to the second examiner from the panel of examiners for evaluation. If the second examiner recommends the award of the degree, the report will be forwarded to the concerned HOD to arrange for the conduct of the viva-voce examination as per the procedure given at **14.0** .

15.1.4. In case the second external examiner also rejects the thesis, the candidate will have to re-register the research credits and carry out the research work afresh.

15.2. A candidate shall not be permitted to submit his/her thesis on more than two occasions.

16. Grading & Transcript:

The University will award the grades to the students on a 10-point scale. A grade report/Transcript for each semester will be issued by the University during the subsequent semester. The University will issue a final transcript (Form V) indicating the courses, credits and OGPA after the successful completion of all the courses, the title of the thesis with the remarks, date of examination and performance in the viva voce examination.

- A minimum OGPA of 6.50 is required for the award of the degree.

17. Eligibility for Degree:

A candidate is eligible for the award of an M.V.Sc. degree after successful completion of the prescribed courses with an OGPA of 6.50 and satisfactory completion of Research including the final thesis viva voce examination.

Candidates securing an OGPA of 8.50 and above and completing the courses, and final thesis viva-voce examination satisfactorily in the first attempt will be awarded a degree in FIRST CLASS WITH DISTINCTION.

Candidates securing an OGPA of 7.50 to 8.49 and completing the courses and final thesis examination satisfactorily in the first attempt will be awarded a degree in FIRST CLASS. All the other candidates who have passed will be placed in the SECOND CLASS.

18. Award of M.V.Sc. Degree:

A degree certificate under the seal of Pondicherry University signed by the Registrar and Vice-Chancellor of the University shall be presented to the candidate on successful completion of the requirements for the award of the degree.

19. Temporary discontinuation and resumption of studies:

If a student wants to discontinue his/her studies temporarily or take a long leave, he/she may do so after successful completion of all the credit requirements of the major courses with the prior approval of Pondicherry University. Discontinuation before successful completion of the above shall result in cancellation of admission. The discontinuation is allowed only once in the M.V.Sc. degree programme. However, the maximum time limit prescribed for the completion of the Master's Programme shall remain unchanged. The M.V.Sc. Students should not be on the active rolls of employment in Government or University or any private or public undertakings during the study period.

19.1 Refund of Stipend: The candidates will be allowed to discontinue the course only after the refund of the stipend received if any during the study. Whenever he/she rejoins, he/she will be entitled to receive this amount after successful completion of the M.V.Sc. degree programme.

20. Fee:

The student shall have to pay the entire fee prescribed by the Institute from time to time. In addition, he/she will also pay the prescribed Registration fee, Matriculation fee, Recognition fee, Examination fee, Sports fee and other fees decided from time to time by the Institute / Pondicherry University.

21. Amendment or Cancellation of result:

If the result of a candidate is discovered to be vitiated by error, malpractice, fraud, improper conduct or any other reason, the Vice-Chancellor shall have the power to amend the result in such a manner as to accord with the true position and to make such a declaration as the Vice-Chancellor may deem necessary in that behalf including debarring the candidate from the University/ College.

22. Removal of Difficulties:

22.1. If any difficulty arises in giving effects to provisions of these regulations, the Dean in consultation with the University may issue necessary orders which appear to the authorities to be necessary or expedient for removing the difficulty.

22.2. No order under Rule 21.1 shall be questioned on the ground that no difficulty as is referred to in the said rule existed or was required to be removed

23. Notwithstanding anything contained in the Regulations, the Institute/University shall make changes, whenever necessary.

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1. Veterinary Anatomy

Course Title with Credit Load

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

Minor subjects:

Veterinary Biochemistry,
Veterinary Physiology
Veterinary Pathology,
Veterinary Gynaecology and Obstetrics
Veterinary Surgery and Radiology
Veterinary Biotechnology.

*Any other discipline as per the requirement of the research problem of the student.

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
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
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
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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	
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.

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, Mulligan 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, Mulligan 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	4

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. Practical

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
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Practical

- Clinical examination of animal by palpation, percussion and auscultation 1
- Site to record temperature, pulse, palpable lymph nodes, collection of blood and pregnancy diagnosis in domestic animals 1
- Area of auscultation for lungs and heart, passing of probang 1
- Preferable site for injections in domestic animals (intradermal, subcutaneous, intramuscular, intravenous, intracardiac, intratracheal, subconjunctival, intra-articular, epidural) 1
- 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
- Surgical conditions of respiratory system (catheterization of guttural pouch, ventriculectomy in horse, tracheotomy, thoracocentesis) 1
- 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.

S. No.	Topic	No. of Lectures/ Practicals
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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 arrangement of four basic tissues in organs of different body systems

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.

Theory

1. General organization of the wall of tubular organs	1	
2. Light microscopic and ultra structural study of tongue, lip and cheek	2	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	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		
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 cerebellum	1	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	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	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 cerebellum	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
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
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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
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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

2. Veterinary Biochemistry
Course Title with Credit Load

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

Minor Subjects:

Veterinary Physiology
 Veterinary Medicine
 Animal Nutrition
 Animal Genetics and Breeding
 Veterinary Biotechnology
 Livestock Production Management
 Veterinary Pharmacology and Toxicology
 Veterinary Microbiology
 Veterinary Parasitology
 Veterinary Pathology
 Veterinary Gynaecology

*Any other discipline as per the requirement of the research problem of the student.

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
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
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
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
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 K_m and V_{max} and their physiological significances. Importance of K_{cat}/K_m .	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 E-galactosidase or acid phosphatase.	3
3	Study of the effect of enzyme and substrate concentrations and determination of K_m and V_{max} .	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.

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, folin-ciocalteu 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,	

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, foihn-ciocalteau 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 glycated 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.

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
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.

S. No.	Topics	No. of Lectures
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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	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 tissue, liver and kidney	2	
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

- 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
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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, Cruieger W and Cruieger 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 requirement s 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
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

S. No.	Topics	No. of Lectures
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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.

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. 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

3.Veterinary Biotechnology

Course Title with Credit Load

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

Minor Subjects:

Veterinary Biochemistry
Veterinary Physiology
Veterinary Microbiology
Animal Genetics and Breeding
Livestock Product Technology
Veterinary Gynaecology and Obstetrics
Veterinary Pathology
Animal Nutrition
Veterinary Parasitology
Veterinary Pharmacology and Toxicology
Veterinary medicine
Veterinary surgery
Veterinary public health
Veterinary wild life

*Any other discipline as per the requirement of the research problem of the student.

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, Vectored 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
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

- 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 Ca^{2+} - 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	
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.

- 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

- 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.

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,	25-26
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, Nanodiagnostics, 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
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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 |
| 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 Idiotypic; 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 monoclonal antibodies, Recombinant antibodies; Modern 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
- Immunoelectrophoresis.
- 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.
- Springer TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

S. No.	Topic	No. of Lectures/ Practicals
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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 Idiotypic	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
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.	Immunoelectrophoresis	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 contigs, 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
11. Introduction to methods/ matrixes 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
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	13-14
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.

S. No.	Topic	No. of Lectures/ Practicals
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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

4. Veterinary Physiology

Course Title with Credit Load

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

Minor Subjects:

Animal Nutrition
Veterinary Biochemistry
Veterinary Gynaecology and Obstetrics
Animal Genetics and Breeding
Veterinary Biotechnology
Veterinary Surgery and Radiology
Veterinary Livestock Production Management
Veterinary Pharmacology and Toxicology
Veterinary Anatomy
Veterinary Medicine
Poultry science
Veterinary pathology

*Any other discipline as per the requirement of the research problem of the student.

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 | 1 |
| 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
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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	
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, Heddwyn 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
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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 carbondioxide 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
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.

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. Absorbptive 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
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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
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
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	1
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.

