

## TANUVAS POSTGRADUATE REGULATIONS – 2009

### 1. Short title and commencement

- (1) These regulations shall be called Tamil Nadu Veterinary and Animal Sciences University Postgraduate Regulations – 2009
- (2) This shall apply to the students admitted from the academic year 2010–2011 onwards.
- (3) In these regulations, unless the context otherwise requires the words and expressions used in these regulations shall be interpreted to have the same meanings as they have in the Act.

### 2. Definitions – In these regulations, unless the context otherwise requires,

1. **“Act”** means Tamil Nadu Veterinary and Animal Sciences University Act, 1989 (Tamil Nadu Act 42 of 1989)
2. **“Government”** means the State Government of Tamil Nadu.
3. **“Statutes”** means Tamil Nadu Veterinary and Animal Sciences University Statutes.
4. **“Academic council”** means academic council of the University.
5. **“University”** means Tamil Nadu Veterinary and Animal Sciences University;
6. **“Degree”** means the course of post-graduate studies in Basic/ Veterinary Sciences, namely M.V.Sc, Fisheries Science namely M.F.Sc and Ph.D (Doctor of Philosophy). They shall comprise of a course of study consisting of curriculum and syllabus provided by the University spread over a minimum of four semesters for M.V.Sc/M.F.Sc and a maximum of eight semesters and for Ph.D a

minimum of six semesters and a maximum of twelve semesters.

7. **“Academic year”** is a period during which a cycle of study is completed. It shall ordinarily **start from August 1** and shall consist of two semesters covering 220 days of instruction including the days of examination.
8. **“Semester”** It is an academic term consisting of not less than 110 instructional days including examination days.
9. **“Syllabus”** and **“curriculum”** means the syllabus, and curriculum for courses of study as specified by the **Indian Council of Agricultural Research(ICAR) and approved by the University;**
10. **“Course”** A course is a unit of instruction or a segment of subject matter to be covered in a semester. It has a specific number, title and credits.
11. **“Major course”** is a course taken by a student from the department in which he is majoring.
12. **“Minor course”** is a course taken by a student from a related department. The list or related department for every branch of PG programme shall be as decided by the University from time to time.
13. **“Supporting course”** is a course taken by a student from a unrelated department. The list such courses for every branch of PG programme other than the course on biostatistics shall be as decided by the Advisory

- committee of a student from time to time.
14. **"Thesis"** is one that consists of report of the research activity taken by the student and it includes introduction, review of literature, materials and methods and results and discussion.
  15. **"Credit hours"** means the weekly unit of work. A lecture class of one hour per week shall be counted as one credit whereas a practical class of two to three hours duration or a working period of four hours in the clinical ward per week shall count as one credit hour
  16. **"Internal examination"** is an examination conducted between 55<sup>th</sup> and 70<sup>th</sup> day of the semester by the course teacher concerned for theory alone.
  17. **"Semester final examination"** is a University examination comprising of a theory and practical examinations separately conducted by the University at the end of each semester.
  18. **"Grade point of a course"** It is a value obtained by dividing the total marks obtained in a course (X) by maximum marks allotted to that course (Y) and multiplied by 10 ( $GP = X/Y * 10$ ).
  19. **"Credit point of course"** It is the product of credit hours and grade point obtained by the student in a course.
  20. **"Grade point average"** It is the quotient of the total credit points obtained by a student both in theory and practical of various courses including research credits at the end of each semester divided by the total credit hours taken by him / her in that semester. The grading is done on a ten- point scale.
  21. **"Over all grade point average"** is the quotient of cumulative credit points obtained by a student in all the courses including research credits both in theory and practicals taken by him / her from the beginning of the first semester of the degree course divided by the total credit hours of all the courses which he / she had completed upto the end of a specified semester from the first year. It determines the overall performance of a student in all courses taken during a period covering more than an academic year.
  22. **"Advisory committee"** means a committee of qualified staff to guide the student during the entire duration of study.
  23. **"Transcript"** means a copy of the consolidated report of marks secured by the student and issued by the University.
- 3 **Description**
- (1) A post-graduate degree course of M.V.Sc/M.F.Sc shall comprise of a course of study consisting of curriculum and syllabus provided in these regulations spread over a minimum of two academic years including a compulsory submission of thesis.
  - (2) A post-graduate degree course of Ph.D shall comprise of a course of study consisting of curriculum and syllabus provided in these regulations spread over a minimum of three academic years including a compulsory submission of thesis.
4. **Admissions** – The admission to the post-graduate courses shall be made in

the beginning of the first semester of the academic year and shall be in accordance with the regulations laid down from time to time by the University and State Government. For admission to Masters degree programmes in veterinary science a Bachelors degree in Veterinary Science and for Masters degree programmes in Fisheries science a bachelors degree in Fisheries science from a recognised University is a must.

5. **Fees** – The fees for application, semester fees, special fees, examination fees and other fees shall be as prescribed by the University from time to time.

6. **Advisory system** – The students on their admission shall be put under an advisory committee and this committee is responsible for guiding the student in carrying out his/her academic programme.

(1) **Composition** – The advisory committee for Masters degree candidate shall comprise of a total of three members including a Chairman. Out of them, two members including the Chairman should be from the subject in which the student is majoring and one member should be from the minor subjects. The advisory committee for the Ph.D degree candidate shall comprise of four members. Out of them **two** members including the Chairman should be from the subject in which the student is majoring and **two** member should be from the **minor/supporting** subjects. For the Ph.D students who are doing their degree in part-time basis under deputation, the Chairman shall be from the nearest college / farm / station. The head of the farm / station where the student is working / doing research shall be made as one of the members of the advisory committee. In case where the head of

the farm / station is not from the major or minor fields in which the student is studying he/she shall be made as an additional member of the advisory committee.

(2) **Formation of advisory committee** – The proposal for formation of advisory committee in the prescribed proforma should be submitted to the Faculty Dean with in **90 days** from the commencement of the first semester. The Head of the Department in consultation with the Dean of the college concerned will form the Advisory Committee and send it to the Faculty Dean for approval.

(3) **Duties and responsibilities** – The advisory committee shall guide the student in the choice of courses in the **minor and supporting subjects**, in the selection of research problem for thesis and in all other matters relating to students academic activities. The advisory committee is also responsible for fixing the programme of course work, research work, evaluation of research credits, finalisation of thesis draft and conduct of comprehensive qualifying and final viva-voce examinations. However, the Chairman of the advisory committee is fully responsible for the academic performance of the candidate including selection of research topic. The head of department will co-ordinate and monitor for the successful completion of the programme.

(4) **Change of advisory committee** – The advisory committee once formed shall not be changed normally till the student completes the programme. However, the change of chairman and members shall be permissible only on grounds of transfer, retirement, resignation or instances where

continuous absence of the chairman and members exceeding six months. In such instances the head of the department shall send the proposal for change of advisory committee clearly stating the reasons to the Faculty Dean for approval. In circumstances where the student require only a short duration for completion of the programme (i.e. less than one semester) and the chairman / member is retiring or on transfer and if the chairman / member expresses his/her willingness to continue as chairman / member, the same may be permitted by the Faculty Dean under intimation to the University. In such cases, the head of the department shall send necessary proposal. Under extraordinary circumstances in which the chairman is not available and an imminent academic activity has to be carried out, the Dean of the college concerned can nominate the Head of the department /any other member in the advisory committee to act as Chairman under intimation to the University till the advisory committee is reconstituted. In the event of the HOD acting as Chairman and not available within this period, the Dean of the College concerned can act as Chairman and conduct evaluation.

- (5) **Eligibility for being chairman / member of advisory committee** – For being chairman of advisory committee of Masters programme, he/she should be a recognised PG teacher by the University. For being the chairman of advisory committee for Ph.D programme he/she should be a PG guide recognised by the University and for being members he/she should be either a PG guide recognised by the University or a PG teacher recognised by the University.
- (6) **Limit for being chairman of advisory committee** – Normally no individual should be chairman for more than three advisory committees at any point of time. However, under extraordinary circumstances, where sufficient number of PG teachers / PG guides are not available, the University with recommendation of the Faculty Dean may permit an individual to exceed the limit.
- (7) **Recognition of PG teacher / guide** – The concerned Faculty Dean normally recognises PG teachers for offering courses and for guiding research students. The recognised teachers shall offer courses as required by the concerned HOD. Normally such courses should be on their own field of specialisations unless extraordinary circumstances demand offering other course. All the PG teachers are competent to guide Masters students in their research work in their own field of specialisation. The PG teachers with Ph.D degree alone are allowed to take courses for Ph.D programme and be members in the advisory committee. However, only a recognised PG guide alone be the chairman of the advisory committee of Ph.D student.
- (a) Eligibility for PG guide: Ph.D degree holders with not less than three years of active experience in the field after completing their Ph.D.
- (b) Eligibility of PG teacher: Professors, Associate Professors and Assistant Professors having Ph.D and three years of service after acquiring Ph.D or Masters degree and ten

years of service are eligible for PG teacher.

- (1) The HODs should send necessary proposals for recognition of PG teacher / guide along with a letter of interest from the concerned individuals to be PG teacher / guide to the Faculty Dean through the Dean of the College concerned . All staff may be given the PG teacher / guide recognition once they satisfy the eligibility conditions. However, under extraordinary circumstances, the Faculty Dean may use his discretionary power to recognise individuals as PG teachers and PG guides on need basis. However, this is permissible only on situation where sufficient number of qualified teachers are not available to be recognised as PG teacher / PG guide.

## 7. Registration

Registration for the first time in the University.-: Students who have received notification of admission from the University will receive on arrival guidelines for registration from the Dean of the respective colleges. A registration programme will be conducted by the Dean of the College for the benefit of the students joining the University for the first time. **Attendance in respect of fresh students for the first semester shall be reckoned from the first day of the commencement of registration. However, only for the students who are registering late due to late admission, attendance shall be reckoned from the date of their registration and this is only for the first semester of the first year PG programme.** The registration will be done in person and failure to register for the first semester before nominated date shall result in forfeiture of admission.

- (1) **Subsequent Registration** – At the beginning of each semester there will be registration for various courses

listed under a subject. The students shall have to register for the set of courses and /or research credits with the guidance of the advisory committee.

- (2) The payment of fees and other arrears due to the college, Department, Hostel, Library, etc., shall precede the commencement of each semester. The students shall be allowed to register for the semester only after payment of fees and production of clearance certificates from hostel, library and such other places.
- (3) The students including new entrants shall register the requisite courses in the beginning of each semester within thirteen working days, the first two working days without fine and the remaining eleven working days with fine **as decided by the University from time to time**. The attendance will however be reckoned from the day the instruction commences as per the academic calendar (i.e. second day of registration week).
- (4) **Preparation of time-table** – The timetable for a semester should be prepared by the head of the concerned department in consultation with course teachers of the semester. The time table should be get approved by the Dean of the College concerned before release
- (5) **Lecture and Practical schedule** – At the commencement of a semester, the lecture and practical schedule should be drawn for a course by the course teacher and concerned head of the department and circulated to the students with a copy to the Dean. The instruction should strictly adhere to the schedule.

## 8. Residential requirement

- (1) **Duration** – The minimum duration for the Masters programme shall

be four semesters and maximum shall be eight semesters. The minimum duration for Ph.D programme shall be six semesters and maximum shall be twelve semesters.

- (2) **Temporary discontinuance** – All Masters and Ph.D students are expected to complete the programme without any break. However, temporary discontinuance is permitted on extraordinary circumstances only after the student **successfully completes the comprehensive qualifying examination**. No student should temporarily discontinue the course without the prior permission of the Dean of the college. Students who have discontinued temporarily may be permitted by the University to rejoin within four semesters for Masters degree and six semesters in case of Ph.D programme from the date of leaving the college. The students should send permission letter for rejoining well in advance through the Dean of the College concerned. However, the student should complete his/her graduation requirement within the maximum duration of 8 semesters in case of Masters degree and twelve semesters in case of Ph.D degree from the date of first admission. Any student who fails to complete graduation requirements within the maximum permissible period is not entitled for obtaining the degree. When a student leaves the College taking T.C. he/she shall not be eligible for readmission.
- (3) **Minimum credit requirement** – The minimum credit requirement shall

be **60 and 75** for Masters and doctoral programme respectively **excluding non-credit compulsory courses for veterinary and animal sciences programme**. Whereas for fisheries programme the minimum credit requirement shall be **55 and 75** for Masters and doctoral programmes respectively **excluding non-credit compulsory courses**. This minimum limit can be exceeded by few credits at the maximum of 4, but should not be lowered in any case. The increase in credit is applicable only for course work. The distribution of credits into major, minor, supporting, **masters/doctoral seminar** and **masters/doctoral research** is as follows. The **minor courses** are to be taken from a **related department**. The list of such related departments for every **majoring subject** is as provided by the **University from time to time**. The supporting courses are to be taken from **unrelated departments**. Under the supporting courses a **course on bio-statistics** is compulsory for all postgraduate students. However, it need not be **registered** by Doctoral students if they have studied the course in Masters degree. **All the non-credit compulsory courses** need to be **registered** by all masters students. **Doctoral students** need not register these courses if they have already studied it in their masters degree. The list of non-credit courses are identified by the **University from time to time**.

	Masters progra mmes	Doctoral program me
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Course work		
Major	28 (20)	17 (15)
Minor	06 (09)	06 (08)
Supporting	05 (05)	05 (05)
Masters/doctoral seminar	01 (01)	02 (02)
Sub-total	40 (35)	30 (30)
Thesis	20 (20)	45 (45)
Total	60 (55)	75 (75)

*(Figures in bracket – for Fisheries programmes)*

- (4) **Permissible workload for a semester** – The maximum permissible workload for any semester shall be 20 for both masters and doctoral programmes. It does not include non-credit compulsory courses. The permissible work load shall be exceeded by few credits at the maximum of 2 credits per semester. It is applicable only for course work. The maximum permissible research credit shall be 15 per semester. However, the maximum research credit a part-time Ph.D student can register shall be 12. The permissible workload for each semester for a student shall be decided by the advisory committee. The part-time students should work for two hours extra on all working days when they are registering for research credits. A certificate in this regard duly signed by the Chairman of advisory committee and HOD should be enclosed along with mark sheet.
- (5) **Credit transfer** – Transfer of course and research credits earned at another University is permissible provided they have studied the same course with same credit load.

However, a committee constituted by the University consisting of the Faculty Dean, Controller of Examination and Professor & Head of the Department of the subject concerned may consider such requests and report to the University subject to following conditions.

- (a) The courses shall not have been studied earlier than three years from the date of admission of the students to the programme at this University.
- (b) Credits to be transferred shall not however have been used for obtaining a degree / diploma elsewhere.
- (6) **Attendance Requirements** – Every student shall ordinarily attend all classes in a course. However a minimum prescribed attendance in a course shall be 80%. The minimum limit of attendance shall be reckoned for theory and practicals separately, for a full period of one semester of study before he/she is eligible for appearing in the final semester examination. A student who fails to put in the minimum attendance either in theory or practical shall not be permitted to appear for the final semester examinations and his/her registration for that paper shall be treated as cancelled. Such of those courses should be reregistered by the student. Dean may depute students on the recommendations of the Vice-President of Student Association / Sports council Chairman, to represent the College/ University at various functions such as

Sports, N.S.S, Medical aid, etc. and the mandatory minimum requirement of attendance under these circumstances is 75% provided; the Dean is informed well ahead of time atleast 2 weeks earlier. However, under no circumstances, absence even on University business, students having less than 75% of attendance in theory and practicals together shall be permitted to take the examinations, such of these students shall repeat the course and complete the same, when the course is offered in the subsequent semesters. The Dean should ensure in ordinary circumstances that no student is officially deputed for University purposes so that he/she fails to secure the 75% attendance. A student who fails to put in a minimum requirement of 80% attendance because of sickness, the mandatory minimum may be reduced to 75% on the basis of medical certificate for hospitalisation obtained from a medical officer of Government Hospital or a private nursing home. The attendance should be maintained by the course teacher and the attendance register should be kept in safe custody by the Head of the Department and the certificate to this effect shall be sent to the University along with attendance in prescribed proforma sufficiently early, to issue hall ticket for semester final examination. Hall Ticket will be issued by the Controller of Examination, based on the prescribed application from the candidate duly filled in and

attendance certificate from the Dean. The attendance particulars should reach the Controller of Examination atleast 3 days prior to issue of Hall Ticket.

- (a) No student will be issued with a hall ticket unless they produce clearance certificate from the competent authority of accounts of Hostel administration.
  - (b) If a student admitted in the 1<sup>st</sup> year and does not register the course of first semester or having registered, failed to put in 80% attendance in all the courses, his/her admission stands cancelled, if no prior permission is obtained from the Dean of the College. He/she shall forfeit the admission to the course. However, on seeking re-admission he/she has to undergo the normal admission procedure as a fresh candidate.
- (7) **How to calculate attendance for a course** – Normally the number of classes conducted are calculated by the course teacher from the first working day (i.e. the second day of registration week as per the time table) to the last working day.
- (a) **Theory class** : Number of classes conducted by course teacher from the first working day i.e. the second day of registration week as per the timetable, to the last theory class of the semester.

(b) **Practical class** : Number of classes conducted by course teacher from the first working day i.e. the second day of registration week as per the time table, to the last practical class of the semester.

9. **Evaluation / Examination** – The detailed guidelines for the conduct of examination, internal and final evaluation, comprehensive qualifying examination, research credit evaluation, grading, recording, preparation of Mark lists, transcripts etc. circulated from time to time by the University shall be followed. The schedule of examinations shall consist of internal and final examination in a semester for course work and a research credit evaluation while doing research.

(1) **Internal Evaluation** – The internal evaluation would invariably be conducted on completion of at least 50% of the course. The examinations for the internal evaluation shall be conducted by the respective course teachers as per the guidelines issued by the Dean and University from time to time. It may be conducted only for theory for duration of two hours for a total mark of 80, which may be converted to 20.

(2) **Final semester evaluation** – It shall be a University examination comprising of theory and practical examinations separately conducted at the end of a semester. The theory examination shall be for duration of two hours for seventy marks (70) and practical examination shall be for fifty (50) marks. The question paper for theory examination shall be set by

the external examiners. The practical examination shall be conducted on the last practical class of the semester. **The practical examination shall be conducted by the course teacher and one more teacher nominated by the head of the department concerned.** The distribution of practical mark shall be as follows

Record / Project work	- 10
Practical	- 30
Viva-voce	- 10

(3) **Term paper** – A term paper may be given for each course and it may be evaluated for a maximum of ten (10) marks. The detailed guidelines for topic of term paper, evaluation and its presentation etc. circulated from time to time by the Dean and the University shall be followed.

(4) **Distribution of marks for calculation of grade point of a course** – The distribution of marks for calculation of grade point of a course is as follows:

(a) **Course with theory & practical**

Internal evaluation	20
Final examination	70
Practical	50
Term paper	10
Total	150

(b) **Course with theory alone**

Internal evaluation	20
Final examination	70
Term paper	10
Total	100

(c) **Course with practical alone**

Record/Term paper / Project work	20
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Practical	60
Viva-voce	20
Total	100

- (5) **Re-examination** – There shall be no supplementary examination for internal or semester final examinations for students absenting themselves due to any reason. The students who absent themselves for internal evaluation may be allowed to write final semester examination by foregoing the 20 marks specified for internal evaluation.
- (6) **Comprehensive qualifying examination (CQE)** – This is a mandatory examination to be taken by all masters and doctoral students after completion of 60% of major and supporting courses separately. Normally it shall be conducted after second semester for masters and during second semester for doctoral students. The students should not be permitted to register for more than five research credits before successful completion of CQE. The details of conduct of CQE, evaluation details and method of conduct of viva-voce shall be as per the guidelines issued by the Dean and University from time to time. The question paper for CQE for Masters and doctoral programmes shall be set by the external examiner. However, the evaluation of answer books and conduct of viva-voce shall be by the advisory committee alone for masters programme. In case of Ph.D programme, the evaluation of answer books shall be by the advisory committee and viva-voce may be conducted by the external

examiner. The results for CQE shall be graded as Satisfactory / unsatisfactory. **The qualifying mark for “satisfactory” shall be 60%.** In case of unsatisfactory performance, the student have to reappear for the CQE after 3 months and such re-appearances are restricted to two. In total, the appearances are restricted to three. In such case, the student has to re-register for the programme.

- (7) **Evaluation of masters/doctoral seminars** – The **masters/doctoral seminar(s)** is/are mandatory for all PG students with a credit load of 1+0 and 2+0 for masters and doctoral students respectively. The advisory committee should assign the seminar topics during the beginning of a semester. The students are expected to prepare a seminar paper after carefully reviewing the literatures and such other materials. The advisory committee shall evaluate the performance of the seminar credits registered by the students during the semester at the end of semester. The evaluation should be conducted during the last fortnight of the semester when all the members of the advisory committee are available. Normally the students are not expected to absent themselves for seminar credit evaluation. Under extraordinary circumstances a late evaluation with in ten working days from the last working day of the semester may be permitted by the Dean of the College concerned on payment of a fine **as decided by the University from time to time.** In circumstances, where a member of

the advisory committee may not be available necessary permission has to be obtained for conduct of evaluation in the absence of one member from the Dean of the College concerned. If more than one member may not be available permission has to be obtained from the University. In circumstances where the chairman is not available for evaluation, late evaluation may be permitted by the Dean with in ten working days from the last working day. In extraordinary circumstances where the chairman may not be available even within this period, the head of department can act as chairman after obtaining permission from the Dean of the College concerned. In the event of HOD acting as Chairman and not available with in this period, the Dean/nominee of the Dean can act as Chairman and conduct evaluation. The performance of the student should be evaluated by the advisory committee as per the following norms;

Coverage of literature	40%
Presentation	30%
Use of AV aids	10%
Capacity to participate in the discussion	20%

A time schedule regarding the conduct of seminar has to be prepared by the chairman and the same has to be communicated to the respective individuals and advisory committee well in advance. In case of failure, the students has to re-register the credit in the subsequent semester.

- (8) **Evaluation of research credit** – The performance of the research credit registered by the students during

the semester shall be evaluated by the advisory committee at the end of each semester preferably during the last week of semester by the advisory committee. The evaluation should be conducted by all members of the advisory committee. Except the semester in which the student is submitting the thesis, the evaluation of the research credit may be done by the advisory committee on a convenient day during last week of semester in which all members are present on completion of mandatory attendance limit and 100 per cent completion of work committed to do at the beginning of the semester by the student. However, the research credit evaluation and submission of thesis in the last semester should be done on the last working day only. In case of unsatisfactory performance a grade of 'Incomplete' shall be awarded and the student has to re-register for the same block of research credit again in the subsequent semester. The student has to get the permission of Dean of the College concerned for re-registration of incomplete research credits. In case of re-registration of same block of research credit after second time, the matter may be referred to the Deans committee and the University. Normally the students are not expected to absent themselves for research credit evaluation. Under extraordinary circumstances a late evaluation within ten working days from the last working day of the semester may be permitted by the Dean of the College concerned

on payment of a fine **as decided by the University from time to time.** However, it is the prerogative of the Dean to decide whether, the circumstances for late evaluation stated by the student really warrants it. In case of wilful absence, the advisory committee in consultation with Dean of the College concerned may award incomplete grade. Normally all members of the advisory committee should present themselves for evaluation of research credit. Under extraordinary circumstances, in which a member of the advisory committee may not be available necessary permission has to be obtained for conduct of evaluation in the absence of one member from the Dean of the College concerned. If more than one member may not be available permission has to be obtained from the University. In circumstances where the chairman is not available for evaluation, a late evaluation may be permitted by the Dean within ten working days from the last working day. In extraordinary circumstances where the chairman may not be available even within this period, the head of department can act as chairman after obtaining permission from the Dean of the College concerned. In the event of HOD acting as Chairman and not available within this period, the Dean/ nominee of the Dean can act as Chairman conduct evaluation. If a student has not got mandatory attendance limit of 80%, a grade of incomplete may be awarded and the student has to

re-register for the same block of research credit again in the subsequent semester. The student has to get the permission of Dean of the College concerned for re-registration of incomplete research credits. In case of re-registration of same block of research credit after second time, the matter may be referred to the Dean's committee and University.

- (9) **Final viva-voce examination** – On the basis of recommendation for acceptance of thesis, the University shall forward the reports of the external examiner to the chairman of the advisory committee for conducting final viva-voce examination for the post-graduate students. The thesis shall be sent to one external examiner for Masters degree and two external examiners for doctoral programmes. The final viva-voce shall be conducted by the advisory committee based on the report of the external examiner for masters programme. Whereas for doctoral programmes, the final viva-voce shall be conducted by one of the external examiners decided by the University along with the advisory committee. The details and method of conduct of final viva-voce shall be as per the guidelines issued by the Dean and University from time to time. The date for final viva-voce should be fixed by the chairman taking into account the availability of all members of the advisory committee after verifying the fact regarding carrying out corrections and suggestions specified by the external examiners. Normally all the members of the advisory

committee should be present for final viva-voce. In case of extraordinary circumstances where a single member may not be available, necessary permission has to be obtained from the Dean of the College concerned . If more than one member may not be available the final viva-voce examination has to be postponed. In circumstances, where the chairman may not be available for a sufficiently longer duration for the conduct of final viva-voce, the Dean of the College concerned may nominate from a panel of three suitable persons from the discipline in which the student is majoring to the University and the person selected by the University may act as chairman for the conduct of final viva-voce examination. During the final viva-voce the candidate shall defend the thesis in front of advisory committee, invited staff, students and external expert. The degree shall be awarded on the unanimous recommendation of the examining committee in regard to the thesis itself and the performance of the student in the final viva-voce examination. The performance shall be evaluated as **satisfactory/unsatisfactory**. The opinion of the majority members shall be taken into account. If difference of opinion arises between members, in such case Chairman of advisory committee's decision shall be the final. In case of failure the student has to reappear for viva-voce examination after three months.

- (10) **Unfair means during examinations**  
- The Dean of the College shall be

responsible for dealing with all cases of "Use of unfair means" in the various examinations. The phrase, "Use of Unfair means" includes possession of any information or material by the student, talking to other students, copying from other students or from printed or written material etc. The Invigilator concerned, on finding the use of unfair means by any student may take the answer scripts of the student and the material evidence, if any, and the explanation from the student. The student may also be sent out of the examination hall immediately. The Invigilator concerned shall report each case of unfair means direct to the Dean immediately with full details of the incident, answer scripts, the available evidence and explanation of the concerned student, if any. The Dean, on receipt of the report, may give an opportunity to the concerned student to represent his case. Considering all the available evidence, the Dean shall take appropriate action immediately. The penalty shall be as indicated below.

- (a) A student found using unfair means during an internal examination should be deemed to have failed in that course.
- (b) A student found using unfair means during the semester final examination should be deemed to have failed that course. In such case, the student shall not be permitted to take the remaining examinations, if any, in that semester and shall also be deemed to have attempted and

failed in the remaining examinations.

- (c) The Dean shall report each case falling under (a) and (b) above immediately, after passing orders to the University.
- (d) For using unfair means of a serious nature such as ignoring the repeated instructions of Invigilator or abusing or threatening or assaulting the Invigilator, warranting higher penalties than those indicated in clauses (a) and (b) above, the Dean, besides treating the students as failed in all the courses he registered in that semester, may further debar the student for the next semester and succeeding year and the fact informed to the University. If further or more severe punishment is felt necessary, the Dean shall immediately inform the University about the full details of each together with all the material evidence, if any, and his recommendation. The explanation or representation of the student, if any, may also be sent. The Vice-Chancellor after examining the case, may debar the student for further period or permanently. The decision of the Vice-Chancellor is final.
- (e) The parent or the guardian of the concerned student shall be informed of any punishment awarded to the student and the reason therefor.
- (11) **Scrutiny of Grades** – The student may apply to the Registrar through the Dean of the College concerned

for revaluation of answer paper in the prescribed format not later than ten working days after declaration of the results / issue of report cards to the students. The fee for the same shall be decided by the University from time to time.

#### 10. **Thesis**

- (1) The thesis should consist of five major sections namely introduction, review of literature, materials and methods, results and discussion. The thesis for the Masters degree should be of such a nature as to indicate the students' potentialities for conducting research. The thesis for the Ph.D degree should be of the nature of definite contribution to the subject.
- (2) **Topic** – The thesis shall be on a topic falling within the field of the major subjects and shall be the result of the independent work of the students.
- (3) **Change of topic** – The topic once chosen and approved for research credit evaluation should not be normally changed. However, on extraordinary circumstances where such a change is warranted it should be done before completion of five research credits in case of M.V.Sc / M.F.Sc thesis and ten research credits in case of Ph.D thesis. On the recommendation of the advisory committee, such changes can be approved by the Faculty Dean. It is the prerogative of the advisory committee to decide on the proportionate retention within the registered / completed research credits. No changes in the area of the research will be approved once the student completes 5 and 10 research

credits successfully for M.V.Sc/M.F.Sc and Ph.D degree respectively. In such cases where a change in area of research is warranted after the completion of 5 and 10 research credits successfully for M.V.Sc / M.F.Sc and Ph.D degree respectively, the student has to reregister for the entire block of research credits.

- (4) **Change of title** – The title given in the synopsis shall be taken as final title and title given at the time of approval of the programme of research shall be taken as tentative. However, change in the area of research and objectives are subject to modifications as specified in 10(3).
- (5) **Synopsis** – The submission of thesis should be preceded by submission of synopsis to the University between 55 and 60<sup>th</sup> day of the semester. The synopsis should not exceed ten pages and should consist of brief report of the work done. The synopsis should be accompanied by a sealed cover consisting of a panel of five experts for the University to select external expert(s) for evaluation. The approved programme of research work should also be furnished along with the synopsis.
- (6) **Pages** – The number of pages for a M.V.Sc / M.F.Sc thesis should not exceed 125 and 250 for Ph.D. The page number includes pages containing plates, graphs and tables. The annexures need not be included in the page numbers.
- (7) **Submission** – The thesis should be submitted only on the last working day of the semester. 2 copies of thesis for MVSc and 3 copies of thesis for Ph.D should be

submitted in paper back. After its final approval and after incorporating the suggestions of examiners if any, 5 copies (6 copies for ICAR fellowship holders) of thesis should be bound and be submitted to the University. It should be hard bound only after completion of final viva-voce and carrying out the corrections suggested by the external experts.

- (8) **Late submission** – The students should submit the MVSc/MFSc/ Ph.D thesis on the last working day of the final semester. The students who could not submit their thesis on the last working day should not be evaluated for the research credits. However, students failing to submit the thesis on the last working day, shall submit the thesis during any time in the extended semester after paying a fee **as decided by the University from time to time** as late fee for thesis submission. In this case, a proposal should be sent by the Advisory Committee to University through Dean of the College concerned for permission for submission of thesis at any time during the extended semester. In circumstances where a student is not able to submit even after the extended period, the grade “incomplete” may be given and the block of research credit has to be reregistered. However, in circumstances where the student is ready with the thesis but the chairman or more than one advisory committee members are not available on last day of the semester, the Dean of the College concerned may decide the date of

submission and evaluation under intimation to the University.

- (9) **Publications** – The students are allowed to publish their work even before submitting the thesis. The copies of such publication should be enclosed with thesis while submission. **The manuscripts of research papers should be submitted along with the thesis during final submission masters students and for doctoral students one research paper should have been accepted in referred and second submitted or one patent filed.**

- (10) **Rejection of M.V.Sc / M.F.Sc thesis** – The M.V.Sc / M.F.Sc thesis rejected by one external expert may be sent to another external expert in the panel on the request of the advisory committee for an independent judgement. If the second expert also rejects the thesis, the thesis is considered as rejected and the student has to resubmit the thesis after a gap of one semester doing necessary work and corrections. In case of varied opinion, a committee constituted by the University shall decide on the merit of the thesis for award of degree. In case of rejection for the second time the student has to reregister for the entire block of research credits.

- (11) **Rejection of Ph.D thesis** – In case of a single dissenting note received from one of the two external experts to whom the thesis was sent, the University on recommendation of the advisory committee may send the thesis to third external expert in the panel for an independent judgement. If the third member recommends the

thesis for acceptance, then final viva-voce may be conducted for award of degree. If the third expert also rejects the thesis, the thesis is considered as rejected and the student has to resubmit the thesis after a gap of one semester doing necessary work and corrections. In case of rejection for the second time the student has to reregister for the entire block of research credits.

- (12) **Final submission** – After the conduct of the final viva-voce, the Chairman of the advisory committee should forward the hardbound thesis along with a certificate for carrying out corrections suggested by the external experts for award of the degree.

#### **11. Academic Status and Scholastic Deficiencies**

- (1) A student shall secure a **OGPA of 6.5 to continue and to obtain degree. The minimum passing grade in a course shall be 6.0 separately in theory and practical.**
- (2) The failed students shall reappear for the failed courses as and when the examinations are conducted by the University.
- (3) **Those candidates who have passed a course but fail to secure OGPA of 6.5 shall appear for re-examination of course(s) in which he has scored less, as and when conducted by the University.**

12. **Year of standing** – The year of standing of a student shall be determined solely on the basis of his/her completion of prescribed number of credit hours successfully.

1. **Graduation requirements** – The student shall satisfy minimum

residential requirement as specified earlier with submission of a thesis.

**2. Requirements for Masters and doctoral degree**

(1) A student undergoing course of study leading to award of M.V.Sc / M.F.Sc and Ph.D shall pass the course and complete the minimum number of credit hours prescribed therefor, by the Academic Council from time to time by obtaining a minimum O GPA of 6.5 in the 10 point scale along with a successful submission of thesis.

(2) The University shall issue a provisional course completion certificate on passing all final semester examination with successful submission of thesis.

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

**16. Record of Courses**– To ensure that requirements for the award of degree have been completed by a student, the University shall keep a record of courses completed by the student. A copy of the same shall be maintained by the Dean of the College concerned .

**17. Authorities to approve results and issues pass certificates, transcripts, etc** – The Vice-Chancellor shall approve the results on the recommendation of the Board of examination and Registrar shall

issue the provisional pass certificates, transcripts etc. to the candidate.

**18. Award of Diploma** – A Diploma under the seal of the University and duly signed by the Officers authorized in this behalf shall be presented at a Convocation to each candidate who has successfully completed the graduation requirements. The award of Diplomas of the candidates who have successfully completed the graduation requirements for the award at a convocation *in absentia*, shall be sent by post. The diploma shall set forth the name of the candidate, father's name, degree, month and year of successful completion of the graduation requirements, etc.

**19. Amending or Cancellation of results** – If the result of a candidate is discovered to be vitiated by error, malpractice, fraud, improper conduct or any other reasons, the Vice-Chancellor shall have the powers to amend the result in such a manner as to accord with the true position, and to make such declaration as the Vice-Chancellor may deem necessary in that behalf. If it is found that the result of a candidate has been vitiated by malpractices, fraud or other improper conduct where by he/she has been benefited and that he/she has in the opinion of the Vice-Chancellor, be a party to or conceived at the malpractice, fraud or improper conduct, the Vice-Chancellor shall have the power at any time, notwithstanding the award of a diploma or a Certificate or prize or a scholarship, to amend the result of such candidate and to make such declaration as the Vice-Chancellor may deem necessary in that behalf, including debarring of the candidate from the University for such a period

as may be specified and the cancellation of the result of the candidate in such a manner as the Vice-Chancellor may decide.

20. **Removal of doubt** – In case of any difficulty arises in giving effect to the provisions of these regulations, the

Vice-Chancellor as per Statute 29 on recommendation of Academic Council may pass such orders as are necessary for the purpose of removing the difficulty.



Bones of appendicular skeleton of ox as a type and their comparison with those of horse, dog, pig and poultry.

### **UNIT III**

Bones of axial skeleton of ox as a type and their comparison with those of horse, 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.

### **Practical**

Demonstration of all bones and dissection of joints of buffalo/Cattle.

### **Suggested Readings**

Dyce KM, Sack WO & Wensing CJG. 1996. Text Book of Veterinary Anatomy. WB Saunders.

Nickel R, Schumer A, Seiferle E, Freewin J & Wills KH. 1986. The Locomotor System of Domestic Mammals. Verlag Paul Parey.

Sisson S & Grossman JD. 1975. The Anatomy of the Domestic Animals. Vols. I, II. WB Saunders.

## **VAN 602 COMPARATIVE SPLANCHNOLOGY**

**2+2**

### **Objective**

To give a detailed splanchnology.

### **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, 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, 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, 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.

### **Practical**

Demonstration of structure and placement of organs in body cavities of all the animals.