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

S. No.	Topic	No. of Lectures/ Practicals
1.	Methods of heat detection in different species of domestic animals	1
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

- *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
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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, 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.
- *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
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
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- | | | |
|---|-----------------------------------|--|
| 1 | Introduction to bioregulation | |
| | – Scientific methods | |
| | – Controlled experimental testing | |
| | – Representative sampling | |
| | – Dose response Relationship | |
| | – Biological Rhythm | |

– Endocrine–Nervous -Immune system interaction	1
2 Methods of endocrine secretion analysis	
– 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	
– 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	
– Morphological functions	
Biological functions	
– Physiological functions	
– Molecular functions	1
5 Mechanism of hormone synthesis of	
– Protein hormones	
– Steroid hormones	
– Eicosanoids	
– Thyroid hormones	
– Monoamines	1
6 Release and transport in blood Mechanisms for regulating release	
– In response to Trophic hormone	
– In response to Nervous stimuli (environmental cues)	
– In response to levels of various metabolites	
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
 - *In vitro* 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
 - 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 ₂ D based systems	
Progestin and other hormones based systems	
• Superovulation and embryo transfer	
• <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	
• Somatotrophin	
• Adipokines	
• Leptin	
• Anabolic steroids and Analogues –mechanism of action delivery	
systems and safety aspects	
• E Adrenergic Agonists –mechanism of action delivery systems and	
safety aspects	
• Dietary supplements	
– chromium, PUFA and CLA	
• Regulation of feed intake	
– Orexigenic hypothalamic neurohormones	
– Anorexigenic hypothalamic neuropeptides	
– Hormonal regulation of mammary gland development and milk	
secretion Artificial induction of lactation	2
20 Avian endocrinology	
– Reproductive hormones	
– Hormonal manipulation of egg production	
– Control of broodiness in poultry	
– Manipulation of moulting	2

- 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
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.

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.	Heamtology	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

5. Veterinary Microbiology

Course Title with Credit Load

Course Code	Course Title	Credit Hours
VMC 501	General Bacteriology*	2+1
VMC 502	Systematic Veterinary Bacteriology	2+1
VMC 503	General Virology*	2+1
VMC 504	Systematic Veterinary Virology	2+1
VMC 505	Principles of Veterinary Immunology*	2+1
VMC 506	Veterinary Mycology*	1+1
VMC 507	Vaccinology	2+0
VMC 508	Techniques in Microbiology	0+2
VMC 509	Techniques in Molecular Microbiology	1+2
VMC 510	Molecular Immunology	1+1
VMC 511	Mucosal Immunology	1+0
VMC 512	Introduction to Microbial Bio-informatics	1+0
VMC 591	Master's Seminar*	1+0
VMC 599	Master's Research	0+30

*Core
Courses

Minor Subjects:

Animal/ Veterinary Biotechnology

Veterinary Biochemistry

Veterinary Pathology

Veterinary Public Health and Epidemiology

Animal Genetics

*Any other discipline as per the requirement of the research problem of the student.

Course Contents -M.V.Sc. in Veterinary Microbiology

- I. Course Title : General Bacteriology
II. Course Code : VMC 501
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 502
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

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 503

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. 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 504

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 viroids.

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. Electrophoretotyping. 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 505

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, Immunodiagnosics 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 506

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, Dermatormycosis, Mycotoxicosis, 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 507

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 vaccine 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 pharmacovigilance. Scaling up methods of vaccine production.

I. Course Title : Techniques in Microbiology

II. Course Code : VMC 508

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 509

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 510
- 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 in native 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 511
- 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 PRRs, 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 cryptopatches. 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, Johne's disease; Assessment of mucosal immune response and potency testing.

I. Course Title : Introduction to Microbial Bioinformatics

II. Course Code : VMC 512

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.

VMC 501: 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

S.No.	Topic of Syllabus	Lecture/ Practical
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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 503: 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
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 504: 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>Picornaviridae</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.	Electrophoretotyping	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 505: 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
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 506: 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 Rhinosporidiosis	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. Mycotoxicosis 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
8. Antifungal sensitivity testing	1
9. Detection of mycotoxin	1
10. Serological and molecular diagnosis in fungi	1
Total	16

VMC 507: 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 508: 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
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 509: 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
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 510: 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.	Inflammasome	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

- Isolation and purification of mammalian and avian immunoglobulin by precipitation technique: - Caprylic acid, PEG, Ammonium Sulphate and Sodium Sulphate 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
- Polyacrylamide gel electrophoresis innative and reducing conditions; fixed and gradient gel 2
- Western blot and Crossed immune-electrophoresis 2
- Solid Phase ELISA and Chemiluminescence assay 1
- Cell cytotoxicity assaya - Non radioactive methods like LDH release assay 2
- Antigen detection by Immuno PCR 1
- Haplotype matching between individuals 2
- Flow cytometry for CD4 and CD8 ratio determination and other applications 1

10.	ELISPOT test for cytokine assay	1
	Total	16

VMC 511 Mucosal Immunology (1+0)

S.No.	Topic of Syllabus	Lectures
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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 512: Introduction to Microbial Bio-informatics (1+0)

S.No.	Topic of Syllabus	Lectures
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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

6. Veterinary Pathology

Course Title with Credit Load

Course Code	Course Title	Credit Hours
VPL 501	General Pathology*	2+1
VPL 502	Techniques in Pathology*	0+2
VPL 503	Animal Oncology	1+1
VPL 504	Clinical Pathology*	1+1
VPL 505	Necropsy Procedures and Interpretations*	1+1
VPL 506	Necropsy Conference*	0+1
VPL 507	Systemic Pathology*	2+1
VPL 508	Pathology of Infectious Diseases of Domestic Animals*	2+1
VPL 509	Toxicopathology	2+1
VPL 510	Avian Pathology*	2+1
VPL 511	Pathology of Wild/ Zoo and Aquatic Animal Diseases	2+1
VPL 512	Pathology of Laboratory Animal Diseases	2+1
VPL 591	Master's Seminar*	1+0
VPL 599	Master's Research	30

*Core
Courses

Minor subjects:

Veterinary Microbiology
 Animal/ Veterinary Biotechnology
 Veterinary Biochemistry
 Veterinary Medicine
 Veterinary Parasitology
 Veterinary Public Health and Epidemiology
 Veterinary Pharmacology and Toxicology

*Any other discipline as per the requirement of the research problem of the student.

Course Contents M.V.Sc. in Veterinary Pathology

- I. Course Title : General Pathology
II. Course Code : VPL 501
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 502
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-503

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

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 504

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 505

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 506

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 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, 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 507

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, Lukhnow

I. Course Title : Pathology of Infectious Diseases of Domestic Animals

II. Course Code : VPL 508

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 509

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 510
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.

- 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 511
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 reovirus disease, 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 512
- 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, Enephalotozoonoses, 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 (corynebacteriosis), 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 parenteral 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 typhilitis, *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 501
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
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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
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 502
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
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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 503

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.

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 504

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 505

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 506

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.

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
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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

I. Course Title : Systemic Pathology

II. Course Code : VPL 507

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.

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
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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 508

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
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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 streptothricosis, 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

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 509

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. *In-vitro* and *in-vivo* 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 510

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, 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: *Salmonella*, *Escherichia coli* 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.

I Course Title : Pathology of Wild/ Zoo and Aquatic Animal Diseases

II. Course Code : VPL 511

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, 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 CO₂ or H₂S 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.

- I. Course Title : Pathology of Laboratory Animal Diseases
 II. Course Code : VPL 512
 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 (corynebacteriosis), Tyzzer's disease, Salmonellosis, Rat bite fever; Protozoan diseases (Trichomonads, <i>Chilomastix bettencorti</i> , <i>Spironucleus 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> , <i>Citrobacter rodentium</i> , 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>Spironucleus 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,	

- Sendai virus, Mouse thymic virus, Mouse polyoma viruses, Reo-3 virus;
Fungal disease (*Pneumocystis 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, *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 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

7. Veterinary Parasitology

Course Title with Credit Load

Course Code	Course Title	Credit Hours
VPA 501	Platyhelminthes-I*	1+1
VPA 502	Platyhelminthes-II*	1+1
VPA 503	Nemathelminthes and Acanthocephala*	2+1
VPA 504	Arthropod Parasites*	2+1
VPA 505	Parasitic Protozoa*	2+1
VPA 506	Diagnostic Parasitology	0+2
VPA 507	Clinical Parasitology	1+1
VPA 508	Management of Parasitic Diseases	1+1
VPA 509	Immunoparasitology	2+1
VPA 510	Parasitic Zoonoses	2+0
VPA 511	Parasites of Wildlife	1+1
VPA 591	Master's Seminar*	1+0
VPA 599	Master Research	30

*Core
Courses

Minor subjects:

Veterinary Microbiology

Animal/ Veterinary Biotechnology

Veterinary Biochemistry

Veterinary Medicine

Veterinary Pathology

Veterinary Public Health and Epidemiology

Veterinary Pharmacology and Toxicology

*Any other discipline as per the requirement of the research problem of the student.

Course Contents
M.V.Sc. in Veterinary Parasitology

I. Course Title : Platyhelminthes-I

II. Course Code : VPA 501

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 502

III. Credit Hours : 1+1

IV. Aim of the course

To study the morphology, biology, pathogenesis and control measures for cestode

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 503

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.

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 504

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

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 505

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.

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 506

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 507

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.

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 508
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 509
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.
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 510
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 511
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 501
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

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 502

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

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: Diphyllbothriidae
- 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.

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- 9-16 Observation on parasitic stages in host tissues and associated pathological lesions

I. Course Title : Nematelminthes and Acanthocephala

II. Course Code : VPA 503

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
- 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.

I. Course Title : Arthropod Parasites

II. Course Code : VPA 504

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.
- 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 505
- 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.
- 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 *Anaplasma*, *Ehrlichia*, *Haemobartonella* 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 506

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
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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.
- 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 507

III. Credit Hours : 1+1

IV. Aim of the course

Collection of clinical material, examination/ investigation and its preservation for interpretations.

Lecture	Topic
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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 *Cryptosporidium* oocysts in faecal samples. Sporulation of

coccidial oocysts.

- I. Course Title : Management of Parasitic Diseases
II. Course Code : VPA 508
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 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 *In vivo* detection of efficacy of and resistance to parasitocidal agents7-16 *In-vitro* detection of efficacy of and resistance to parasitocidal agents

- I. Course Title : Immunoparasitology
II. Course Code : VPA 509
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 510
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.
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 511
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.

8. Veterinary Pharmacology and Toxicology

Course Title with Credit Load

Course Code	Course Title	Credit Hours
VPT 501	Concepts of Pharmacology, Drug Design and Development*	2+0
VPT 502	Autonomic and Autacoid Pharmacology*	2+1
VPT 503	CNS Pharmacology	2+1
VPT 504	Digestive and Respiratory Pharmacology	2+1
VPT 505	Cardiovascular and Urinary System Pharmacology	2+0
VPT 506	Endocrine and Reproductive Pharmacology	2+1
VPT 507	Chemotherapy*	2+1
VPT 508	Toxicology of Xenobiotics*	2+1
VPT 509	Toxinology	2+1
VPT 510	Pharmacological Techniques*	0+2
VPT 511	Techniques in Toxicology*	0+2
VPT 512	Ethnopharmacology	1+1
VPT 513	Fundamentals of Pharmacokinetics	1+1
VPT 591	Master's Seminar*	1+0
VPT 599	Master's Research	30

*Core courses

Minor Subjects:

Veterinary Biochemistry;
Animal/ Veterinary Biotechnology;
Veterinary Physiology;
Veterinary Microbiology;
Veterinary Pathology;
Veterinary Medicine;
Veterinary Public Health and Epidemiology

*Any other discipline as per the requirement of the research problem of the student

Course Contents

M.V.Sc. in Veterinary Pharmacology and Toxicology

- I. Course Title : Concepts of Pharmacology, Drug Design and Development
- II. Course Code : VPT 501
- 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 502
- 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.
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 503

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 504

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 505

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.

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 506

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 507

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, Carbacephems, 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 508

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 : Toxinology

II. Course Code : VPT 509

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 propionitril, 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 510

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 EC_{50} , median effective (ED_{50}), toxic (TD_{50}) or lethal doses (LD_{50}) 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.

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 511

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 512
- 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.

Standardization and clinical validation of bioactive molecules from plant sources.

Therapeutic and adverse effects of potential herbal drugs. Indigenous drugs used as glactagogues, carminatives, antiseptics, antidiarrhoeals, anthelmintics, Immuno- stimulants, 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 513
- 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 501
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
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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 502
III. Credit Hours : 2 + 1
IV. Aim of the course

To study the pharmacological basis of therapeutic uses of autonomic and autacoid drugs.

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
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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 503

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
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 504

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
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 505
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
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 506
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 507

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.

S. No.	Name of Topic	No. of Tentative Lectures/ Practicals
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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, Antitrepatodal 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-508

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
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 509

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 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 510

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

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, PD _v , PD _x 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 511

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 512
 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 513
 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
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

9. Veterinary Public Health and Epidemiology

Course Title with Credit Load

Course Code	Course Title	Credit Hours
VPE 501	Concepts in Veterinary Public Health and One Health*	2+0
VPE 502	Zoonoses-I*	2+1
VPE 503	Zoonoses-II*	2+1
VPE 504	Principles of Epidemiology*	2+1
VPE 505	Hygiene and Safety of Foods of Animal and Aquatic Origin*	2+1
VPE 506	Food-borne Infections and Intoxications	2+1
VPE 507	Food Safety Standards, and Regulations	2+1
VPE 508	Environmental Hygiene and Safety	2+1
VPE 509	Applied Epidemiology	2+1
VPE 510	Biosecurity, Bioterrorism and Disaster Management	2+0
VPE 511	Laboratory Techniques in Veterinary Public Health*	0+3
VPE 591	Master's seminar*	0+1
VPE 599	Master's research	30

*Core courses

Minor Subjects:

Veterinary Microbiology,
 Animal/Veterinary Biotechnology,
 Veterinary Medicine,
 Veterinary Parasitology,
 Veterinary Pathology,
 Veterinary Pharmacology and Toxicology,
 Statistics

*Any other discipline as per the requirement of the research problem of the student.

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 501
 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 502
 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

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 503

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 504

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.

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 505
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. 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 Publishinged.
- Wro and Bruno. *Fish Disease and Disorders – Viral Bacterial and Fungal Infections*.

- I. Course Title : Food-borne Infections and Intoxications
II. Course Code : VPE 506
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*,

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 others. 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 507

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.

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 508
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.

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 509

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.

- 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 510

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 511

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-ware, 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 thermotolerant 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*.
- Gradwohl's *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 501
 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 502
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, melioidosis, 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 *Bacillus anthracis* and zoonotic *Mycobacterium* species.
3. Isolation, identification and characterization of zoonotic *Streptococcus* and *Staphylococcus* species.