### **Suggested Readings**

Dyce KM, Sack WO & Wensing CJG. 1996. Text Book of Veterinary Anatomy. WB Saunders.

Nickel R, Schummer & Seiferle E. 1979. The Viscera of the Domestic Mammals. II revised edition. Verlag Paul Parey. Berlin.

Sisson S & Grossman JD. 1975. The Anatomy of the Domestic Animals. Vols. I, II. WB Saunders.

## **VAN 603 MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX 1+3**

### **Objective**

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.

### **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.

### **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.

### **Suggested Readings**

Dyce KM, Sack WO & Wensing CJG. 1996. Text Book of Veterinary Anatomy. WB Saunders.

Nickel R, Schummer A, Seiferle E, Freewin J & Wills KH. 1986. The Locomotor System of the Domestic Mammals. Verlag Paul Parey.



Durry RAB & Wallington EA. 1973. Carleton's Histological Techniques. Oxford Univ. Press.  
Luna LG. 1968. Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology. McGraw-Hill.  
Thomson SW & Hunt RD. 1968. Selected Histochemical and Histopathological Methods. Charles C Thomas Publ.

**VAN 606          GENERAL HISTOLOGY AND ULTRASTRUCTURE          3+1**

**Objective**

To understand basic principles of light microscopy and light and ultrastructure of four basic tissues.

**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.

**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.

**Suggested Readings**

Banks WJ. 1993. Applied Veterinary Histology. Mosby Year Book.  
Dellmann HD. 1993. Text book of Histology. Lea & Febiger.  
DiFiore MS, Mancini R & Derbertis EDP. 2006. New Atlas of Histology. Williams & Wilkins, Lippincott.  
Greep RO. 1977. Histology. McGraw-Hill.  
Ham AW & Cormack DH. 1979. Histology. JB Lippin.

**VAN 607          SYSTEMIC HISTOLOGY AND ULTRASTRUCTURE          3+1**

**Objective**

To understand and identify arrangement of four basic tissues in organs of different body systems.

**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.

#### **Practical**

Study of histological structure of organs of digestive, respiratory, urinary, genital and cardiovascular systems of buffalo, horse and dog/cat.

#### **Suggested Readings**

- Banks WJ. 1993. Applied Veterinary Histology. Mosby Year Book.  
Dellmann HD. 1993. Text Book of Histology. Lea & Febiger.  
DiFiore MS, Mancini R & Derbertis EDP. 2006. New Atlas of Histology. Williams & Wilkins, Lippincott.  
Greep RO. 1977. Histology. McGraw-Hill.  
Ham AW & Cormack DH. 1979. Histology. JB Lippin.

### **VAN 608 DEVELOPMENTAL ANATOMY**

**3+1**

#### **Objective**

To understand the developmental processes of different body systems at various stages of pregnancy.

#### **Theory**

##### **UNIT I**

Gametogenesis, fertilization, cleavage and gastrulation.

##### **UNIT II**

Development of foetal membranes and placenta in domestic animals.

##### **UNIT III**

Histogenesis of nervous system, sense organs, endocrine organs and cardiovascular system.

##### **UNIT IV**

Embryonic development of digestive, respiratory, uro-genital and musculoskeletal system.

#### **Practical**

Study of serial sections of the chick and pig embryos at different stages of development.

#### **Suggested Readings**

- Arey LB. 1965. Developmental Anatomy. WB Saunders.  
Freeman WH & BraceGirdle B. 1967. Atlas of Embryology. Heilemann Edu. Books Ltd.  
Langman J. 1981. Medical Embryology. William & Wilkin.

- Latshaw WK. 1984. Veterinary Developmental Anatomy; A Clinically Oriented Approach. B.C. Decker Inc., Philadelphia.
- Patten BM. 1985. Foundation of Embryology. Tata McGraw-Hill.
- Tuchmann-Duplessis MH, David G & Haegel P. 1972. Illustrated Human Embryology. Vol. I. Embryogenesis. Springer Verlag.
- Tuchmann-Duplessis MH, David G & Haegel P. 1972. Illustrated Human Embryology. Vol. II. Organogenesis. Springer Verlag.

**VAN 801 MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY 0+3  
OF EQUINE, CANINE AND PORCINE**

**Objective**

To teach students about anatomy of muscles, blood vessels, nervous tissue and sense organs in equine, canine and porcine.

**Practical**

Dissection of different body regions with respect to muscles, blood vessels and nerves; and see the topographic positioning of different organs in different body cavities in equine, canine and porcine.

**Suggested Readings**

Selected articles from journals.

**VAN 802 PRINCIPLES AND APPLICATIONS OF BIOMECHANICS 2+0**

**Objective**

To sensitize the student about the importance of biomechanics.

**Theory**

**UNIT I**

Biomechanics, its definition and scope with reference to anatomy and physiology of domestic animals and musculo-skeletal dynamics.

**UNIT II**

Locomotion and clinical applications. Biomechanics of cortical and trabecular bones.

**UNIT III**

Biomechanics of fracture fixation. Instrumentation and techniques in locomotion and their applications in lameness.

**Suggested Readings**

Selected articles from journals.

**VAN 803 AVIAN ANATOMY 1+2**

**Objective**

To give detailed overview of poultry anatomy.

**Theory**

**UNIT I**

The study of the gross features of different body systems of domestic fowl.

**UNIT II**

The study of microscopic features of different body systems of domestic fowl.

**Practical**

Dissection and demonstration of various body systems of fowl and turkey.  
Microscopic examination of slides of various organ systems of fowl.

**Suggested Readings**

Selected articles from journals.

**VAN 804      NEUROANATOMY      3+1**

**Objective**

To provide in-depth knowledge of nervous system.

**Theory**

**UNIT I**

The gross and microscopic anatomy of the brain and spinal cord.

**UNIT II**

Study of various cranial and spinal nerves along with their associated nuclei and ganglia.

**UNIT III**

Motor and sensory pathways, different ascending and descending tracts of brain and spinal cord and autonomic nervous system.

**Practical**

Gross dissection and microscopic examination of the brain and spinal cord; demonstration of the nerves, nerve plexuses, ganglia of cranial importance, study of the serial sections of the brain and spinal cord in domestic animals.

**Suggested Readings**

Selected articles from journals.

**VAN 805      ENDOCRINE ANATOMY      2+1**

**Objective**

To project the importance and details of endocrine glands.

**Theory**

**UNIT I**

Advanced gross and microscopic anatomy of the hypothalamus and pituitary gland.

**UNIT II**

Advanced gross and microscopic anatomy of the thyroid, parathyroid and thymus.

**UNIT III**

Advanced gross and microscopic anatomy of the adrenal glands, islets of Langerhans, pineal body and other tissues associated with endocrine secretions.

**Practical**

Demonstration of the topographic anatomy in the embalmed specimens and microscopic examination of the endocrine glands of ruminants.

**Suggested Readings**

Selected articles from journals.

**VAN 806      THEORY AND APPLICATIONS OF ELECTRON MICROSCOPE      2+1**

**Objective**

To give an overview of the electron microscope.

**Theory**

**UNIT I**

Introduction and principles of electron microscopy.

**UNIT II**

Methods for transmission electron microscopy.

**UNIT III**

Methods for scanning electron microscopy.

**Practical**

Preparation of blocks and demonstration of various techniques used for carrying out TEM and SEM.

**Suggested Readings**

Selected articles from journals.

**VAN 807      HISTOENZYMOLOGY AND IMMUNOCYTOCHEMISTRY      2+1**

**Objective**

To give a student hands-on practice for various advanced histoenzymic and histochemical techniques.

**Theory**

**UNIT I**

Classification of enzymes – Principles of enzymes histochemistry methods.

**UNIT II**

Substrates –combination-coupling azo-dye methods –capture reagents.

**UNIT III**

Localization of enzymes and controls in enzyme histochemistry.

**UNIT IV**

Fluorescence microscopy in enzyme histochemistry. Immunohistochemistry–principles and techniques.

**Practical**

Preparation of fixatives and buffers used in histochemistry. Methods of preparations and microscopical examination of routine and special preparations showing different cell organelles and inclusions. Methods for tryptophan–SS, SH groups; Glycogen–glycoproteins; Mucopolysaccharides and lipids. Methods and identification of alkaline and acid phosphatases – succinic dehydrogenase, cytochrome– oxidase, choline–esterase, catecholamines by fluorescence microscopy. Immunohistochemistry – principles and techniques.

**Suggested Readings**

Selected articles from journals.

**VAN 808      APPLIED EMBRYOLOGY AND TERATOLOGY      1+2**

**Objective**

To apprise the students about the current trends in developmental processes.

**Theory**

**UNIT I**

Principles of experimental embryology and teratology.

**UNIT II**

Factors affecting the developmental mechanisms of embryo.

**UNIT III**

Use of organizers implants, chemical and hormonal preparations in the developmental models and available literature on teratogenic experimentation.

**Practical**

Collection and study of various teratological specimens from domestic animals. Class discussions on experimental models and available literature on teratogenic experimentation.

**Suggested Readings**

Selected articles from journals.

**VAN 809      FUNCTIONAL VETERINARY ANATOMY**

**2+0**

**Objective**

To make the student understand the functional anatomy of various organs/systems in relation to structure.

**Theory**

**UNIT I**

The relationship of structure to form and function.

**UNIT II**

The relationship of structure for adaptation and behaviour.

**UNIT III**

Relationship of structure in relation to clinical conditions/ applications.

**Suggested Readings**

Selected articles from journals.

**VAN 810      GROSS ANATOMY OF LABORATORY ANIMALS**

**1+1**

**Objective**

To give an overview of different body systems of laboratory animals.

**Theory**

**UNIT I**

Study of different organs of digestive system of different laboratory animals.

**UNIT II**

Detailed study of urinary, male and female reproductive systems of different laboratory animals.

**UNIT III**

Complete study of respiratory system of different laboratory animals

**UNIT IV**

Study of organs of circulation and nervous system of different laboratory animals.

**UNIT V**

Descriptive anatomy of endocrine glands of different laboratory animals.

**Practical**

Demonstration of placement and relations of different organs in the body cavities of different laboratory animals.

**Suggested Readings**

Papesko P, Rajtova V & Horak J. 2002. A Colour Atlas of Anatomy of Small Laboratory Animals: Rabbit, Guinea Pig. 2nd Ed. Wolfe Publ.

**VAN 890      SPECIAL PROBLEM****0+2****Objective**

To provide expertise in handling practical research problem(s).

**Practical**

Short research problem(s) involving contemporary issues and research techniques.

**List of Journals**

- \* Acta Anatomica
- \* American Journal of Anatomy
- \* Anatomia Histologia and Embryologia
- \* Anatomical Record
- \* Anatomy and Embryology
- \* Indian Journal of Veterinary Anatomy
- \* Journal of Anatomy

**e-Resources**

- \* <http://www.interscience.wiley.com/journal/117927935/grouphome/home.html> (American Journal of Anatomy)
- \* <http://www.ovid.com/site/catalog/Journal/1057.jsp> (Journal of Anatomy)
- \* <http://www.interscience.wiley.com/jpages/0003-276X/> (Anatomical Record)
- \* <http://www.blackwellpublishing.com/submit.asp> (Anatomia Histologia and Embryologia)

**Suggested Broad Topics for Master's and Doctoral Research**

- \* Gross anatomical disposition of various organs of animals of local interest
- \* Light and ultra-structural studies of important organs and systems of animals of local importance
- \* Developmental studies of different body systems

## VETERINARY AND ANIMAL HUSBANDRY EXTENSION

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
AHE 601	FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION	2+1
AHE 602	COMMUNICATION FOR LIVESTOCK DEVELOPMENT	1+1
AHE 603	DIFFUSION AND ADOPTION OF ANIMAL HUSBANDRY PRACTICES	2+1
AHE 604	EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS	2+1
AHE 605	ANIMAL HUSBANDRY PROGRAMME PLANNING AND EVALUATION	2+1
AHE 606	RESEARCH METHODOLOGY IN VETERINARY AND ANIMAL HUSBANDRY EXTENSION	2+1
AHE 607	SOCIAL PSYCHOLOGY AND GROUP DYNAMICS	2+1
AHE 608	ANIMAL HUSBANDRY DEVELOPMENT PROGRAMMES	1+0
AHE 609	DEVELOPMENTS IN THE CONCEPT OF EXTENSION	1+0
AHE 610	HUMAN RESOURCE MANAGEMENT IN ANIMAL HUSBANDRY SECTOR	2+1
AHE 611	GENDER AND LIVESTOCK DEVELOPMENT	1+0
AHE 612	INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT	1+1
AHE 691	MASTER'S SEMINAR	1+0
AHE 699	MASTER'S RESEARCH	20
AHE 801	ORGANIZATIONAL MANAGEMENT	3+0
AHE 802	FARM JOURNALISM AND PUBLIC RELATIONS	2+1
AHE 803	ADVANCED RESEARCH TECHNIQUES IN SOCIAL RESEARCH	3+1
AHE 804	TRAINING FOR HUMAN RESOURCE DEVELOPMENT	2+1
AHE 805	POLICIES AND REGULATIONS IN LIVESTOCK SECTOR	2+0
AHE 806	EDUCATIONAL TECHNOLOGY	2+1
AHE 807	DYNAMICS OF CHANGE	2+0
AHE 808	ORGANIZATIONAL COMMUNICATION	2+1
AHE 890	SPECIAL PROBLEM	0+2
AHE 891	DOCTORAL SEMINAR I	1+0
AHE 892	DOCTORAL SEMINAR II	1+0
AHE 899	DOCTORAL RESEARCH	45

### Course contents

AHE 601	FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION	2+1
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## **Objective**

To acquaint the students with the genesis, development and present status of animal husbandry extension and linkages among departments and various institutions.

## **Theory**

### **UNIT I**

Concept, philosophy, principles, genesis, growth and scope of extension education.

### **UNIT II**

Earlier extension efforts and their implications. Emerging issues, problems and challenges of animal husbandry extension education.

### **UNIT III**

Extension approaches of State and Central Governments, ICAR, SVUs/SAUs, NGOs and other organizations in delivery of animal husbandry and veterinary services.

### **UNIT IV**

Linkages between researcher-extension agent – livestock farmer-industry in the generation, dissemination and utilization of animal husbandry practices.

## **Practical**

Study of the organizational set-up and functioning of State Animal Husbandry Department and dairy/rural development agencies. Study of indigenous technical know-how about animal husbandry practices in villages.

## **Suggested Readings**

- Adams ME. 1982. Agricultural Extension in Developing Countries. Longman, Singapore Publ.
- Burton ES, Robert PB & Andrew JS. 1997. Improving Agricultural Extension – A Reference Manual. FAO.
- Dahama OP & Bhatnagar OP. 1987. Education and Communication for Development. Oxford & IBH.
- Mosher AT. 1966. Getting Agriculture Moving– Essentials for Development and Modernization. Praeger, New York.
- Mosher AT. 1978. An Introduction to Agricultural Extension. ADC.
- Owen E, Kitalyi A, Jayasuryia N & Smith T. (Ed). 2005. Livestock and Wealth Creation – Improving of the Husbandry of Animals Kept by Resource Poor People in Developing Countries. Nottingham Univ. Press.
- Roling N. 1988. Extension Science. Information Systems in Agricultural Development. Cambridge Univ. Press.
- Rivera WM & Schram SG. (Ed). 1987. Agricultural Extension World wide – Issues, Practices and Emerging Priorities. Croome Helm, London.
- Rivera WM. & Gustafson DJ. (Ed). 1991. Agricultural Extension: Worldwide: Institutional Evolution and Forces for Change,. Elsevier.
- Samanta RK. (Ed). 1990. Development Communication for Agriculture. BR Publ. Corp., Delhi.
- Swanson BE. (Ed). 1984. Agricultural Extension: A Reference Manual. 2nd Ed. FAO.

Van den Ban AW & Hawkins HS. 1998. Agricultural Extension. Longman Scientific Tech.

**AHE 602            COMMUNICATIONFORLIVESTOCKDEVELOPMENT            1+1**

**Objective**

To acquaint the students with concept and models of communication and to improve their communication skills

**Theory**

**UNIT I**

Communication– meaning, concept, purpose and process.

**UNIT II**

Models and theories of communication. Types of communication–intrapersonal, interpersonal, verbal and non–verbal. Criteria of effective communication, Determinants of communication– Empathy, credibility, fidelity, distortion, feed back and barriers to communication.

**UNIT III**

Group and mass communication. Modern communication technologies. Key communicators and their role in animal husbandry development.

**Practical**

Exercises in oral communication and group discussion. Exercises in written communication. Writing for newspapers, magazines. Script writing for radio and TV. Client management in veterinary clinics . Identification of key communicators in a village.

**Suggested Readings**

- Cragan FJ. & Wright WD. 1999. Communication in Small Groups – Theory, Process, Skills. Wadsworth Publ.
- Mcquail D & Windahl S. 1993. Communication Models for the Study of Mass Communications. Longman Publ.
- Ray GL. 1991. Extension, Communication and Management. Naya Prokash.
- Rogers EM & Shoemaker FF. 1971. Communication of Innovations: A Cross – Cultural Approach. The Free Press.
- Roloft Michael F. 1981. Interpersonal Communication. Sage Publ.
- Servaes J, Thomas LJ. & Whitle AS. (Ed). 1997. Participatory Communication for Social Change. Sage Publ.

**AHE 603            DIFFUSION AND ADOPTION OF ANIMAL HUSBANDRY PRACTICES            2+1**

**Objective**

To sensitize the students towards technology generation, dissemination and its adoption through effective communication.

**Theory**

**UNIT I**

Concept of diffusion. Elements in diffusion process, models and theories of diffusion. Decision–making, Stages in diffusion–adoption process.

**UNIT II**

Concepts and stages of adoption. Adoption models. Adopter categories and their characteristics. Factors influencing adoption. Attributes of innovations, rate of adoption and sources of information. Consequences of adoption of innovations.

### **UNIT III**

Role of change agents in transfer of technology. Diffusion studies in veterinary extension. Role of communication in diffusion and adoption process.

#### **Practical**

Study of selected animal husbandry innovations– the adoption and non–adoption of various practices. Reasons for adoption and non–adoption of innovations

#### **Suggested Readings**

Brown Lawrence A. 1981. Innovation Diffusion: A New Perspective. Methuen.

Cragan FJ & Wright WD. 1999. Communication in Small Groups – Theory, Process, Skills. Wadsworth Publ.

Rogers EM. 2003. Diffusion of Innovations. Free Press.

Servaes J, Thomas LJ & Whitle AS. (Ed). 1997. Participatory Communication for Social Change. Sage Publ.

## **AHE 604          EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS**

**2+1**

### **Objective**

To train the students about various techniques/methods for transfer of animal husbandry technologies through suitable audio–visual aids.

### **Theory**

#### **UNIT I**

Teaching learning process and its principles. Steps in extension teaching process, cone of experience. Learning situation. Criteria for effective teaching and learning.

#### **UNIT II**

Extension approaches in livestock development– individual, group and mass approach (electronic and non electronic). Relative merits and demerits of different teaching methods in animal husbandry extension.

#### **UNIT III**

Audio–visual aids– classification, use and evaluation. Selection criteria of audio–visual aids.

#### **UNIT IV**

Multi–media projection and computer aided teaching aids for animal husbandry extension.

#### **UNIT V**

Selection of different extension methods for dissemination of animal husbandry technologies and media–mix.

#### **Practical**

Preparation and presentation of various audio–visual aids. Use of different teaching methods in field situations. Review of research studies in teaching methods and A.V. aids.

#### **Suggested Readings**

Dahama OP & Bhatnagar OP. 1987. Education and Communication for Development. Oxford & IBH.

Hass KB & Packer HQ. 1962. Preparation and Use of Audio-Visual Aids. Prentice Hall.

Mathialagan P. 2005. Text Book of Animal Husbandry and Livestock Extension. International Book Distributing Co.

Mody Bella 1992. Designing Messages for Development Communication. An Audience Participation based Approach. Sage Publ.

Oakley P & Garforth C. 1985. Guide to Extension Training. FAO.

Priyanjam Kartik 2005. Audio Visual Aids and Education. Dominant Publ.

Ray GL. 1991. Extension, Communication and Management. Naya Prokash.

## **AHE 605 ANIMAL HUSBANDRY PROGRAMME PLANNING AND EVALUATION 2+1**

### **Objective**

To expose the students on planning, formulation, implementation and evaluation of various animal husbandry development programmes.

### **Theory**

#### **UNIT I**

Importance of programme planning in veterinary and animal husbandry extension. Objectives, principles and steps in programme planning process. Role of animal husbandry extension agencies, local leaders, livestock owners and institutions in planning and implementation of need-based veterinary extension programmes.

#### **UNIT II**

Genesis, nature and principles of planning. Planning Commission and its role. Five Year Plans with reference to animal husbandry development. Organizational structure for planning at different levels.

#### **UNIT III**

Concept, principles, types and methods of evaluation. Importance of monitoring various livestock development programmes.

#### **UNIT IV**

Needs assessment- meaning, importance, classification and steps. Concept of FSR, Participatory Approaches- Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA)

#### **UNIT V**

Project management techniques- Programme Evaluation and Review Technique (PERT). Critical Path Method (CPM). Project formulation. Project appraisal in terms of social benefit analysis, logical frame work.

### **Practical**

Preparation of livestock development plan for a village. Developing instruments for monitoring and evaluation of on-going development programme at village level (Logical Frame Work ). Exercises on Participatory approaches (RRA, PRA, Case study, Problem Based Learning).

### **Suggested Readings**

Collinson M. 2000. A History of Farming System Research. CAB Publ.

Dantwala ML & Beroneda JN. 1990. Rural Development, Approaches and Issues in Indian Agricultural Development since Independence. Oxford & IBH.

Penders JMA. 1958. Methods and Programme Planning in Rural Extension. Veenman & Zonen.

Swanson BE. (Ed). 1997. Agricultural Extension: A Reference Manual. FAO.

Thyagrajan M. 1982. Project Management through Network Techniques (PERTCPM). Indian Institute of Public Administration, New Delhi.

White Shirley (Ed). 1999. The Art of Facilitating Participation – Releasing the Power of Grassroots Communication. Sage Publ.

**AHE 606            RESEARCH METHODOLOGY IN VETERINARY AND ANIMAL            2+1**  
**HUSBANDRY EXTENSION**

**Objective**

To apprise the students about the selection criteria of research problem, variables, research design, sampling techniques, data collection procedure and report writing in the field of animal husbandry extension.

**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. Variables, types and their measurement. Selection and formulation of research problem. Hypothesis– importance, selection criteria (quality of workable hypothesis), formulation and testing of hypothesis.

**UNIT II**

Measurement and levels of measurement; Research designs– exploratory, experimental, and ex–post–facto research design. Action research. 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 and projective techniques. Action research. Reliability and validity of measurements.

**UNIT IV**

Social statistics – Parametric and non–parametric. Data processing and analysis. Report writing. Review of studies in social research.

**Practical**

Selecting a research problem and working it out with all the steps; report writing and presentation of the report.

**Suggested Readings**

Arlene Fink (Ed). 2003. The Survey Kit (10 booklets). Sage Publ.

Creswell John W. 1994. Research Design – Qualitative and Quantitative Approaches. University of Nebraska, Lincoln.

Edwards AL. 1969. Techniques of Attitude Scale Construction. Vakil, Feffer & Simons

Garrett HE. 1966. Statistics in Psychology and Education. International Book Bureau, Hyderabad.

Goode WJ & Hatt PK. 1952. Methods in Social Research. McGraw–Hill.  
 Guilford JP. 1971. Psychometric Methods. TATA McGraw Hill.  
 Henerson EM, Morris LL. & Gibbon CT. 1987. How to Measure Attitudes. Sage Publ.  
 Kerlinger FN. 1994. Foundations of Behavioural Researches. Holt, Rinehart & Winstons.  
 Kumar, R. 1999. Research Methodology – A Step by Step for Beginners. Sage Publ.  
 Miller Delbert C. 1991. Handbook of Research Design and Social Measurement. Indiana University. Sage Publ.  
 Oppenheim AN. 1979. Questionnaire Design and Attitude Measurement. Heinemann Educational Books.

**AHE 607 SOCIAL PSYCHOLOGY AND GROUP DYNAMICS 2+1**

**Objective**

To acquaint the students with the structure and functioning of social groups and socio–psychological aspects in interacting with livestock farmers.

**Theory**

**UNIT I**

Meaning, scope and importance of psychology in animal husbandry extension work. Orientation of psychology.

**UNIT II**

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 owners, formation of stereo types and prejudice, factors in attitude change.

**UNIT III**

Motivation– nature, characteristics, theories, types and techniques of motivating farm people. Emotion– nature, types of emotional response, theories and role of emotion in regulating the human behaviour. Learning– principles, theories of learning and experiential learning.

**UNIT IV**

Intelligence– nature, theories and measurement. Personality– nature, traits, types, biological and socio–cultural determinants of personality. Group and individual behaviour.

**UNIT V**

Concept and types of groups; Typology and importance in rural development; Group structures – attraction, coalition, communication and power; Processes in group development and group identity; Factors affecting group performance; Conflicts in groups; Group belongingness.

**Practical**

Study of structure and functioning of selected Self Help Groups (SHGs), factors influencing the success/ failure of SHGs, Milk Cooperative Societies.

**Suggested Readings**

Baron RA. 1995. Psychology. Prentice Hall.  
 Cragan, FJ & Wright WD. 1999. Communication in Small Groups – Theory, Process, Skills. Wadsworth Publ.

- Kagan J & Havemann E. 1980. Psychology - An Introduction. Harcourt Brace Javanovich Inc.
- Morgan CT, King RA & Robinson NM. 1979. Introduction to Psychology. Tata McGraw-Hill.
- Napier RW & Gershenfeld MK. 2006. Groups - Theory and Experience. AITBS Publ.
- Secord PF & Backman CW. 1964. Social Psychology. McGraw-Hill.

**AHE 608          ANIMALHUSBANDRY DEVELOPMENT PROGRAMMES          1+0**

**Objective**

To make the students aware of livestock development programmes launched by various agencies.

**Theory**

**UNIT I**

Concept of development, social and economic development; Historical overview on Rural Development in India

**UNIT II**

Ongoing Animal Husbandry Development Programmes -NPCBB, PM assistance livestock development programme, rural development programmes with special reference to livestock- SGSY, EGS

**UNIT III**

Transfer of Technology (TOT) programmes of ICAR- National Demonstration, Krishi Vigyan Kendra, Trainers' Training Centres, Lab to Land Programme, Operational Research Project, National Agricultural Research Project, Agricultural Technology Management Agency, National Agricultural Innovative Project.

**UNIT IV**

Understanding the functioning of livestock development institutions -DRDA, NABARD, Insurance Companies, NGOs.

**Suggested Readings**

- Candler W & Kumar N. 1998. India. The Dairy Revolution - The Impact of Dairy Development in India and the World Bank Contribution. The World Bank.
- Dahama OP & Bhatnagar OP. 1987. Education and Communication for Development. Oxford & IBH.
- Govt. of India 2005. A Reference Manual. Ministry of Information and Broadcasting, New Delhi. <http://www.dahd.nic.in>
- Mathialagan P. 2005. Text Book of Animal Husbandry and Livestock Extension. International Book Distributing Co.
- Ray GL. 1991. Extension, Communication and Management. Naya Prokash.

**AHE 609          DEVELOPMENTS IN THE CONCEPT OF EXTENSION          1+0**

**Objective**

To acquaint the students with the recent development in extension.

**Theory**

**UNIT I**

Important concepts in extension science; various schools of thought; Systems concept in extension.

#### **UNIT II**

Changing approaches – Farmer participatory approaches; Global concepts of extension as applied to Indian Context.

#### **UNIT III**

Recent trends in extension. Privatisation of extension. Public Private Partnership. Contract farming. Organic animal husbandry. Indicators of livestock sustainability. Animal welfare programmes

#### **UNIT IV**

Various stake holders in Livestock development; stakeholder analysis, problem tree

#### **Suggested Readings**

Blackburn DJ. 1989. Foundations and Changing Practices in Extension Univ. of Guelph, Canada.

Jones GE. (Ed). 1985. Investing in Rural Extension: Strategies and Goals. Elsevier.

Roling N. 1988. Extension Science. Cambridge Univ. Press.

### **AHE 610 HUMAN RESOURCE MANAGEMENT IN ANIMAL HUSBANDRY SECTOR 2+1**

#### **Objective**

To expose the students in human resource management techniques and dealing with the hierarchical and organizational problems.

#### **Theory**

##### **UNIT I**

Concept, importance and functions of human resource management. Process of management– planning, organizing, staffing, directing, coordination, reporting and budgeting. Principles, levels and types of organization.

##### **UNIT II**

Training– models, methods, identification of training needs, training evaluation and developing strategies for human resource development in animal husbandry sector.

##### **UNIT III**

Supervision– meaning, process and techniques. Work motivation. Job efficiency and job satisfaction.

##### **UNIT IV**

Organizational communication. Organizational climate. Conflict management.

##### **UNIT V**

Personnel management in animal husbandry organizations and disaster management.

#### **Practical**

Training needs assessment, development of training module, organization, evaluation of a training programme

#### **Suggested Readings**

Buford JA, Bedeian AG & Lindner JR. 1995. Management in Extension. Ohio State Univ., USA.

Dwivedi RS. 1979. Human Relations and Organizational Behaviour – A Global Perspective. 5th Ed. McMillan India.

Keith D. 2004. Human Behaviour. 8th Ed. Mc Graw Hill.  
 Lynton R & Pareek U. 1990. Training for Development. Vistar Publ.  
 Lynton R & Pareek U. 2000. Training for Organizational Transformation. Sage Publ.  
 Mishra DC. 1990. New Directions in Extension Training. Directorate of Extension, Ministry of Agriculture, Govt. of India, New Delhi.  
 Stoner JAF & Freeman RF. 1994. Management. 5th Ed. Prentice Hall.  
 Turban E & Meredith J. 1991. Fundamentals of Management Science. 5<sup>th</sup> Ed. Home Wood I.L. Irwin.  
 Weirich H & Koontz H. 1993. Management – A Global Perspective. McGraw–Hill.

**AHE 611                    GENDER AND LIVESTOCK DEVELOPMENT                    1+0**

**Objective**

To acquaint the students with the concept of gender, its importance in livestock development, livestock development policies and programmes of the government to empower women.

**Theory**

**UNIT I**

Basic concepts – gender, empowerment and livestock. Role of livestock sector in Indian economy and poverty alleviation. Enterprise integration– women in agriculture and livestock. Livestock and agrarian scenario – trends in numbers, growth, composition and exports and imports.

**UNIT II**

Policies and programmes in livestock for empowering women, Composition of livestock sector– dairying and poultry sector, Women entrepreneurship in livestock, Institutional structure in livestock production, processing and marketing– co–operatives, contract farming and SHGs, Case studies– success and failures– from the state, country and other countries.

**UNIT III**

Globalization and livestock development – opportunities and challenges, WTO– need for quality standards in livestock production– assurance and safety measures– SWOT analysis, Extension techniques for livestock development, Group project work– livestock feasibility report/live–in situation report.

**Suggested readings**

Bura N, Deshmukh J, Ranadive & Murthy KR. (Ed). 2006. Micro Credit, Poverty and Empowerment – Linking the Triad. Sage Publ.  
 NABARD. 2005. SHG Bank Linkage Programme. [http:// www.nabard.org](http://www.nabard.org)  
 Ramkumar S, Garforth C, Rao SVN & 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 & Ramkumar S. 2002. Landless Women and Dairying – Opportunities for Development within a Poverty Perspective. RAGACOVAS, Pondicherry.

**AHE 612 INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT 1+1**

**Objective**

To apprise the students about information system, networking and use of various ICT tools.

**Theory**

**UNIT I**

ICT – concept, importance and types of tools; Development and application of ICT tools including information kiosks, E-learning

**UNIT II**

Concept of information system and networking, component of information system, information resources, sharing and networking. Types of net work – PAN, LAN, WAN, Internet, AGRINET, AKIS, Indian National Agricultural Research database.

**UNIT III**

ICT programmes in livestock development, Problems and prospects of ICTs in livestock development, Digitisation, Simulation models.

**Practical**

Study of various ICT tools in livestock development.

**Suggested Readings**

Anonymous 2002. Handbook of Animal Husbandry. ICAR.

Arnon I. 1989. Agriculture Research and Technology Transfer. Elsevier Science Publ. England.

Ramkumar S & Rao SVN. 2004. Knowledge Dissemination on Cattle Health through Information Kiosks in Veterinary Centres. RAGACOVAS, Pondicherry.

Singhal A & Rogers EM. 1989. India's Information Revolution. Sage Publ.

**AHE 801 ORGANIZATIONAL MANAGEMENT 3+0**

**Objective**

To acquaint the students with the general administration, management and motivational techniques for organizational change and development.

**Theory**

**UNIT I**

Concept, approaches and functions of management. Principles and process of organization, hierarchy of organization, departmentalisation. Authority and responsibility. Components of individual behaviour in organization. Organizational climate, decision making by consensus and participation by subordinates.

**UNIT II**

Motivation– nature and significance, motivational process, theories of motivation with respect to animal husbandry work. Importance of human needs, priority of needs, Managing work motivation.

**UNIT III**

Conflict – types and management. Leadership and its role in conflict resolution. Morale in organizations, organizational factors affecting morale, attitude, and

productivity, methods of improving morale and evaluation of morale. Performance appraisal process.

#### **UNIT IV**

Supervision– principles, techniques and functions of supervision. Qualities of supervisor, supervisor–subordinate relationship and interaction process. Changing organizational structure and system, changing organizational climate and interpersonal style, issues and choice involved in making organizational climate.

#### **UNIT V**

Organization development– history, nature, characteristics, assumptions and process. Organization development interventions.

#### **Suggested Readings**

Selected articles from journals.

**AHE 802      FARM JOURNALISM AND PUBLIC RELATIONS      2+1**

#### **Objective**

To sensitize students about the role of mass media, news papers, magazines, radio, T.V. and internet for promoting animal husbandry.

#### **Theory**

##### **UNIT I**

Concept of farm journalism and communication. Journalism as a means of mass–communication and its role in livestock development. Opportunities, strength and limitations. Ethics and principles of journalism for effective writing.

##### **UNIT II**

Art of writing, news items, news stories, feature articles, success stories, magazines, bulletins, folders etc. Fundamentals of lay–out in writing. Writing of research papers and popular articles in journals and farm magazines.

##### **UNIT III**

Methods and techniques of broadcasting of farm programmes. Writing scripts for radio and televisions. Importance of public relations in veterinary and animal husbandry extension.

##### **UNIT IV**

Rapport building with different categories of clients involved in veterinary and animal husbandry extension programmes. Art of speaking. Importance of listening and reading. Relations with press media.

##### **UNIT V**

Event management, Organization of press meet. Qualities of a good public relation manager. Writing for press news.

#### **Practical**

Designing and preparation of news stories, feature articles, success stories related to animal husbandry. Designing and preparation of magazines, folders, popular research articles, radio and T.V. scripts. Visit to agricultural information and communication centre to record the activities of preparation, editing and publication of news articles and research publications. Exercise on the art of good speaking in class–room and field situations.

### **Suggested Readings**

Selected articles from journals.

**AHE 803          ADVANCED RESEARCH TECHNIQUES IN SOCIAL RESEARCH          3+1**

#### **Objective**

To train the students about various research and management techniques/ methods applicable to animal husbandry researches.

#### **Theory**

##### **UNIT I**

Measurement- meaning and levels, tests, and scales. Different types of Variables.

##### **UNIT II**

Techniques of attitude scale construction viz. paired comparison, equal appearing interval, successive interval, summated ratings, scalogram analysis.

##### **UNIT III**

Measurement of reliability and validity of tests and scales. Sociometry. Critical incidence techniques. Q - sort technique, observation techniques, case studies.

##### **UNIT IV**

Experimental and quasi experimental research designs. Content analysis and projective techniques.

##### **UNIT V**

Multivariate analysis, systems analysis, principle component analysis, discriminant analysis and their application in extension education research.

#### **Practical**

Exercises on scaling techniques, attitude scale construction - Paired Comparison, Equal Appearing interval, Summated Rating Scale, Critical Incident Technique, Knowledge Test.

### **Suggested Readings**

Selected articles from journals.

**AHE 804          TRAINING FOR HUMAN RESOURCE DEVELOPMENT          2+1**

#### **Objective**

To make the students aware of planning, implementation and evaluation of various training programmes.

#### **Theory**

##### **UNIT I**

Concept of training and education. Training infrastructure for extension personnel and farmers in India. Role of institution, organization and participants in success of training programme.