Lecture(s) Topic

4. Isolation, identification and characterization of agents of *Clostridium tetani* and zoonotic *Listeria* species.
5. Isolation, identification and characterization of zoonotic *Leptospira* and *Borrelia* species.
6. Isolation, identification and characterization of *Burkholderia mallei* and *Burkholderia pseudomallei*
7. Isolation, identification and characterization of zoonotic *Brucella* species
8. Isolation, identification and characterization of food-borne and zoonotic *Salmonella* species including serotyping of isolates
9. Isolation, identification and characterization of zoonotic *Yersinia* and *Vibrio* 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 503
 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

	and management of Ebola, Marburg and Hantavirus
17-18	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 *Toxoplasma gondii*
12. Detection and characterization of zoonotic *Trypanosoma* species
13. Detection and characterization of zoonotic *Cryptosporidium* species of health significance
14. Detection and characterization of zoonotic *Leishmania* species
15. Detection and characterization of zoonotic *Sarcocystis* species
16. Detection and characterization of zoonotic agents responsible for dracunculiosis, paragonimiosis and diphylobothriosis

I. Course Title	: Principles of Epidemiology
II. Course Code	: VPE 504
III. Credit Hours	: 2+1

Lecture(s)	Topic
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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 505

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

Lecture(s)	Topic
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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 506
III. Credit Hours : 2+1

Lecture(s)	Topic
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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 *Salmonella* and *Campylobacter* species
- 18-19 Foodborne disease due to *Clostridium*, *Staphylococcus*, *Listeria* and *Bacillus* species
- 20-22 Foodborne diseases due to species of *Vibrio*, *Escherichia*, *Shigella*, *Yersinia*, 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

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	<ol style="list-style-type: none"> 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 507
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

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 *in-vitro* 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 508
III. Credit Hours	: 2+1

Lecture(s)	Topic
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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

Lecture(s)	Topic
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- 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.

I. Course Title : Applied Epidemiology
II. Course Code : VPE 509
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 9-10
- Disease occurrence and ecology of disease
- 11 Monitoring and surveillance
- 12 Outbreak investigation protocol
- 13 Path, regression and discriminate analyses
- 14 Time series analysis
- 15 Statistical analysis of the data - Analysis of variance
- 16 Animal disease economics - cost-benefit analysis, internal rate of return payback period, etc.

- 17 Animal disease economics - partial budgeting
- 18 Animal disease economics - decision analysis
- 19 Bayesian analysis
- 20 Monte-Carlo and Markovian processes and system evaluation
- 21 Multivariate analysis
- 22 Disease outbreaks and participatory epidemiology
- 23 Disease reporting system - tracing and notification
- 24 Disease control strategies
- 25 Risk assessment
- 26 Exotic diseases and trans-boundary diseases
- 27 Vaccination for the prevention of diseases
- 28 Disease intelligence
- 29 Tele-epidemiology
- 30 Application of remote sensing technology
- 31 Geographic information system
- 32 Disease surveillance and early warning system

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 510
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, tsunamis, 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 511
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 thermotolerant organisms
22-23	Microbiological techniques: enumeration techniques for psychrophilic, mesophilic, thermophilic and thermotolerant 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)

10. Animal Genetics and Breeding

Course Title with Credit Load

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

Minor Subjects:

Animal/ Veterinary Biotechnology

Livestock Production and Management

Veterinary Gynaecology and Obstetrics

Veterinary Biochemistry

Veterinary Physiology

Animal Nutrition

*Any other discipline as per the requirement of the research problem of the student.

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.
- 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.

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*, vol II. *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. 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.

Theory

VI. 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 Tantia 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
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.

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.

Animal Production Sciences: Animal Genetics and Breeding

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

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

VII. 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.

VIII. Teaching methods

Blackboard; PPT-animations; research article discussion in the classroom

- IX. Learning outcome
Different breeds of cats and dogs and their breeding management
- X. 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.
- 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.
- 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

- Dmitriev 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: χ^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 χ^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.

11. Animal Nutrition

Course Title with Credit Load

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

Minor Subjects:

Animal/ Veterinary Biotechnology

Livestock Production and Management

Veterinary Biochemistry

Veterinary Physiology

Livestock product Technology

*Any other discipline as per the requirement of the research problem of the student.

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. 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. 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.10.
- 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 piggery 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.

- 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

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

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.

- 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.

II. Course Title : Non-Conventional Feed Resources

III. Course Code : ANN 610

IV. Credit Hours : 1+1

V. 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.

VI. 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.

VII. 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. 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.

VIII. 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.

IX. Teaching methods

- Classroom lectures using audio-visual aids
- Instructional conversations and discussions
- Hands-on learning and assignments
- Hands-on training of laboratory techniques

X. Learning outcome

Comprehensive knowledge on the integration of alternative feed resources in practical farm animal production.

XI. 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*

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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. 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.

12. Livestock Production and Management

Course Title with Credit Load

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

Minor Subjects:

Animal Nutrition

Animal Genetics and Breeding

Livestock product Technology

Veterinary and Animal Husbandry Extension Education

*Any other discipline as per the requirement of the research problem of the student

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.

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, tupping. 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.
- *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
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.

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 managemental 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, Timdall 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
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. 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.

- 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 it's 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.

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.

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.
- 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

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.

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

13. Livestock Products Technology

Course Title with Credit Load

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

Minor Subjects:

Veterinary Biochemistry

Veterinary Microbiology

Veterinary public health

Livestock Production and Management

*Any other discipline as per the requirement of the research problem of the student

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.

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.
 • 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.

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.

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.

- 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.

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*.

14. Poultry Science

Course Title with Credit Load

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
- 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

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.

- 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.

- 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

- 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.

15. Animal Reproduction Gynaecology and Obstetrics
Course Title with Credit Load

Course Code	Course Title	Credit Hours
VGO 501	General Gynaecology*	2+1
VGO 502	Female Infertility in Farm Animals*	2+1
VGO 503	Veterinary Obstetrics*	2+1
VGO 504	Andrology and Male Infertility*	2+1
VGO 505	Semen Preservation and Artificial Insemination	2+1
VGO 506	Basics of Reproductive Biotechnology*	2+1
VGO 507	Clinical Practice-I*	0+3
VGO 508	Clinical Practice-II*	0+3
VGO 509	Canine and Feline Reproduction	2+1
VGO 510	Caprine and Ovine Reproduction	2+1
VGO 511	Equine Reproduction	2+1
VGO 512	Camel Reproduction	2+1
VGO 513	Elephant Reproduction	2+1
VGO 514	Wild and Zoo Animal Reproduction	2+1
VGO 515	Porcine Reproduction	2+1
VGO 516	Ultrasonography In Animal Reproduction	1+2
VGO 590	Special Problem	0+1
VGO 591	Master's Seminar	1+0
VGO 599	Master's Research	30

*Core
Courses

Minor Subjects:

- Veterinary Pathology
- Veterinary Pharmacology
- Veterinary Physiology
- Veterinary Biochemistry
- Veterinary Bacteriology
- Veterinary Immunology
- Veterinary Surgery
- Veterinary Medicine

*Any other discipline as per the requirement of the research problem of the student.

Course Contents -M.V.Sc. in Animal Reproduction Gynaecology and Obstetrics

I. Course Title : General Gynaecology

II. Course Code : VGO 501

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 502

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

Managerial 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, histopathological 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.
- 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 503

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 anesthesia.

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 anesthesia, 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.

- 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 Dufty JH. 1980. *Handbook of Bovine Obstetrics*. Williams and Wilkins.

I. Course Title : Andrology and Male Infertility

II. Course Code : VGO 504

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 it's 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.

- 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 505
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.

- 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 506

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.
- Tacia Gomes Bergstein-Galan. 2018. *Reproduction Biotechnology in farm animals*. Avid Science.

I. Course Title : Clinical Practice-I

II. Course Code : VGO 507

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 508
 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 509
 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 510

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 511

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 its management.

Unit IV

Pregnancy diagnosis and management of the pregnant mare. Fetal development, abortion, induced parturition and dystocia. 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 Pycock 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 512

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.

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 513

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 bioilogy of wild Asian elephants Elephas maximus*. Int. Zoo Yb. 40: 1-8.
- Thitaram C. 2009. *Elephant reproduction: Improvement of breeding efficiency and development*
- 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 514

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 515

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,

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 516
 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.

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 Willemse. 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 590
 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 591 Master's Seminar 1+0

VGO 599 Master's Research 30

VGO 501: 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 502: 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. Managemental 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 503: 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 504: 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 animal.