##### **UNIT II**

Assessment of training needs, curriculum design and development. Training strategies, models of training.

##### **UNIT III**

Planning, development and execution of training programmes.

##### **UNIT IV**

Training methods- Lecture, symposium, workshop, case studies, group discussion, conference, convention, panel discussion, buzz session, forum, debates, syndicate, simulation exercises, role playing, brain storming.

#### **UNIT V**

Evaluation and follow-up of training programmes.

#### **Practical**

Preparation of training programmes for extension personnel, livestock and poultry farmers. Evaluation of on-going training programmes.

#### **Suggested Readings**

Selected articles from journals.

### **AHE 805      POLICIES AND REGULATIONS IN LIVESTOCK SECTOR      2+0**

#### **Objective**

To sensitize the students about policies and regulations in animal husbandry sector.

#### **Theory**

##### **UNIT I**

World Trade Organization in relation to livestock sector. Impact of WTO on Indian international trade of food products of animal origin, Intellectual Property Rights in relation to animal husbandry.

##### **UNIT II**

HACCP, Sanitary and phyto-sanitary measures to protect the animals' life and health, food safety uses in relation to animal husbandry sector. Introduction to Agreement on Technical Barriers to Trade (ATBT).

##### **UNIT III**

Animal welfare laws- legislations in veterinary and animal sciences.

##### **UNIT IV**

Prevention of Cruelty to Animals Act-1960 and Rules. Animal Welfare Board, ABC Programme. Acts related to animals and animal diseases. Animal quarantine and certification.

#### **Suggested Readings**

Selected articles from journals.

### **AHE 806      EDUCATIONAL TECHNOLOGY      2+1**

#### **Objective**

To acquaint students with different concepts of education technology and preparation of teaching aids

#### **Theory**

##### **UNIT I**

Educational Technology - Meaning, concepts and components. Curriculum development at macro and micro levels. Formulation of instructional objectives.

##### **UNIT II**

Preparation of course outline for instructions, lesson planning. Designing instructions for theory and practical, Instructional methods and devices in class room instruction, computer aided learning. Understanding learners' behavior, learning styles, motivating learners.

### **UNIT III**

Student counselling and guidance, Student evaluation – meaning and methods, construction of measuring instrument – question banking.

### **UNIT IV**

Performance appraisal of teachers –meaning and methods, construction of assessment instruments. Use of library for effective learning.

### **Practical**

Preparation of course outline, Preparation of lesson plans, Planning and preparation of instructional aids, Individual classroom instructional exercises, Development of student evaluation instrument, Development of performance appraisal instrument for teachers.

### **Suggested Readings**

Selected articles from journals.

## **AHE 807      DYNAMICS OF CHANGE**

**2+0**

### **Objective**

To make the students aware of dynamics of change, group dynamics and social change.

### **Theory**

#### **UNIT I**

Definition of change, development, social and cultural change. Dimensions, characteristics, types, rate and directions of social change. General conditions of social change.

#### **UNIT II**

Process of change. Concept, importance and problems of planned change. Role of change agents. Approaches of change agents towards planned change. Acceptance and rejection to planned change in animal husbandry. Techniques for accelerating change.

#### **UNIT III**

Theories of change: Darwin, Kurt, Lewin, Ogburn & influence process of change, assessment of resources, fixation of change objective, evaluating change effect. Barrier to change– psychological, social & economical, stimulants to change: psychological, social & economical.

#### **UNIT IV**

Agrarian changes with reference to livestock development.

### **Suggested Readings**

Selected articles from journals.

## **AHE 808      ORGANIZATIONAL COMMUNICATION**

**2+1**

**Objective**

To sensitize the students towards communication and networking to increase the efficiency of an organization.

**Theory****UNIT I**

Organizational communication- its importance, function and characteristics. Understanding of organizational communication. Types of organizational communication- upward, downward, diagonal and grapevine. Communication network.

**UNIT II**

Effectiveness and efficiency of organizational communication.

**UNIT III**

Essentials of a sound organizational communication system. Social and Psychological barriers to effective organization communication. Causes of poor organization communication.

**Practical**

Studies on organizational communication patterns in animal husbandry

**Suggested Readings**

Selected articles from journals.

**AHE 890 SPECIAL PROBLEM****0+2****Objective**

To provide expertise in handling practical research problem(s).

**Practical**

Short research problem(s) involving contemporary issues and research techniques.

**List of Journals**

- \* Communicator
- \* Development communication
- \* Indian Dairyman
- \* Indian journal of Adult Education
- \* Indian Journal of Dairy Science
- \* Indian Journal of Extension Education
- \* Indian Journal of Psychology
- \* Indian Journal of Public Administration
- \* Journal of Dairy Research
- \* Journal of Extension Systems
- \* Journal of Rural Development
- \* Journal of Training and Development
- \* The Indian Journal of Animal Sciences
- \* The Indian Veterinary Journal
- \* Journal of Agriculture Extension and Education
- \* Indian Journal of Animal Research
- \* Indian Journal of Gender of Studies
- \* Kurukshetra

- \* Yojana
- \* Economic and Political weekly
- \* Indian Farming

### **e-Resources**

- \* [www.informaworld.com](http://www.informaworld.com) (Journal of Agricultural Education and Extension)
- \* [www.blackwellpublishing.co](http://www.blackwellpublishing.co) (International Journal of Training & Development)
- \* [www.blackwellpublishing.co](http://www.blackwellpublishing.co) Educational Measurement: Issue and Practices
- \* [www.academicjournals.net](http://www.academicjournals.net) (International Journal of Dairy Science)
- \* [www.cipav.org.co](http://www.cipav.org.co) (Livestock Research for Rural Development)
- \* [www.joe.org](http://www.joe.org) Journal of Extension Suggested Broad Topics for Master's and

### **Doctoral Research**

- \* Veterinary Education
- \* Training
- \* Communication and development
- \* Diffusion and adoption
- \* Management and entrepreneurship
- \* Livestock economics
- \* Evaluation of animal husbandry programmes 38

## VETERINARY BIOCHEMISTRY

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
VBC 601	CHEMISTRY OF ANIMAL CELL	2+0
VBC 602	TECHNIQUES IN BIOCHEMISTRY	0+2
VBC 603	APPLICATIONS OF GENOMICS AND PROTEOMICS IN MOLECULAR BIOLOGY	2+0
VBC 604	BIOCHEMISTRY OF BIOMOLECULES: CARBOHYDRATES, LIPIDS AND MEMBRANE'S STRUCTURE	2+0
VBC 605	ENZYME CATALYSIS, KINETICS, INHIBITION AND REGULATION	2+0
VBC 606	METABOLISM-I: CARBOHYDRATES AND LIPIDS	2+0
VBC 607	METABOLISM-II: NUCLEIC ACIDS AND AMINO ACIDS	2+0
VBC 608	METABOLISM-III: INTEGRATION AND REGULATION.	2+0
VBC 609	CENTRAL DOGMA AND PROTEIN FUNCTION	2+0
VBC 610	CLINICAL BIOCHEMISTRY OF ANIMALS	2+1
VBC 611	BIOCHEMICAL BASIS OF DISEASES OF DOMESTIC ANIMALS	2+0
VBC 612	ENDOCRINOLOGY AND REPRODUCTIVE BIOCHEMISTRY	2+0
VBC 613	BIOCHEMICAL BASIS OF ANIMAL PRODUCTION	2+1
VBC 691	MASTER'S SEMINAR	1+0
VBC 699	MASTER'S RESEARCH	20
VBC 801	ADVANCES IN BIOCHEMISTRY OF RUMINANT DISORDERS	2+0
VBC 802	ADVANCES IN ENZYMOLOGY	2+0
VBC 803	ADVANCES IN CLINICAL BIOCHEMISTRY	0+2
VBC 804	MEMBRANE DYNAMICS AND SIGNAL TRANSDUCTION IN ANIMAL CELL	2+0
VBC 805	METHODS IN PROTEIN ANALYSIS	2+1
VBC 806	NUTRITIONAL BIOCHEMISTRY	2+0
VBC 807	ADVANCES IN INTERMEDIARY METABOLISM	2+0
VBC 808	ENDOCRINE CONTROL OF FUEL METABOLISM	2+0
VBC 809	DIAGNOSTIC ENZYMOLOGY-I	2+0
VBC 810	DIAGNOSTIC ENZYMOLOGY-II	2+0
VBC 811	BIOCHEMISTRY OF DEVELOPMENT AND DIFFERENTIATION	2+0
VBC 812	ADVANCES IN TECHNIQUES IN BIOCHEMISTRY	1+1
VBC 813	ADVANCES IN MINERAL AND VITAMIN METABOLISM AND RELATED DISEASES	2+0
VBC 890	SPECIAL PROBLEM	0+2
VBC 891	DOCTORAL SEMINAR I	1+0

VBC 892	DOCTORAL SEMINAR II	1+0
VBC 899	DOCTORAL RESEARCH	45

### Course contents

**VBC 601 CHEMISTRY OF ANIMAL CELL 2+0**

#### **Objective**

Teaching of principles of physical chemistry as applicable to veterinary sciences.

#### **Theory**

##### **UNIT I**

Pre-biotic world, chemical evolution. cellular architecture, molecular organization and metabolic function.

##### **UNIT II**

Thermodynamics, chemical equilibrium, standard state, living cell as steady state, open system obeying laws of thermodynamics. Minimum energy conformation, quantum mechanical calculation. .G and ATP.

##### **UNIT III**

Properties of water, homeostasis, pH, osmosis, viscosity, surface forces adsorption, dialysis, diffusion rate and the sizes of organisms. The blood buffering system. Chemical basis of oral and parental fluid/electrolyte therapies, Bacterial toxigenic diarrhoeas.

#### **Suggested Readings**

Chang 2005. Physical Chemistry for the Bioscience. Univ. Science Books.  
 Dvorak AM & Harris W. 1991. Blood Cell Biochemistry. 2nd Ed. Plenum.  
 Garby L. 1995. Bioenergetics. Cambridge.  
 Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

**VBC 602 TECHNIQUES IN BIOCHEMISTRY 0+2**

#### **Objective**

To make students well versed with methodologies used in biochemistry.

#### **Practical**

Solving problems using Henderson–Hasselbalch equation, pH, pKa and buffer concentration, normality. Application of colorimetry, spectrophotometry and NMR,X–ray crystallography. Paper, column and thin layer chromatography. Partition and adsorption coefficient,quantitative and qualitative chromatography of amino acids, lipids and sugars including elution. Gas chromatography. Packing of column and choice of detectors and densitometry. Application of electrophoresis. Electrophoresis of proteins and nucleic acids. Use of sodium dodecyl sulfate(SDS–PAGE) for and molecular weight determination. Densitometry procedures and quantitative assays. Immunoelectrophoresis, its applications. Isoelectrofocussing and isotachophoresis. Molecular sieving and its application in Biochemistry. General properties of dextran, acrylamide, agar and other media used for gel filtration.

Ultracentrifugation– its principle and use, preparative analytical and density gradient ultracentrifugation. Fractionation of sub–cellular components and molecular weight determination using ultracentrifuge.

### **Suggested Readings**

David L Nelson & Cox Michael M. 2007. Lehninger’s Principles of Biochemistry. 4th Ed. Freeman.  
 Garrity S. 1999. Experimental Biochemistry. 3rd Ed. Academic Press.  
 Gowenlock AH. 1996. Varley’s Practical Clinical Biochemistry. 6th Ed. CBS.  
 Holme DJ & Hazel P. 1983. Analytical Biochemistry. Longman.

## **VBC 603          APPLICATIONS OF GENOMICS AND PROTEOMICS IN MOLECULAR BIOLOGY**

**2+0**

### **Objective**

To acquaint students about molecular basis of structure and functional aspects of NA and AA.

### **Theory**

#### **UNIT I**

Nucleotides, nucleic acids, higher order structures, cohesins and condensins in chromosome structure. SMC proteins, sequencing, mutation, evolution. DNA libraries. Bacterial RNA polymerase, RNA interference. DNA replication, RNA synthesis, control of gene expression. DNA microarrays/chips.

#### **UNIT II**

PCR, Recombinant DNA technology in improving domestic animals. RFLP, Gene and gene products. Genetic changes in hereditary diseases, cancer and detection ion DNA probes. Gene Therapy DNA vaccines, antitumor antibodies. Telomerases and Topoisomerases in treatment of diseases. Staphylococcus resistance to erythromycin.

#### **UNIT III**

Peptide bonds, acid–base properties, stereochemistry, side chain modifications, biological activities. Green fluorescent protein. Polypeptide diversity, protein purification and analysis, protein sequencing, reconstructing the sequence. Gene duplication and protein families, protein modules, combinatorial peptide libraries folding. Structural bio–informatics. Protein structure prediction and design. Proteomics. Drug molecules, myoglobin and haemoglobin. Mechanism and co–operativity in Hb. High altitude adaptation in ruminants and equines. Use of amino acid analysis in disease diagnosis.

### **Suggested Readings**

David L Nelson & Cox Michael M. 2007. Lehninger’s Principles of Biochemistry. 4th Ed. Freeman.  
 Murray RK, Granner DK, Mayes PA & Rodwell, VK. 2000. Harper’s Biochemistry. Lange Medical Book.  
 Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

**VBC 604            BIOCHEMISTRY OF BIOMOLECULES: CARBOHYDRATES            2+0**  
**LIPIDS AND MEMBRANES STRUCTURE**

**Objective**

Teaching of molecular basis of structure and functional aspects of carbohydrates and lipids.

**Theory**

**UNIT I**

Carbohydrates: Structure, glycoconjugates in cell surface, extra cellular matrix, sugar code functions, peptidoglycan-specific antibiotics. Cellular effects of Insulin. Glucose supply and removal, Ruminant fermentation, role of liver, glucose tolerance, indirect monitoring of blood glucose, ketone bodies.

**UNIT II**

Lipid classification, metabolism of LCFA, TAG, PL, Sphingolipids, cholesterol, lipoproteins. Regulation of lipid metabolism in fed and fasted states. Regulation of FA oxidation. FAs as regulatory molecules. Glucose production and FAs in type II diabetes. Ketone bodies as fuel.

**UNIT III**

Lipid bilayers, lipid motility, integral membrane proteins, lipid linked proteins, peripheral membrane proteins, fluid mosaic model, membrane skeleton, lipid asymmetry, vesicle trafficking, secretory pathway, membrane rafts, caveolae fusion, lung surfactant, structure of bacterial rhodopsin. thermodynamics of membrane transport, ionophores, porins, ion channels, aquaporins, transport proteins, P and F types ( $\text{Na}^+ - \text{K}^+$ ) ATPases,  $\text{Ca}^{2+}$ , Ion-gradient, Gap Junction,  $\text{Cl}^- \text{HCO}_3^-$ -exchanger, cardiac glycosides, abnormalities in cell membrane fluidity. Haemolytic anaemia.

**Suggested Readings**

Combs GF. 1992. The Vitamins – Fundamental Aspects in Nutrition and Health. Academic Press.

David L Nelson & Cox Michael M. 2007. Lehninger's Principles of Biochemistry. 4th Ed. Freeman.

Kaneko JJ, Harvey JH & Bruss ML. 1999. Clinical Biochemistry of Domestic Animals. 5th Ed. Academic Press.

**VBC 605            ENZYME CATALYSIS, KINETICS, INHIBITION AND REGULATION            2+0**

**Objective**

To give thorough knowledge of molecular basis of enzyme action in relation to diagnostic importance.

**Theory**

**UNIT I**

Mechanisms: Enzyme activation energy and reaction co-ordination, acid-base, covalent, metal ion. Proximity and orientation effects. Preferential transitional state binding.

**UNIT II**

Chemical kinetics, enzyme kinetics, kinetic data analysis, bisubstrate reactions. Competitive, Uncompetitive, Mixed inhibitors. Allosteric regulation. Drug design, drug discovery, bioavailability and toxicity, clinical trials. Cytochrome P450 and adverse drug reactions; synthesis of bacterial peptidoglycans, oxygenases, mixed function oxidases. .Enzyme linked diagnostics.

### UNIT III

Lysozyme. Serine proteases, physiology and tumor cell metastasis. Nerve poisons, blood coagulation cascade, Equine immuno-deficiency enzyme inhibitors. Suicide activators (DFMO for inhibition of ornithine decarboxylases in trypanosomiasis).

#### **Suggested Readings**

David L Nelson & Cox Michael M. 2007. Lehninger's Principles of Biochemistry. 4th Ed. Freeman.

Hang C & Wang T. 1988. Enzyme Dynamics and Regulation. Springer- Verlag.

Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

## **VBC 606 METABOLISM-I: CARBOHYDRATES AND LIPIDS**

**2+0**

### **Objective**

To teach regulatory mechanisms of carbohydrate and lipid metabolism in health and diseases.

### **Theory**

#### UNIT I

Metabolic control, analysis for enzymes limiting the flux through a pathway. Trophic strategies, universal mapping of metabolic pathways. Thermodynamic relationships. .G, ATP and phosphoryl group transfer, coupled reactions, thioesters, NAD<sup>+</sup> and FAD.

#### UNIT II

Overview of carbohydrate and lipid cycles, control of glycolysis, glycolysis in cancer cells, control of pentose phosphate pathways, deficiency of glucose-6-phosphate dehydrogenase. Control of glycogen metabolism, control of gluconeogenesis. Glycogen storage diseases (GSD). Regulation of citric acid cycle, pathways that use citric acid intermediates, Sugar interconversions and nucleotide - linked sugar formation. Disorders associated with impairment of metabolism.

#### UNIT III

Electron transport and oxidative phosphorylation. Generation of heat by uncoupling in brown adipose tissue.

#### UNIT IV

Regulation of fatty acid metabolism, inhibitors of fatty acids biosynthesis, sphingolipid degradation and lipid storage disease. Regulation of cholesterol synthesis. PGs in NSAID, leukotrienes, HETEs, hypersensitivity. Influence of glucose metabolism on lipid metabolism.

#### **Suggested Readings**

David L Nelson & Cox Michael M. 2007. Lehninger's Principles of Biochemistry. 4th Ed. Freeman.

Glaser JA & Deutscher MP. 1995. Introduction to Biophysical Methods for Protein and Nucleic Acid Research. Academic Press.

Russell TR, Brew K, Faber H & Schultz J. 2001. From Gene to Protein: Information Transfer in Normal and Abnormal Cells. Miami Winter Symposium-16. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

**VBC 607            METABOLISM-II: NUCLEIC ACIDS AND AMINO ACIDS            2+0**

**Objective**

To understand regulatory mechanisms of amino acid and nucleic acid metabolism in health and diseases.

**Theory**

**UNIT I**

Overview of pathways of amino acid and nucleic acid metabolism. Lysosomal degradation, ubiquitin, proteasome, breakdown of amino acids, heme biosynthesis and degradation, biosynthesis of physiologically active amines. Nitric oxide, homocystein as marker of disease. Diseases of amino acid metabolism, porphyrias.

**UNIT II**

Nucleotide synthesis and degradation, inhibition of thymidylate synthesis in cancer therapy. Mutation in coenzyme binding sites and diseases. Forces stabilizing NA structure, restriction endonucleases, small inhibitory RNAs. Chromatin organization. Inhibitors of topoisomerases as antibiotic and anticancer agents, interfering with purine and pyrimidine metabolism.

**UNIT III**

Viral nucleic acids, DNA damage and repair, telomerase, ageing and cancer. Topoisomerases as drug targets. Chemotherapy can target precursors of DNA synthesis. Antibiotics and toxins that target RNA polymerase. Lysosomal enzymes, gout, diseases in purine and pyrimidine nucleotide metabolic impairment.

**Suggested Readings**

David L Nelson & Cox Michael M. 2007. Lehninger's Principles of Biochemistry. 4th Ed. Freeman.

Kaneko JJ, Harvey JH & Bruss ML. 1999. Clinical Biochemistry of Domestic Animals. 5th Ed. Academic Press.

Swenson MJ & Reece WO.1996. Dukes' Physiology of Domestic Animals. 11th Ed. Panima.

Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

**VBC 608            METABOLISM-III:INTEGRATION AND REGULATION            2+0**

**Objective**

To give exposure in inter-relationship of cellular metabolism of various macromolecules.

### **Theory**

#### **UNIT I**

Regulation and integration of all metabolic pathways.

#### **UNIT II**

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.

#### **UNIT III**

Signal transduction, gated ion channels, G-proteins, adenylate cyclase, receptor tyrosine kinase, protein phosphatases, cGMP, Ca<sup>2+</sup>, interaction with phosphoserine/tyrosine, integrations, drugs and toxins, cell cycle and CDKs that affect cell signaling.

#### **UNIT IV**

Oncogenes and cancers. Mitochondrial genes and diseases. Reactive oxygen species. Cyanide and arsenic poisoning. Metabolic interrelationships in obesity, diabetes, cancer, aerobic and anaerobic exercise in horses, pregnancy, lactation and stress injury. Mitochondria in apoptosis and oxidative stress. Cell suicide, liver diseases, renal diseases, acid-base balance. Metabolic/sensory transduction in nervous tissue. Vision. Blood coagulation.

### **Suggested Readings**

Kaneko JJ, Harvey JH & Bruss ML. 1999. Clinical Biochemistry of Domestic Animals. 5th Ed. Academic Press.

Kurjan J & Taylor BL. 1993. Signal Transduction. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

## **VBC 609            CENTRAL DOGMA AND PROTEIN FUNCTION**

**2+0**

### **Objective**

Teaching of applied aspects of replication, transcription and translation.

### **Theory**

#### **UNIT I**

Overview of transcription and translation in eukaryotes. Collision between DNA polymerase and RNA polymerase, inhibitors of transcription, introns, evolution and expansion of the genetic code.

#### **UNIT II**

The effects of antibiotics and toxins on protein synthesis. X - chromosome inactivation. Eukaryotic gene expression, protein targeting.

#### **UNIT III**

Actin structure, microfilament dynamics, actin-myosin reacting cycle, tubulin dimer, microtubules dynamics, kinensins, dyneins.

#### **UNIT IV**

Antigen–antibody binding, cytokines, principles of immunochemical methods: agglutination, precipitation, typing of major histo–compatibility antigens. Blood group substances in farm animals.

#### **UNIT V**

Proteins as infectious agents (prions – BSE). Protein misfolding and aggregation. Plasma proteins, synthesis, functions. Influences of physiological factors and inflammation on proteins. Dysproteinemias. Defects in collagen synthesis. Transmissible multiple drug resistance, transcription factors and cardiovascular diseases. Transferrin, Lactoferrin, Ferritin and Ceruloplasmin.

#### **Suggested Readings**

Creighton TE. 1993. Protein Structures and Molecular Properties. WH Freeman.

David L Nelson & Cox Michael M. 2007. Lehninger's Principles of Biochemistry. 4th Ed. Freeman.

Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

### **VBC 610          CLINICAL BIOCHEMISTRY OF ANIMALS**

**2+1**

#### **Objective**

To make a student well versed with biochemical basis for diagnosis and prognosis of diseases in animals and poultry.

#### **Theory**

##### **UNIT I**

Disturbances of gastro–intestinal function, disturbances of rumen function. Lactic acidosis, Pickled pigs and malignant hyperthermia. Diagnosis of neuromuscular disorders.

##### **UNIT II**

Myocardial infarction, respiratory distress syndrome. Primary renal dysfunctions and test, doping. Problems in game horses.

##### **UNIT III**

Enzymes of diagnostic importance. Toxicity of ammonia in animals. Genetic defects in urea cycle. Lysosomal storage diseases. ATP synthase inhibitory protein during ischemia. Ischaemic – reperfusion injury.

##### **UNIT IV**

Molecular oncology and tumor markers. CSF characteristics in diseases. Clinical biochemistry in toxicology. Glycosylated hemoglobin, HbA1c, fructosamine. Deranged glucose metabolism in cancerous tissue. Free Radical damage.

#### **Practical**

Estimation of constituents (enzymes, metabolites and electrolytes) of body fluids during normal and pathological conditions. Estimation of hormones. Liver and kidney function tests. Total volatile fatty acids and the fractions in ruminants.

#### **Suggested Readings**

Devlin 2005. Textbook of Medical Biochemistry with Clinical Correlations. Wiley Liss.

Juristica I & Wigle D. 2006. Knowledge and Discovery in Proteomics. CRC.

- Kaneko JJ, Harvey JH & Bruss ML. 1999. Clinical Biochemistry of Domestic Animals. 5th Ed. Academic Press.
- Liebler DL. 2002. Introduction to Proteomics. Humana Press.
- Pryor WA. 1996. Free Radicals in Biology. Academic Press.
- Searcy RL. 1969. Diagnostic Biochemistry. McGraw-Hill.

**VBC 611            BIOCHEMICAL BASIS OF DISEASES OF DOMESTIC ANIMALS            2+0**

**Objective**

To give a detailed overview of role of biomolecules in health and diseases in animals and poultry.

**Theory**

**UNIT I**

Diabetes mellitus, hyperinsulemia, galactosemia, hypoglycaemia of baby pigs, Glycogen Storage Disease. Carbohydrate balance in ruminants. Biochemical alterations in body fluids of ruminants in hypoglycaemia, Ruminant ketosis.

**UNIT II**

Hypercholesterolemia, atherosclerosis, hyperlipidemia in canine, feline, equine. Pathophysiology of ketonemia. Ketosis associated with fasting, diabetes, pregnancy, lactation and post exercise.

**UNIT III**

Anemias of the newborn, cytosolic enzyme deficiencies and membrane abnormalities in erythrocytes. Porphyrins and porphyrias. Disorders of iron metabolism, neutrophil function defects and its testing. Equine immunodeficiency.

**UNIT IV**

Hepatic insufficiencies and its laboratory assessment. Pancreatitis and insufficiency. Metabolic diseases of Ca, P, Mg metabolism. Iron overload and injection, inorganic polyphosphate metabolism.

**Suggested Readings**

- David L Nelson & Cox Michael M. 2007. Lehninger's Principles of Biochemistry. 4th Ed. Freeman.
- Kaneko JJ, Harvey JH, Bruss ML. 1999. Clinical Biochemistry of Domestic Animals. 5th Ed. Academic Press.
- Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

**VBC 612            ENDOCRINOLOGY AND REPRODUCTIVE BIOCHEMISTRY            2+0**

**Objective**

To give a conceptual discussion on role of biomolecules in health and diseases in animals and poultry.

**Theory**

**UNIT I**

Mechanism of hormone action, Receptor binding, biosynthetic and metabolic aspects in physio-pathology of hormones, factors, and minerals.

**UNIT II**

Metabolic functions of the hormones of the hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal, pineal, ovaries and testes. Biochemistry of prostaglandins and related agents. Clinical endocrine aspects in production and reproduction status in domestic animals and poultry.

#### **Suggested Readings**

Morgane PJ & Panksepp J. 2002. Hand Book of Hypothalamus. Dekker.

Nes WR & McKean ML. 1977. Biochemistry of Steroids and other Isoprenoids. University Park Press.

Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry of Life at the Molecular Level. 2nd Ed. John Wiley & Sons.

### **VBC 613            BIOCHEMICAL BASIS OF ANIMAL PRODUCTION            2+1**

#### **Objective**

To teach about biochemistry of draft capacity, meat production and dairy chemistry.

#### **Theory**

##### **UNIT I**

Chemistry of milk lipids, proteins, carbohydrates, minerals, vitamins, pigments, and enzymes. Structure of milk lipids, fat globular membranes, modification of milk fat. Milk proteins – casein, amino acid composition, whey proteins, immunoglobulins, genetic polymorphism. Carbohydrates: structure and sweetness.

##### **UNIT II**

The biochemistry controlling postmortem energy metabolism mechanisms. Application of genomic technologies to the improvement of meat quality of farm animals. Identification of meat quality parameters by proteomics. Application of proteomics to understand the molecular mechanisms behind meat quality. Oxidative stability of post mortem muscles from sheep of various ages.

##### **UNIT III**

Metabolic demands of draft animals, and biochemical aspects of work and kinesiology.

#### **Practical**

Biochemical tests for proteins of meat, milk and egg and analysis of wool structure.

#### **Suggested Readings**

Eston R & Reilly T. 1986. Kinanthropometry and Exercise Physiology. Laboratory Manual.            E & FN SPON.

Hay JG. 2002. Basic Mechanics of the Skeletal System. Prentice Hall.

Hudson BJE. 1994. New Developing Sources of Food Proteins. Chapman & Hall.

Jeness R & Patton S. 2001. Principles of Dairy Chemistry. Wiley Eastern.

Miller GD, Jarus JK & McBean LD. 2004. Dairy Food and Nutrition. CRC.

### **VBC 801            ADVANCES IN BIOCHEMISTRY OF RUMINANT DISORDERS            2+0**

#### **Objective**

To give exposure about biochemical changes in diseases of ruminants.

#### **Theory**

### **UNIT I**

Comparative ruminant metabolism, metabolism of various nutrients by microflora. Postruminal digestion of dietary and microbial biomolecules.

### **UNIT II**

Metabolic disorders of rumen and recent development in disorders of ruminants associated with protein, carbohydrate and fat metabolism.

### **UNIT III**

Recent development in disorders of ruminants associated with mineral and electrolyte metabolism.

### **Suggested Readings**

Selected articles from journals.

## **VBC 802      ADVANCES IN ENZYMOLOGY**

**2+0**

### **Objective**

To teach current developments in actions of enzymes.

### **Theory**

#### **UNIT I**

Current concept on how enzymes work.

#### **UNIT II**

Recent innovations in enzymes kinetics to understand mechanism.

#### **UNIT III**

Current topics on regulatory enzymes.

#### **UNIT IV**

Lysozymes, serine proteases, drug design.

### **Suggested Readings**

Selected articles from journals.

## **VBC 803      ADVANCES IN CLINICAL BIOCHEMISTRY**

**0+2**

### **Objective**

To educate students about current developments in clinical biochemistry.

### **Theory**

#### **UNIT I**

Scope of clinical biochemistry and its application in disease diagnosis.

#### **UNIT II**

Molecular basis of cell injury and diseases.

#### **UNIT III**

Molecular basis of autoimmunity, immunodeficiency, oncogenesis.

#### **UNIT IV**

Functional tests : DNA finger printing, micro and mini satellites, PCR/RFLP in clinical biochemistry, DNA microarrays. Biomolecular prospecting and molecular designing.

### **Practical**

Nucleic acid extraction, protein arrays, RT-PCR, hybridization, electrophoretogram and chromatogram of macromolecules.

### **Suggested Readings**



To give exposure about biochemical principle as applicable to nutrition in animals and poultry.

### **Theory**

#### **UNIT I**

Evolution of diet and nutritional status of animals, digestion, absorption in ruminants, equine and poultry.

#### **UNIT II**

Calorimetry, BMR, SDA, PER, nutritional need for growth, work, production and disease. Parental nutrition.

#### **UNIT III**

Obesity, food additives and naturally occurring toxic substances in food, dietary factors in carcinogenesis, free radical, antioxidant and pro-oxidant.

### **Suggested Readings**

Selected articles from journals.

## **VBC 707      ADVANCES IN INTERMEDIARY METABOLISM      2+0**

### **Objective**

To teach methods and approaches in research on metabolism.

### **Theory**

#### **UNIT I**

Energy transformation in living cell, enzymes system, high energy compounds.

#### **UNIT II**

Overview of cycles, role of TCA in producing biological precursor in evolution. Control of fatty acid metabolism, lipoprotein metabolism, pathways of amino acids, integration of cycles, metabolism of purines, pyrimidines. CoA, NAD<sup>+</sup>, FAD and ATP.

#### **UNIT III**

Analytical approaches in studies on intermediary metabolism.

### **Suggested Readings**

Selected articles from journals.

## **VBC 808      ENDOCRINE CONTROL OF FUEL METABOLISM      2+0**

### **Objective**

To study hormonal regulation and integration of mammalian metabolism.

### **Theory**

#### **UNIT I**

Hormone: Diverse structure for diverse functions.

#### **UNIT II**

Tissue specific metabolism.

#### **UNIT III**

Hormonal regulation of fuel metabolism.

#### **UNIT IV**

Regulation of body mass, production of beef, egg, poultry and fish.

### **Suggested Readings**

Selected articles from journals.





### **List of Journals**

- \* Indian Journal of Chemical Technology
- \* Indian Journal of Biochemistry and Biophysics
- \* Indian Journal of Chemistry – Section B
- \* Indian Veterinary Journal
- \* Journal of Chemical Sciences
- \* Journal of Indian Chemical Society
- \* Meat Science – An International Journal
- \* The EMBO Journal
- \* Theriogenology
- \* Trends in Biochemical Sciences

### **e-Resources**

- \* [www.niscair.res.in/ScienceCommunication](http://www.niscair.res.in/ScienceCommunication) (Indian Journal of Biochemistry)
- \* [www.medind.nic.in/iaf/iafm.shtml](http://www.medind.nic.in/iaf/iafm.shtml) (Indian Journal of Clinical Biochemistry)
- \* [www.ijcb.co.in](http://www.ijcb.co.in) (Indian Journal of Clinical Biochemistry)
- \* [www.mcponline.org](http://www.mcponline.org) (Molecular & Cellular Proteomics)
- \* [www.elsevier.com/vj/proteomics](http://www.elsevier.com/vj/proteomics) (Proteomics Virtual Journal)
- \* [www.elsevier.com](http://www.elsevier.com) (Journal of Proteomics)
- \* [www.elsevier.com](http://www.elsevier.com) (Clinical Biochemistry)
- \* [www.sciencedirect.com/science/journal](http://www.sciencedirect.com/science/journal) (Science Direct –Clinical Biochemistry)
- \* [www.jbc.org](http://www.jbc.org) (Journal of Biological Chemistry)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Biochemical parameters in body fluids of patients in livestock and poultry
- \* Assay of enzymes for diagnosis of diseases in poultry and livestock.
- \* Endocrine studies on domestic and companion animals in relation to production and health status

## VETERINARY PHYSIOLOGY

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
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	VITAMINS AND MINERALS IN ANIMAL PHYSIOLOGY	2+0
VPY 606	PHYSIOLOGY OF ANIMAL REPRODUCTION	2+1
VPY 607	CLINICAL PHYSIOLOGY	2+1
VPY 608	NEUROMUSCULAR PHYSIOLOGY	2+1
VPY 609	CHEMICAL BIOREGULATION IN PHYSIOLOGICAL FUNCTIONS	3+0
VPY 610	RESEARCH TECHNIQUES IN VETERINARY PHYSIOLOGY	0+2
VPY 691	MASTER'S SEMINAR	1+0
VPY 699	MASTER'S RESEARCH	20
VPY 801	APPLIED PHYSIOLOGY OF BODY FLUIDS AND ELECTROLYTES	2+1
VPY 802	PHYSIOLOGY OF ANIMAL BEHAVIOUR	2+0
VPY 803	COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION	2+1
VPY 804	ADVANCES IN NEURO-ENDOCRINOLOGY	2+1
VPY 805	MYOPHYSIOLOGY AND KINESIOLOGY	2+1
VPY 806	AVIAN PHYSIOLOGY	2+1
VPY 807	PHYSIOLOGY OF LACTATION	2+1
VPY 808	ADVANCES IN ENVIRONMENTAL PHYSIOLOGY AND GROWTH	2+1
VPY 809	ADVANCES IN RUMEN MICROBIOLOGY AND METABOLISM	2+1
VPY 810	ADVANCES IN IMMUNOPHYSIOLOGY	2+1
VPY 811	PHYSIOLOGY OF STRESS	2+1
VPY 890	SPECIAL PROBLEM	0+2
VPY 891	DOCTORAL RESEARCH I	1+0
VPY 892	DOCTORAL RESEARCH II	1+0
VPY 899	DOCTORAL RESEARCH	45

### Course contents

**VPY 601      PHYSIOLOGY OF DIGESTION      2+1**

**Objective**

To teach comparative physiology of digestive system of monogastric animals, ruminants and birds, and basic techniques.

### **Theory**

#### **UNIT I**

Basic characteristics and comparative physiology of digestive system of domestic animals.

#### **UNIT II**

Gastro-intestinal motility, secretory functions of gastro-intestinal tract, their regulation and gastro-intestinal hormones.

#### **UNIT III**

Absorption, metabolism and excretion of various nutrients, appetite and control of feed intake.

#### **UNIT IV**

Development of ruminant system and rumen environment. Ruminant microbial digestion, its advantages and disadvantages. Rumino-reticular motility, its significance and control.

#### **UNIT V**

Rumen microbiology. Digestion in birds.