VGO 505: 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 506: 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 509: 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, ovariectomy and caesarean section.
7. Surgical procedure related to reproductive disorders in both male and female dogs and cats.

VGO 510: 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 511: 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 512: 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 513: 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 514: 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.
- 6.

VGO 515: 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 516: 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.

17. Veterinary Surgery and Radiology

Course Title with Credit Load

Course Code	Course Title	Credit Hours
VSR 501	Clinical Practice-I*	0+3
VSR 502	Clinical Practice-II*	0+3
VSR 503	Principles of Surgery*	2+1
VSR 504	Anaesthesia And Analgesia*	2+1
VSR 505	Diagnostic Imaging Techniques*	2+1
VSR 506	Soft Tissue Surgery	2+1
VSR 507	Orthopaedic Surgery*	2+1
VSR 508	Anaesthesia of Zoo, Wild, Exotic and Laboratory Animals	1+1
VSR 509	Urogenital Surgery	1+1
VSR 510	Ophthalmology	1+1
VSR 511	Dentistry and Oral Surgery	1+1
VSR 512	Camel Surgery	1+1
VSR 513	Elephant Surgery	1+1
VSR 587	Clinical Case Conference	0+1
VSR 588	Special Problem in Radiology	0+2
VSR 589	Special Problem in Anaesthesia	0+2
VSR 590	Special Problem in Surgery	0+2
VSR 591	Masters Seminar	1+0
VSR 599	Masters Research	0+30

*Core
Courses

Minor Subjects:

Veterinary Physiology
Veterinary Biochemistry
Veterinary Biotechnology
Veterinary Anatomy
Veterinary Medicine
Veterinary Pathology
Animal Reproduction, Gynaecology and Obstetrics

*Any other discipline as per the requirement of the research problem of the student.

Course Contents - M.V.Sc. in Veterinary Surgery and Radiology

I. Course Title : Clinical Practice-I

II. Course Code : VSR 501

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 502

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 503

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 504

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.

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 505

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 506

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, Richter 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.

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 507
- 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 508
- 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 509

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, ovariohysterectomy 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-hydropulsion, Restraint and anaesthesia for urogenital tract surgery, Cystotomy, Tube cystostomy, Nephrotomy, Ureterocolostomy, Urethrotomy, Urethrostomy, Castration, Vasectomy, Penile deviation, Epididymectomy, Amputation of penis, Episiotomy, Ovariohysterectomy, 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 510
- 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.
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 511
- 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 512

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 513
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 587
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 588
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 589
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 591 MASTERS SEMINAR (1+0)

VSR 599 MASTERS RESEARCH (0+30)

Course Outline: Lecture wise

VSR 503: Principles of Surgery (2+1)

S. No.	Topics	No. of Lectures/ Practicals
Theor	Unit I	
y	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

- 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 504: 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 euthanasia	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 505: 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

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 506: Soft Tissue Surgery (2+1)

S. No.	Topics	No. of Lectures/ Practicals
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Theory

Unit I

1.	Skin, adnexa, integument, appendages, horn, tail, sinus affections of equine and bovine	3
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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.

S. No.	Topics	No. of Lectures/ Practicals
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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

- | | |
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| 8. Various affections of the joints and their treatment | 3 |
| 9. Various affections of the ligaments and tendons and their treatment | 3 |

Unit IV

- | | |
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| 10. Spinal affections and injury to axial skeleton | 3 |
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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 interlocking 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 Othopaedics 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 508: 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 rhinolith	1
10.	Pharyngostomy	1
11.	Ingluviotomy	1
12.	Ventriculotomy	1

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 509: Urogenital Surgery (1+1)

S. No.	Topics	No. of Lectures/ Practicals
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

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, urethroostomy	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 510: 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

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 511: 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

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 512: 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

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, cystorrhesis	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

- *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 513: 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

17. Veterinary Medicine

Course Title with Credit Load

Course Code	Course Title	Credit Hours
VMD 501*	Ruminant Medicine-internal	3+0
VMD 502*	Ruminant Medicine-infectious	3+0
VMD 503	Equine Medicine	2+0
VMD 504*	Canine and Feline Medicine-I	2+0
VMD 505*	Canine and Feline Medicine-II	2+0
VMD 506	Metabolic and Endocrine Diseases, Nutritional Deficiencies and Diseases of Mammary Gland	2+0
VMD 507	Paediatrics and Geriatrics	2+0
VMD 508	Avian and Swine Medicine	2+0
VMD 509	Zoo, Wild and Laboratory Animal Medicine	1+0
VMD 510	Toxicology and Forensic Medicine	1+0
VMD 511*	Clinical Diagnostic Techniques	0+2
VMD 512	Emergency Medicine	0+2
VMD 513*	Diagnosis of Veterinary Infectious Diseases	0+1
VMD 514	Oncology and Ethno-veterinary Medicine	1+0
VMD 515	Animal Disease Investigation and Biosecurity	1+1
VMD 516*	Clinical Practice-I	0+3
VMD 517*	Clinical Practice-II	0+3
VMD 591	Master's Seminar	1+0
VMD 599	Master's Research	0+30

Minor courses:

Veterinary Physiology
 Veterinary Microbiology
 Veterinary Parasitology
 Veterinary Pharmacology and Toxicology
 Veterinary Surgery and Radiology
 Veterinary Public Health and Epidemiology

*Any other discipline as per the requirement of the research problem of the student.

Course Contents - M.V.Sc. in Veterinary Medicine

I. Course Title : Ruminant Medicine - Internal

II. Course Code : VMD 501

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 502

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, Colibacillosis, 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, Scrapie, Bovine Anaplasmosis, Theileriosis, Babesiosis, Fascioliosis, 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 503

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, Coccidiomycosis 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 504
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 505
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 Dermatomycosis, 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.

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 506

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, Peri-parturient 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 507

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.

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 508
- 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 509
- 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 510

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 511

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, Brochoscopy, 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 512

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 513**
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 scraping 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 514**
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 515**
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 516**

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 517**

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 501: 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 502: 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.	Actinomyces/ Actinobacillosis	1
18.	Ringworm	1
19.	Systemic mycotic infections (Aspergillosis, candidiasis, histoplasmosis, sporotrichosis, coccidioidomycosis, 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

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 503: 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 504: 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

- *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 505: 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 *Publisher:* Saunders
- Research and Review Papers in Current Journals.

MD 506: 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 I	
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 507: 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 508: 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 (Ascaridiasis 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 Karriker, 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 509: 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 510: 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 511: 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

- *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 512: 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 513 : 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 514: 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

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 515: 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.

18. Veterinary Extension Education

Course Title with Credit Load

Course Code	Course Title	Credit Hours
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+30

Minor Subjects:

Animal Nutrition

Poultry Science

Livestock Production Management

Public Health and Epidemiology

Livestock Economics

Statistics

Livestock products technology

*Any other discipline as per the requirement of the research problem of the student.

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 approaches, functions, roles, responsibilities, organizational 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.
https://cgspace.cgiar.org/bitstream/handle/10568/99/Source_book.pdf
- Ashok G, Sharma P, Anisha S and Prerna T. 2018. *Agriculture Extension System in India Review of Current Status, Trends and the Way Forward*, Indian Council for Research on

International Economic Relations (ICRIER).

<http://icrier.org/pdf/Agriculture-Extension-System-in-India-2018.pdf>

- Bitzer V, Wongtschowski M, Hani M and Blum M. 2016. *New directions for inclusive Pluralistic Service Systems. In New Directions for Inclusive Pluralistic Service Systems* Rome (Italy). FAO. <http://www.fao.org/3/a-i6104e.pdf>
- Burton ES and Kristin D. 2014. *Status of Agricultural Extension and Rural Advisory Services Worldwide*. GFRAS: Lindau, Switzerland.
<http://www.g-fras.org/en/knowledge/gfras-publications.html?download=391:status-of-agricultural-extension-and-rural-advisory-services-worldwide>
- Burton ES, Robert PB and Andrew JS. 1997. *Improving agricultural extension A reference manual*, FAO Rome
https://www.oerafrica.org/FTPFolder/Website%20Materials/Agriculture/haramaya/Perspective_Agricultural_Extension/Attachment/Improving%20AgEx.-FAO.pdf
- Dahama OP and Bhatnagar OP. 1987. *Education and Communication for Development*. Cambridge Univ. Press.
- Davis K and Sulaiman RV. 2016. *Extension Methods and Tools*. Module 2 NELK. GFRAS. <https://www.g-fras.org/en/component/phocadownload/category/70-new-extensionist-learning-kit-nelk.html?download=560:nelk-module-2-extension-methods-and-tools-textbook>
- Dharma OP. 2017. *Development Perspectives in Extension Education* Agro Tech Publishing Academy, Udiapur
- FAO. 2016. *New directions for inclusive Pluralistic Service Systems*. Report of FAO Expert Consultation. Food and Agriculture Organization of the United Nations and Royal Tropical Institute, Rome.
<http://www.fao.org/3/ai6103e.pdf>
- GFRAS. 2016. *The New Extensionist Learning Kit*.
<http://g-fras.org/en/knowledge/new-extensionist-learningkit-nelk.html#module-1-introduction-to-the-new-extensionist>
- Gwyn EJ and Garforth C. n.d. *The history, development, and future of agricultural extension*. FAO. Rome.
<http://www.fao.org/docrep/W5830E/w5830e03.htm>
- 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>
- Swanson BE. 2008. *Global Review of Good Agricultural Extension and Advisory Service Practices*. Food and Agriculture Organization of the United Nations. Rome.
<http://www.fao.org/docrep/pdf/011/i0261e/i0261e00.pdf>
- 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
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.
- Mcquail D and Windahl S. 1993. *Communication Models for the Study of Mass Communications*. Longman Publ.
- Ray GL. 2011. *Extension, Communication and Management*. Kalyani Publishers, Ludhiana.
- Rogers EM and Shoemaker FF. 1971. *Communication of Innovations: A Cross – Cultural Approach*. The Free Press.
- Roloft Michael F. 1981. *Interpersonal Communication*. Sage Publ.
- Ruben Brent D. *Communication and Human Behaviour*. McMillan Publishing Company. New York. 1984.
- Sehgal MK and Khetrapal V. 2008. *Business Communication*. Excel Books. New Delhi.
- Srinivasa Raju Melkote and H Leslie Steeves. 2001. *Communication for Development Theory and Practice for empowerment and social justice*. Sage Publications
- Andres D and Woodard J. 2013. *Social media handbook for agricultural development practitioners*. Publication by FHI360 of USAID.
<http://ictforag.org/toolkits/social/SocialMedia4AgHandbook.pdf>
- Barber J, Mangnus E and Bitzer V. 2016. *Harnessing ICT for agricultural extension*. KIT Working Paper 2016: 4.

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- Bheenick K and Bionyi I. 2017. *Effective Tools for Knowledge Management and Learning in Agriculture and Rural Development*. CTA Working paper.
https://publications.cta.int/media/publications/downloads/1986_PDF.pdf
- FAO 2011. *E-learning methodologies a guide for designing and developing e-learning courses*. Food and Agriculture Organization of the United Nations.
<http://www.fao.org/docrep/015/i2516e/i2516e.pdf>
- George T, Bagazonzya H, BallantyneP, Belden C, Birner R, Del CR and Treinen S. 2017. *ICT in agriculture: connecting smallholders to knowledge, networks, and institutions*. Washington, DC: World Bank.
https://openknowledge.worldbank.org/handle/10986/12613_16
- Mayer RE. 2005. *The Cambridge handbook of multimedia learning*. New York: University of Cambridge.
- Mittal N, Surabhi, Gandhi, Sanjay and Gaurav T. 2010. *Socio-Economic Impact of Mobile Phones on Indian Agriculture*. ICRIER Working Paper No. 246, Indian Council for Research on International Economic Relations (ICRIER), New Delhi.
- Saravanan R and Suchiradipta B. 2016. *Social media policy guidelines for agricultural extension and advisory services, GFRAS interest group on ICT4RAS, GFRAS: Lindau, Switzerland*.
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.
<https://openknowledge.worldbank.org/handle/10986/27526>

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	
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
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.
- Dasgupta. 1989. *Diffusion Agricultural Innovations in Village India*. Wadsworth Publ.
- 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
- ILRI. 2014. *Innovation Platform practice briefs*. International Livestock Research Institute. <https://clippings.ilri.org/2014/02/03/ipbrief1/>
- Leeuwis C and van den Ban A W. 2004. *Communication for rural innovation: Rethinking agricultural extension*. John Wiley and Sons. Methuen.
- OECD. 2012. *Innovation for Development. A Discussion of the Issues and an Overview of Work of the OECD Directorate for Science, Technology and Industry*. <https://www.oecd.org/innovation/inno/50586251.pdf>
- Ray GL. 2005. *Extension Communication and Management*. Kalyani Publishers, AA. 1987.
- Rogers EM. 2003. *Diffusion of Innovations*. Free Press.
- Wiley Eastern. Jaliha KA and Veerabhadraiah V. 2007. *Fundamentals of Extension Education and Management in Extension*. Concept Publ. Co.
- World Bank. 2006. *Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems*. Washington, DC: World Bank. © World Bank. <https://openknowledge.worldbank.org/handle/10986/7184>
- World Bank. 2012. *Agricultural Innovation Systems: An Investment Source book*. Washington DC, World Bank. <http://siteresources.worldbank.org/INTARD/Resources/335807-1330620492317/9780821386842.pdf>

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
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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.
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- 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
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Theory

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|----|---|---|
| 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
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.

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.

- 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.

- 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.
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	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

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://cgispace.cgiar.org/bitstream/handle/10568/33425/GenderInLivestock.pdf>
- <http://wcd.nic.in/womendevlopment/national-policy-women-empowerment>

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
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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.	
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.

SYLLABUS OF COMMON COURSES FOR PG PROGRAMMES
GS 601 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 602 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.

PGS 603 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 604 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. Erbis 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 605 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.

SYLLABUS OF SUPPORTING COURSES FOR PG PROGRAMMES

I. Course Title : Statistical Methods for Applied Sciences

II. Course Code : STAT 502

III. Credit Hours : 3+1 IV.

IV. Aim of the course 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.

V. Theory

Unit I

Box-plot, 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.

Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.

Unit III

Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination, Fitting of quadratic models.

Unit IV

Non-parametric tests – sign, Wilcoxon, Mann-Whitney U-test, Run test for the randomness of a sequence. Median test.

Unit V

Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.

VI. 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 Correlation and regression analysis, fitting of Linear and Quadratic Model.
- Non-parametric tests. ANOVA: One way, Two Way, SRS.

VII. Suggested Reading

- Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
- Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
- Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
- Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.
- Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill.
- Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
- Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.

- Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed . John Wiley

I. Course Title : Data Analysis Using Statistical Packages

II. Course Code : STAT 522

III. Credit Hours : 2+1

IV. Aim of the course

This course is meant for exposing the students in the usage of various statistical packages for analysis of data. It would provide the students a hands on experience in the analysis of their research data. This course is useful to all disciplines.

V. 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.

VI. 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-squares 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.

VII. 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.

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 - Weisberg S. 1985. Applied Linear Regression. John Wiley.
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- Wetherill GB. 1986. Regression Analysis with Applications. 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.

I. Course Title : Basic Biochemistry

II. Course Code : BIOCHEM 501

III. Credit Hours : 3+1

IV. Why this course?

To impart the fundamental knowledge on structure and function of cellular components involved in biological processes and an elementary introduction to the study of molecular biology.