### **Practical**

Collection of saliva and its enzymatic studies. Activity of pepsin and trypsin enzymes. Gastric and intestinal motility. Estimation of digestive metabolites such as glucose, ketone bodies, triglycerides, cholesterol, urea-nitrogen and total proteins. Liver function tests. Method of collection of rumen liquor, merits and demerits. Determination of pH, total volatile fatty acids, ammonia-nitrogen and total-nitrogen in strained rumen liquor. Rate of passage of digesta and its estimation. Rumino-reticular movements. Artificial rumen, counting of protozoa and bacteria.

### **Suggested Readings**

Cunningham JG. 1992. Text book of Veterinary Physiology. WB Saunders. Swenson MJ & Reece WO. 2005. Duke's Physiology of Domestic Animals. Panima. D.C. Church. (1988) Digestive Physiology & Nutrition of Ruminants. Praeice Hall. Hungate R.E. 1966. Rumen and its Microbes. Acad. Press. N.Y. Forbes JM. & France J. 1993. Quantitative aspects of Ruminant Digestion & Metabolism. CAB International. Cambridge. UK

**VPY 602**

**CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY**

**2+1**

### **Objective**

To teach function and regulation of heart, recording of ECG and respiration in different animals and basic techniques.

### **Theory**

#### **UNIT I**

Heart muscle, heart as pump, origin and propagation of heart beat. Electrophysiology of heart, rhythmic excitation of heart, cardiac cycle, heart sound and dynamics of valvular and congenital heart defect.

#### **UNIT II**

Cardiac output and its measurements, factors affecting cardiac output. Venous return and its regulation. Control of the heart.

### **UNIT III**

Normal electro-cardiogram, electrocardiographic interpretation in cardiac myopathies and cardiac arrhythmias.

### **UNIT IV**

Circulation and hemodynamics, coronary, systemic and pulmonary circulation, their regulation, energetics of circulation, pathophysiology of circulation.

### **UNIT V**

Respiration, mechanism of ventilation, hemoglobin, oxygen and carbon-dioxide transport. Respiratory gas exchange. Respiratory adjustment at high altitude and deep swimming. Neural and chemical control of respiration, artificial respiration. Respiration in birds.

### **Practical**

Determination and recording of cardiac output, blood pressure and electrocardiogram, blood volume. Estimation of lung volumes and capacities by spirometry, effect of various levels of exercise on lung functional capacities. Estimation of blood gases.

### **Suggested Readings**

Cunningham JG. 1992. Text book of Veterinary Physiology. WB Saunders.

Swenson MJ & Reece WO. 2005. Duke's Physiology of Domestic Animals. Panima.

Patton 1989. Howell's Text book of Physiology. WB. Saunders.

Ganong FW. 2003. Review of Medical Physiology. Prentice-Hall.

## **VPY 603          RENAL PHYSIOLOGY AND BODY FLUID DYNAMICS          2+1**

### **Objective**

To impart knowledge regarding excretory system of mammals and birds, maintenance of body fluid homeostasis.

### **Theory**

#### **UNIT I**

An overview of nephron structure and function. Renal homeostatic function and renal excretory function.

#### **UNIT II**

Quantitative analysis of renal function, renal haemodynamics. Glomerular filtration- its mechanism and measurement. Permselectivity of the glomerular capillary wall, structural basis of GFR, tubular reabsorption and transport.

#### **UNIT III**

Role of kidney in acid-base balance. Physiology of micturition, endocrine control of renal function. Non excretory functions of kidney.

#### **UNIT IV**

Skin- general anatomy of epidermis, dermis, hypodermis, mechanical protection, permeability, actinic irradiation, sweat glands, sebaceous glands. Skin grafting. Immune properties of skin.

#### **UNIT V**

Composition of body fluids and their regulation. Excretory system in birds.

#### **Practical**

Collection and preservation of urine. Physical and chemical analysis of urine and its interpretation in health and disease condition. Demonstration of various kidney function tests, glomerular filtration rate, creatinine clearance rate, urea clearance rate and glucose tolerance test.

#### **Suggested Readings**

Klahar S. 1983. The Kidney and Body Fluids in Health and Diseases. Plenum Press.  
Swenson MJ & Reece WO. 2005. Duke's Physiology of Domestic Animals. Panima.

**VPY 604**

**HAEMATOLOGY**

**2+1**

#### **Objective**

To acquaint the students about haematology of different animals including hands-on training.

#### **Theory**

#### **UNIT I**

Red blood cells, anaemia, different types of anaemia, polycythemia and their effect on circulation in mammals and birds.

#### **UNIT II**

Resistance of the body to infection, leukocytes, tissue macrophage system and inflammation.

#### **UNIT III**

Immunity, immunoglobulins, immunogenetics, polymorphism in hemoglobin, transferrin etc. Changes in blood during diseases. Iatrogenic blood diseases, hemorrhagic diathesis, hemophilias.

#### **UNIT IV**

Hemostasis and coagulation factors, role of platelets, fibrinolysis. Blood groups, transfusion of blood. Tissue and organ transplantation. Conditions causing bleeding disorders.

#### **Practical**

Haemograms, platelet count, erythrocyte fragility. Estimation of serum iron and iron binding capacities of plasma. Separation of variants of hemoglobin and transferrin by electrophoresis. Examination of bone marrow. Isolation of different types of blood cells by sedimentation and column chromatography.

#### **Suggested Readings**

Dacie JV & Lewis SM. 1991. Practical Hematology. Churchill Livingstone.  
Jain NC. 1993. Essentials of Veterinary Hematology. Lea & Febiger.  
Rapaport SI. 1987. Introduction to Hematology. JB Lippincott.

**VPY 605            VITAMINS AND MINERALS IN ANIMAL PHYSIOLOGY            2+0**

**Objective**

To teach the importance of these nutrients in normal body functions and in disease conditions.

**Theory**

**UNIT I**

Introduction and brief history, definition, general properties and overview of functions.

**UNIT II**

Fat soluble vitamins, their functions and deficiency diseases.

**UNIT III**

Water soluble vitamins and vitamin-like compounds, their functions and deficiency diseases.

**UNIT IV**

Physiological functions of trace elements, their role in metabolism, toxicity, deficiency diseases.

**Suggested Readings**

McDowell LR. 1989. Vitamins in Animal Nutrition. Academic Press.

Underwood EJ. 1977. Trace Elements in Human and Animal Nutrition. Academic Press.

**VPY 606            PHYSIOLOGY OF ANIMAL REPRODUCTION            2+1**

**Objective**

To impart knowledge of male and female reproductive system of different species of animals including birds.

**Theory**

**UNIT I**

Functional histomorphology of male and female reproductive system, development of male and female sex organs. Endocrine and neuroendocrine relation in male and female reproductive function in different domestic animals.

**UNIT II**

Sexual cycles and mating behaviours in females, oogenesis, folliculogenesis and ovulation. Secretions of female reproductive tract in different species of animals.

**UNIT III**

Male mating behaviour, spermatogenesis, spermiogenesis, Seminiferous, epithelial cycles. Spermatozoa- structure and composition, maturation and transportation. Secretions of male reproductive tract.

**UNIT IV**

Transport of male and female gametes, fertilization, implantation. Pregnancy and parturition. Post-partum recovery in different species of domestic animals.

**Practical**

Heat detection in different animals, palpation of reproductive organs. Physical and biochemical evaluation of semen, determination of sperm enzyme, leakage during freezing. Preservation of semen, RIA of steroid hormones.

### **Suggested Readings**

- Hafeez ESE. 2000. Reproduction in Farm Animals. Lippincott, Williams & Wilkins.  
Pineda & Doley 2003. McDonald's Veterinary Endocrinology. Iowa State University Press, Ames.  
Salisbury GW & Demark NL. 1978. Physiology of Reproduction and Artificial Insemination. WB Saunders.  
Swenson MJ & Reece WO. 2005. Duke's Physiology of Domestic Animals. Panima.

**VPY 607                  CLINICAL PHYSIOLOGY                  2+1**

### **Objective**

To teach physiological basis of clinical abnormalities in body functions.

### **Theory**

#### **UNIT I**

Cardiovascular, respiratory, hepatic and renal evaluation of body functions in relation to clinical conditions.

#### **UNIT II**

Carbohydrate, fat, protein and mineral metabolism in health and disease of various species.

#### **UNIT III**

Functions and dysfunctions of liver, kidney and gastro-intestinal tract.

#### **UNIT IV**

Clinico-immunological evaluation of immune responses and clinical enzymology.

### **Practical**

Qualitative tests for glucose, ketone bodies, protein and calcium in urine. Quantitative determination of glucose in blood and urine. Electrophoresis of plasma proteins. Determination of sodium and potassium in serum. Determination of serum chloride. Separation of amino acids. Thin-layer chromatography of serum lipids.

### **Suggested Readings**

- Henry RJ. 1974. Clinical Chemistry. Principles and Techniques. Harper D Row Publishers.  
Kaneko JJ, Harvey JW & Bruss ML. 1997. Clinical Biochemistry of Domestic Animals. Academic Press.  
King EJ & Wooton IDP. 1956. Microanalysis in Medical Biochemistry. Churchill Livingstone.  
Oser BL. 1976. Hawk's Physiological Chemistry. Tata McGraw-Hill.  
Rose BD. 1989. Clinical Physiology of Acid Base and Electrolyte Disorders. McGraw-Hill.  
Tietz NW. 1970. Fundamentals of Clinical Chemistry. WB. Saunders.

**Objective**

To impart knowledge of coordination of body functions and regulation of brain functions and sense organs.

**Theory****UNIT I**

Types and classification of muscles, comparative histopathology of muscles. Skeletal muscle fibers, membrane and action potential at myoneuronal junction. Molecular characteristics of contractile filaments, molecular mechanism of muscle contraction, relationship between actin and myosin filaments, overlap and tension developed by the contracting muscles. Contractile process of smooth muscles.

**UNIT II**

Length and tension relationship, force and velocity relationship. Skeletal muscle energetics, metabolism and lactate shuttle. Exercise, adaptation to training and performance. Neuromuscular disorders of domestic animals.

**UNIT III**

Nervous system, synapse, transmission and processing of information, receptors, brain and spinal reflexes, motor functions of brain stem, limbic system, memory, sleep, learning, autonomic nervous system.

**UNIT IV**

Special senses and somatic senses.

**Practical**

Recording of electro-myogram, fatigue, tetanus in muscles. Effect of temperature on different types of muscles, demonstration of intestinal movements, effect of drugs on all types of muscles, estimation of muscles specific enzymes.

**Suggested Readings**

- Basmajian JV. 1978. Muscle Alive: their Functions Revealed by Electromyography. Williams & Wilkins.
- Cooper R. 1980. EEG Technology. Butterworths, London.
- Klemm. WR. 1969. Animal Electroencephalography. Acad. Press Inc. New York.
- Smith R.F. 1978. Fundamentals of Neurophysiology. Springer Verlag.
- Swenson MJ & Reece WO. 2005. Duke's Physiology of Domestic Animals. Panima.

**Objective**

To acquaint the students about different endocrine glands of the body and their relationship with production.

**Theory****UNIT I**

Methods of study 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.

### **Suggested Readings**

Pineda MH & Doley MP. 2003. McDonald's Veterinary Endocrinology. Blackwell Publ.  
Turner CD & Bagnara JT. 1976. General Endocrinology. WB Saunders.  
Williams RH. 1982. Text Book of Endocrinology. WB Saunders.

## **VPY 610          RESEARCH TECHNIQUES IN VETERINARY PHYSIOLOGY          0+2**

### **Objective**

Training in various techniques for application in research in Animal Physiology.

### **Practical**

Recording of ECG, EMG, blood pressure, pulse rate, movement of GI tract by Physiograph. Gas Liquid Chromatography. Electrophoresis. Estimation of various electrolytes. Estimation of bacterial production rate and VFA production rate, solid and liquid digesta flow rates and body composition using radio-isotopes, in vitro and in sacco rumen studies, ELISA. R.I. A. techniques of various hormones.

### **Suggested Readings**

Abraham GE. 1977. Handbook of Radioimmunoassay. Marcel Dekker.  
Armstrong ML. 1978. Electrocardiograms: A Systematic Method of Reading Them. KM Verghese.  
Oser BL. 1976. Hawk's Physiological Chemistry. Tata McGraw-Hill.  
Smorto MP & Basmajian JV. 1979. Clinical Electroneurography – An Introduction to Nerve Conduction Tests. Williams & Wilkins.

## **VPY 801          APPLIED PHYSIOLOGY OF BODY FLUIDS AND ELECTROLYTES          2+1**

### **Objective**

To teach physiological and clinical implication of changes in electrolytes and body fluids.

### **Theory**

### **UNIT I**

Volume and composition of body fluids, exchange of water and electrolytes between body compartments, blood and external environment. Osmolarity of fluid.

#### UNIT II

Regulation of volume and osmolarity of extra cellular fluid. Regulation of pH and acid base balance. Formation and composition of cerebrospinal fluid and lymph.

#### UNIT III

Clinical implications of change in electrolytes and body fluids. Structural and functional consideration of plasma and its composition. Diuresis and endocrine control of renal functions.

#### UNIT IV

Clinical feature in fluid and electrolyte imbalance, clinicopathological indicators of fluid and electrolytes imbalance.

#### **Practical**

Determination of electrolytes viz. sodium, potassium and chloride in plasma, determination of total body water and plasma volume by various techniques i.e. dye dilution and radioisotope technique, Estimation of osmolarity and osmolality of body fluids.

#### **Suggested Readings**

Selected articles from journals.

### **VPY 802      PHYSIOLOGY OF ANIMAL BEHAVIOUR**

**2+0**

#### **Objective**

To impart knowledge on various aspects of animal behaviour viz. communication in animals, sexual behaviour, feeding behaviour etc.

#### **Theory**

##### UNIT I

Introduction to animal ethology. Neurophysiological basis of animal behaviour.

##### UNIT II

Behaviour in relation to changes in the environment. Feeding behaviour, grazing, stall feeding and rumination.

##### UNIT III

Sexual behaviour in the female and male. Maternal behaviour. Milk let down.

##### UNIT IV

Social behaviour, communication in animals, animal temperament. Response of dogs and horses to training.

#### **Suggested Readings**

Selected articles from journals.

### **VPY 803      COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION**

**2+1**

#### **Objective**

To teach functional development of rumen and comparative digestive functions in different ruminant species.

### **Theory**

#### **UNIT I**

Functional development of ruminant stomach. Rumen motility and its control.

#### **UNIT II**

Salivary secretion and its regulation. Intraruminal environment, rumen metabolites and their assimilation, NPN feeding, nitrogen recycling.

#### **UNIT III**

Synthesis of microbial proteins and vitamins. Rumen dysfunctions. Comparative efficiency of rumen function in different species. Stoichiometry of carbohydrate fermentation.

#### **UNIT IV**

Manipulation of rumen fermentation, protected nutrients feeding, probiotics supplementation etc. Rumen flow rate and rumen volume.

### **Practical**

Reticulo-ruminal motility, artificial rumen techniques, total volatile fatty acids and their fractions, bacteria, protozoa and fungi in rumen. Flow rates of ruminal contents.

### **Suggested Readings**

Selected articles from journals.

**VPY 804**

**ADVANCES IN NEURO-ENDOCRINOLOGY**

**2+1**

### **Objective**

To acquaint the students about neuro-endocrine integrating mechanism in animals and birds.

### **Theory**

#### **UNIT I**

Neuroendocrine integrating mechanism. Structure of hypothalamus, pituitary gland, limbic and other neural pathways and endocrine functions.

#### **UNIT II**

Neural control of oxytocin, adrenocorticotrophic hormone, aldosterone, thyrotropic hormone, growth hormone, gonadotrophins etc. Hypothalamic releasing factors and the neuro-vascular link between brain and anterior pituitary.

#### **UNIT III**

Role of afferent impulses from genitals and other regions in reproductive system. Influence of hormones on brain activity.

#### **UNIT IV**

Effects of drugs on neuro-endocrine system. Neuro-endocrine mechanisms in birds. Interaction of nervous, endocrine and immune system in animal production and reproduction.

### **Practical**

Radio-immuno assay of progesterone, effects of ovariectomy, effects of testosterone treatment. Bioassay of estrogens. Estimation of T3 and T4 in blood.

### **Suggested Readings**

Selected articles from journals.

### **VPY 805 MYOPHYSIOLOGY AND KINESIOLOGY**

**2+1**

#### **Objective**

To impart the knowledge regarding exercise and work physiology, molecular basis of muscle contraction.

#### **Theory**

##### **UNIT I**

Structure of muscle, chemical composition, muscle contraction and irritability. Mechanical properties of skeletal muscle.

##### **UNIT II**

Thermal properties of muscles. Chemical correlates of contraction.

##### **UNIT III**

Molecular basis of muscular contraction of skeletal muscle. Pathophysiology of muscles and myocardium.

##### **UNIT IV**

Lever systems of body joints, Synovial fluid formation and its physiology. Principles of Kinesiology and its application in work physiology.

#### **Practical**

Electromyogram, Tetany. Electro-cardiogram. Intestinal movements. Effects of various drugs on all types of muscles.

### **Suggested Readings**

Selected articles from journals.

### **VPY 806 AVIAN PHYSIOLOGY**

**2+1**

#### **Objective**

To impart complete knowledge about physiology of domestic fowl and comparative physiology of other birds.

#### **Theory**

##### **UNIT I**

Digestive and urinary system.

##### **UNIT II**

Blood, cardiovascular and respiratory system.

##### **UNIT III**

Reproductive and endocrine system.

##### **UNIT IV**

Nervous system and musculo-skeletal system.

#### **Practical**

Study of blood cells, haemoglobin, packed cell volume (haematocrit) and erythrocyte sedimentation rate. Determination of glucose, calcium, uric acid and urea in blood. Electrophoretic separation of plasma proteins and egg proteins.

### **Suggested Readings**

Selected articles from journals.

**VPY 807      PHYSIOLOGY OF LACTATION      2+1**

**Objective**

To acquaint students with physiology and mechanism of lactation.

**Theory**

**UNIT I**

Functional anatomy, histology and cytology of mammary gland in domestic animals.

**UNIT II**

Development of mammary gland, hormonal control of mammary gland growth.

**UNIT III**

Process of lactation, initiation of milk secretion, hormonal control of lactation. Biochemical and histological changes in mammary gland during lactation. Mechanism of galactopoiesis.

**UNIT IV**

Neural control of lactation, milk let down, milk ejection and inhibition of milk ejection. Induced lactation. Composition of milk in different species of animals.

**Practical**

Examination of normal udder of cow and buffalo. Composition of colostrum and milk during different phases of lactation. Effect of adrenalin and oxytocin on milk let down, artificial induction of lactation. Estimation of lactogenic hormones.

**Suggested Readings**

Selected articles from journals.

**VPY 808      ADVANCES IN ENVIRONMENTAL PHYSIOLOGY AND GROWTH      2+1**

**Objective**

To acquaint the students about co-relation of various environmental factors on growth and performance of animals.

**Theory**

**UNIT I**

Ecology of farm animals, biological rhythms, mammalian circadian rhythms, their regulation. Components of physical environment, biometeorology and principles of thermoregulation in mammals and birds.

**UNIT II**

Physiological response of farm animals to heat and cold. Effect of various climatic components on health and production (growth and egg production), reproduction and climatic adaptation.

**UNIT III**

Concept and definitions of cellular, prenatal and postnatal growth- patterns in different species of domestic animals.

**UNIT IV**

Factors affecting live weight growth viz. nutrition, hormones, vitamins, antibiotics, environment. Ageing and senescence. Growth anomalies.

**Practical**

Growth measurement and growth curves, recording of various climatic variables, effect of climatic variables on growth and production.

**Suggested Readings**

Selected articles from journals.

**VPY 809            ADVANCES IN RUMEN MICROBIOLOGY AND METABOLISM            2+1**

**Objective**

Students will learn about rumen ecosystem and symbiotic relationship of flora and fauna, their structure and functions. Rumen manipulation techniques.

**Theory****UNIT I**

Introduction to rumen bacteria, protozoa and fungi. Development and natural fluctuation in rumen microbial population.

**UNIT II**

Microbial ecology and physiology of feed degradation within the rumen. Metabolism of nitrogen containing compounds.

**UNIT III**

Degradation of carbohydrate, fat and protein by rumen microbes, NPN utilization, Microbe–microbe interaction. Protected nutrients and other feed additives.

**UNIT IV**

Genetics and biotechnology of rumen microbes, rumen anaerobic fungi, their role and interaction with other rumen microbes.

**Practical**

Counting of total and differential protozoa, total and viable bacteria and fungi in rumen liquor. Individual VFA by GLC. Defaunation and manipulation of rumen fermentation. Culture of bacteria and fungi.

**Suggested Readings**

Selected articles from journals.

**VPY 810            ADVANCES IN IMMUNOPHYSIOLOGY            2+1**

**Objective**

To study cells and organs of immune system, its development and role in physiological functions and immunomodulation.

**Theory****UNIT I**

Introduction, history, body defense, organs of immune system, ontogeny and phylogeny of immune system, vertical transmission of immunity and difference between vertebrates and invertebrates

**UNIT II**

Immunoglobulins–basic structure and functions, hematopoiesis, T-cell and B-cell–evolution, development and their functions, species specific immunity, cytokines–sources and actions, MHC, genetic organization of immunoglobulin, MHC and complement system.

### **UNIT III**

Immune–endocrine interactions, immune system in reproduction, ageing, stress and other physiological functions, immunomodulation.

### **UNIT IV**

Hypersensitivity, diseases related to immune system, dysfunction, autoimmune disorders and their genesis, immunodeficiency.

### **Practical**

Qualitative & quantitative analysis of immunoglobulins in body fluids, RIA, ELISA, Electrophoresis techniques in immunophysiology, raising hyperimmune sera and blood group immunophysiology.

### **Suggested Readings**

Abbas AK, Lichtman AH & Pillai S. (Eds). 2007. Cellular and Molecular Immunology. 6th Ed. Elsevier.

Goldsby RA, Kindt TJ, Osborne PA & Kuby J. 2007. Immunology. 6th Ed. WH. Freeman.

Roitt IM. 1997. Essential Immunology. 9th Ed. Blackwell, Oxford.

Tizzard IR. 2004. Veterinary Immunology. 5th Ed. WB. Saunders.

## **VPY 811      PHYSIOLOGY OF STRESS**

**2+1**

### **Objective**

To teach the mechanism and effect of stress on production and reproduction in domestic animals.

### **Theory**

#### **UNIT I**

Definition of stress, various types of stresses, their effect on animal production and reproduction.

#### **UNIT II**

Physico–chemical changes of blood composition due to exercise and work. Energy utilization and requirement of muscles during work and exercise.

#### **UNIT III**

Capacity of work under field and controlled laboratory conditions, factors that regulate it.

#### **UNIT IV**

Effect of various stresses on endocrine status of animals, endurance in animals.

### **Practical**

Measurement of various biochemical parameters during stress and /or exercise in animals, measurement of various hormones during different stresses in animals, measurement of cardio–respiratory reactions during stresses.

### **Suggested Readings**

Selected articles from journals.

**Objective**

To provide expertise in handling practical research problem(s). Practical Short research problem(s) involving contemporary issues and research techniques.

**List of Journals**

- \* Acta Endocrinologica
- \* Advances in Clinical Chemistry
- \* Advances in Reproductive Physiology
- \* Advances in Veterinary Sciences
- \* American Journal of Clinical Nutrition
- \* American Journal of Physiology
- \* American Journal of Veterinary Research
- \* Animal Nutrition and Feed Technology
- \* Animal Reproduction Science
- \* Animal Sciences
- \* Annual Review of Physiology
- \* Buffalo Journal
- \* Domestic Animal Endocrinology
- \* Indian Journal of Animal Reproduction
- \* Indian Journal of Animal Nutrition
- \* Indian Journal of Animal Physiology
- \* Indian Journal of Animal Research
- \* Indian Journal of Animal Science
- \* Indian Veterinary Journal
- \* Journal of Endocrinology
- \* Journal of Physiology
- \* Journal of Reproduction and Fertility
- \* Neuroendocrinology

**e-Resources**

- \* <http://intl-joe.endocrinology-journals.org> (Journal of Endocrinology)
- \* <http://intl-ajpcon.physiology.org> (American Journal of Physiology)
- \* <http://arjournals.annualreviews.org> (Annual Review of Physiology)
- \* [www.jneurosci.org](http://www.jneurosci.org) (Journal of Neuroscience)
- \* [www3.interscience.wiley.com](http://www3.interscience.wiley.com) (Journal of Physiology & Animal Nutrition)
- \* <http://jp.physioc.org>. (Journal of Physiology)

**Suggested Broad Topics for Master's and Doctoral Research**

- \* Manipulation of rumen fermentation to enhance growth and productivity in ruminants.
- \* Normal renal functions of domestic animals.

- \* To study the mechanism of regulation of various hormones involved in production and reproduction in domestic animals.
- \* Dietary effects on growth and production in poultry.

## ANIMAL GENETICS AND BREEDING

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
AGB 601	ANIMAL CYTOGENETICS AND IMMUNOGENETICS	2+1
AGB 602	MOLECULAR GENETICS IN ANIMAL BREEDING	2+1
AGB 603	POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING	2+1
AGB 604	SELECTION METHODS AND BREEDING SYSTEMS	3+1
AGB 605	BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING	3+1
AGB 606	CONSERVATION OF ANIMAL GENETIC RESOURCES	2+0
AGB 607	CATTLE AND BUFFALO BREEDING	2+1
AGB 608	SMALL FARM ANIMAL BREEDING (SHEEP, GOAT, SWINE AND RABBIT)	2+0
AGB 609	POULTRY BREEDING	2+1
AGB 610	LABORATORY ANIMAL BREEDING	1+0
AGB 691	MASTER'S SEMINAR	1+0
AGB 699	MASTER'S RESEARCH	20
AGB 801	RECENT ADVANCES IN ANIMAL GENETICS	2+0
AGB 802	RECENT TRENDS IN ANIMAL BREEDING	2+0
AGB 803	ADVANCES IN BIOMETRICAL GENETICS	2+1
AGB 804	ADVANCES IN SELECTION METHODOLOGY	2+1
AGB 805	BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING	2+0
AGB 806	ADVANCES IN MOLECULAR CYTOGENETICS	2+0
AGB 807	UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS	2+1
AGB 891	DOCTORAL SEMINAR I	1+0
AGB 892	DOCTORAL SEMINAR II	1+0
AGB 899	DOCTORAL RESEARCH	45

### Course contents

**AGB 601      ANIMAL CYTOGENETICS AND IMMUNOGENETICS      2+1**

#### **Objective**

To educate about basic principles of cytogenetics and immunogenetics and their applications in improving farm animals.

#### **Theory**

#### **UNIT I**

Development in animal cytogenetics and immunogenetics of farm animals. Immunoglobulins and their types: antigen-antibody interactions, Immune response, ELISA.

#### UNIT II

Major histocompatibility complex; Genetics of biochemical variants and their applications; Ir-genes and concepts of disease resistance including major genes; hybridoma and its significance; concept of immuno-fertility, BoLA, BuLA, TLRs, Interleukins.

#### UNIT III

Chromatin structure of eukaryotes; chromosome number and morphology in farm animals, banding and karyotyping; chromosomal and genetic syndromes, DNA packing in chromosomes, Z+B DNA, FISH chromosome painting and PRINS. RH Panel Mapping.

#### UNIT IV

Mutation and assays of mutagenesis; sister chromatid exchanges; recombinant DNA technique and its application in animal improvement programme.

#### **Practical**

Polymorphism of haemoglobulins, transferrins, enzymes/proteins; preparation of monovalent blood reagent-isoimmunization, titre testing and absorption of polyvalent serum; identification of bar 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.

#### **Suggested Readings**

Hare WCD & Elizabeth L Singh 1999. Cytogenetics in Animal Reproduction. CABI.  
Roitt I. 1997. Essential Immunology. Blackwell.  
Stine GJ. 1989. The New Human Genetics. Wm C Brown Publ.  
Summer AT & Chandley AC. 1993. Chromosome Today. Chapman & Hall.

### **AGB 602 MOLECULAR GENETICS IN ANIMAL BREEDING**

**2+1**

#### **Objective**

To educate about molecular techniques to identify molecular markers as an aid to selection.

#### **Theory**

##### UNIT I

Basic concept: Genesis and importance of molecular techniques; Genome organization – physical and genetic map, current status of genome maps of livestock

##### UNIT II

Molecular markers and their application; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting

##### UNIT III

DNA sequencing, Genome sequencing, Genomic Library, Polymerase Chain Reaction (PCR), its types (PCR-RFLP, AS-PCR etc.) and applications; Transgenesis and methods of gene transfer

#### **UNIT IV**

Statistical techniques for analyzing molecular genetic data, Quantitative Trait Loci (QTL) mapping and its application in animal breeding, Genome scan, Candidate gene approach, Genomic selection, Marker Assisted Selection– basic concept

#### **Practical**

Extraction and purification of genomic DNA, Gel electrophoresis, Restriction enzyme digestion of DNA and analysis, PCR, PCR-RFLP, PCR-SSCP, Bioinformatics tool for DNA sequence analysis, Design of primer, Isolation of RNA, cDNA synthesis, Statistical methods for analyzing molecular genetic data.

#### **Suggested Readings**

Akano IE 1992. DNA Technology. IAP Academic Press.  
Micklos DA, Fryer GA & Crotty DA. 2003. DNA Science. Cold Spring Harbour.  
Setlow JK. 2006. Genetic Engineering – Principles and Methods. Springer.

### **AGB 603      POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING 2+1**

#### **Objective**

To study genetic structure of animal population and importance of genetic variation and covariation among traits.

#### **Theory**

##### **UNIT I**

Individual Vs population. Genetic Structure of population. Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal populations. Approach to equilibrium under different situations: Viz: Single autosomal locus with two alleles, single sex-linked locus, two pairs of autosomal linked and unlinked loci;

##### **UNIT II**

Small population: random genetic drift, effective population size, pedigreed populations, regular and irregular inbreeding systems.

##### **UNIT III**

Quantitative genetics–gene effects, population mean and variance and its partitioning, biometric relations between relatives.

##### **UNIT IV**

Genetic and phenotypic parameters–their methods of estimation, uses, possible biases and precision. Scale effects and threshold traits.

#### **Practical**

Problems relating to 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, environmental and phenotypic correlations and their standard errors.

### **Suggested Readings**

Bulmer MG. 1980. The Mathematical Theory of Quantitative Genetics. Clarendon Press.

Crow JF & Kimura M. 1970. An Introduction to Population Genetics. Theory. Harper & Row.

Falconer DS & Mackay TFC 1996. An Introduction to Quantitative Genetics. Longman.

Jain JP. 1982. Statistical Techniques in Quantitative Genetics. Tata McGraw-Hill.

Pirchner F. 1981. Population Genetics in Animal Breeding. S. Chand.

## **AGB 604 SELECTION METHODS AND BREEDING SYSTEMS**

**3+1**

### **Objective**

To explain the methodology of selection and breeding systems for genetic improvement of livestock and poultry.

### **Theory**

#### **UNIT I**

Type of selection and their genetic consequences. Response to selection and its prediction and improvement of response to selection.

#### **UNIT II**

Theoretical aspects of accuracy and efficiency of different base of selection. Prediction of breeding value using different criteria. Combined Selection. Correlated response to selection and efficiency of indirect selection.

#### **UNIT III**

Selection of several traits. Evaluation of short term and long term selection experiments viz: bidirectional selection and asymmetry of response, selection plateau and limit.

#### **UNIT IV**

Genetic aspects and consequences of various mating systems. Effects of mating systems on mean and variance. Application of various mating system in animal improvement. Selection for general and specific combining ability. Genetic polymorphysim and its application in genetic improvement.

### **Practical**

Estimation of breeding values from different sources of information. Prediction of direct and correlated response to different bases of selection. Computation of breeding values using different sources of information for female and male selection. Computation of realized heritability and genetic correlation. Selection index: Computation, Accuracy and response in component traits. Estimation of heterosis for different types of crosses. Estimation of GCA and SCA

### **Suggested Readings**

Falconer DS & 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; Vol. II. Quantitative Inheritance. Universal Publ.

**AGB 605      BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING      3+1**

**Objective**

To educate about the various biometrical techniques for data analysis and their applications in animal breeding research.

**Theory**

**UNIT I**

Review of basic concepts in statistical inference and balanced experimental designs. Nature of structure of animal breeding data and sources of variation.

**UNIT II**

Introduction to matrix algebra, types of matrices and matrix operations. Determinants and their properties, methods of finding inverse of a matrix and their application

**UNIT III**

ANOVA, Regression and Correlations, Henderson's methods for estimation of variance components, Basic concepts of linear models, Least-squares analysis, maximum likelihood; Method of estimation; Generalized LS and weighted LS. Fisher's discriminant function and its application, D2 – Statistics in divergent analysis.

**UNIT IV**

Linear models in animal breeding, Methods of analysis of unbalanced animal breeding data. Adjustment of data. Data base management and use of software packages in animal breeding.

**Practical**

Matrix applications, determinant and inverse of matrices; Building of models for various types of data; Estimation of variance components; Least squares method for analysis of research data; Collection, compilation, coding, transformation and analysis of animal breeding data by using above bio metrical techniques with computer application.

**Suggested Readings**

Henderson CR. 1984. Application of Linear Models in Animal Breeding. Univ. of Guelph.  
Kaps M & Lamberson WR. 2004. Biostatistics for Animal Science. CABI.  
Mather K & Jinks JI. 1977. Introduction to Biometrical Genetics. Chapman & Hall.  
Searle Sr. 1971. Linear Models. John Wiley & Sons.

Singh RK & Choudhary BD. 1977. Biometrical Methods in Quantitative Genetic Analysis. Kalyani.

**AGB 606          CONSERVATION OF ANIMAL GENETIC RESOURCES          2+0**

**Objective**

To educate about the concept of conservation of Animal Genetic Resources and their sustainable utilization.

**Theory**

**UNIT I**

Domestic Animal Diversity in India, its origin, history and utilization. Present status and flow of Animal Genetic Resources and its contribution to livelihood security. Methodology for genotypic characterization of livestock and poultry breeds through systematic surveys. Fodder availability; 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**

Methodology for molecular genetic characterization, 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. National and international strategies for conservation of Animal Genetic Resources.

**UNIT III**

Status, opportunities and challenges in conservation of AnGR. IPR issues pertaining to animal genetic resources/animal products or by-products. Registration of livestock breeds and protection of livestock owner's rights in India.

**Suggested Readings**

Lasley JF. 1987. Genetics of Livestock Improvement. 3rd Ed. IBH.

Nicholas FW. 1987. Veterinary Genetics. Claredon Press.

Ross CV. 1989. Sheep Production and Management. Prentice Hall.

Schmidt GM & Van Vleck LD. 1974. Principles of Dairy Science. WH Freeman.

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. Genetics for Animal Sciences. WH Freeman.

**AGB 607          CATTLE AND BUFFALO BREEDING          2+1**

**Objective**

To educate about the concept of cattle and buffalo breeding.

**Theory**

**UNIT I**

History of dairy cattle and buffalo breeding. Breeds of cattle and buffalo and their Characterisation. Inheritance of important economic traits. Recording and handling

of breeding data. Standardization of records. Computation of correction factors for the adjustment of the data. Estimation of breeding values of the cows and bulls.

#### **UNIT II**

Sire evaluation methods using single trait and multiple traits: construction of Sire indices, Sire evaluation under animal model, sire model; and maternal grand sire model. Open nucleus breeding systems with MOET.

#### **UNIT III**

Methods of cross breeding. Breeding of type, milk quality and production efficiency. Plans for developing new breeds of dairy cattle. History of development of important breeds of dairy cattle.

#### **UNIT IV**

Considerations in the import of exotic germplasm for breeding cattle in the tropics. Appraisal of buffalo and cattle breeding programme. Role of breed associations in dairy improvement.

#### **Practical**

Performance recording – milk recording – Estimation of economic traits – Standardization of records – Index cards – Sire evaluation – Comparison of latest methods – Computation of genetic parameters – Genetic gain – Estimation of heterosis – Culling and replacement.

#### **Suggested Readings**

Lasley JF. 1987. Genetics of Livestock Improvement. 3rd Ed. IBH.  
Nicholas FW. 1987. Veterinary Genetics. Claredon Press.  
Ross CV. 1989. Sheep Production and Management. Prentice Hall.  
Schmidt GM & Van Vleck LD. 1974. Principles of Dairy Science. WH Freeman.  
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. Genetics for Animal Sciences. WH Freeman.

**AGB 608      SMALL FARM ANIMAL BREEDING(Sheep,Goat,Swine and Rabbit)      2+0**

#### **Objective**

To educate about the small farm animal breeding concepts.

#### **Theory**

##### **UNIT I**

Breeds–Economic traits–Prolificacy–Breeding records and standardization.

##### **UNIT II**

Genetic parameters – Selection of males and females – Breeding systems. Development of new breeds.

##### **UNIT III**

Breeding policy – Breeding research – Conservation of breeds.

##### **UNIT IV**

Culling and replacement – EADR.

#### **Suggested Readings**

Ross CV. 1989. Sheep Production and Management. Prentice Hall.  
Turner HN & Young SSY. 1969. Quantitative Genetics in Sheep Breeding. MacMillan.  
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. Genetics for Animal Sciences. WH Freeman.

**AGB 609      POULTRY BREEDING      2+1**

**Objective**

To educate about the advances in poultry breeding practices.

**Theory**

**UNIT I**

Origin and history of poultry species: Chicken, turkey, duck and quail – Important qualitative traits in poultry including lethals – Economic traits of egg-type chicken and their standardization – Selection criteria – Aids to selection: Index selection and Osborne index – Restricted selection index – Economic traits of meat – type chicken and their standardization.

**UNIT II**

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 – Inbred lines – Strain development – Crossing : strain and line crosses – Introduction to diallel cross – Utilisation of heterosis and reciprocal effect – Reciprocal recurrent selection and recurrent selection.

**UNIT III**

Industrial breeding – Artificial insemination in chicken – Autosexing – Random Sample Test.

**UNIT IV**

Biochemical variants and immunogenetics of poultry – Use of molecular genetics in poultry breeding – Quantitative trait loci and marker-assisted selection – Conservation of poultry genetic resources

**Practical**

Inheritance of qualitative traits – Economic traits of egg-type and meat-type chicken – Procedures of standardization – Estimations of heritability, 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 – Diallel cross.

**Suggested Readings**

Crawford RD.1990. Poultry Breeding and Genetics. Elsevier.  
Hutt FB. 2003. Genetics of Fowl. Norton Greek Press.  
Singh RP & KumarJ. 1994. Biometrical Methods in Poultry Breeding. Kalyani.

**AGB 610      LABORATORY ANIMAL BREEDING      1+0**

**Objective**

To educate about the laboratory animal breeding principles.

## Theory

### UNIT I

Introduction to laboratory Animal Genetics – Breeding colonies of mice, rats, hamsters, guinea pigs and rabbits.

### UNIT II

Selection and Mating methods/systems – monogamous, polygamous and others.

### UNIT III

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.

### UNIT IV

Genetic control and monitoring – Record keeping – Ethics of laboratory animal use.

## Suggested Readings

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. Genetics for Animal Sciences. WH Freeman.

**AGB 801**

**RECENT ADVANCES IN ANIMAL GENETICS**

**2+0**

### Objective

To impart knowledge about the latest tools and techniques of Animal Genetics and their uses in animal sciences.

## Theory

### UNIT I

Eukaryotic genome: Gene families, Pseudogenes SnRNPs, Gene conversion, tandemly repeated genes, Nuclear Organiser region, mRNA splicing, Minisatellites, Microsatellites and its usage.

### UNIT II

Transposons, RNA processing Transcription regulation of gene expression, selective gene amplification, post transcriptional regulation. The proteasome and longevity of proteins.

### UNIT III

Transgenic animals their benefits in livestock production, somatic cell nuclear transfer, transgenic animals in biomedical research, ethical consideration of transgenic animals; gene therapy and transgenic animal production. Pharming of Pharmaceutical.

### UNIT IV

Radiation hybrid panels and their usage in livestock, microdissection of chromosomes, In-situ hybridization, chromosome painting, meiotic crossing over, genome selection; Structure and functions of major histocompatibility complex, T Cell receptor, CD4, Toll Like Receptors and their functions.

## Suggested Readings

Selected articles from journals

**AGB 802 RECENT TRENDS IN ANIMAL BREEDING**

**2+0**

**Objective**

To acquaint with recent trends in animal breeding and designing of need-based breeding strategies.

**Theory**

**UNIT I**

Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application and use of programme in the field of animal breeding.

**UNIT II**

Formulation of detailed breeding plans, ongoing breed improvement programmes and their impact analysis in various species of livestock under different situations.

**UNIT III**

Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

**Suggested Readings**

Selected articles from journals.

**AGB 803 ADVANCES IN BIOMETRICAL GENETICS**

**2+1**

**Objective**

To impart knowledge about recent advances in population genetic theory and application in animal breeding.

**Theory**

**UNIT I**

Mating designs; genetic basis of tripple test cross analysis (TTC); triallel analysis, partial diallel crosses and mating design for studying reciprocal and maternal differences.

**UNIT II**

Models for studying the inheritance of endosperm characters; classificatory problems; discriminant function, D2 analysis; principal component analysis.

**UNIT III**

Use of genetic parameters for prediction of recombinant inbred lines; advances in studies of genotype environment interaction and selection indices.

**UNIT IV**

Generation matrix and its use in population genetics; gene mapping of QTL (quantitative trait loci).

**Practical**

Estimation of genetic parameters – Diallel analysis – Triallel analysis – D2 analysis – Problems in Matrix.

### **Suggested Readings**

Selected articles from journals.

**AGB 804      ADVANCES IN SELECTION METHODOLOGY      2+1**

### **Objective**

To educate about the latest advances in selection theory and their application in animal breeding.

### **Theory**

#### **UNIT I**

Fundamental theorem of natural selection; Selection in finite populations, effect on genetic structure and variance. Optimum designs for the estimation of genetic parameters. Design of selection experiments for testing selection theory.

#### **UNIT II**

Methods of measurement of genetic and environmental trends. Advances in selection indices Multistage, Restricted and retrospective selection indices.

#### **UNIT III**

Multi-information, Empirical evaluation of selection theory: genetic slippage, limits to selection, asymmetry of response, selection experiments, effect of selection on variance.

#### **UNIT IV**

Selection for threshold traits; single and multiple trait best linear unbiased estimation (BLUE) and prediction (BLUP); selection under single and multiple trait animal models; direct and correlated response through various selection indices, relationship between BLUP and selection index; fundamentals of marker assisted selections.

### **Practical**

Estimation of relative economic values; determination of culling levels and selection intensity; construction of various indices; estimation of direct and correlated response; QTL analysis using LDMS & LEMAS.

### **Suggested Readings**

Selected articles from journals

**AGB 805      BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING      2+0**

### **Objective**

To educate about basic concepts of bioinformatics and their applications in Animal Genetics and Breeding.

### **Theory**

#### **UNIT I**



## **UNIT II**

Partitioning of between cross variance – general combining ability, specific combining ability and reciprocal effects; methods of analyzing diallel crosses; utilization of non-additive genetic variance.

## **UNIT III**

Crossbreeding systems – crossbreeding effects; recurrent and reciprocal recurrent selection and their forms.

## **UNIT IV**

Development of specialized sire and dam lines; inbred lines and their maintenance; inbreeding and hybridization.

## **Practical**

Computation of degree of dominance using NC Plans; analysis of partial and complete diallel cross data; estimation of crossbreeding effects; estimation of genetic correlation among paternal purebred and crossbred half sibs; computation of response through RS and RRS.

## **Suggested Readings**

Selected articles from journals.

## **List of Journals**

- Animal Biotechnology
- Animal Production
- Animal Reproduction Science
- Animal Genetics
- Animal Science
- Animal Genetic Resource Information
- Asian–Australian Journal of Animal Sciences
- Biochemical Genetics
- Biometrical Journal
- Biometrics
- Biodiversity and Conservation
- British Veterinary Journal
- Canadian Journal of Animal Sciences
- Canadian Journal of Genetics and Cytology
- Chromosoma
- Chromosome Research
- Current Genetics
- Current Genomics
- Current Opinion in Genetics and Development
- Cytogenetics and Cell Genetics
- Developmental Genetics
- DNA Sequence

- DNA and Cell Biology
- Evolution
- Gene
- Gene Expression
- Gene Therapy
- Genetica
- Genetics
- Genetics and Molecular Biology
- Genetical Research
- Genome Research
- Genomics
- Heredity
- Immunogenetics
- Indian Journal of Animal Science
- Indian Journal of Experimental Biology
- Indian Journal of Heredity
- Indian Journal of Animal Reproduction
- Japanese Journal of Breeding
- Journal of Animal Genetics & Breeding
- Journal of Dairy Research
- Journal of Dairy Sciences
- Journal of Heredity
- Journal of Animal Science
- Journal of Genetics & Breeding
- Journal of Research, HAU
- Journal of Research, PAU
- Journal of Rural Development
- Journal of Genetics
- Molecular Biology
- Theoretical and Applied Genetics
- World Animal Review
- World Review of Animal Production

### **e-Resources**

- <http://www.ncbi.nlm.nih.gov/>
- <http://www.genome.gov>
- <http://www.hgsc.bcm.tmc.edu/projects/bovine>
- <http://www.animalgenome.org>
- <http://www.blackwell-synergy.com>
- <http://www.genomics.liv.ac.uk>
- <http://www.biomedcentral.com>
- <http://www.genomealliance.org.au>
- <http://www.csiro.au>

- <http://www.isag.org.uk>
- <http://www.ebi.ac.uk/imgt/>
- <http://www.csrees.usda.gov>

#### **Suggested Broad Topics for Masters and Doctoral Research**

- Animal Genetic Resources characterization and evaluation using field survey and molecular markers
- Animal Genetic Resource enhancement through selection/crossbreeding/reproductive biotechnology/molecular biology
- Identification of molecular markers for economic traits
- Genetic basis for improvement in quantitative traits
- Breeding tools for Sire evaluation
- Appropriate models for evaluating animal breeding values
- Transgenesis and gene transfer
- Genetics of Disease Resistance

## ANIMAL NUTRITION

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
ANN 601	ANIMAL NUTRITION - ENERGY AND PROTEIN	3+0
ANN 602	ANIMAL NUTRITION - MINERALS, VITAMINS AND FEED ADDITIVES	3+1
ANN 603	FEED TECHNOLOGY	1+1
ANN 604	FEED CONSERVATION, STORAGE AND QUALITY CONTROL	2+2
ANN 605	RUMINANT NUTRITION	2+1
ANN 606	NON-RUMINANT NUTRITION	1+1
ANN 607	NUTRITION OF COMPANION/LABORATORY , WILD AND ZOO ANIMALS	2+1
ANN 608	RESEARCH TECHNIQUES IN ANIMAL NUTRITION	1+3
ANN 609	NON CONVENTIONAL FEED STUFF AND TOXIC CONSTITUENTS/ANTIMETABOLITES IN ANIMAL FEEDSTUFF	2+1
ANN 691	MASTER'S SEMINAR	1+0
ANN 699	MASTER'S RESEARCH	20
ANN 801	MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION	3+0
ANN 802	MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS	2+0
ANN 803	NUTRITION AND RUMEN FERMENTATION	1+1
ANN 804	ADVANCES IN MICRONUTRIENTS	1+0
ANN 805	ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH	1+2
ANN 806	ADVANCES IN FEED TECHNOLOGY	1+1
ANN 807	CLINICAL NUTRITION	1+1
ANN 808	NUTRIENT AND DRUG INTERACTION	2+0
ANN 809	NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING	2+0
ANN 891	DOCTORAL SEMINAR I	1+0
ANN 892	DOCTORAL SEMINAR II	1+0
ANN 899	DOCTORAL RESEARCH	45

### Course Contents

**ANN 601      ANIMAL NUTRITION - ENERGY AND PROTEIN      3+0**

#### **Objective**

Familiarization with fundamental concepts of energy and proteins, metabolism of carbohydrate, fat and protein and their efficiency of utilization. Requirement of carbohydrates, fat and proteins for various physiological functions.

## Theory

### UNIT I

Basic terminology and classification of carbohydrates, fats and proteins. Fundamental concepts of Digestion and metabolism of Carbohydrate Fat and Protein in different species of animals. Gluconeogenesis, Recent advances in glucogenic precursors on acetate utilization. NPN metabolism, urea fermentation potential and metabolizable protein. Amino acids imbalance, antagonism and toxicity.

### UNIT II

Measures of feed energy. Partitioning of feed energy. Efficiency of energy and Protein utilization. Feeding standards– comparative appraisal and limitations.

### UNIT III

Rumen degradable Protein (RDP), and rumen undegradable protein (UDN) and Kinetics. Energetics of protein synthesis and turn over. Quantification of microbial protein synthesis. Protein quality determination in monogastrics and utility.

### UNIT IV

Energy balance, Fasting catabolism. Direct and indirect calorimetry. Determination of energy and protein requirements. Energy and protein requirement for maintenance, growth, pregnancy and lactation in ruminants, companion animals and poultry.

## Suggested Readings

- Blaxter K. 1989. Energy Metabolism in Animal and Man. Cambridge Univ. Press.  
Bondi A. 1987. Animal Nutrition. Wiley InterScience.  
Crampton EW & Harris LE. 1969. Applied Animal Nutrition. WH Freeman.  
Maynard LA, Loosli JK, Hintz HF & Warner RG. 1987. Animal Nutrition. McGraw–Hill.  
McDonald P, Edwards RA & Greenhalgh JFD. 1995. Animal Nutrition. Longman.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. Basic Animal Nutrition and Feeding. Wiley Dreamtech India.  
Singh UB. 1987. Advanced Animal Nutrition for Developing Countries. Indo–Vision.

## ANN 602 ANIMAL NUTRITION – MINERALS, VITAMINS AND FEEDADDITIVES 3+1

### Objective

Role, requirement, functions, deficiency and toxic effects of vitamins, essential, probably essential and toxic minerals. Understanding soil–plant–animal–human relationship for utilization of minerals. Recent trends in the use of feed additives, probiotics, prebiotic and enzymes in animal feeding.

## Theory

### UNIT I

Essential minerals, general role of minerals, soil–plant–animal–human relationship, requirement of minerals, factors affecting requirements. Macro elements and micro elements, their distribution, metabolism, physiological functions, deficiencies and excesses, requirements and sources. Probable essential minerals. Toxic minerals. Definition, history, classification, chemistry, functions, deficiencies and excesses, requirements and sources of water soluble and fat–soluble vitamins.

### UNIT II

Critical minerals for ruminants and non-ruminants, chelates and chelated minerals. Inter-relationship of minerals with other nutrients. Impact of minerals arising from industrial affluent on animal health and production. Critical limits of minerals in edible herbage. Bioavailability studies in minerals. Impact of minerals on reproduction. Area specific minerals.

### **UNIT III**

Relationship of vitamins with other nutrients. Critical vitamins for ruminants and non-ruminants. Feed additives including probiotics Prebiotics, Symbiotics and feed enzymes. Research techniques in nutrition.

### **Practical**

General principles of mineral estimation, Sampling and processing techniques, Estimation of macro- and micro-minerals. Determination of bioavailability of minerals. Formulation of mineral mixture for various species. Identification of adulterants and quality control. Atomic absorption spectrometry in mineral estimation. Preparation of diets for mineral studies. Principles of vitamin estimation. Estimation of some important vitamins (vitamin A,E,C). Formulation of vitamin mixture for various species.

### **Suggested Readings**

Banerjee GC. 1988. Feeds and Principles of Animal Nutrition. Oxford & IBH.  
Krishna G & Ranjhan SK. 1991. Special Analytical Techniques. Kalyani.  
McDonald P, Edwards RA & Greenhalgh JFD. 1995. Animal Nutrition. Longman.  
McDowell LR. 2003. Minerals in Animal and Human Nutrition. Reed Elsevier India.  
Peter RC. 2005. Applied Animal Nutrition Feeds and Feeding. Pearson Prentice Hall.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. Basic Animal Nutrition and Feeding. Wiley Dreamtech India.  
Reddy DV. 2003. Principles of Animal Nutrition and Feed Technology. Oxford & IBH.  
Underwood EJ & Shuttle 1999. The Mineral Nutrition of Livestock. 3rd Ed. CABI.

## **ANN 603 FEED TECHNOLOGY**

**1+1**

### **Objective**

Introduction to the subject, formula feed manufacturing and different operations involved. Layout, designing, operation and management of feed mill.

### **Theory**

#### **UNIT I**

Importance of feed technology in relation to animal productivity. The integrated biological, chemical and physical basis for evaluating the inherent nutritional quality of feed ingredients and feeds. Familiarization of various feed mill equipments, layout and operations. Problems of feed manufacturing units and control measures. Quarantine measures.

#### **UNIT II**

Introduction to the formula feed manufacturing including principles of material handling, grinding, mixing, pelleting and other major processing operations.

Crumbling, Flaking, Popping, Extrusion. Principles of instrumentation and analysis, with emphasis on application to quality control and research in the feed industry.

### **UNIT III**

The formulation of concentrate mixtures, premixes and rations using computer. Automated feed mill. Personal management in feed plants, laws and regulation of feed manufacturing industry. Codex alimentarius, HACCP. Organizational charts for small, medium and large feed plants, labour standard, planning and production programme, handling of plant equipment. Merits and demerits of automated feed plant

#### **Practical**

Identification of feed ingredients and their specifications, as well as compound feed for different categories of livestock and poultry. Feed microscopy. Formulating premixes. Introduction to Pulverisers, pelletisers, complete feed blocks equipments Plant layout and design of different capacity of feed mills, problems related to feasibility, records keeping in different sections of feed mill. Experiential learning at the feed plant for preparing feed, urea molasses mineral blocks, mineral mixture.

#### **Suggested Readings**

- Banerjee GC. 1988. Feeds and Principles of Animal Nutrition. Oxford & IBH.  
Givens DI. 2000. Forage Evaluation in ruminant Nutrition. Great Britain Publ.  
Gohl BO. 1985. Tropical Feeds. FAO.  
Lohan OP, Chahal SM & Kishore N. 1998. Feed Quality Evaluation Techniques. CCS Haryana Agricultural Univ. Press.  
McEllihner, Robert R. 1994. Feed Manufacturing Technology. The American Feed Industry Assoc.  
Perry TW. 2004. Feeds and Feeding. Prentice Hall.  
Ponds WG, Church DC & Pond KR. 1995. Basic Animal Nutrition and Feeding. John Wiley & Sons.  
Zaworski F. 1997. Feed Industry Red Book. ZMAG Publ.

**ANN 604      FEEDCONSERVATION, STORAGE AND QUALITY CONTROL      2+2**

#### **Objective**

To acquaint with inherent nutritional quality of feed ingredients and feeds. Evaluation of feeds and fodders and feed preservation techniques. Procurement and storage of feed ingredients. Losses during storage and its control.

#### **Theory**

### **UNIT I**

Principles of feed and fodder processing and preservation techniques, their merits and demerits. Procurement, planning and purchase procedures; traditional and modern farm level storage structures. Feed storage and godown management, estimation of storage capacity and stack plan.

### **UNIT II**

Evaluation of processed and preserved feeds and forages. Role of moisture, temperature and relative humidity during storage of feedstuffs and their effect on biotic factors. Handling and storage of liquid feed Ingredients. Physical and chemical changes in feeds during storage; storage losses; insect pests and rodents in feed stores and their control; Role of fungi, tolerance limits and measures to check them in stored products.

### **UNIT III**

Factors affecting the quality of feed and feedstuffs on preservation. Microbiological evaluation of processed and preserved feeds, Effect of preservation on nutritional value of feed. Properties and mode of action of pesticides and fumigants; principles of good sanitation and hygiene of godowns.

### **UNIT IV**

Proximate composition, Limitations of various systems of analysis, Partitioning of forage fibre by Van Soest method, Quality control of fed ingredients, Specifications of feed ingredients and finished feeds, BIS standard., Pesticide and insecticide residues in feeds.

### **Practical**

Laboratory evaluation of preserved and processed feed and forages. Physical properties of feeds and feedstuffs; identification of insect-pests and fungi in stored products; techniques for detection of hidden infestation in grains; quality control and inspection of stored feed materials; moisture equilibrium determination and estimation of chemical changes including alcoholic acidity, rancidity and uric acid in feeds during storage. Weende proximate analysis, Van Soest fibre fractionation, Enzymatic evaluation, Pro rata deduction (Feed laws), urea, FFA, peroxide value, adulterants, and heavy metal

### **Suggested Readings**

- Givens DI. 2000. Forage Evaluation in Ruminant Nutrition. Great Britain Publ.
- Khare BP. 1994. Stored Grain Pests and their Management. Kalyani.
- Krishna G & Ranjhan SK. 1991. Special Analytical Techniques in Nutritional Biochemistry. Kalyani.
- Lohan OP, Chahal SM & Kishore N. 1998. Feed Quality Evaluation Techniques. CCS Haryana Agricultural Univ. Press.
- McEllihner Robert R. 1994. Feed Manufacturing Technology. The American Feed Industry Assoc.
- Ponds WG, Church DC & Pond KR. 1995. Basic Animal Nutrition and Feeding. John Wiley & Sons.

**ANN 605 RUMINANT NUTRITION**

**2+1**

### **Objective**

Requirement of nutrients for different physiological functions in various ruminant species. Latest concepts of feeding the nutrients for maximising production.

### **Theory**

### **UNIT I**

Nutrients and their metabolism with special reference to milk, meat and wool production.

#### **UNIT II**

Feeding standards, their history, comparative appraisal and limitations. Classification of feedstuffs. Nutrient requirements for calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat.

#### **UNIT III**

Introduction to rumen microflora and fauna. Development of rumen. Role of milk replacers and calf starters

#### **UNIT IV**

Feed formulation of large and small ruminants for different physiological stages. Concept of complete feed. Limiting nutrients and strategic feeding of high yielding ruminants. Concept of by-pass nutrients and their impact on production, reproduction and immune status. Importance of CLA, omega fatty acids, Scope for value addition in milk, Different systems of feeding buffalo for beef production.. Feeding during natural calamities, feeding in various agro-climatic zones of India.

#### **Practical**

Design and planning of feeding experiments. Identification of feed and fodder on the basis of its composition. Artificial rumen technique, Methods for evaluation of feedstuffs–in vitro gas, in sacco digestion kinetics. Determination of nutritive value of feeds and fodders by metabolism trial in dairy cattle, determination of nutritive value of pastures by the use of range techniques, study of rumen metabolic profile. Preparation of Bypass Nutrients Identification of rumen microbes and rumen studies.

#### **Suggested Readings**

Dhority BA. 2003. Rumen Microbiology. Nottingham Univ. Press.  
Kellems RO & Church DC. 2002. Livestock Feeds and Feeding. Prentice Hall.  
Ranjhan SK. 2001. Animal Nutrition in the Tropics. Sangam Books.

### **ANN 606 NON-RUMINANT NUTRITION**

1+1

#### **Objective**

Requirement of nutrients and feeding of various non-ruminants species for efficient quality production.

#### **Theory**

##### **UNIT I**

Nutrients, their metabolism and requirements for poultry and swine during different stages of growth and production. Limiting iminoacids–lysine and methionine.

##### **UNIT II**

Feeding systems and feed additives, feed formulations for different purposes including least cost rations.

##### **UNIT III**

Quality control of poultry and swine rations for efficient egg and meat production. Nutrition in relation to disease and stress.

##### **UNIT IV**

Nutritional factors affecting quality of the products. Hind gut fermentation and its importance, Nutrient requirements of rabbits and equines, Nutritional manipulation for producing value added egg, meat / pork

### **Practical**

Design and planning for poultry and swine feeding experiments, formulation and compounding of general and least cost rations, determination of nutritive value of poultry and swine feeds by balance experiments, evaluation of protein quality, Visit to poultry and piggery units, feed and fodder stores, Use of software in least cost feed formulations. Basic principles governing the least cost formulation software's.

### **Suggested Readings**

Leeson S & Summers JD. 2005. Commercial Poultry Nutrition. International Publ. House.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. Basic Animal Nutrition and Feeding. Wiley Dreamtech India.  
Rose SP. 1996. Principles of Poultry Science. CABI.  
Stevan I, Scott ML & John DS. 2001. Nutrition of the Chicken. Univ. of Guelph.

## **ANN 607 NUTRITION OF COMPANION, LABORATORY, WILD AND ZOO ANIMALS**

2+1

### **Objective**

Preparation, storage and evaluation of feeds and feeding standards of companion / laboratory / wild and zoo animals

### **Theory**

#### **UNIT I**

Feed Habbits, food Patterns, digestive structure and functions companion, laboratory , wild and zoo animals. Natural dietary habits. Nutritional requirements of various species of animals.

#### **UNIT II**

Feeding standards and feeding habits of companion / laboratory animals. Importance of colostrum and feeding of neonates and growing animals. Feeding and care of nursing mothers. Feeding of sick and old animals. Post Surgical nutrition.

#### **UNIT III**

Ration formulation for captive animals. Artificial feeding and feeding during emergency. Nutritive characteristics of forages for wild animals. Adequacy of forage plants for wild and zoo animals. Diets used in captivity. Raising orphans. Nutritional melodies. . Nutrition of semi wild and semi domestic animals like mithun and yak under special topography

#### **UNIT IV**

Composition, presentation, sterilization, palatability, assessment and storage of companion / laboratory animal diets. companion food tables and their nutritional

assessment. Mistakes and misleading information on companion food labels and labeling.

#### **UNIT V**

Nutraceuticals in companion / laboratory foods and animal foods. Nutritional deficiency diseases. Geriatric nutrition – corrective measures

#### **Practical**

Formulation and preparation of hygienic, balanced diets and feeding for companion/laboratory animals. Characteristics of ration formulation and feeding schedules wild and zoo animals. Feeding schedules for sick and orphan wild / zoo animals. Artificial and emerging feeding. General feeding habits and different feed constituents of wild and captive animals. Research methodology of companion/laboratory animals. Processing and storage of companion/laboratory diets. Visit to Zoological parks and wildlife sanctuary.

#### **Suggested Readings**

Case LP. 1995. Canine and Feline Nutrition. St. Louis Publ.  
Church DC. 1980. Digestive Physiology and Nutrition in Ruminants. Oxford Press.  
Givens DI, Owel E, Aford REF & Omed HM. 2000. Forage Evaluation in Ruminant Nutrition. CABI.  
Petter WL & Pearson AEG. 1971. The Laboratory Animals– Principles and Practices. Academic Press.  
Reddy DV. 2003. Applied Nutrition. Oxford & IBH.  
Robbins C & Cunha T. 1994. Wildlife Feeding and Nutrition. Reed Elsevier.

**ANN 608          RESEARCH TECHNIQUES IN ANIMAL NUTRITION          1+3**

#### **Objective**

Planning and designing of experiments, use of various techniques in estimating chemical and bio-chemical constituents in feeds, fodders, blood, milk, rumen liquor, meat, wool etc.

#### **Theory**

##### **UNIT I**

Principles of animal experimentation. Specialized feed compounding. Introduction and principle of GLC, HPLC, AAS, tracer technique, flame photometer, NIR, SF6, amino acid analyzer.

##### **UNIT II**

Importance and principle of various techniques in estimating chemical and biochemical constituents and toxic principles in feeds, fodders. Importance, principles and procedures for estimating chemical and biochemical constituents in blood, milk, rumen liquor, meat, wool etc.

#### **Practical**

Cell Wall partitioning, Lignin as internal marker in feedstuffs, Mineral estimation by atomic absorption spectrophotometer, In-vitro/in-sacco determination of digestibility and digestion kinetics. Determination of energy content of feed, faeces

and urine using bomb calorimeter. Methodology for quality improvement of animal feeds. Interpretation and presentation of results. Tracer techniques in Animal Nutrition. Quality evaluation of silage and hay, feed energy estimation; nitrate, urea, aflatoxin, salmonella, glycosides and sedimentation tests. Blood profile, meat quality.

### **Suggested Readings**

- Bondi AA. 1987. Animal Nutrition. Wiley InterScience.  
Gupta PC, Khatta VK & Mandal AB. 1988. Analytical Techniques in Animal Nutrition. CCS HAU Press.  
Pandey DN & Bajpai A. 2003. Recent Trends in Animal Nutrition and Feed Technology for Livestock, Pets and Laboratory Animals. International Book Distr.  
Reddy DV. 2003. Principles of Animal Nutrition and Feed Technology. Oxford & IBH.

<b>ANN 609</b>	<b>NON CONVENTIONAL FEEDSTUFFS AND TOXIC CONSTITUENTS / ANTIMETABOLITES IN ANIMAL FEEDSTUFF</b>	<b>2+1</b>
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### **Objective**

To understand the importance of alternate feeds and their use in augmenting profit in livestock farm. Different toxins present in feed stuffs, their properties and detoxification techniques.

### **Theory**

#### **UNIT I**

Present and future feed requirements and current availability for livestock and poultry. Use of non-traditional feeds – By-products of agricultural, industrial, food processing units and forest by-products. Evaluation by chemical and biological methods. Formulation of economical rations. Level of inclusion of various non conventional feeds in livestock ration

#### **UNIT II**

Classification of toxic principles in animal feedstuffs. Chemico-physical properties of various toxins. Effect of toxins on biological system and nutrients utilization in different species of livestock. Detoxification of toxin principles by various physical, chemical and biological techniques. Insecticide and pesticide residue detection.

### **Practical**

Estimation of various protease inhibitors; tannins; and mycotoxins in various feeds and feedstuffs. Nitrates, HCN, oxalates, insecticide and pesticide residues, saponins, Gossypol, mimosine, heavy metals.

### **Suggested Readings**

- Banerjee GC. 1988. Feeds and Principles of Animal Nutrition. Oxford & IBH.  
Liner IE. 1980. Toxic Constituents of Animal Food Stuffs. Academic Press.  
Lohan OP, Chahal SM & Kishore N. 1998. Feed Quality Evaluation Techniques. CCS Haryana Agricultural Univ. Press.  
McDonald P, Edwards RA & Greenhalgh JFD. 1995. Animal Nutrition. Longman.

Ponds WG, Church DC & Pond KR. 1995. Basic Animal Nutrition and Feeding. 4th Ed. John Wiley & Sons.

Ranjhan SK. 2001. Animal Nutrition in the Tropics. Sangam Books.

Reddy DV. 2003. Principles of Animal Nutrition and Feed Technology. Oxford & IBH.

**ANN 801          MODERN CONCEPTS OF FEEDING RUMINANTS AND          3+0**  
**FORAGE UTILAZIATION**

**Objective**

To impart knowledge of modern concepts in nutrient requirement and feeding and enhanced utilization in ruminant and recent development in analysis of forages.

**Theory**

**UNIT I**

Developments in ruminant digestive physiology – Energy protein requirement and measurement – Requirements of other nutrients. Importance of energy and protein quantity and quality Feed input and milk output relationship.

**UNIT II**

Concept of limiting amino acids for high yielders. Strategic feeding of high yielding dairy cows and meat producing ruminants. Concept of Phase feeding. Bypass Nutrient technology. Feeding during stress. Nutrition–immunity interaction. Designer milk and meat. Rumen manipulation to reduce methanogenesis. Nitrogen oxide emission and heavy metal residues. Metabolic profile tests.

**UNIT III**

Use of conserved forages in ruminant feeding. Chemical composition of common and newer forage – Factors affecting nutritive value of commonly available grasses, pastures, silage, hay and crop residues, voluntary intake of fodder at different stages of growth. Newer methods of forage evaluation – calculated in vitro ME and DOMD by using prediction equations. Merits and demerits of using leaf protein. Top feeds and their effective utilization – pasture consumption and evaluation studies.

**UNIT IV**

Seminars on current topics of special interest.

**Suggested Readings**

Selected articles from journals

**ANN 802          MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS          2+0**

**Objective**

To impart knowledge on modern concepts in nutrient requirement and feeding of monogastric livestock

**Theory**

**UNIT I**

Nutritional factors affecting egg quality and hatchability in poultry. Feeding for designer eggs. Role of essential fatty acids, amino acids imbalance, toxicity and interactions in monogastrics

#### **UNIT II**

Developments in digestive physiology of swine – equines – Measurement of protein and energy requirements – Influence of processing of feeds and fodders in mono-gastric animal nutrition.

#### **UNIT III**

Modern concepts of amino acid nutrition at various physiological status – Role of vitamins and minerals in health and disease. Advances in new generation feeds and feed additives.

#### **Suggested Readings**

Leeson S & Summers JD. 2005. Commercial Poultry Nutrition. International Publ. House.

Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. Basic Animal Nutrition and Feeding. Wiley Dreamtech India.

Selected articles from journals

### **ANN 803      NUTRITION AND RUMEN FERMENTATION**

**1+1**

#### **Objective**

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation

#### **Theory**

##### **UNIT I**

Nutrient requirements for fertility and gestation, prenatal growth and foetal nutrition. Post-natal feeding, growth and developments – Body composition at prenatal and postnatal stages, abnormalities due to malnutrition.

##### **UNIT II**

Rumen microflora and microfauna –considerations and limitations in relation to ruminant feeding practices. Manipulation of rumen fermentation – physical, chemical and biological means – Role of sulphur and phosphorus in rumen fermentation –. Modeling ruminant digestion and metabolism – principles.

#### **Practical**

Microbial and protozoal count, Determination TVFA by chromatography. Estimation of ammonia in rumen liquor – study on protection of protein in relation to degradability ,Rumen fermentation products – Artificial rumen techniques. Rumen enzyme assay

#### **Suggested Readings**

Selected articles from journals.

### **ANN 804      ADVANCES IN MICRONUTRIENTS**

**1+0**

## **Objective**

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation

## **Theory**

### **UNIT I**

Developments in the study of major, minor and toxic minerals in animals – animal – soil – plant interrelationship – concepts in absorption and transport of micronutrients – Kinetics and metabolism physiological and biochemical interactions among nutrients – interrelationship of minerals and vitamins in relation to metabolism and requirements – mineral toxicities in relation to livestock feeding.

### **UNIT II**

Developments in vitamin and mineral requirements for growth, reproduction and lactation – Identification and correction of deficiencies and toxicities of minerals in farm animals.

### **UNIT III**

Bio-availability of macro and micro nutrients – factors affecting the bio-availability of minerals – bio-marker concept for mineral requirement for correction of deficiencies and toxicity of minerals.

## **Suggested Readings**

Peter RC. 2005. Applied Animal Nutrition Feeds and Feeding. Pearson Prentice Hall.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. Basic Animal Nutrition and Feeding. Wiley Dreamtech India.  
Selected articles from journals.

**ANN 805      ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH      1+2**

## **Objective**

To impart knowledge on use of advanced analytical techniques in nutrition research

## **Theory**

### **UNIT I**

Developments in analysis of nutrients in feeds. Estimation of toxins and mycotoxins – Application of atomic absorption spectrophotometer, HPLC – Enzymatic methods of feed analysis – Isotopes in nutrition research – Feed microscopy – Analytical aspect of feeds and fodders using N.I.R.

### **UNIT II**

Faecal inoculum as alternative to rumen liquor in in vitro studies – Degradability of feeds by various techniques – rates of VFA and microbial production.

## **Practical**

Estimation of major, minor and toxic minerals by atomic absorption spectrophotometer, Estimation of mycotoxin by HPLC, Estimation of oxalate,

nitrites, tannin and mimosine, VFA fractionation by GC. SF6 Technique, amino acid analyzer, NIR, HPLC, Purine derivatives, milk fat and FA estimation.

### **Suggested Readings**

Selected articles from journals.

**ANN 806      ADVANCES IN FEED TECHNOLOGY      1+1**

### **Objective**

To impart knowledge on modern feed processing methods and automated feed plant layout

### **Theory**

#### **UNIT I**

Feed and fodder processing – Particle size reduction – bulk density – processing of grains and oil seeds – processing of roughages – feed plant layout and design – feed plant management – storage of feeds.

#### **UNIT II**

Non conventional feed resources – Formulation of concentrates, premixes and rations – improvement of nutritive value of poor quality roughages – liquid feed supplements. Solid state fermentation (SSF) technology.

### **Practical**

Feed microscopy tests for certain adulterants and anti nutritional factors, Feed plant design– processing of roughages – feed plant sanitation, Wild seed identification – qualitative tests for rancidity, minerals and adulterants, Visit to commercial feed plant

### **Suggested Readings**

Selected articles from journals.

**ANN 807      CLINICAL NUTRITION      1+1**

### **Objective**

Impact of nutrition on health, immunity, digestive/metabolic disorders, reproductive performance, bacterial and parasitic infestations, organic toxins and stress nutrition, feeding management of sick animals.

### **Theory**

#### **UNIT I**

Nutritional factors responsible for disorders. Metabolic disorders and production diseases in farm animals. Prevention of metabolic disorders – recommended dietary regimen.