V. Aim of the course

The course is designed to provide elementary knowledge/overview of structure and function of proteins, carbohydrates, lipids, nucleic acids and other biomolecules and their metabolism.

No. Blocks Units

1. Introduction to Biochemistry

1. Scope and importance of biochemistry

2. Foundation of life

3. Water

4. Physical techniques for structure determination

2. Structure and function of

1. Biomolecules biomolecules 2. Immunoglobulins and PR proteins

3. Plant secondary metabolites

3. Metabolism – the basics 1. Molecules aiding metabolism

2. Thermodynamics –principles and energetic of life

4. Catabolism and its regulation

1. Catabolism of energy molecules

2. ATP formation

5. Fundamentals of Molecular biology 1. Molecular biology processes and genetic engineering 2. Recombinant DNA technology

VI. Theory

Block 1: Introduction to Biochemistry

Unit 1: Scope and importance of biochemistry (1 Lecture)

Biochemistry as modern science and its various divisions, Scope and importance of biochemistry in agriculture and allied sciences.

Unit 2: Foundation of life (2 Lectures)

Fundamental principles governing life, supramolecular structures, significance of weak non covalent interactions in biology

Unit 3: Water (3 Lectures)

Structure of water, ionization of water, acid base concept, pH and buffers, significance of structure-function relationship.

Unit 4: Physical techniques for structure determination (2 Lectures)

General introduction to physical techniques for determination of structure of biopolymers.

Block 2: Structure And Function of Biomolecules

Unit 1: Biomolecules (10 Lectures)

Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids.

Unit 2: Immunoglobulins and PR proteins (2 Lectures)

Structure, formation and different forms of immunoglobulins, PR proteins and their classification.

Unit 3: Plant secondary metabolites (3 Lectures)

Structure, classification and function of plant secondary metabolites.

Block 3: Metabolism – The Basics

Unit 1: Molecules aiding metabolism (2 Lectures)

Structure and biological functions of vitamins and coenzymes, enzymes: classification and mechanism of action; regulation, factors affecting enzyme action. Hormones: animal and plants.

Unit 2: Thermodynamics –principles and energetic of life (2 Lectures)

Fundamentals of thermodynamic principles applicable to biological processes, Bioenergetics.

Block 4: Catabolism and its Regulation

Unit 1: Catabolism of energy molecules (5 Lectures)

Important and basic degradative metabolic pathways of carbohydrates, lipids and proteins and their regulation.

Unit 2: ATP formation (3 Lectures)

Formation of ATP, substrate level phosphorylation, electron transport chain and oxidative phosphorylation, chemiosmotic theory and proton motive force.

Block 5: Fundamentals of Molecular Biology and Genetic Engineering

Unit 1: Molecular biology processes (4 Lectures)

Overview of replication, transcription and translation.

Unit 2: Recombinant DNA technology (3 Lectures)

Restriction enzymes, DNA cloning, applications of cloning, transgenics.

VII. 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

Basic Sciences: Biochemistry

- 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
- Qualitative tests for secondary plant metabolites.

VIII. Teaching methods/activities

- Classroom lectures (oral + audio-visual)
- Assignment (Reading/Writing)
- Oral presentation by students on specified topics
- Class room quiz

IX. Learning outcome

With this course, the students are expected to be able to understand the actual concepts and fundamental processes of biology at molecular level

X. 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.

I. Course Title : Techniques in Biochemistry

II. Course Code : BIOCHEM 505*

III. Credit Hours : 2+2

Why this course?

Biochemical studies rely on the availability of appropriate analytical techniques and their applications. This course will examine modern methods and technologies that are used in biochemical analysis with emphasis on instrumentation, underlying principles, aims, strategies and current applications.

V. Aim of the course

To provide hands-on experience to different biochemical techniques commonly used in research along with the knowledge on principles and the instrumentation.

No. Blocks Units

1. Separation techniques 1. Chromatography techniques
2. Electrophoretic technique
3. Hydrodynamic methods
4. Centrifugation
2. Spectroscopic techniques 1. Spectrophotometry
2. Mass spectroscopy
3. Atomic absorption spectrophotometry
3. Microscopy 1. Microscopic techniques
4. Tracer, imaging, immunochemical 1. Tracer techniques and other techniques 2. Imaging techniques
3. Immunochemical techniques
4. Other techniques

VI. Theory

Block 1: Separation Techniques

Principles and applications of separation techniques.

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 (2 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.

Block 2: Spectroscopic Techniques

Unit 1: Spectrophotometry (3 Lectures)

Principles and applications of UV-visible, Fluorescence, IR and FTIR, Raman, NMR and FTNMR, ESR and X-Ray spectroscopy.

Unit 2: Mass spectroscopy (3 Lectures)

MS/MS, LC-MS, GC-MS, MALDI-TOF, applications of mass spectrometry in biochemistry.

Unit 3: Atomic absorption spectrophotometry (2 Lectures)

Principle, function and instrumentation of atomic absorption spectrophotometry.

Block 3. Microscopy

Unit 1: Microscopic techniques (2 Lectures)

Principles and applications, light, UV, phase contrast, fluorescence and electron microscopy, flow cytometry.

Block 4: Tracer, Imaging, Immunochemical and Other Tec

Block 4: Tracer, Imaging, Immunochemical and Other Techniques

Unit 1: Tracer technique (2 Lectures)

Tracer techniques in biology: concept of radioactivity, radioactivity counting methods with principles of different types of counters, concept of α , β and γ emitters, scintillation counters, J-ray spectrometers, autoradiography, applications of radioactive tracers in biology.

Unit 2: Imaging techniques (2 Lectures)

Principles and applications of phosphor imager, MRI and CT scan.

Unit 3: Immunochemical technique (2 Lectures)

Production of antibodies, immunoprecipitation, immunoblotting, immunoassays, RIA and ELISA.

Unit 4: Other techniques (2 Lectures)

Cryopreservation, polymerase chain reaction (PCR), FACS.

VII. 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

VIII. Teaching methods/activities

- Classroom lectures (oral + audio-visual)
- Assignment (Reading/Writing)
- Oral presentation by students on specified topics

- Class room quiz
- Case study

IX. Learning outcome

At the end of the course, the student will acquire the basic knowledge of the main biochemical methods used in the separation, identification, characterization and analysis of biomolecules.

X. 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

Annexure

Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry-9

CONSTITUTION OF ADVISORY COMMITTEE AND APPROVAL

1. Name of the Student :
2. Reg. No. :
3. Department :
4. Degree :
5. Date of Joining :
6. Major Field :
7. Minor Fields :
8. Proposed Research Problem : (*Broad area of research*)
9. Degrees Earned :

Degree	University / College	Year	% of Marks / OGPA

Whether the prescribed core courses included? YES/NO

(Details of course work done enclosed – Form 2(a))

Advisory Committee Proposed

Sl.No.	Name & Designation	Status	Signature
		Chairman	
		Member	
		Member	
		Member	

Recommended

Chairman, Advisory Committee

Date:

Approved

Dean

Date:

Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry-9

CONSTITUTION OF ADVISORY COMMITTEE AND APPROVAL

Details of Course Work Done:

Course No.	Course Title	Semester	Credit Hours	
			Theory	Practical
Major Field:				
Minor Field:				

Signature of the Student

Date:

Chairman, Advisory Committee

Date:

**PONDICHERRY UNIVERSITY
PUDUCHERRY– 605 014**

College: Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry-9

Submission of Thesis for M.V.Sc Degree

1. Subject :
 2. Name of the Student :
 3. Reg. No. :
 4. Academic year of Admission :
 5. Date of Admission :
 6. Date of thesis submission in the
department :
 7. Title of the thesis :
 8. State whether the thesis is as per the
approved outline of Research work :
 9. Whether details of courses completed
in major & minor fields enclosed :
- (Copy of the transcripts to be enclosed)
10. Certified that the thesis is the result of original work carried out.