#### **UNIT II**

Effect of coccidiostats and dietary antigens in early weaned livestock. Nutrition in relation to emerging diseases. Effect of nutrition on fertility, reproduction and lactation. Toxic minerals and counter action (Selenium and fluorine).

### **UNIT III**

Stress nutrition and post surgical nutrition. Nutritional manipulation and feeding of sick animals. Pesticides residues in feeds and fodders and their impact on animal health, reproduction and production.

#### **Practical**

Determination of blood glucose, blood urea nitrogen, SGOT SGPT, total protein, cholesterol and ketone bodies, Metabolic profile tests.

#### **Suggested Readings**

Selected articles from journals.

### **ANN 808      NUTRIENT AND DRUG INTERACTION      2+0**

#### **Objective**

To impart knowledge on the effects of drugs on nutrient utilisation

#### **Theory**

##### **UNIT I**

Effects of drugs on digestion and absorption of nutrients – Drugs and intestinal microbial interaction – Effect of drugs and antibiotics as feed additives. Physiological effects – Use and abuse.

##### **UNIT II**

Nutrients in drug detoxification – Antagonists – Hormones and their effect on growth and carcass qualities. Drug residues in animal products – milk and meat – effect on food change. Legal aspects of drugs in animal products.

#### **Suggested Readings**

Selected articles from journals.

### **ANN 809      NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING      2+0**

#### **Objective**

To impart knowledge on newer feed resources and their value in animal feeding and various toxic substances prevalent in feeds and fodders.

#### **Theory**

##### **UNIT I**

Demand and availability of feed – formulation of database in computer – strategy in food animal production – agricultural by-products – Agroindustrial by-products, Farm waste, crop residues, organic wastes of animal origin. Slaughter house waste, industrial waste and their feeding value in animals.

##### **UNIT II**

Processing to enhance feed utilization and availability. Possible health hazards due to waste utilization–chemical and nutritional changes in waste product due to processing. Quality standard and their acceptance.

### **UNIT III**

Naturally occurring toxicants – Toxicants of plants and non-microbial origin. Naturally occurring alkaloids, mycotoxins and their toxicity – Acquired toxicants, pesticides, weedicides and heavy metals.

### **UNIT IV**

Effect of toxins on rumen fermentation and nutrient utilization. Methods of detoxification. Food and feed contaminants – their impact on animal performance

### **Suggested Readings**

Selected articles from journals.

### **List of Journals**

- Animal feed science and technology
- Animal research
- Animal science journal
- Archives of animal nutrition
- British journal of nutrition
- British poultry science
- Grass and forage science
- International journal of sheep and wool science
- Italian journal of animal science
- Journal of animal and feed sciences
- Journal of animal physiology and animal nutrition
- Livestock research for rural development
- Malaysian journal of nutrition
- Nutrition journal
- Pakistan journal of nutrition
- Small ruminant research
- Animal nutrition and feed technology
- Australian journal of animal sciences
- Canadian journal of animal sciences
- Feed industry review
- Feed international
- Feed management
- Feed stuffs
- Feed trends
- Indian journal of animal nutrition
- Indian journal of animal science
- Indian journal of dairy science
- Indian journal of poultry sciences
- Journal of animal nutrition
- Journal of food science and technology

### **e-Resources**

- <http://www.vivo.colostate.edu/hbooks/pathphys/digestion/index.html>
- <http://www-biol.paisley.ac.uk/kinetics/contents.html>
- [http://en.wikipedia.org/wiki/Enzyme\\_kinetics#column-one](http://en.wikipedia.org/wiki/Enzyme_kinetics#column-one)
- <http://mark.asci.ncsu.edu/SwineReports/2004-2005/Contents.htm>
- <http://www.das.psu.edu/dairynutrition/>
- <http://www.vet.ed.ac.uk/clive/cal/RUMENCAL/Frames/frmMega.html>
- <http://www.uky.edu/~dhild/biochem/supp.html>
- <http://vanat.cvm.umn.edu/run/plate7.html>
- <http://www.ales2.ualberta.ca/afns/drtc/>
- <http://www.clfmaofindia.org/>
- [www.nianp.res.in/](http://www.nianp.res.in/)
- <http://www.nutrisocietyindia.com/>
- <http://www.fao.org>
- [http://www.codexalimentarius.net/web/index\\_en.jsp](http://www.codexalimentarius.net/web/index_en.jsp)
- <http://www.ars.usda.gov>
- <http://www.fao.org/ag/AGA/AGAP/FRG/afris/default.htm>
- <http://www.aphca.org/>
- <http://www.fao.org/ag/AGA/AGAP/FRG/frg1.htm>
- <http://www.fao.org/prods/index.asp>
- <http://www.fao.org/ag/AGA/AGAP/FRG/Feedsafety/feedsafety.htm>

### **Suggested Broad Topics for Masters and Doctoral Research**

- Utilization of non conventional feed/ fodder resources
- Evolving / Assessing feed additives / supplements
- Manipulation of rumen fermentation to enhance productivity
- Feed processing for efficient utilization
- Improving palatability, digestibility of companion food
- Preservation and storage of feed / fodder
- Developing functional foods through dietary manipulation
- Neonatal growth stimulants
- Developing sick diet / Geriatric diet to companion/ domestic/ Wild animals
- Problem solving approach like formulating area specific mineral mixture
- Developing residue free animal produce through dietary management
- Addressing global issues /pollutants through feeding manipulation

## LIVESTOCK PRODUCTION AND MANAGEMENT

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
LPM 601	CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	2+1
LPM 602	SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1
LPM 603	SWINE PRODUCTION AND MANAGEMENT	1+1
LPM 604	LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+1
LPM 605	SHELTER MANAGEMENT	1+1
LPM 606	PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT	2+0
LPM 607	CLIMATOLOGY AND ANIMAL PRODUCTION	1+0
LPM 608	POULTRY FARM AND HATCHERY MANAGEMENT	2+1
LPM 609	FARM ANIMAL BEHAVIOR	1+0
LPM 610	INTEGRATED LIVESTOCK FARMING SYSTEM	2+1
LPM 611	EQUINE PRODUCTION AND MANAGEMENT	1+1
LPM 612	WILD LIFE MANAGEMENT AND CONSERVATION	2+0
LPM 613	LIVESTOCK BUSINESS MANAGEMENT	1+1
LPM 691	MASTER'S SEMINAR	1+0
LPM 699	MASTER'S RESEARCH	20
LPM 801	ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	3+0
LPM 802	ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1
LPM 803	ADVANCES IN SWINE PRODUCTION AND MANAGEMENT	2+1
LPM 804	ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+0
LPM 805	ADVANCES IN POULTRY PRODUCTION MANAGEMENT	2+1
LPM 806	ADVANCES IN ENVIRONMENTAL MANAGEMENT	1+1
LPM 807	ADVANCES IN EQUINE MANAGEMENT	2+0
LPM 891	DOCTORAL SEMINAR I	1+0
LPM 892	DOCTORAL SEMINAR II	1+0
LPM 899	DOCTORAL RESEARCH	45

### Course contents

**LPM 601      CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT      2+1**

#### **Objective**

To acquaint students on basic aspects of dairying in India compared with developed countries, problems and prospectus of dairying, detailed aspects of care and management of different classes of dairy cattle and buffaloes.

## **Theory**

### **UNIT I**

Introduction – Development of Dairy Industry in India and world –Present status and future prospects of livestock development in India

### **UNIT II**

Important breeds of cattle and buffalo, traits of economic importance and their inter–relationships – Selection of high quality animals – Role of management in improving the reproduction efficiency in farm animals. – Housing and rearing systems.

### **UNIT III**

Breeding Management: System of breeding Economic traits. Methods of Breeding – Prenatal and postnatal care and management of cattle and buffalo – Care of neonate and young calves – Management strategies for reducing mortality in calves, age at first calving and calving interval in cattle and buffaloes.

### **UNIT IV**

Management of labour, Milking management, Machine milking and hand milking, Different laws governing the livestock sectors to produce quality products on par with international standards – Technique of harvesting clean and hygienic livestock products, transportation of animals, health management. Wallowing in buffaloes– Management of draught animals and summer management

### **UNIT V**

Feed and fodder resources used for feeding of cattle and buffaloes– Scientific technique of feeding, watering – Computation of practical and economical ration, supply of green fodder around the year and enrichment of poor quality roughages.

## **Practical**

Visits to cattle farms and critical analysis of various types of managerial practices – Study of breeding management in the farm– Analysis of practical feeding management– Disease control– Housing – milking – calf, heifer and adult management– Dairy Cattle and Buffalo judging – Project preparation for external funding and commercial farms and enterprises for dairy products – marketing strategies for milk and milk products and meat.

## **Suggested Readings**

Arora SP. 1997. Feeding of Dairy Cattle and Buffaloes. Kalyani.

Dutta G. 1994. Care and Management of Dairy Cattle and Buffaloes. 3rd Ed. ICAR.

Thomas CK & Sastry NSR.1991 .Dairy Bovine Production. Kalyani.

**LPM 602 SHEEP AND GOAT PRODUCTION AND MANAGEMENT**

**2+1**

## **Objective**

To acquaint students on status of sheep and goat farming in India, importance of record keeping, 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.

## **Theory**

### **UNIT I**

Introduction –Population structure and importance–Advantages and disadvantages of sheep farming under different systems of management – type of housing and equipments– Important sheep and goat breeds– Advantages and disadvantages of sheep and goat farming.

### **UNIT II**

Breeding Management: Breeding seasons – fitness of purchase for first breeding – methods of detection of heat – Natural Service and artificial insemination – Care of the pregnant Animals – Breeding stock – Use of teaser –Culling.

### **UNIT III**

Feeding Management: Feeding methods – Principles to be followed in feeding and watering– feeder space, waterer space, Designing feeders and waterers. –Range management – Stocking rate and pasture improvement and utilization; management under stall fed conditions, Transportation of sheep and goat.

### **UNIT IV**

Disease Management: Role of management in the prevention and control of diseases. Special Management: Deworming – Dipping and spraying– shearing – Avoidance of goatry odour in milk, Topping

### **UNIT V**

Wool: Importance of wool – Fiber structure– Fleece characters – Goat fibers – Characters of mohair and pashmina, fur and Angora – Marketing of goat fibers / wool.– Planning of sheep and goat farm of various sizes – Economics of sheep and goat farming.

## **Practical**

Visit to sheep and goat farms and critical analysis of various managerial practices under different conditions. Study of practical housing management Analysis of practical diseases control management – Shearing management – Record keeping. – Preparation of project for commercial farming – Characterization of sheep and goats; handling of sheep and goat; daily and periodical operations for sheep and goats – Methods of identification of sheep and goat. Cost of rearing sheep and goat for mutton and wool – Housing plans for various age and categories of sheep and goat – Dipping; Vaccination of sheep and goat – Shearing of wool.

## **Suggested Readings**

Devendra C & Mecleroy GB. 1982. Goat and Sheep Production in Tropics. Longman.  
Gupta JL. 2006. Sheep Production and Management. BS Publ.  
ICAR. 2002. Handbook of Animal Husbandry 3rd Ed. ICAR.  
Kaushish 1994. Sheep Production in the Tropics and Sub Tropics. Scientific Publ.

**LPM 603**

**SWINE PRODUCTION AND MANAGEMENT**

**1+1**

**Objective**

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.

## **Theory**

### **UNIT I**

Introduction – Population and importance – Economic contribution of pigs – Advantages and disadvantages of swine keeping – Systems of management – Problems in pig farming.

### **UNIT II**

Breeds of pigs – Selection of breeding stock – Breeding seasons – Age and weight at first services – Methods for detection of heat – Natural service and artificial insemination – Care of pregnant sows, piglets and growers – Care of breeding boar.

### **UNIT III**

Housing, sanitation and hygiene, disease prevention measures – Housing and equipment – Wallowing – Sanitation and hygiene – Role of management in the prevention and the control of diseases.

### **UNIT IV**

Feeding and management of new born, weaner and finishers, dry, pregnant and farrowing sows – Feeding principles to be followed – Methods of watering – Feeder space – Water space, etc – Marketing: Methods of marketing in swine production – Record keeping.

## **Practical**

Visits to piggeries and critical Analysis of various types of managerial practices – Analysis of the trend and structures of pig population – Analysis of practical breeding management methods, practical disease control management – special management methods – Ageing and identification – Judging – Constraints and remedial measures in pig farming – Economics of production – Project preparation for research and commercial farms.

## **Suggested Readings**

Boden (e) S.1995. Swine Practice. WB London.

Narayankhedkar SG. 1997. Production and Management of Swine, Camel, Equine and Yak. Tindall Publ.

**LPM 604      LABORATORY ANIMAL PRODUCTION AND MANAGEMENT      1+1**

## **Objective**

To educate the students become familiarize with various aspects of rabbit farming, 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 .

## **Theory**

### **UNIT I**

Introduction – Importance of rabbit for meat and fur production, rats, mice and guinea pigs, – Common breeds and strains.

## **UNIT II**

System of housing – Common diseases and their control measure. Management of specific pathogen free and gnotobiotic animals, concepts related to welfare of laboratory animals

## **UNIT III**

Breeding – Age at maturity, litter size – Weaning – Feeding of growers – Selection of replacement stock, transportation of rabbit.

## **UNIT IV**

Transportation of Laboratory animals – marketing of meat and fur.

### **Practical**

Handling and restraining of laboratory animals – Visits to small animal farms and critical analysis of various types of managerial practices– Analysis of the trend and structures of Laboratory animals population – Analysis of practical breeding management methods – practical disease control management and special management methods – Ageing and identification – Judging Economics of production.

### **Suggested Readings**

Indian Soil Institute. 1993. Rabbit Management. IBH & Oxford.

Reddy DV. 2007. Applied Nutrition: (Livestock, Poultry, Human, Pet, Rabbit and Laboratory Animal Nutrition). IBH & Oxford.

Ronald N & Penman S. 1991. A Manual for Small Scale Rabbit Production. South Asia Publ.

## **LPM 605 SHELTER MANAGEMENT**

**1+1**

### **Objective**

To familiarize students with type of houses suited for different livestock under varying climatic conditions.

### **Theory**

#### **UNIT I**

General principles in planning animal houses– farmstead and animal houses – Selection of site and planning; layouts for livestock farm of different sizes in different climatic zones in India – Farm structures – General principles of construction of enclosures, floor and road.

#### **UNIT II**

Housing requirements of different classes of Livestock – Preparation of layouts, plans, arrangement of alleys– Fitting and facilities in the houses for horses, dairy cattle, calves, bulls, work cattle, dogs, pigs, sheep, goats, and poultry.

#### **UNIT III**

Improvement of existing buildings; water supply; feed and fodder delivery systems – Economics of Livestock housing.

#### **UNIT IV**

Housing – Disease control measures and sanitation of all classes of livestock

### **Practical**

Score card for animal houses – Time and motion study in Animal houses – Preparation of plans for Animal houses for horses, cattle, sheep, pigs, goats, and other livestock – Dogs and other pet animals – Economics of livestock housing – Preparation of plan for animal houses of different sizes and climatic zones of India.

### **Suggested Readings**

Sastry NSR & Thomas CK. 2006. Livestock Production and Management. Kalyani.  
Thomas CK & Sastry NSR 1991. Dairy Bovine Production. Kalyani.  
Wathes CM & Charles DR. 1994. Livestock Housing. CABI.

## **LPM 606      PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT**

**2+0**

### **Objective**

To familiarize students on principles of air and water hygiene with reference to impurities and inclusions of water, collection and disposal of waste from the animal house, modern techniques in manure disposal and biosecurity measures to be adapted for hygienic production of livestock products.

### **Theory**

#### **UNIT I**

Animal air hygiene: Definition – Composition of air – Air pollution – Factors affecting outdoor and indoor pollution – Assessment of these factors on animal health and production – Methods to control these factors.

#### **UNIT II**

Water Hygiene: Importance of water – Impurities and inclusions – Sterilization – Examination of water and water supplies – Collection of samples– Topographical physical, chemical, bacteriological and microscopic examination of water – Hygienic requirements and standards for drinking water – Quantity of water required by domestic animals – Methods of watering.

#### **UNIT III**

Manure – Quantity of manure voided by domestic animals – Animal excreta a factor in spread of disease – Hygienic and economic disposal of farm waste – Modern techniques used in automation / semi-automation in disposal of farm waste.

#### **UNIT IV**

Environmental protection act, Air (Prevention and control of pollution) act and water (Prevention and control of pollution) act – Biosecurity measures to be adapted for efficient and healthy production

#### **UNIT V**

Effect of environmental pollution on livestock and its products directly and indirectly – Controlling environmental pollution – Different factors affecting the quality of livestock and its products meant for human consumption

### **Suggested Readings**

- Baba MD. 2007. Environmental Changes and Natural Disasters. New India Publ.  
Overcash MR. 1983. Livestock Waste Management. CRC Press.  
Thapliyal DC & Misra DS. 1996. Fundamentals of Animal Hygiene and Epidemiology. International Book Distr. Co.

### **LPM 607          CLIMATOLOGY AND ANIMAL PRODUCTION          1+0**

#### **Objective**

To familiarize students on climate, weather, various climatic factors and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and assessing the heat tolerance of bovines.

#### **Theory**

##### **UNIT I**

Definition of climate –Classification of climatic regions – Climatic factors– Assessment of climate – Study of climatic factors in relation to animal production.

##### **UNIT II**

Light, natural and artificial light–mechanism of light action–photo period and light responses – Applications – Importance of light in production of animals and birds.

##### **UNIT III**

Introduction of breeds into different climatic regions – Agro meteorology and weather forecasting for Animal Husbandry activities – Micro climate modification in animal houses.

##### **UNIT IV**

Estimation of microclimatic conditions in Animal house – Measurement of Temperature, Relative humidity, Air Velocity and Mean temperature of the surrounding, measurement of intensity of light in animal houses – Construction of climographs and hythergraphs –Estimation of cooling power of atmosphere–heat tolerance test in bovines.

#### **Suggested Readings**

- Lal DS. 1998. Climatology. Sharda Pustak Bhavan, Allahabad.  
McDowell RE. 1972. Improvement of Livestock Production in Warm Climates. WH Freeman.  
Siddhartha K & Roger B. 1996. Atmosphere, Weather and Climate. ELBS.

### **LPM 608          POULTRY FARM AND HATCHERY MANAGEMENT          2+1**

#### **Objective**

To acquaint students on basic aspects of housing, feeding, breeding and health care of poultry and comparing the performance under cage and floor system of

management of poultry, biosecurity measures to be followed to reduce mortality and efficient hatchery management to produce healthy young ones.

### **Theory**

#### **UNIT I**

Poultry housing systems Cage Vs floor system, litter management and lights for poultry, rearing turkey, duck and quails.

#### **UNIT II**

Management of chicks, growing, laying and breeding flocks, broiler production, selection and culling of laying flocks.

#### **UNIT III**

Procuring, care and pre-incubation storage of hatching eggs – Method of incubation, sanitation disinfection and management of hatchery.

#### **UNIT IV**

Embryonic development and factors effecting fertility and hatchability of eggs.

#### **UNIT V**

Chick sexing, packing and hatchery business – Transporting management of farm and hatchery waste.

### **Practical**

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.

### **Suggested Readings**

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.  
Prashad J. 2005. Poultry Production and Management. Kalyani.  
Singh RA. 1996. Poultry Production. 3rd Ed. Kalyani.

## **LPM 609 FARM ANIMAL BEHAVIOR**

**1+0**

### **Objective**

To make acquainted students on principles of farm animal behaviour with regard to environmental influence, group formation, social behaviour and behavioural adaptations under domestication.

### **Theory**

#### **UNIT I**

Introduction to Animal behaviour – Importance of animal behaviour studies – Patterns of behaviour – Daily and seasonal cycles of behaviour – Physiological basis of behaviour.

#### **UNIT II**

Environmental modification of behaviour – Developmental changes in behaviour – Genetic differences in behaviour – Behavioural disorders.

### **UNIT III**

Group formation – Social relationship, process of socialisation locality and behaviour – Practical application – Behavioural character for managemental practices – Favourable and unfavourable behaviour for domestication – Behavioural adaptations under domestication.

### **UNIT IV**

Physical environment and behaviour – Common vices and their remedial measures – Analysis of behaviour in relation to location – Analysis of behaviour in relation to climatic environment – Analysis of social behaviour.

### **Suggested Readings**

Arora MP. 1995. Animal Behaviour. WB London.  
Bouenger EG. 1994. Animal Behaviour. WB London.  
Fraser AF & Broom DM. 1997. Farm Animal Behaviour and Welfare. CABI.  
Fraser AF & Broom DM. 1999. Farm Animal Behaviour and Welfare.  
Kumar V. 1996. Animal Behaviour. WB London.

**LPM 610      INTEGRATED LIVESTOCK FARMING SYSTEM      2+1**

### **Objective**

To familiarize on various aspects viz., scope and limitations of integrated livestock farming system, recent approach and economic feasibility of different integration models for sustainable production

### **Theory**

#### **UNIT I**

Scope and limitation of integrated farming systems – Sustainability of integrated Livestock Farming Systems and their economic importance.

#### **UNIT II**

Integration of fish, arable farming and different livestock enterprises vis-à-vis gobar gas plant, FYM, solar and wind energy utilization, cattle, buffalo sheep, goat, pig, poultry, rabbit, silk worm, bee keeping etc.

#### **UNIT III**

New approach for changing farming systems in present energy crises.

#### **UNIT IV**

Project formulation and evaluation of various livestock enterprises.

### **Practical**

Various livestock farming units and their economic analysis – Evaluation of different farming systems and their economic importance – Preparing feasibility report for various farming projects.

### **Suggested Readings**

Mukherjee TK. 1992. Integrated Livestock Fish Production Systems.  
Raman KV & Balaguru T. (Eds.). 1992. Farming Systems Research in India: Strategies for Implementation. NAARM.

Renard C. (Ed.). 1997. Crop Residues in Sustainable Mixed Crop/Livestock Farming Systems. CABI.

Speirs M. & Opsen O. 1992. Indigenous Integrated Farming System in the Sahel. World Bank.

## **LPM 611 EQUINE PRODUCTION AND MANAGEMENT**

**1+1**

### **Objective**

To educate 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 .

### **Theory**

#### **UNIT I**

Equine population in India – Breeds of native and exotic horses – Types and classes of light and work horses

#### **UNIT II**

Housing and routine management practices –Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses– unsoundness and stable vices

#### **UNIT III**

Feeding and breeding of horses donkey and Mules, foaling, care of foal

#### **UNIT IV**

Foot care and shoeing care, Stud farms – Race clubs – Race horses and their care – Horse behaviour and training – Exercising – Basic Horsemanship

#### **UNIT V**

Health management & diseases control. Control of internal and external parasites of horse– Colic and its prevention

#### **UNIT VI**

Mode of transport – Facilities requirement – Cleaning, disinfection and preparation of vehicles Transport stress – Management during transport – Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport – Laws governing the import and export of livestock and its products– – Horse passport and trading

### **Practical**

Control of horse for examination, passing of stomach tube, dentition and ageing, saddling, exercising of horse, hoof care.

### **Suggested Readings**

Blancchard TL et al. 2002. Manual of Equine Reproduction. Mosby Publ.

Frape D. 1986. Equine Nutrition and Feeding. Blackwell Publ.

Kacker RN & Panwar BS. 1996. Text Book of Equine Husbandry. Vikas Publ.

Mills DS & Nankervis KJ. 1998. Equine Behaviour: Principles and Practice. Blackwell Publ.

Pilliner S. 1994. Care of the competition Horse. BT Batsford.

Rose RJ & Hodgson DR. 2000. Manual of Equine Practice. WB Saunders.

**LPM 612      WILD LIFE MANAGEMENT AND CONSERVATION      2+0**

**Objective**

To acquaint students with the principles and concepts of wild life sanctuaries and national parks, classification of wild animals, role of authorities in conservation and management of wild animals in captivity.

**Theory**

**UNIT I**

Zoo and captive wild animals – Principles and concepts – Ecology of wild life sanctuaries and National parks– wild life legislation in India – Status of forest in India – Biological and ecological basis of management of wild life.

**UNIT II**

Voluntary organization on wild life – Rules and regulations of zoo authority of India –Wild life protection act – Zoological classification of wild animals – Funding agencies for wild life research and preparation of project. – Conservation of wild animals.

**UNIT III**

Wild life health control – Reproduction in zoos – Population analysis – Population manipulation – Habit analysis and design – The resources and its management – Distribution of important Indian animals – Zoo animals and birds – Breeding characteristics – Movements – Cover requirements – Food –Population density – Mortality – Nesting losses caused by predators, predator and prey relationship – Human interference – Refuge rehabilitation

**UNIT IV**

Restraints – Maps – Survey and plans of management systems – Principles, protective measures – Development and conservation of water supply– puberty – Breeding seasons – pregnancy – Parturition – Lactation postnatal survival of the young – Social factors among various species – Miscellaneous management procedures.

**Suggested Readings**

- Berwick SH & Saharia VB. (Eds.). 1995. The Development of International Principles and Practices of Wild Life Research and Management. Deford Univ. Press.
- Bobbins CT. 1983. Wild Life Feeding and Nutrition. Daya Publ. House.
- Giles RH. 1978. Wild Life Management. Wild Life Society.
- Giles RH. 1984. Wild Life Management Techniques. 3rd Ed. Wild Life Society.
- Jadhav NV, Baig MI & Devangare AA. 2004. Handbook of Wild Animals and Livestock Management.
- WWF. 1994. Wild Life (Protection) Act 1972 (as Amended up to 1991). Natraj Publ.

**LPM 613      LIVESTOCK BUSINESS MANAGEMENT      1+1**

**Objective**

To acquaint students with knowledge in principles, planning, technical approach and preparing financial statement in Livestock Business Management and preparing projects for financing.

### **Theory**

#### **UNIT I**

Management principles –Planning –Techniques, strategic planning, organization structure, co-ordination and controlling techniques – Approaches to management.

#### **UNIT II**

SWOT analysis, financial accounting – Accounting records – Balance sheet, fund flow statement – Cost and analysis for managerial decisions – Budgeting and control.

#### **UNIT III**

Tools of financial analysis, working capital financing – Long term financial management – Investment analysis – Capital markets – Corporate risk management – Venture capital.

#### **UNIT IV**

Marketing – Objectives, strategies – Selecting and managing marketing channels – Pricing strategies – Sales promotion – Legislation relating licensing – Company law.

### **Practical**

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.

### **Suggested Readings**

- Koontz H & 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.

<b>LPM 801</b>	<b>ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT</b>	<b>3+0</b>
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### **Objective**

To acquaint students on latest developments on dairying in India compared with developed countries, problems and prospectus of dairying, detailed aspects of care and management of different classes of dairy cattle and buffaloes.

### **Theory**

#### **UNIT I**

Dairy farming in India – Global scenario – Present status and reasons for the same – Avenues for progress – The needs of the nation and how to achieve it.

#### **UNIT II**

Advances in housing management of dairy cattle and buffaloes in various agroclimatic zone of India – Management systems for cattle and buffaloes.

### **UNIT III**

Establishing Dairy Cattle Enterprise – Characteristics of a successful dairy farm – Choice of the foundation stock – Breeding Management Problems associated with reproduction.

### **UNIT IV**

Advances in Feeding Management of cattle and buffalo, Feed for milking herd, dry cows, bulls and calves, Management of high yielding animals.

### **UNIT V**

Milking Management – Biosynthesis of milk – Factors affecting the composition and yield of milk – milk ejection reflex – Milking systems – Sanitary standards for the quality milk – Cessation of milking, advances in herd management– raising calves – growing heifers, replacements and culling – marketing, Computerization of dairy enterprises.

### **UNIT VI**

Advance in health management of dairy animals, metabolic diseases of high yielders– advances in preventive measures for production related diseases

### **Suggested Readings**

Clarence HE . 2007. Dairy Cattle & Milk Production. Daya Publ. House.Selected articles from journals.

Thomas CK & Sastry NSR. 1991. Dairy Bovine Production. Kalyani.

<b>LPM 802</b>	<b>ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT</b>	<b>2+1</b>
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### **Objective**

To educate the students on advances in sheep and goat farming for improving their productivity through different management practices.

### **Theory**

#### **UNIT I**

Utility origin – Domestication – Numbers and distribution of meat and dual purpose breeds – Methods of rearing – Range sheep production –

#### **UNIT II**

The farm flock – Pure bred flock – Management during breeding season – The sexual seasons and its control – Puberty – Time of the year to breed – Flushing – Ram–Ewe ratio.

#### **UNIT III**

Advances in feeding management, Nutrient deficiencies in range forage, Feed to supplement range forage,General feeding practices, Feeding materials, Lamb feeding, Use of antibiotics and hormones, Hand feeding, Self feeding,Pellet feeding , Feeding lambs and ewes during lactation.

#### **UNIT IV**

Recent development in sheep and goat management and their relevance under Indian economic conditions, needs and possibilities for future research.

#### **UNIT V**

Role of sheep husbandry in dry farming in India, Present development programmes in sheep and goat production, Advances in reproduction, housing, feeding and watering, diseases, Shearing methods and culling of sheep and goat.

#### **UNIT VI**

Role of goat in animal agriculture, Goat farming in India, selection of Breeding stock, Breeding problems, Housing, Principles of feeding, Practices, Crops and crop residues for goats, Milking practices.

#### **Practical**

Study of population trend and structure – Visit to sheep and goat farms and critical analysis of various farm practices, Analysis of breeding, feeding, housing – Disease control management, management of young ones and maturing systems Estimation of fibre diameter medullation percentage crimps, tensile strength, Grease, pH and moisture content of wool – Score card and grading of wool.

#### **Suggested Readings**

Gupta JL. 2006. Sheep Production and Management. CBS. Selected articles from journals.

### **LPM 803      ADVANCES IN SWINE PRODUCTION AND MANAGEMENT      2+1**

#### **Objective**

To educate about the latest advances of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of swine.

#### **Theory**

##### **UNIT I**

The past, present and future of Swine production systems in India and production policies adopted in advanced countries.

##### **UNIT II**

Advances in breeding and selection – Prenatal and postnatal development – Growth reproduction and lactation – Economic traits of swine production.

##### **UNIT III**

Advances in feeding and nutrition in pigs; automatic feeding and watering techniques, Feed stuffs, Energy, protein, minerals and vitamin sources, metabolic and nutritional disorders – Toxic substances.

##### **UNIT IV**

Advances in housing of pigs, environmental physiology – Infectious diseases and parasitism. reduction in new born piglet mortality.

#### **Practical**



## **UNIT II**

Demand, supply, present status of poultry production.

## **UNIT III**

Problems and new management techniques in poultry for egg and meat in India vis-à-vis in other countries of the world, automation in poultry houses, management of specific pathogen free flocks.

## **UNIT IV**

Poultry development policies and planning for higher production constraints in development and solutions, Ethology and entology in relation to poultry production

### **Practical**

Planning and preparation of research and commercial projects on broiler and layer production management.

### **Suggested Readings**

Selected articles from journals.

## **LPM 806      ADVANCES IN ENVIRONMENTAL MANAGEMENT**

**1+1**

### **Objective**

To educate the students on advances in climate, weather, various climatic factors monitoring and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and environmental influences on the performance of farm animal production.

### **Theory**

#### **UNIT I**

The animal Industry and the quality of the environment – Management of the living environment – Microenvironment and macro environment.

#### **UNIT II**

Air Pollution: Indoor and out door – Chemical, physical and bacteriological changes – Causes – Standards and the extent tolerated by animals – Effects on animal production.

#### **UNIT III**

Fixing standards in relation to CO<sub>2</sub> – Air supply in relation to cubic space, temperature, air, velocity, relative humidity, dust particles, bacterial count, effective temperature and cooling power – Methods to get over pollution – Cleaning and washing – Air conditioning.

#### **UNIT IV**

Utilisation and disposal of animal waste, Health hazards, Waste utilization, technologies for processing and treatment of animal wastes, Health and economic impacts, Legal constraints, Microbiology of wastes, Waste properties, Gases and odour.

#### **UNIT V**

Water Pollution: Significance, treatment and control – Funding agencies for animal welfare

## **Practical**

Assessment of various factors in Indoor and outdoor environment– Assessment of CO<sub>2</sub>, air supply, dust particles and bacterial count in air – Visit to sewage treatment plant – Planning farm waste disposals – Physical chemical and bacteriological examination of water watering of farm animals.

## **Suggested Readings**

Baba MD. 2004. Environmental Changes and Natural Disasters. New India Publ. Agency. Selected articles from journals.

## **LPM 807      ADVANCES IN EQUINE MANAGEMENT**

**2+0**

### **Objective**

To familiarize the students on latest aspects of 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.

### **Theory**

#### **UNIT I**

New indigenous and exotic horses breeds– Types and classes of light and work horses

#### **UNIT II**

Advances in housing and routine management practices –Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses– unsoundness and stable vices

#### **UNIT III**

New Feeding techniques and breeding of horses donkey and Mules, foaling, care of foal

#### **UNIT IV**

Foot care and shoeing care, Stud farms,Race clubs,Race horses and their care, Horse behaviour and training, Exercising ,Basic Horsemanship

#### **UNIT V**

Advances in health management & diseases control. Control of internal and external parasites of horse– Colic and its prevention

#### **UNIT VI**

Mode of transport, Facilities requirement, Cleaning, disinfection and preparation of vehicles Transport stress,Management during transport , Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport, Laws governing the import and export of livestock and its products, Horse passport and trading.

### **Suggested Readings**

Selected articles from journals.

### **List of Journals**

- Asian Journal of Buffalo Production and Management
- Australian Journal of Animal Science
- British Poultry Science
- Canadian Journal of Animal Science
- Indian Dairyman
- Indian Journal of Animal Nutrition
- Indian Journal of Animal Production and Management
- Indian Journal of Animal Science
- Indian Journal of Dairy Science
- Indian Journal of Poultry Science
- Indian Journal of Field Veterinarians
- Internal Journal of Animal Science
- Journal of Animal Sciences
- Journal of Dairy Sciences
- Livestock Production Science
- Poultry Science
- The Indian Veterinary Journal
- World Poultry Science Journal

#### **e-Resources**

- [www.pork.org](http://www.pork.org)
- [www.ilri.org](http://www.ilri.org)
- [www.fao.org](http://www.fao.org)
- [www.defra.org.uk](http://www.defra.org.uk)
- [www.aciar.gov.au](http://www.aciar.gov.au)
- [www.asap.asn.au](http://www.asap.asn.au)
- [www.thepigsite.com](http://www.thepigsite.com)
- [www.epa.com](http://www.epa.com)
- <http://animalscience.ucdavis.edu>
- [www.tanu.edu](http://www.tanu.edu)
- [www.sciencedirect.com](http://www.sciencedirect.com)
- <http://trop.edmgr.com>
- [www.nianp.res.in/](http://www.nianp.res.in/)
- <http://www.aphca.org>
- <http://www.ars.usda.gov>

#### **Suggested Broad Topics for Master's and Doctoral Research**

##### Dairy cattle and buffalo Production

- Pre and postpartum management of dairy animals
- Reducing age at first calving
- Reducing calf mortality
- Reducing calving intervals
- Increasing reproductive efficiency
- Farming system research / extension approach
- System approach to livestock development
- Housing management of animals in semi arid region Poultry Production

- Poultry housing system
- Stocking density in poultry
- Environmental effects on poultry
- Feeding management of poultry
- Methods of processing poultry manure
- System of approach for poultry development
- Sheep and goat housing system
- Impact study on scientific management of sheep and goat
- Environmental effects on sheep and goat
- Feeding management of sheep and goat
- Rabbit production
- Rabbit housing system
- Feeding management of rabbit
- Productive and reproductive performance of rabbit under tropical climate
- Swine production
- Swine housing system
- Feeding management of swine
- Productive and reproductive performance of pigs under tropical climate

## LIVESTOCK PRODUCTS TECHNOLOGY

### Course structure at a glance

<b>CODE</b>	<b>COURSE TITLE</b>	<b>CREDITS</b>
LPT 601	FRESH MEAT TECHNOLOGY	1+1
LPT 602	MEAT PROCESSING, PACKAGING, QUALITY CONTROL AND MARKETING	2+1
LPT 603	POULTRY AND FISH PRODUCTS TECHNOLOGY	2+1
LPT 604	EGG AND EGG PRODUCTS TECHNOLOGY	1+1
LPT 605	ABATTOIR AND POULTRY PROCESSING PLANT PRACTICES	1+1
LPT 606	SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY	2+1
LPT 607	PROCESSING AND MARKETING OF WOOL	2+1
LPT 608*	MARKET MILK PROCESSING AND DAIRY PLANT PRACTICES	2+1
LPT 609	QUALITY CONTROL OF MILK AND MILK PRODUCTS	1+1
LPT 610	TECHNOLOGY OF MILK PRODUCTS	2+1
LPT 611	BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN	1+1
LPT 612*	IN-PLANT TRAINING (NON CREDIT)	0+2
LPT 691	MASTER'S SEMINAR	1+0
LPT 699	MASTER'S RESEARCH	20
LPT 801	ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION	2+1
LPT 802	ADVANCES IN FRESH AND PROCESSED MEAT PRODUCTS TECHNOLOGY	3+1
LPT 803	ADVANCES IN POULTRY PRODUCTS TECHNOLOGY	2+1
LPT 804	ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY	3+1
LPT 805	ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS	2+0
LPT 806	BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS	1+1
LPT 891	DOCTORAL SEMINAR I	1+0
LPT 892	DOCTORAL SEMINAR II	1+0
LPT 899	DOCTORAL RESEARCH	45

\* Non-Credit (Satisfactory/Unsatisfactory)

### Course contents

**LPT 601      FRESH MEAT TECHNOLOGY**

**1+1**

### **Objective**

To impart knowledge about history, current status of meat industry, muscle composition, functions and sensory quality of meat. To educate on factors influencing quality of meat and nutritive value.