Signature of the Student

**Name & Signature of the Chairman
Advisory Committee**

Submitted to the Dean

Signature of the Head of the Department

Encl.:

1. Three copies of Thesis
2. Approved ORW
3. 'No dues' certificate
4. Thesis fee receipt

**PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014**

College: Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry-9

Thesis Evaluation Report

(FORMAT)

Name of student	
Admission No.	
Degree sought	
Discipline	
Thesis Title	
1. Technical Comments	Remarks
A. Significance of research problem	
B. Abstract	
C. Research Techniques & Methodology:	
D. Results and their interpretation:	
E. Summary and Conclusions	
F. Review of literature	
2. Presentation of data	
A. Clarity of expression:	
B. Tabulation	
C. Quality of illustrations	
3. Language, Grammar and Spelling mistakes etc.	
Correctness	
Punctuation etc.	
Bibliography	
Suggested improvements, if any	
4. Contribution made in the relevant discipline	
5. Recommendations :	Highly Commended/Commended/Revise and Resubmit /Rejected (Strike out whichever is not applicable)

Signature of Examiner

Name and Address

**PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014**

College: Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry-9

Report of M.V.Sc. Thesis and Viva-Voce Examination

Name of the Student:

Reg.No.

Degree:

Subject:

Date of Viva-Voce Examination:

Title of the thesis:

The external examiner and members of the Advisory committee hereby certify that we had examined the evaluation report of the above thesis and conducted Viva-Voce examination. In the judgment of the examining body, the performance of the candidate is _____ (To be written by hand 'SATISFACTORY' or 'UNSATISFACTORY' whichever is applicable) AND the thesis is _____ (to be written by hand ACCEPTED or NOT ACCEPTED) for the award of MVSc Degree

Chairman:	Name	Signature
External Examiner:	Name	Signature
Member:	Name	Signature
Member:	Name	Signature
Member:	Name	Signature

Forwarded (in duplicate) to the Dean, RIVER for onward transmission to the University.

Head of the Department

PONDICHERRY UNIVERSITY**PUDUCHERRY – 605 014****College: Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry-9****MVSC DEGREE PROGRAMME****MARK SHEET FOR I/II/III/IV SEMESTER (Academic year).****Name:****Reg. No.****Subject:**

Sl. No.	Course No.	Title of course	Credit hrs.	Theory					Practical					Grade Point of the Course	Result (Pass/ Fail)
				Internal 50	External 50	Total Marks/ 100	Grade points	Credit points	Internal 50	External 50	Marks/ 100	Grade points	Credit points		
				Grade Point Average (GPA)											

Previous_____OGPA

Cumulative_____OGPA

Minimum OGPA for Pass: 6.50.**IV SEMESTER**

TITLE OF THESIS: _____

Remarks of the Examiner: HIGHLY COMMENDED/ COMMENDED *

Date of Viva Voce Examination: _____

Remarks : SATISFACTORY / UNSATISFACTORY *

* Strike out which ever is not applicable

Date:

Signature

Format of ORW and Thesis

Format of Outline of Research Work (Guidelines)

<Title>



Outline of Research Work

for

M.V.Sc. Degree

in

<subject>

Submitted by

<Name of the Student>

<Registration Number>

To

*Rajiv Gandhi Institute of Veterinary Education and Research,
Kurumbapet, Puducherry – 605 009*

<year>

Outline of Research Work for M.V.Sc Degree

1. Name of the Student :
2. Reg. No. :
3. Department :
4. Degree :
5. Date of Joining :
6. Major Field :
7. Minor Fields :
8. Title of the thesis :
9. Objectives :
10. Review of Literature :
11. Plan of Research Work
including Methodology :
12. Facilities required & their availability :

(Signature of the student)

Date:

Advisory Committee

Sl.No.	Name	Status	Signature
		Chairman	
		Member	
		Member	
		Member	

Certified that the ORW of the student has been formulated and finalized in accordance with the laid down procedures.

Signature of the Head of the Department

Date:

ARROVED / NOT APPROVED

Signature of the Dean

FORMAT OF THE THESIS *(Guidelines)*

The thesis should be prepared with the following contents:

- | | | |
|--------------------------|---|--|
| 1. Cover page | - | <i>Page 1 of thesis format</i> |
| 2. Inside Cover | - | <i>Page 1 of thesis format</i> |
| 3. Certificates | - | <i>Page 2 & 3 of thesis format</i> |
| 4. Dedication, if any | | |
| 5. Acknowledgements | | |
| 6. List of Abbreviations | | |
| 7. Abstract | - | <i>Page 4 of thesis format</i> |

INDEX (Indicate the starting and ending page of each section, eg. 9-17)

8. *Introduction (including Objectives)
 9. *Review of Literature
 10. *Materials and Methods
 11. *Results
 12. *Discussion
 13. *Summary
 14. *Conclusion
 15. *Appendices (Optional) – Additional data (tables / figures etc.,) in support of the results, if required
 16. *References - *Page 5 of thesis format*
-

* Before beginning of each of the above topics, a separate sheet with heading printed in bold letters should be inserted.

- The thesis should be typed in A4 size paper in MS word format using New Times Roman font with letter size 12 on the one side of the paper
- 1.5” margin on left side and 1” margin on right side should be given
- The space between the lines should be 1.5
- The thesis should be soft bound

<Title of the Thesis>

Thesis

Submitted in partial fulfillment of
the requirements for the award of the degree of

Master of Veterinary Science
in
<Subject>

To
Pondicherry University

by

Dr. *. *****
(Reg. No. #####)



Department of xxxxxx

RAJIV GANDHI INSTITUTE OF VETERINARY EDUCATION AND RESEARCH

Puducherry – 605 009

<Month> <Year>

**RAJIV GANDHI INSTITUTE OF VETERINARY EDUCATION AND RESEARCH
Puducherry – 605 009**



Dr. xxxxxx
Designation
Department

Date: _____

CERTIFICATE

This is to certify that the thesis entitled “xxxxxxxxxxxxxxxxxxxxxxxxxxxxx” submitted by Dr. xxxxxx in partial fulfillment of the requirements for the award of degree of **MASTER OF VETERINARY SCIENCE** (subject) of the Pondicherry University is a bonafide research work carried out under my guidance and supervision and no part of the thesis has been submitted for the award of any other degree or diploma.

(Name)
Major Advisor & Chairman

<***Title of Thesis***>

Thesis Submitted to
Pondicherry University, Puducherry
in partial fulfillment of the requirements for the
award of the degree of

Master of Veterinary Science
in
<***Subject***>

by

Dr. *. *****
(Reg. No. #####)

APPROVED

External Examiner
(Signature & Name)

Major Advisor & Chairman
(Signature & Name)

Members, Advisory Committee

1. Name, Designation & Address
(Signature)

2. Name, Designation & Address
(Signature)

3. Name, Designation & Address
(Signature)

[To be signed after the successful completion of Viva –Voce]

ABSTRACT (not more than 300 words)

1. Name of the Candidate :
2. Reg. No. :
3. College :
4. University :
5. Degree :
6. Major Field :
7. Year of submission :
8. Title of the thesis :
9. Name of the Supervisor :

(Type the content of the abstract in single line spacing)

REFERENCES

The references are to be arranged according to the alphabetical order of the first author's name in the following format.

Gillespie BE and Oliver SP (2005) Simultaneous detection of mastitis pathogens, *Staphylococcus aureus*, *Staphylococcus uberis*, and *Streptococcus agalactiae* by multiplex real – time polymerase chain reaction. *J. Dairy Science*, 88: 3510-3518.

Gillespie BE and Oliver SP (2005) Simultaneous detection of mastitis pathogens, *Staphylococcus aureus*, *Staphylococcus uberis*, and *Streptococcus agalactiae* by multiplex real – time polymerase chain reaction. *J. Dairy Science*, 88: 3510-3518.

Use 1.0 space within the reference and 1.5 space between the references