### **Theory**

#### **UNIT I**

History and development of meat science and meat industry, current trends and prospects of meat industry–Structure and chemistry of animal tissues, muscle functions and postmortem changes– Rigor mortis – Effect of transport on meat quality – its veterinary and clinical importance – PSE and DFD in meat quality – Conversion of muscle to meat.

#### **UNIT II**

Composition, nutritional content and general quality characterization and evaluation of meat and its products– meat microbiology –Factors affecting quality of meat – Essential nutrients in meat and poultry meat – Tenderization. Chemical residues in meat meat and their effects on the health of the consumer.

### **Practical**

Microbiological sampling and evaluation of meat. Evaluation of physicochemical and sensory properties of meat and meat products. Estimation of pH – Colour – Water holding capacity – ERV – Tyrosine value – Thiobarbituric acid number – Estimation of texture profile of meat – Estimation of glycogen, R-value, myoglobin, proximate analysis of meat and meat products including poultry products – Estimation of drip loss – Determination of Sarcomere length, fibre diameter and myofibrillar fragmentation index. Retail and wholesale cuts.

### **Suggested Readings**

- Gracey JF. 1999. Thornton's Meat hygiene. 10th Ed. WB Saunders.  
Kerry J, Kerry J & Ledward D. 2005. Meat Processing–Improving Quality. Woodhead Publishing Ltd., UK.  
Pearson AM & Dutson TR. 1999. Advances in Meat Research. Vol. IX. Quality Attributes and their Measurement in Meat, Poultry and Fish Products. Aspen Publishers, Inc, Maryland, USA.  
Swatland H & Compbell T. 2004. Meat Cuts and Muscle Foods. Nottingham Univ. Press.

<b>LPT 602</b>	<b>MEAT PROCESSING, PACKAGING, QUALITY CONTROL AND MARKETING</b>	<b>2+1</b>
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### **Objective**

To impart knowledge on preservations, methods, product development, quality control and packaging practices in meat.

### **Theory**

#### **UNIT I**

Factors affecting fresh meat quality, ageing, basic principles of preservation, chilling, freezing, thermal processing, dehydration, irradiation and use of chemicals and antibiotics; meat curing and smoking.

#### **UNIT II**

Comminuted meat; preparation of various kinds of fresh and cooked meat products–Canning – Heat processing – Sausages – Ham, Bacon, Tandoori–Barbecueing of Poultry.Senses of taste and olfaction–factors influencing sensory measurements, physical and chemical properties related to sensory evaluation, types of sensory panels, discriminate and descriptive testing.

#### **UNIT III**

Meat adulteration and substitution – Different techniques for meat speciation – Agar gel immuno diffusion techniques – Démonstration of CIE, IEF, ELISA, PCR

#### **UNIT IV**

Principles of packaging–Product characteristics affecting packaging requirements; packaging material and their characteristics – different methods of packaging meat – Vacuum packaging – MAP – Retort pouch processing.

#### **UNIT V**

Marketing of meat, setting up of a meat retailing unit and other meat merchandising practices. MFPO, BIS Standards for meat products.National and international specifications and standards.

#### **Practical**

Proximate composition of meat, tyrosine value, nitrite content, TBARS value, peroxide value, Formulation of different meat products, emulsion stability, shear force value, cooking determinants, subjective and objective method of sensory evaluations.

#### **Suggested Readings**

Kerry J, Kerry J & Ledward D. 2005. Meat Processing–Improving Quality.Woodhead Publishing Ltd., UK.

Pearson AM & Dutson TR. 1999. Advances in Meat Research. Vol. IX. Quality Attributes and their Measurement in Meat, Poultry and Fish Products. Aspen Publishers, Inc, Maryland, USA.

Swatland H & Compbell T. 2004. Meat Cuts and Muscle Foods. Nottingham Univ. Press.

**LPT 603            POULTRY AND FISH PRODUCTS TECHNOLOGY**

**2+1**

#### **Objective**

To impart knowledge on structure, functional quality, microbiology, processing and preservation of poultry meat, eggs and fish.

#### **Theory**

## **UNIT I**

History and development of poultry meat and egg processing industry. Different species of poultry and their production potentials– commonly occurring anti nutrients, and antibiotics in poultry feed ingredients and its effect on egg and meat nutrition – Quality identification, quality maintenance, chemical, nutritional and microbiological quality of poultry meat. Preservation and packing techniques of shelled and liquid eggs. Quality identification of shell eggs and factors influencing the quality

## **UNIT II**

Pre-slaughter care, transportation, resting, fasting, ante-mortem examination, methods of slaughter and slaughtering procedure–postmortem inspection–reasons for condemnation of carcass–yield and grading of dressed chicken, cut up parts and de boned meat.

## **UNIT III**

Structure, nutritive value, compositional chemistry, microbiology and functional properties of eggs. Low cholesterol eggs, GMP, HACCP procedures for food safety – Codex regulation for food products safety – WTO/GOI regulations for import and export of poultry products. National and international regulations, standards, quality control and marketing of fish and fish products, utilization of fish processing waste.

## **UNIT IV**

Fishery resources, marine and fresh water fishes, transportation, processing, preservation, grading, standards. Quality control, labeling and marketing of fish and fish products, utilization of fish processing waste.

## **UNIT V**

Post processing value added meat for export– Integration, poultry and fish processing and marketing–Storage, packaging and chilling, freezing, dehydration, canning, irradiation, curing, smoking, barbecuing, cooking and preparation of further processed poultry and fish products.

## **Practical**

Organization, sanitation and maintenance of poultry processing plants. Slaughtering, ante-mortem and postmortem inspection, meat cutting, grading, production of ready to eat, smoked and cured poultry meat Comminuted and other poultry based convenient items. Visit to poultry processing plant/egg processing plant. Postmortem inspection, carcass yield and grading. Meat bone ratio, quality maintenance, tenderization water holding capacity. TBA values and preparation of further processed and freeze dried poultry products. Whole egg powder, shell meal processing plant waste meal–HACCP–egg powder processing plant. Grading of shelled eggs, liquid eggs, egg powder foaming property, pasteurization of liquid egg, testing microbial load in different foams of egg, visit of egg powder plant/egg processing plant poultry and fish products and its Proximate analysis, microbiological and sensory evaluation and poultry meat and fish.

## **Suggested Readings**

Mead GC. 1989. Processing of Poultry. Elsevier.

Mountney GJ. Poultry Products Technology. 2nd Ed. AVI Publ.  
Pearson AM & Gillett TA. 1996. Processed Meats. 3rd Ed. Chapman & Hall.  
Stadelman W & Cotterill OJ. 2002. Eggs Science and Technology. 4th Ed. CBS.  
Suzuki T. 1981. Fish and Krill: Protein Processing Technology. Applied Science Publ.

**LPT 604          EGG AND EGG PRODUCTS TECHNOLOGY          1+1**

**Objective**

To impart knowledge about composition and marketing of eggs and nutritive value of eggs, preservation methods –quality maintenance, functional and value added egg product development, packaging and standards

**Theory**

**UNIT I**

Preservation and maintenance of quality of eggs– spoilage of egg and its prevention.–Preparation of fast foods.

**UNIT II**

Egg breaking plant lay out and organization– freezing– pasteurization– desugarisation–dehydration – quality estimation.

**UNIT III**

Principles involved in preparation of egg powder and other egg products– Development of convenient egg based products– packaging of egg and egg products.

**UNIT IV**

Specifications, standards and marketing of egg and egg products–Quality control of egg products.

**Practical**

Evaluation of physical, chemical, functional and microbial quality of egg and egg products. Preservation of eggs– Preparation of dehydrated and convenient egg products– Visit to egg processing plant.

**Suggested Readings**

Romanoff AL & Romanoff AJ. 1949. Avian Egg. John Wiley & Sons.  
Stadelman WL & Cotterill OJ. 2002. Egg Science and Technology. 4th Ed. CBS.

**LPT 605          ABATTOIR AND POULTRY PROCESSING PLANT PRACTICES          1+1**

**Objective**

Teaching about abattoir design, sanitation and basic slaughterhouse practices, effluent treatment and proper disposal of wastes.

**Theory**

**UNIT I**

Layout, designing – operation and maintenance of slaughter houses and processing plants–disposal of slaughter house effluents and different designs of effluent treatment plants – equipments, organization and Slaughter house, maintenance,

record keeping and operation–sanitation of slaughterhouse–Sanitary practices in meat plant and its benefits; quality control.

#### **UNIT II**

Pre–slaughter judging, inspection, grading, pre–slaughter care, slaughter of meat animals; Humane slaughter – Principles and methods of stunning – Ritual slaughter of food animals and poultry – Machineries for slaughter and dressing– processing of different kinds of meat animals–Ante–mortem inspection and Post–mortem examination of animals. Disposal and condemnation of unfit materials.

#### **UNIT III**

Carcass quality appraisal, judgement and their grading, meat cutting, measuring yields. Application of HACCP, GMP, ISO 9000, ISO 14000, ISO 22000, BIS Standards and any recent standards for meat and processing industries

#### **Practical**

Visit to slaughterhouse– Plan and outlay of modern abattoir– Procedure for slaughter of food animals and poultry – Ante–mortem and postmortem inspection, slaughtering, grading and meat cutting, carcass yield, meat bone ratio measurement of effluent characteristics: pH, BOD, COD, suspended solids etc.

#### **Suggested Readings**

Gerrard F. 1977. Meat Technology. Northwood.

Gracey JF. 1999. Thornton’s Meat hygiene. 10th Ed. WB Saunders.

**LPT 606**

**SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY**

**2+1**

#### **Objective**

To Impart knowledge on animal by–products,processing and industrial utilization.

#### **Theory**

##### **UNIT I**

Slaughterhouse byproducts industry in India and abroad – Importance of utilizing slaughterhouse offals – Rendering– Planning a by–product plant – Utilization of blood, bones, hooves, glands, intestines, feathers, glandular by– products and other minor by–products for industrial exploitation.

##### **UNIT II**

Meat fat characteristics – Preservation and Processing of ruminal contents – Ensiling of ruminal contents – Value products preparation from slaughterhouse by–products.processing of animal byproducts for pet foods.

##### **UNIT III**

Flaying – Classification and factors affecting quality of hides and skin–Physical and chemical characteristics of hide and skin– Processing of hide and skin for manufacture of leather– Preparation and quality control of gelatin and glue. Microscopic, physical and chemical characteristics of leather; testing and marketing of leather– Preservation and packaging practices of various kinds of hides and skin.

##### **UNIT IV**

Designing of animal byproduct plant. Collection and scope for further utilization of slaughter house byproducts. Waste treatment and pollution control- Environmental Audits-Regulations on pollution control.

### **Practical**

Identification of quality defects in leather- preparation of sausage casing- blood meal, feather meal and meat meal. Demonstration of carcass meal - Meat meal - Bone meal - Preparation of animal casings - Grading of casings and wool - Preparation of slime meal - Collection and preservation of glandular products - Preparation of pet foods - Visit to local by-products, processing units. Quality evaluation of rendered animal fat.

### **Suggested Readings**

Dilon M & Griffith C. 2001. Auditing in the Food Industry -From Safety and Quality to Environmental and other Audits. Woodhead Publ. Ltd.,UK.  
GregoryNG. 1988. Animal Welfare and Meat Science. CABI.  
Ockerman HW & Hansen CL. 2000. Animal by-product processing and utilization. Technomic Publ. Co. Ltd., Pennsylvania, USA.  
Ockerman HW & Hansen CL. 2002. Animal Byproducts Processing and Utilization. CRC.

## **LPT 607 PROCESSING AND MARKETING OF WOOL**

**2+1**

### **Objective**

To impart knowledge on grading, manufacturing process, marketing and specifications of wool and specialty fibers- growth and structure of wool and fiber, their use.

### **Theory**

#### **UNIT I**

Status and prospects of wool -Grading of wool. Faults and impurities in wool and their removal.

#### **UNIT II**

Wool types and their uses. Growth and molecular structure of wool fibre; physical and chemical properties of wool. Characteristics of hair fibres and their use, factors influencing quality of wool and hair fibres - Principles and steps involved in manufacturing processes of wool- specialty hair fibres.

#### **UNIT III**

Physical and chemical testing of wool. Proclaimed wool and secondary raw material - Marketing of wool, specification and regulation for quality control.

### **Practical**

Visit to wool industry and acquaintance with various steps of manufacturing wool and its quality control, physical and chemical testing of wool. Characterization of wool, grading of wool.

### **Suggested Readings**

Bergen WV. 1963. Wool Hand Book. Vols. I, II. InterScience.

**LPT 608            MARKET MILK PROCESSING AND DAIRY PLANT PRACTICES            2+1**

**Objective**

To impart knowledge about milk composition, legislation, milk processing techniques, cleaning and sanitation of dairy equipments.

**Theory**

**UNIT I**

Milk standards and legislation and related agencies.

**UNIT II**

Composition of milk, major and minor constituents of milk, physico-chemical, microbial and nutritional properties of milk and preservation of raw milk.

**UNIT III**

Layout Designing and organization of dairy plant, Milk procurement, handling and transportation. Chilling, centrifugation, separation, clarification, bacto-fugation and homogenization. Thermal processing- pasteurization, UHT processing, sterilization, bacto-therm and packaging, Storage and distribution of processed milk. Fortified, reconstituted and mild floured milks.

**UNIT IV**

Membrane processing and related techniques; application of ultrafiltration, reverse osmosis; nanofiltration and microfiltration in the dairy industry.

**UNIT V**

Current trends in cleaning and sanitization of dairy equipment, biological detergents, ultrasonic techniques in cleaning; biodegents. Disposal of dairy effluents.

**Practical**

Platform tests. Determination of fat, SNF, TS, protein, lactose and ash contents of milk. Standardization, pasteurization and sterilization. HCT profile of milk systems. Judging of different types of milks. Layout plan of market milk plant.

**Suggested Readings**

Walstra P, Wouters JTM & Geurts TJ. 2006. Dairy Science and Technology. 2nd Ed. Taylor & Francis.

Web BH, Johnson AH & Alford JA. 1987. Fundamental of Dairy Chemistry. 3rd Ed. Westport AVI Publ.

**LPT 609            QUALITY CONTROL OF MILK AND MILK PRODUCTS            1+1**

**Objective**

To impart knowledge about quality control, TQM, HACCP, SPS, CAC and legal standards.

**Theory**

**UNIT I**

Importance of quality control in dairy industry. PFA Act, BIS standards, AgMark standards and ISO standards of milk products.

#### **UNIT II**

Total quality management in processing of milk products – HACCP and SPS.

#### **UNIT III**

Types of microorganisms associated with milk and milk products–Milk borne diseases.

#### **UNIT IV**

Physico–chemical and microbial changes during procurement, processing and storage of milk and milk products.

#### **UNIT V**

Fundamental rules for sensory evaluation, Hedonic scale, score cards and their use for grading of milk and milk products.

#### **Practical**

Determination of pH and acidity, electrical conductivity, viscosity, phosphatase test, MBRT, Resazurin test, DMC, SPC. Analysis of milk and milk products in reference to BIS/PFA standards. Grading of milk and milk products.

#### **Suggested Readings**

Jennes R & Patton S. 1969. Principles of Dairy Chemistry. Wiley Eastern.  
Yadav JS, Grover S & Batish VK. 1993. Comprehensive Dairy Microbiology. Metropolitan Publ.

### **LPT 610      TECHNOLOGY OF MILK PRODUCTS**

**2+1**

#### **Objective**

To impart knowledge about techniques for preparation of different milk products.

#### **Theory**

##### **UNIT I**

Drying of milk and milk products; freeze dehydration, water activity; sorption behaviour of foods– dried ice cream mix – cream and butter powder.

##### **UNIT II**

Hurdle technology and its application in development of dairy products.

##### **UNIT III**

Manufacture of milk products; butter, evaporated milk, condensed milk, milk powders, ice cream and other frozen desserts. Manufacture of yoghurt– acidophilus milk–bulgaricus milk– kumiss–kefir. Manufacture of cheddar– mozzarella– cottage and processed cheese. Manufacturing of indigenous milk products– paneer– channa– khoa– ghee– dahi and shrikhand.

##### **UNIT IV**

Manufacturing of casein- caseinate- co-precipitates- Whey protein concentrate (WPC) – lactose- dairy whiteners; functional properties of whey proteins- casein- co-precipitates- Ultra Filtration retentate and their modifications.

#### **UNIT V**

Evaluation of functional properties. Packing, storage and marketing of milk products. Defects in milk products, their preventions and remedies.

#### **Practical**

Preparation of butter- paneer- channa- ghee- ice cream-cheese-cheddar- Mozzarella and cottage cheese- khoa- dahi- yoghurt- casein- caseinate- coprecipitate- determination of degree of browning chemical/physical methods; measurement of different functional properties of different milk products.

#### **Suggested Readings**

Aneja RP, Mathur BN, Banerjee AK & Chandan RC. 2002. Technology of Indian Milk Products. Dairy India.

Spreer E. 1993. Milk and Dairy Products. Marcel Dekker.

Walstra P, Wouters JTM & Geurts TJ. 2006. Dairy Science and Technology. 2nd Ed. Taylor & Francis.

### **LPT 611          BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN          1+1**

#### **Objective**

To impart knowledge about new techniques of biotechnology for improving food value.

#### **Theory**

Role of Biotechnology in productivity of livestock, Meat Speciation and quality control. Use of Biotechnology in production of food additive. Use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, consumer concerns about risks and values, biotechnology and food safety. Future of food biotechnology in India.

#### **Practical**

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.

#### **Suggested Readings**

Selected articles from journals.

### **LPT 612          IN-PLANT TRAINING          0+2** **(Non Credit: Satisfactory/Unsatisfactory)**

### **Objective**

To impart industrial exposure to post graduate students in meat, milk, poultry and fish industry.

### **Practical**

APT students will undergo in-plant training in any one of the specialized area of Animal Products Technology for a period of three weeks in an institute in private/public sector industry. After completion of the training, the student will submit a training report. Evaluation will be based on viva-voce examination and a report submitted by student-Preparation of Project report.

### **Suggested Readings**

Selected articles from journals.

<b>LPT 801</b>	<b>ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION</b>	<b>2+1</b>
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### **Objective**

To impart knowledge on advances in animal byproducts utilization such as leather, fat, casings, gelatin and abattoir effluent treatment. To expose the importance of environmental pollution and their pollutants.

### **Theory**

#### **UNIT I**

Existing situation of slaughterhouses and processing plants in India – Collection of inedible and edible by-products for industrial uses – Disposal of slaughterhouse effluents – Effluent treatment plant – Different designs of effluent treatment plants– Sanitary and phytosanitary measures– SSOP – Advances in chemistry and technology of leather. Latest techniques in handling, preservation, tannery procedure, manufacture and testing of leather.

#### **UNIT II**

Progress in gelatin, glue and natural casings production. Latest technology for utilization of animal byproducts, industry-waste as food, pharmaceuticals and other miscellaneous byproducts. Characterization, processing and quality control of meat fat.

#### **UNIT III**

Current trends in utilization of byproducts of egg, meat and poultry processing industry for feed, fertilizer and other useful products of economic importance– Organization, layout and operation of dry and wet rendering plants–Latest trends in disposal of slaughterhouse effluents and control of environmental pollution.

### **Practical**

Visit to various slaughterhouses and meat processing plants – Plan and outlay of various components of modern abattoir – Designs of ETP – Estimation of BOD and COD from abattoir effluents – Ante-mortem inspection of food animals – Methods of stunning – Stunning instruments – Electrical stunning – Slaughter and dressing of

food animals – Post mortem inspection of carcasses of food animals – Fabrication of carcasses of food animals.

### **Suggested Readings**

Gracey JF. 1999. Thornton's Meat Hygiene. 10th Ed. WB Saunders. Selected articles from journals.

Wilson W. 2005. Wilson's Practical Meat Inspection. 7th Ed. Blackwell Publ.

<b>LPT 802</b>	<b>ADVANCES IN FRESH MEAT AND PROCESSED MEAT PRODUCTS TECHNOLOGY</b>	<b>3+1</b>
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### **Objective**

To empower students on recent advances in processing, preservation, quality control, packaging, regulations and standards of meat. To bring out knowledge on harmful residues in meat and to impart information on meat species identification.

### **Theory**

#### **UNIT I**

Development of muscular tissue – Abnormal growth and developments in muscle – Genetic nutritional and physiological aspects – Muscle proteins – Myofibrillar, sarcoplasmic and connective tissue proteins – Cytoskeletal proteins – Skeletal muscle fibre types – Lipid profile – Factors affecting muscle function and composition – Stress on the animal – Stress and the meat quality– Latest findings in the area of pre-slaughter care of meat animals– Keeping and Eating quality of meat – Properties of fresh meat – Odour, Colour, Water holding capacity – texture profile – Artificial tenderization – Meat in human nutrition – Essential nutrients in meat and poultry meat – Prefabricated meat – Chemical residues in meat and their effects on the health of the consumer.

#### **UNIT II**

Principles of preservation – Methods – temperature control – Refrigeration – Chilling – Freezing – Mechanisation of chiller and freezer – Thermal processing – Canning – retort processing – Intermediate moisture meat – Moisture control – Dehydration – Freeze drying – Curing – Smoking – Direct microbial inhibition – Irradiation – Use of antibiotics and chemical preservatives – Organic acids – Recent advances in preservation of meat. Meat adulteration and substitution – Different techniques for meat speciation Packaging of meat and meat products–Critical assessment of ageing, chilling, freezing, smoking, curing, tenderization and irradiation techniques.

#### **UNIT III**

Basic meat processing procedure–Functional properties of tissue component in meat processing–forming processed meat products. Approaches for new product development–different equipments used for processing of meat products– Indigenous and heritage meat products–purpose of smoking–composition of smoke–method of smoking–liquid smoke preparation–Ham, bacon,sausages, patties, burger, meat loaves–various novel meat products.

#### **UNIT IV**

Fermented meat products–heat processing–restructured meat products–Reformed meat products–Effect of massaging,tumbling and flaking techniques and quality–intermediate, moisture meat–Enrobed meat products–Meat analogues and substitutes–Thermal processing of meat–Browning reaction–Enzymatic and non enzymatic–Protein changes in processed meat products–lipid changes–protein and lipid interaction–protein and carbohydrate interaction.

#### **UNIT V**

Meat additives and regulations pertaining to processed and convenient meat based products–Meat packaging and retailing practices–National and international standards, grading, specifications and quality control of meat and meat products.

#### **Practical**

Estimation of Colour – Estimation of texture profile of meat – Estimation of glycogen, Lactic acid, R-value, myoglobin, proximate analysis of meat and meat products – Estimation of hydroxy proline – Histological structure of muscle – Estimation of emulsion stability, thawing in meat and meat products- Identification of different packaging material – Agar gel immuno diffusion techniques – Demonstration of CIE, IEF, ELISA, PCR – Different methods of packaging of meat and meat products including poultry products – Visit to different cold stores.Evaluation of carcass quality,Estimation of muscle fiber diameter, Estimation of lipid profile of meat. Organoleptic evaluation of meat–Estimation of Nitrate–Preparation of some novel meat products and studies on their shelf life–Total viable count and differential counts of meat and meat products–Visit of meat /poultry processing units.

#### **Suggested Readings**

Kerry J, Kerry J & Ledward D. 2005. Meat Processing–Improving Quality. Woodhead Publ. Ltd., UK. Selected articles from journals.  
Swatland H & Compbell T. 2004. Meat Cuts and Muscle Foods. Nottingham Univ. Press.

### **LPT 803          ADVANCES IN POULTRY PRODUCTS TECHNOLOGY**

**2+1**

#### **Objective**

Discussion on latest development in processing, preservation, quality control, packaging, regulations and standards of poultry meat.

#### **Theory**

#### **UNIT I**

Indian scenario of poultry processing industry Advances in poultry dressing, meat yield, preservation, microbiology and quality control methods. Automation in broiler farming, catching, transporting, control of shrinkage and methods of slaughter.

#### **UNIT II**

Preservation techniques, Room temperature preservation of poultry fast foods by multi hurdle technology critical evaluation of application of refrigeration, tenderization, canning, dehydration, irradiation, curing, smoking and cooking techniques in poultry processing and development of additional processed

products.- Regulation of CAC and European standards of poultry meat and meat products.

#### **UNIT III**

Recent trends in packing and marketing of poultry and poultry products. Modified atmosphere packaging- Different packing materials for meat and cooked products.

#### **UNIT IV**

Policies and marketing trends in poultry meat -Regulations, specifications, standards and use of additives in poultry products.

#### **UNIT V**

Poultry product development formulation and profitability.

#### **Practical**

Cooked and uncooked meat quality standards- sensory evaluation of poultry meat- packaging material- Modified Atmosphere Packaging-Factors influencing meat quality at different freezing temperatures and thawing.

#### **Suggested Readings**

Selected articles from journals.

**LPT 804            ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY            3+1**

#### **Objective**

To disseminate knowledge about production of high quality milk, preservation method, advances in processing of milk and milk products and packaging.

#### **Theory**

##### **UNIT I**

Principles and practices of production of high quality milk Advances in methods of chilling and preservation of milk. Thermal processing of milk, principles and methods, types of UHT-processing plants. Advances in packaging of milk.

##### **UNIT II**

Bacteriological, physical, chemical and nutritional effects of processing on milk - New concepts in milk processing - radiation and microwave processing- Membrane processing in dairy industry such as Reverse Osmosis(R.O), Ultra Filtration (UF), Nano Filtration (NF) and Micro Filtration (MF)- Fouling and cleaning of membranes.

##### **UNIT III**

New concepts in technology of dairy products. Cream powder, sterilized cream, frozen products, ice-cream mix, low, medium, high heat milk powder, milk based infant foods. Advances in starter cultures and their application, butter, butter spread, butter powder, cheese and cheese spread, probiotic products.

##### **UNIT IV**

Indigenous dairy products, khoa powder, paneer/channa powder, gulab jamun powder, kulfi powder- Recent advances in utilization of dairy byproducts in product

development, preservation of milk products. Application of immobilized enzyme in dairy products.

### **Practical**

Use of Starter cultures, lyophilization process, Maintenance of cultures. Demonstration of Membrane processing Technology, Advances in Packaging-Retort, Vacuum and Control Atmosphere Packaging Technology.

### **Suggested Readings**

Selected articles from journals.

Walstra P, Wouters JTM & Geurts TJ. 2006. Dairy Science and Technology. 2nd Ed. Taylor & Francis.

## **LPT 805          ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS          2+0**

### **Objective**

To impart knowledge about the advances in quality control in dairy and meat industry.

### **Theory**

#### **UNIT I**

Recent advances in quality control in dairy and meat industry in special reference to Total Quality management, HACCP – good manufacturing practices for manufacturing of quality and safe livestock products.

#### **UNIT II**

PFA and BIS standards, international standards organization (ISO 9000), product quality certification, international standards for milk powders, American Dairy Products Institute (ADPI) standards.

#### **UNIT III**

Rheology of milk products–Preservatives, antioxidants, antibiotics and pesticides residue in milk– Advances in bacteriological and physico–chemical analysis of milk and milk products

#### **UNIT IV**

Importance of quality assurance of livestock products for domestic and export trade – quality standards for meat – Effect of processing on nutritional and chemical qualities of meat products – Sensory evaluation of meat products – Physicochemical and microbiological quality assessment and standards – Economics of processing and product development. good manufacturing practices, meat hygiene regulations in relation to slaughter houses and processing plants–international regulations–State Municipal and other regulations pertaining to meat trade–Meat Food Products Order–ISO certification–Codex alimentarius–Bureau of Indian standards.

### **Suggested Readings**

Selected articles from journals.

## **LPT 806          BIOTECHNOLOGICAL TECHNIQUES AND          1+1                          PROCESSES IN ANIMAL PRODUCTS**

## **Objective**

To impart knowledge about biotechnological techniques, methods, starter cultures and industrial application of biotechnology in meat industry.

## **Theory**

### **UNIT I**

Introduction, development and prospects of biotechnology in animal products, ancient and traditional food processing biotechniques.

### **UNIT II**

Modern biotechnological methods and processes in animal products development, chemical and physical factors required for growing microbial cultures in nutritive substrate– Meat species identification– Quality control – Screening products for contaminants – Polymerase Chain Reaction (PCR) based products.

### **UNIT III**

Basic principles of the industrial use of bio–reactions for production of biomass– upstream and downstream processing–application of micro–organisms as starter cultures in meat industry, microbial production of food ingredients.

## **Practical**

Production, selection and purification of microbial cultures, making products using different microbial cultures, production of acidulation, buttery flavour, pigments, anti–microbial agents to improve the product quality and safety– Polymerase Chain Reaction (PCR).

## **Suggested Readings**

Selected articles from journals.

### **List of Journals**

- Advances in Food Research
- Beverage and Food World
- British Poultry Science
- Dairy Foods
- Dairy Indian
- Dairy Industries International
- Dairy Science Abstracts
- Flieshwirtschaft
- Food Processing
- Food Technology
- Food Technology
- Indian Dairy Man
- Indian Food Industry
- Indian Journal of Dairy Technology
- Indian Journal of Food Science and Technology
- Indian Journal of Poultry Science
- Indian Journal of Veterinary Research

- International Dairy Federation
- International Dairy Journal
- International Food Hygiene
- International Journal of Dairy Technology
- Journal of Animal Science
- Journal of Dairy Research
- Journal of Dairy Science
- Journal of Food Protection
- Journal of Food Science
- Journal of Meat Science
- Milk Industry
- Poultry Science
- Processed Food Industry
- Science of Food and Agriculture

#### **e-Resources**

- [www.meatscience.org](http://www.meatscience.org)
- [www.amis.org](http://www.amis.org)
- [www.meatami.com](http://www.meatami.com)
- [www.mla.org.au](http://www.mla.org.au)
- [www.FAO.org](http://www.FAO.org)
- [www.agresearch.co.nz/mirinz](http://www.agresearch.co.nz/mirinz)
- [www.usa.gov](http://www.usa.gov)
- [www.fsis.usda.gov](http://www.fsis.usda.gov)
- [www.poultryhelp.com](http://www.poultryhelp.com)
- [www.nddb.org](http://www.nddb.org)
- [www.ndri.res.in](http://www.ndri.res.in)
- [www.amul.com](http://www.amul.com)
- [www.idfa.org](http://www.idfa.org)

#### **Suggested Broad Topics for Master's and Doctoral Research**

- Development of shelf stable meat products
- Development of intermediate moisture meat products
- Application of active packaging for improving shelf life
- Development of low sodium meat products
- Development of low fat meat products
- Enrichment of meat with fiber
- Enrichment of meat with calcium
- Utilization of edible byproducts
- Utilization inedible byproducts
- Prevention of oxidative rancidity in meat products
- Development in processing of poultry meat.
- Recent advances in processing of egg and egg products.
- Recent advances in preservation and quality control of egg and egg products

- Development in packaging, regulations and standards of poultry meat.
- Development in preservation and quality control of poultry meat.
- Development of functional casinates for food industry
- Development of phytoformula
- Development of geriatric biofoods
- Development of hydrolysed lactose milk drinks to lactose intolerants
- Membrane utilization in indigenous dairy products



Systems of Breeding – Systems of Mating – Selection methods – Breeding programme for developing egg-type and Broiler type of birds – Developing hybrids – Other species of Poultry breeding and management – Formation and Management of inbred, pure lines, grand parent and parent stock.

### **UNIT III**

Industrial breeding–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.

### **Practical**

Breeds of poultry – Factors affecting inheritance of qualitative and quantitative traits in poultry – Constructing index and Osborne index–Estimating heritability – Breeding program for developing commercial hybrid layers, broilers, Japanese quail, duck, turkey, fancy birds, Guinea Fowl and Pigeons – Semen collection, evaluation & insemination in chicken & turkey – Breeding records –Use of computers to maintain breeding records and for selection.

### **Suggested Readings**

Crawford RD. 1990. Poultry Breeding and Genetics. Elsevier.

Singh RP & Kumar J. 1994. Biometrical Methods in Poultry Breeding. Kalyani.

## **PSC 602          POULTRY NUTRITION AND FEEDING**

**2+1**

### **Objective**

Teaching about nutrients & their functions, nutrient requirements of poultry and factors influencing the same. Imparting knowledge of different types of feeds and feeding methods.

### **Theory**

#### **UNIT I**

Digestive system, digestion, metabolism and absorption of feed in poultry – Factors influencing the feed consumption in birds – Macro and micro-nutrients – Nutrient requirements for various species of poultry. Partitioning of energy – Calorie: protein ratio – Nutrient interrelationships – Factors influencing the nutrient requirements.

#### **UNIT II**

Feed ingredients composition, feed storage technique–milling and quality control– Processing of feed – Types & forms of feeds and feeding methods – Commonly occurring anti nutrients 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**

Systems of feeding – restricted, forced, controlled and phase feeding –Use of Additives and Non additives– enzymes, probiotics, prebiotics antibiotics, herbs, performance enhancers – Utilization of non-conventional feedstuff – Feeding of ducks, turkeys, Japanese quails, Guinea fowls.

#### **UNIT IV**

Organic, functional, designer & SPF feed production – Production of drug residue, pesticide residue & toxin free feeds – regulations for Import and Export of feed and feed supplements.

#### **Practical**

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 – Estimation of Aflatoxin, Calcium, Phosphorus, Sand, Silica and Salt – Mash, pellet & crumble feed preparation – Feeding procedures. Visit to feed mills – Preparation of Project report for a feed mill–Hands on Training in feed analytical lab– Preparation & quality control of organic and designer feeds.

#### **Suggested Readings**

Einsminger ME. 1992. Poultry Science. Poultry International Book Distributing Co.  
Mac O' North & Bell D. 1990. Commercial Chicken Production Manual. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.  
Singh RA & Panda B.1992. Poultry Production. Kalyani Publishers.

### **PSC 603          COMMERCIAL LAYER PRODUCTION**

**2+1**

#### **Objective**

To impart knowledge on different systems of rearing commercial egg laying birds, care and management of commercial layers for optimal egg production.

#### **Theory**

#### **UNIT I**

Layer Industry in India and the World – Systems of layer farming – Location – Lay out of the farm – Systems of housing – Types of roofs, roof materials, pillars, trusses for poultry houses – Design of different Poultry Houses for large & medium size layer farms – Cages & modified cages for egg type birds – Layer farm equipments – Automation in poultry houses and its maintenance –Management of layers in different systems of rearing.

#### **UNIT II**

Deep litter & cage system of management – Medication and vaccination schedules & procedure for layers – Lighting programme for egg type birds – Water quality standards, watering of layer and water sanitation – Brooder, grower and layer management – All in All out and Multiple batch system of rearing layers.

#### **UNIT III**

Management of layers during peak egg production and maintaining the persistency in production–Factors causing uneven growth and low egg production –Monitoring egg production curve.

#### **UNIT IV**

Culling of unproductive birds – Record keeping – Biosecurity & health management – Management during different seasons – Induced moulting.HACCP application for

safe egg, value added egg production – Production of eggs free from harmful microbes, Mycotoxins & drug residues– Integration in layer production.

### **Practical**

Layer farm lay out and blue print– Design of different chick, grower & layer houses, their specifications & blue print of deep litter and cage system– Selection & culling of layers, debeaking, dubbing, deworming, delicing, vaccination & other farm routines and operations – Farm sanitation, disinfection & waste disposal – Maintaining farm records – Visit to commercial layer farms – Record keeping – Calculating Hen day egg production, Hen housed egg production and other economic traits – Case study of production loss, reasons and corrective measures – Preparing project reports for layers under different batch systems – Calculating the cost of production of eggs.

### **Suggested Readings**

Mac O' North & Bell D. 1990. Commercial Chicken Production Manual. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

## **PSC 604 COMMERCIAL BROILER PRODUCTION**

**2+1**

### **Objective**

To deal with different systems of rearing commercial broilers, manage mental practices for higher bodyweight with best feed efficiency in commercial broilers. Marketing of broilers efficiently.

### **Theory**

#### **UNIT I**

Broiler Industry in India and the World – Systems of rearing broilers – Location, layout and design of Broiler houses – Broiler farm equipment.

#### **UNIT II**

Brooding and rearing of broilers– All in all out and multiple batch systems – Litter materials and deep litter management – Lighting for broilers – Environmentally controlled broiler houses & their management – Water quality and Watering of broiler and water sanitation– Management during different seasons.

#### **UNIT III**

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 & feed efficiency– Broiler performance indices – Broiler farm records.

#### **UNIT IV**

Broiler farm routine, medication and vaccination schedule – Bio–security and health management and their control – Systems of Integration in broiler production and marketing –transport of broilers– Different ways of marketing of broilers– Regulations and specifications for production of export quality broilers – Organic broiler meat production.

### **Practical**

Location and blue print for a broiler farm – Broiler house design – Preparation of project report for broiler farm – Visit to broiler farms – Judging of live broilers and ready-to-cook broilers– Broiler vaccination, medication, brooding and transportation and farm routines. Record keeping – Calculating the cost of production of broilers – Feeding of broilers at different ages – Working out Feed efficiency – Case study on low body weights, reasons and corrective measures.

### **Suggested Readings**

Mac O' North & Bell D. 1990. Commercial Chicken Production Manual. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

## **PSC 605 BREEDER STOCK, FLOCK HEALTH AND HATCHERY MANAGEMENT 3+1**

### **Objective**

To impart knowledge about care and management of breeders, hatchery operation, health management. And to study about common diseases and disorders of poultry, diagnosis, vaccination, prevention, control and treatment. Bio security measures in control of general & hatchery borne diseases.

### **Theory**

#### **UNIT I**

History of Natural and Artificial incubation– embryo development–different breeder flocks – Planning a hatchery, breeder farm – Special care of breeder flock – Collection, selection and care of hatching eggs – Breeder male and female management – Flock testing & culling – Farm and hatchery equipments – Incubation practices – Ventilation and temperature control – Hatchery Management, Fumigation and sanitation – Breeder farm and hatchery operations, routine & schedule – Factors affecting fertility and hatchability.

#### **UNIT II**

Care of day old chicks and their vaccination – Restricted & controlled feeding of breeders – Sex separate feeding and nutrient supplementation. – Seasonal management of breeders – Location of hatchery – Layout and design of breeder houses, hatchery & other buildings.

#### **UNIT III**

Biosecurity, health management and waste disposal – Vaccination & medication schedule for breeders. Control of vertically transmissible & hatchery borne diseases.

#### **UNIT IV**

Principles of bio security– Farm sanitation and disinfection procedures–Common bacterial diseases– Salmonella, Pasteurella, E.coli, Fowl typhoid, CRD, Infectious Coryza, Viral diseases–Newcastle, Infectious bronchitis, Infectious laryngo tracheitis, Mareks, Fowl pox, Infectious Bursal disease, Egg drop syndrome–76, Avian Encephalomyelitis, Avian influenza, Duck viral Enteritis, Duck viral hepatitis– Fungal diseases– Aspergillosis, Mycotoxicosis, Metabolic disorders– Fatty liver haemorrhagic syndrome (FLHS), Gout and Ascites, Protozoan diseases– Coccidiosis, Ecto and endo parasitic infestation of poultry. Diagnosis, vaccination, prevention, treatment and control – Locational, structural & operational biosecurity in Poultry

farms – Water sanitation & control of water borne diseases – Quarantine of poultry. Packaging and transportation of hatching eggs and chicks.

#### **UNIT V**

Hatching egg & SPF egg 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.

#### **Practical**

Breeder farms and hatchery records, selection, fumigation, care and storage of hatching eggs. Layout and blue prints for breeder farm and hatchery –Incubation requirements –Incubator management – Hatchery sanitation & fumigation procedures – Pedigree hatching – Hatchery waste disposal and recycling – Calculating cost of production of hatching eggs and day-old-chicks – Attending breeder farm routines & operation – Flock testing & culling of reactors – Analyzing hatchability results and hatchery records–Economics of layer and broiler hatchery.

#### **Suggested Readings**

Crawford.RD. 1993. (Ed.). Poultry Breeding and Genetics. Elsevier.

Mac O' North & Bell D. 1990. Commercial Chicken Production Manual. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

### **PSC 606            MANAGEMENT OF POULTRY OTHER THAN CHICKEN**

**2+1**

#### **Objective**

Care and management of different breeds, varieties of poultry other than chicken, methods of rearing and common diseases affecting them and their control measure.

#### **Theory**

##### **UNIT I**

Breeds and varieties of Turkey, Duck, Goose, Pigeon, Guinea fowl, Budgerigar, Japanese quail, Emu and Ostrich – Incubation periods & incubation procedure for different species – Housing, cage & equipments for different species – Duck, Turkey, Japanese Quail, Guinea fowl, Emu, Ostrich production and rearing under different systems.

##### **UNIT II**

Management and rearing of Turkey, duck, goose, Guinea fowl, Japanese quail, pigeon, emu and ostrich– Feeding standards and feeding, watering and rearing systems and procedure for different species of poultry– Breeding policies of egg and meat production in different species – Preparation of Project reports for different species for commercial exploitation.

##### **UNIT III**

Common diseases affecting poultry other than chicken and their control – Regulations for import and export of different species of poultry – prevention of exotic diseases through import of poultry products and live birds.

## **Practical**

Layout and design of housing & cages for other species of poultry. Visit to 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. Preparing project reports for different species and calculating the cost of production.

## **Suggested Readings**

Einsminger ME. 1992. Poultry Science. Poultry International Book Distr. Co.

## **PSC 607          POULTRY PRODUCTS TECHNOLOGY AND MARKETING          2+1**

### **Objective**

Composition and nutritive value of eggs and chicken meat, grading and preservation methods of eggs and meat, functional and value added poultry products, marketing of eggs and poultry meat.

### **Theory**

#### **UNIT I**

Physical and chemical composition and nutritive value of eggs and meat – Grading of eggs & meat by different standards – Preservation of eggs – Egg quality deterioration – Factors affecting egg quality – Handling, processing, packaging materials, packaging, transport and marketing of eggs.

#### **UNIT II**

Quality control of poultry meat – Quality preservation – Marketing of egg and poultry meat – Marketing channels – Integration in poultry processing and marketing – Functional and value added eggs and meat – Further processing of eggs and meat – Various egg and meat fast foods.

#### **UNIT III**

Sanitary and phyto sanitary measures to ensure food safety – Post oviposition value addition to the eggs & Post processing value addition to the meat for export – Production of low cholesterol eggs – 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.

### **Practical**

Measuring internal and external egg qualities – 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 – Estimation of pesticides, antibiotics and mycotoxin residues in eggs and meat – Measures of microbial safety of poultry products for export.

## **Suggested Readings**

Mountney GJ & Parkhairst CR. 1995. Poultry Products Technology. 3rd Ed. AVI Publ.

**Objective**

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.

**Theory**

**UNIT I**

Glossary of terms used in poultry economics & projects – Measures of performance efficiency in broiler, layer, breeder and other poultry species, hatcheries and other poultry related operations – Production standards and goals.

**UNIT II**

Planning poultry enterprise –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.

**UNIT III**

Integration in Poultry production – Marketing channels for eggs and meat – Integration in marketing of eggs and meat – Cost of production of egg, broiler, hatching egg, day-old chick, compounded feed – Effect of new economic policies on poultry industry – Viability of poultry projects.

**Practical**

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, benefit: cost ratio & other farm economic indices – Preparation of feasibility & viability reports.

**Suggested Readings**

Mac O' North & Bell D. 1990. Commercial Chicken Production Manual. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

**Objective**

To study the basic principles of physiology of poultry production in relation to egg formation, production, incubation, stress and role of environment.

**Theory**

**UNIT I**

Skeletal system of poultry – Comb pattern, 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– muscle growth–bone growth and growth of body parts–Types of muscle fibre and functions.

**UNIT II**

Poultry nervous system and its function – Excretory system – Male and female reproductive system–Reproductive tract–Semen production–semen characteristicsArtificial insemination–Semen extenders–reproductive tract–egg formation–egg laying pattern–photo periodic responses – Role of endocrine glands and their functions. Thermoregulatory mechanism – Stress due to adverse environmental factors –Acid –base balance – Poultry ethology.

### **UNIT III**

Neuro–endocrine control of egg production–Ovulation and Oviposition – Clutch and Pause.

### **Practical**

Demonstration of various systems of birds – structure of feather– Identification of endocrine glands –hormones in poultry production and reproduction–Haematology of poultry species – SGOT, SGPT, free fatty acids – Morphology of Poultry spermatozoa.

### **Suggested Readings**

Rose SP.1997. Principles of Poultry Science. CABI.

## **PSC 801 APPLIED POULTRY NUTRITION**

**2+1**

### **Objective**

Teaching about nutrients and their functions, nutrient requirements of poultry and factors influencing the same. Different methods and forms of feeds and feeding of poultry.

### **Theory**

#### **UNIT I**

Developments in the nutrient requirement for egg and meat–type chicken – Concepts in various poultry feeding procedures and methods for optimal production – Factors influencing the nutrient requirements, feed intake and feed efficiency in poultry–Problems encountered in nutritional deficiencies – Protein and energy utilization and calorie protein ratio, Vitamins, minerals and their interactions in poultry rations.

#### **UNIT II**

In Ovo –Juvenile nutrition for optimal growth rate and feed efficiency – Care in grower feeding – Nutrition and feeding of layers /breeders during peak egg production– Nutritional requirements for higher egg production, broiler meat production, higher fertility and hatchability and other special purposes.

#### **UNIT III**

Feeding of broilers for uniform growth rate and feed efficiency – Feeding to enhance egg quality and nutrients–Enzymes–additives–non–additives in feed production – organic, functional and designer feeds. Advances in feed milling technology –

Specialty feed production to produce microbial safe foods, SPF eggs and organic foods.

#### **UNIT IV**

HACCP implementation in feed quality control – Production of drug, Mycotoxins and pesticide residue free feeds.

#### **Practical**

Computing of specialty and functional feeds – Estimation of available carbohydrate, Aflatoxin, tannins, hydro cyanic acid and other toxins in the feed. Evaluation of various feeds for its quality – Field methods of feed quality control including feed microscopy – Estimation of carotenes, cholesterol and peroxides. Quality control of functional poultry feeds – Preservation of feed quality from production to consumption.

#### **Suggested Readings**

Einsminger ME. 1992. Poultry Science. Poultry International Book Distributing Co. Selected articles from journals.

**PSC 802            CONCEPTS IN COMMERCIAL POULTRY PRODUCTION            2+1**

#### **Objective**

To impart knowledge on different systems of poultry rearing, care and management of commercial layers/broilers for optimal egg and meat production.

#### **Theory**

##### **UNIT I**

Global trends in poultry production – Advances in broiler production in India – concepts in egg production – Latest concepts in breeder management – advances in hatchery operations for higher hatchability & chick quality.

##### **UNIT II**

Optimal microclimatic condition in poultry houses and cages for higher production – Management of poultry in environmentally controlled houses – Management of poultry under adverse climatic conditions – advances in the management of other species of poultry – Behaviour patterns of poultry in different growing systems.

##### **UNIT III**

Advanced management techniques for egg and meat production – advances in lighting management, feeding management, litter management and manure management.

##### **UNIT IV**

The role of integration in poultry production – Factors influencing egg production in different species of poultry – Factors influencing growth rate and egg production – Automation in poultry production.

##### **UNIT V**

Regulations for cage-free egg production and organic chicken production – Functional feeds for functional foods – Production of HACCP and GMP certified table eggs, meat, chicks, hatching eggs and other value added products for export.

### **Practical**

Performance study in commercial layer, broiler, Japanese quail, duck, turkey and other species of poultry farms by Interpretation of the farm records –Managerial routines of different species of poultry – calculating the cost of production – Estimation of microclimatic condition and comparing the productive traits– Modern poultry house and cage design for optimal efficiency and cost reduction.

### **Suggested Readings**

Selected articles from journals.

## **PSC 803          DEVELOPMENTS IN POULTRY PRODUCTS TECHNOLOGY          2+1**

### **Objective**

Composition and nutritive value of eggs and chicken meat, grading, packaging and preservation methods of eggs and meat, functional and value added poultry products, marketing of eggs and poultry meat.

### **Theory**

#### **UNIT I**

Global trends in poultry and egg processing – Indian scenario of poultry processing industry – Nutrients & Non-nutrient components in regular and value added poultry products – various measures of egg and meat quality control – advances in value addition to poultry products.

#### **UNIT II**

Concepts in poultry meat and egg preservation – Newer concepts in meat tenderization, canning, dehydration, curing, irradiation, etc. –Modified atmosphere packaging – Other processed products – Room temperature preservation of poultry fast foods by multi hurdle technology.

#### **UNIT III**

Egg desugarization – pasteurization – Functional properties of eggs – Industrial uses of eggs – Marketing trends in poultry meat and eggs.

#### **UNIT IV**

Improving the product quality to meet Codex & European standards – Standards for egg, meat and their products –Production of immunoglobulins, lecithin, lysozyme, sialic acid and other pharmaceutical products from eggs – Sanitary & phytosanitary measures for food safety.

### **Practical**

Preparation of value added products suitable for preservation at room temperature – Further processing – Barbecuing and Tandoori preparation – preparation of locale specific poultry meat and egg products – Meat balls, meat patties – Estimation of various egg and meat qualities – Preservation of meat and eggs Measuring the microbial quality of poultry foods – Drug, pesticide, mycotoxin and antibiotic residue assay

### **Suggested Readings**

Selected articles from journals.

**PSC 804            EMERGING DISEASES OF POULTRY AND FLOCK HEALTH            2+1**

**Objective**

To study about common diseases and disorders of poultry, their diagnosis, vaccination, prevention & treatment, emphasis on control of emerging poultry diseases of zoonotic importance, disease diagnostic techniques.

**Theory**

**UNIT I**

The concepts of disease prevention in poultry – Emerging and reemerging avian diseases – Factors influencing immuno suppression and stimulation – Developing immunity in poultry

**UNIT II**

Water sanitation, hatchery sanitation procedures – Control of vertically transmissible diseases – non-infectious and metabolic diseases in poultry and their control – Bio security – Mycotoxins and their control.

**UNIT III**

Stress alleviation – prevention and control of bacterial and viral diseases in poultry – Biosecurity measures – Control measures of problematic re-emerging diseases of poultry like Ranikhet, Avian influenza, Marek's disease, Infectious bursal disease, Infectious Bronchitis, Infectious laryngo tracheitis.

**UNIT IV**

Flock management for Specific pathogen free egg production – Maintaining the HACCP standards in poultry farms – developments in the Exim policies for flock health.

**Practical**

Studying the Immune status of birds – Egg inoculation techniques in laboratory diagnosis – differential diagnosis of various poultry diseases by postmortem, and laboratory techniques – Antibiotic sensitivity test – Vaccination – Disinfection and ectoparasite control, medication procedures.

**Suggested Readings**

Selected articles from journals.

**PSC 805            ADVANCED POULTRY BREEDING METHODS            2+1**

**Objective**

To impart knowledge about different systems of breeding, selection methods and implementation of breeding programme in developing egg-type and broiler hybrids. Modern tools in poultry breeding.

**Theory**

**UNIT I**

Gene and genotypic frequency– Sex linked, limited and influenced traits–Auto sexing– Qualitative and quantitative traits and its inheritance in poultry– methods of selection – family selection – selection for multi characteristics and construction of selection indices – restricted selection indices – indirect selection – Reciprocal recurrent selection – Recurrent selection – Random bred control populations – Selection limit – Osborne’s index – construction of selection index for multiple traits – Advances in commercial poultry breeding.

#### **UNIT II**

Modern methods in commercial layer and broiler breeding, performance testing – Pure line breeding – Inbreeding and hybridization – Diallele mating, lethal and semi lethals in poultry. Pedigree hatching. Genotype versus environmental interaction.

#### **UNIT III**

Exploitation of additive and non-additive gene action for commercial poultry production – Heterosis – Exploitation of hybrid vigour for commercial production of layers and broilers– Formation of synthetic lines – Development of strains in poultry–Comparative efficiency of different selection methods in poultry.

#### **Practical**

Construction of selection index – Analysis of breeding data collected from breeding records – Problem in qualitative and quantitative inheritance– Estimation of heritability and standard error of heritability by different methods – analysis of heritability for different traits – Estimation of inbreeding coefficient – Artificial insemination in poultry.

#### **Suggested Readings**

Muir WM & Aggrey SE. 2003. Poultry Genetics and Biotechnology. CABI. Selected articles from journals.

**PSC 806            POULTRY ECONOMICS, MARKETING AND INTEGRATION            2+1**

#### **Objective**

To study about measures of performance efficiency in poultry farms and its allied sectors, hatcheries and developing poultry projects.

#### **Theory**

##### **UNIT I**

Present practices and future trends in production of egg and meat – consumption – demand and supply–seasonal variations in production and consumption. Marketing channels– procedures of marketing for eggs and meat – Market intelligence– Advertising and branding of poultry products – wholesaling and retailing – quality of eggs and meat.

##### **UNIT II**

Various poultry enterprises – choice of production size of business – input and output analysis – calculating cost of various inputs – calculating cost of production . Price determination – Least demand and supply indices of performance – Performance targets and achievements–marketing and business management–

market managerial skills and human resource development–cost and financial management.

### **UNIT III**

Future trends in broiler and egg production –factors influencing the profit margin in poultry enterprises.

#### **Practical**

Study of marketing channels of egg and meat, calculating cost of production of eggs, meat, day–old chick, feed and processing plants– preparing other related poultry projects.

#### **Suggested Readings**

Einsminger ME. 1992. Poultry Science. Poultry International Book Distri. Co.  
Selected articles from journals.

#### **List of Journals**

- Avian Diseases
- Avian Pathology
- Avian Research
- British Poultry Science
- Indian Journal of Poultry Science
- International Poultry Production
- Japanese Poultry Science
- Journal of Applied Poultry Research
- Journal Avian Biology
- Poultry Abstract
- Poultry Science
- World Poultry Science Channel
- Tamilnadu Journal of Veterinary and Animal Sciences
- Indian Journal of Veterinary and Animal Sciences

#### **e–Resources**

- [www.alabamapoultry.org](http://www.alabamapoultry.org)
- [www.eggcom.com](http://www.eggcom.com)
- [www.dpichicken.com](http://www.dpichicken.com)
- [www.georgiaeggs.org](http://www.georgiaeggs.org)
- [www.ansc.purdue.edu/ISEB](http://www.ansc.purdue.edu/ISEB)
- [www.ag.ansc.purdue.edu/ISP](http://www.ag.ansc.purdue.edu/ISP)

- [www.MidwestPoultry.com](http://www.MidwestPoultry.com)http:
- [www.MinnesotaTurkey.com](http://www.MinnesotaTurkey.com)http:
- [www.nebraskapoultry.org](http://www.nebraskapoultry.org)http:
- [www.ncegg.org](http://www.ncegg.org)
- [www.ohiopoultry.org](http://www.ohiopoultry.org)
- [www.aeb.org](http://www.aeb.org)http
- [www.fb.org](http://www.fb.org)
- [www.afia.org](http://www.afia.org)http
- [www.albcusa.org](http://www.albcusa.org)http
- [www.amerpoultryassn.com](http://www.amerpoultryassn.com)
- [www.avianresearch.co.uk](http://www.avianresearch.co.uk)
- [www.canr.uconn.edu/ansci/](http://www.canr.uconn.edu/ansci/)
- [www.ansc.cornell.edu](http://www.ansc.cornell.edu)http
- [www.castscience.org](http://www.castscience.org)http
- [www.enconline.org](http://www.enconline.org)http
- [www.internationalegg.com](http://www.internationalegg.com)
- [www.eatchicken.com](http://www.eatchicken.com)http
- [www.foodsafety.gov/~dms/fstoc](http://www.foodsafety.gov/~dms/fstoc).
- [www.nmaonline.org](http://www.nmaonline.org)
- [www.eatturkey.com](http://www.eatturkey.com)
- [www.naga.org](http://www.naga.org)
- [www.mtgplace.com](http://www.mtgplace.com)
- [www.poultryscience.org](http://www.poultryscience.org)
- [www.posc.tamu.edu/library/dother.html](http://www.posc.tamu.edu/library/dother.html)
- [www.poultryegg.org](http://www.poultryegg.org)
- [www.usapeec.org](http://www.usapeec.org)
- [www.wattpoultry.com](http://www.wattpoultry.com)
- [www.afns.ualberta.ca](http://www.afns.ualberta.ca)
- [www.poultryresearchcentre.c](http://www.poultryresearchcentre.c)
- [www.poultryscience.uark.edu/poultry](http://www.poultryscience.uark.edu/poultry)
- [www.ag.auburn.edu/dept/ph/index.html](http://www.ag.auburn.edu/dept/ph/index.html)
- [www.aes.ucdavis.edu/animalscience.ucdavis.edu/animalscience.ucdavis.edu/extension/](http://www.aes.ucdavis.edu/animalscience.ucdavis.edu/animalscience.ucdavis.edu/extension/)
- [www.calstate.edu](http://www.calstate.edu)
- [www.csupomona.edu](http://www.csupomona.edu)
- [www.animalscience.calpoly.edu](http://www.animalscience.calpoly.edu)
- [www.clemson.edu/avs/](http://www.clemson.edu/avs/)

## VETERINARY MICROBIOLOGY

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
VMC 601	BACTERIOLOGY- I	3+1
VMC 602	BACTERIOLOGY - II	3+1
VMC 603	VETERINARY MYCOLOGY	1+1
VMC 604	GENERAL VIROLOGY	2+1
VMC 605	SYSTEMATIC ANIMAL VIROLOGY	3+1
VMC 606	PRINCIPLES OF IMMUNOLOGY	2+1
VMC 607	VACCINOLOGY	2+0
VMC 608	DIAGNOSTICS OF INFECTIOUS DISEASES	1+2
VMC 609	TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY	0+3
VMC 691	MASTER'S SEMINAR	1+0
VMC 699	MASTER'S RESEARCH	20
VMC 801	ADVANCES IN BACTERIOLOGY	2+1
VMC 802	ADVANCES IN MYCOLOGY	2+1
VMC 803	BACTERIAL GENETICS	2+1
VMC 804	MICROBIAL TOXINS	2+1
VMC 805	MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS	2+1
VMC 806	ADVANCES IN VIROLOGY	2+1
VMC 807	MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS	2+1
VMC 808	STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES	3+0
VMC 809	ONCOGENIC VIRUSES	2+0
VMC 810	SLOW VIRAL INFECTIONS AND PRIONS	2+0
VMC 811	MOLECULAR IMMUNOLOGY	2+1
VMC 812	ADVANCES IN CELLULAR IMMUNOLOGY	2+1
VMC 813	CYTOKINES AND IMMUNOMODULATORS	2+0
VMC 814	ADVANCES IN VACCINOLOGY	2+0
VMC 815	ADVANCES IN IMMUNODIAGNOSTICS	1+1
VMC 816	MODERN IMMUNOTECHNOLOGY	1+2
VMC 817	CURRENT TOPICS IN INFECTION AND IMMUNITY	3+0
VMC 818	VETERINARY MICROBIAL BIOTECHNOLOGY	2+1
VMC 890	SPECIAL PROBLEM	0+2
VMC 891	DOCTORAL SEMINAR I	1+0
VMC 892	DOCTORAL SEMINAR II	1+0



Systematic study of following pathogenic bacteria: Gram positive cocci, family Micrococaceae, endospore forming Gram positive rods and cocci, family Bacillaceae genus Bacillus, Sporolactobacillus and Clostridium. Spirochetes. Family Spirochetaceae and other families like Spirillaceae, coryneform bacteria, Dermatophilaceae, Streptomyetaceae.

#### **UNIT II**

Mycobacteria and Nocardia, family Actinomycetaceae. Atypical prokaryotes such as Chlamydia, Rickettsiae, Mycoplasma, Achleplasma, Spiroplasma, Anaeroplasma and Thermoplasma.

#### **UNIT III**

Regular non-sporing Gram positive rods such as Listeria and Erysipelas. Anaerobic Gram negative straight, curved and helical rods, family Bacteroidaceae and genus Bacteroides and Fusobacterium.

#### **Practical**

Detailed and comparative study of morphology, biochemical reactions, physiology, serology and pathogenicity of various bacteria studied in theory, isolation of bacteria from field materials leading to their characterization and identification.

#### **Suggested Readings**

Glen Sonder J & Karen W Post 2005. Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases. Cold Spring Harbor Lab. Press.

Prescot LM, Harley JP & Klen DA. 2005. Microbiology. Wm. C. Brown Publ.

Tortora GJ, Funke BR & Case CL. 2004. Microbiology: An Introduction. Benjamin/Cummins Publ.

### **VMC 603 VETERINARY MYCOLOGY**

**1+1**

#### **Objective**

To learn general and pathogenic mycology.

#### **Theory**

##### **UNIT I**

Morphology, physiology, reproduction, cultural characters, classification of fungi, immunology of pathogenic fungi.

##### **UNIT II**

Systematic study of animal mycoses such as aspergillosis, candidiasis, cryptococcosis, epizootic lymphangitis, mycetomas, sporotrichosis, histoplasmosis, blastomycosis, coccidioidomycosis, haplomycosis, rhinosporidiosis, zygomycosis, mycotic abortion, mycotic mastitis, mycotic dermatitis, dermatophytoses, mycotoxicosis etc.

#### **Practical**

Collection and processing of clinical material for isolation of fungi. Study of gross and microscopic characters of pathogenic fungi.

#### **Suggested Readings**

Glen Sonder J & Karen W Post 2005. Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases. Cold Spring Harbor Lab. Press.

**Objective**

To study general aspects of viral structure, classification, replication, interactions and immunity to viruses.

**Theory****UNIT I**

History of virology; origin and nature of viruses; biochemical and morphological structure of viruses; nomenclature and classification of viruses.

**UNIT II**

Replication of DNA and RNA viruses, viral genetics and evolution.

**UNIT III**

Genetic and non-genetic interactions between viruses, virus-cell interactions, viral pathogenesis, viral persistence, oncogenic viruses, epidemiology of viral infections.

**UNIT IV**

Immune response to viruses, viral vaccines, viral chemotherapy.

**Practical**

Orientation to a virology laboratory, preparation of equipment for sterilization, collection, preservation, transportation of samples and their processing, isolation and cultivation of viruses in animals/ birds, embryonated chicken eggs; media and reagents for cell culture, trypsinization and maintenance of monolayer cell cultures, isolation of virus in cell cultures, titration of viruses by 50% end-point cytopathogenicity, and haemagglutination; detection of viral antibodies by serum neutralisation test, agar gel precipitation test, haemagglutination inhibition and ELISA.

**Suggested Readings**

Acheson NH. 2006. Fundamentals of Molecular Virology. Wiley.

Carter J & Saunders V. 2007. Virology: Principles and Applications. 1<sup>st</sup> Ed. Wiley.

Knipe DM, Howley PM, Griffin DE. 2006. Fields Virology. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.

Mahy BWJ & Kangaroo HO. 1996. Virology Methods Manual. Academic Press.

Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. Veterinary Virology. 3rd Ed. Academic Press.

**Objectives**

To study viral properties, epidemiology, pathogenesis, diagnosis and control of diseases caused by animal viruses.

**Theory****UNIT I**

Studies on animal viruses belonging to various families, and prion agents given below with reference to antigens, cultivation, pathogenesis, epidemiology, disease status in India, diagnosis, immunity and control. Capripoxvirus, avipoxvirus, cowpoxvirus;

bovine herpes viruses, equine herpes viruses, infectious laryngotracheitis virus, Marek's disease virus, pseudorabies virus, malignant catarrhal fever virus; infectious canine hepatitis virus, egg drop syndrome virus, inclusion body hepatitis, hydropericardium virus, papillomatosis, canine parvoviruses, feline panleucopenia virus.

#### **UNIT II**

Newcastle disease virus, canine distemper virus, rinderpest virus, PPR virus; infectious bursal disease virus; rotavirus, blue tongue virus, African horse sickness virus; rabies virus, ephemeral fever virus, borna virus.

#### **UNIT III**

Infectious bronchitis virus, transmissible gastroenteritis virus; equine arteritis virus, equine encephalomyelitis viruses; swine fever virus, BVD, mucosal disease virus; foot and mouth disease virus, duck hepatitis virus; visna/maedi virus, equine infectious anemia virus, avian leucosis complex virus, bovine leukemia virus, chicken anemia virus; prions: scrapie, bovine spongiform encephalopathy.

#### **Practical**

Isolation of viruses in embryonated eggs and cell cultures; cytopathogenicity of representative animal viruses viz., cell death, syncytia formation, inclusion body etc.; diagnosis of animal viruses employing various serological tests, viz., haemagglutination and haemagglutination inhibition for Newcastle disease virus, agar gel diffusion and virus neutralization test for infectious bursal disease viruses; diagnosis of IBD virus and rotavirus by latex agglutination test, serotyping of FMD virus by ELISA, electrophoretotyping of rotavirus, PCR for diagnosis of viral infections.

#### **Suggested Readings**

Acheson NH. 2006. Fundamentals of Molecular Virology. Wiley.  
Carter J & Saunders V. 2007. Virology: Principles and Applications. 1<sup>st</sup> Ed. Wiley.  
Knipe DM, Howley PM, Griffin DE. 2006. Fields Virology. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.  
Mahy, BWJ & Kangaroo HO. 1996. Virology Methods Manual. Academic Press.  
Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. Veterinary Virology. 3rd Ed. Academic Press.

### **VMC 606      PRINCIPLES OF IMMUNOLOGY**

**2+1**

#### **Objective**

To impart knowledge about fundamental principles of immunology and its applications in the field of infectious diseases.

#### **Theory**

##### **UNIT I**

History of immunology, immunity types, cardinal features, phylogeny. Vertebrate immune system: lymphoid organs and tissues; development of B and T lymphocyte repertoires and other leukocytes, differentiation markers and other distinguishing characters of leukocytes; lymphoid cells trafficking.

##### **UNIT II**

Antigens: fundamental features, types, factors affecting immuno-ogenicity, adjuvants. Antibodies: structure, functions and classification; theories of antibody production; immunoglobulin genes and genetic basis of antibody diversity. Complement system: activation pathways and biological activities.

### **UNIT III**

Major histocompatibility complex: structure, functions and gene organization. T lymphocyte subsets. Antigen-specific T cell receptors: structure, gene organization and genetic basis of diversity. Immune response development: phases of humoral and cell-mediated immune response development, cellular interactions, properties and classification of various cytokines, immunoregulation.

### **UNIT IV**

Immunity against veterinary infectious agents, immunological surveillance and cancer immunity, immunological tolerance, its breakdown and autoimmunity, immuno-deficiencies: types and examples, hypersensitivity: classification, mechanisms of induction and examples.

### **Practical**

Preparation of antigens for laboratory animals immunization; production, collection and preservation of antisera; quantitation of immunoglobulins in antisera by zinc sulphate turbidity and single radial immunodiffusion; examination of lymphoid organs of animals; tests for in vivo and in vitro phagocytosis; separation and counting of peripheral blood lymphocytes; separation and concentration of immunoglobulin by ammonium sulphate precipitation and dialysis; demonstration of antigen- antibody interactions in serological tests such as agar gel precipitation, immunoelectrophoresis, bacterial agglutination, direct and passive hemagglutination, latex agglutination, complement fixation, enzyme-linked immunosorbent assay, immunoblotting.

### **Suggested Readings**

Kindt TJ, Goldsby RA & Osborne BA. 2007. Kuby Immunology. 6th Ed. WH Freeman.  
Male D, Brostoff J, Roth DB & Roitts I. 2007. Immunology. 7th Ed. Mosby-Elsevier.  
Tizard IR. 2004. Veterinary Immunology: An Introduction. 7th Ed. Saunders/Elsevier.

## **VMC 607 VACCINOLOGY**

**2+0**

### **Objective**

To understand science and practice of vaccines for prevention of bacterial and viral diseases.

### **Theory**

#### **UNIT I**

History of veterinary vaccinology. Vaccines: classification, comparison of major types. Components of various types of vaccines: immunogens, adjuvants, stabilizers, preservatives, vehicles. Vaccine qualities: definitions and methods of testing. Vaccine development: cost-effectiveness of preventive immunization programmes, stages of development, clinical trials and regulatory requirements.

#### **UNIT II**

Traditional vaccines: inactivated, attenuated and toxoid vaccines. Methods of construction of traditional vaccines: microbial cultures, embryonated eggs, cell culture. Seed-lots of vaccine organisms. Methods of nactivation and attenuation of pathogens.

### **UNIT III**

Modern vaccines: nucleic acids, vectored vaccines, recombinant expressed immunogens, synthetic peptides, marker vaccines, etc. Combination/multivalent vaccines. Novel immunomodulators and delivery systems. Modern methods of vaccine construction: methods based on synthetic chemistry and rDNA technology.

### **UNIT IV**

Vaccine formulation: pharmacopeal requirements. Vaccine stability and preservation: cold chain. Immunization schedules of veterinary vaccines, logistic problems and vaccination failure. Strategies of disease control and eradication by vaccination.

### **Suggested Readings**

- Dodds WJ & Schulz R. (Eds). 1999. Veterinary Vaccines and Diagnostics. Vol. 41 (Advances in Veterinary Medicine) 1st Ed. Academic Press.
- Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. New Generation Vaccines. 3rd Ed. Marcel-Dekker.
- Pastoret PP, Blancou J, Vannier C & Verschueren C. 1997. Veterinary Vaccinology. Elsevier.

## **VMC 608      DIAGNOSTICS OF INFECTIOUS DISEASES**

1+2

### **Objective**

To provide training in essential immunological and molecular diagnostic techniques.

### **Theory**

#### **UNIT I**

Diagnosis of infectious diseases: an overview. Principles of serodiagnostic: agglutination-reaction based tests, precipitation-reaction based tests, complement fixation test and enzyme immunoassays.

#### **UNIT II**

Principles of molecular diagnostic tests: PCR, RT-PCR, Southern blotting, northern blotting, western blotting, dot-blot. DNA diagnostics versus serodiagnostics. Development and validation of diagnostic tests.

### **Practical**

Serodiagnostic tests for infectious diseases: bacterial slide and microtitre plate agglutination, agar gel immunodiffusion test, passive hemagglutination, hemagglutination inhibition and latex agglutination tests, complement fixation test, enzyme linked immunosorbent immunoassays, dot-ELISA, fluorescent antibody technique, immuno-electron microscopy, virus neutralization test, etc. Molecular diagnostic techniques: protein profiling of infectious agents by SDS-polyacrylamide gel electrophoresis, antigen profiling of infectious agents by immunoblotting, nucleic acids isolation from infectious agents, detection of infectious agent nucleic acids by various formats of polymerase chain reaction and reverse transcription-PCR, dot-blot technique, etc.

### **Suggested Readings**

- Detrick B & Hamilton RG. (Eds). 2006. Manual of Molecular and Clinical 7<sup>th</sup> Laboratory Immunology. Ed. American Society for Microbiology.
- Rose NR, Friedman H & Fahey JL. (Eds). 1986. Manual of Clinical Laboratory Immunology. American Society for Microbiology.
- Weir DM. 1986. Handbook of Experimental Immunology. Vol. IV. Blackwell.

**VMC 609      TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY      0+3**

### **Objective**

To learn various important techniques of bacteriology, virology and immunology.

### **Practical**

Preparation of different media used in bacteriology and mycology; isolation and identification of bacteria and fungi; antibiotic sensitivity of microorganisms from clinical specimens. Plasmid profiling, pathogenicity test in cell culture or laboratory animals, maintenance and preservation of bacteria and fungi. Cryopreservation and reconstitution of preserved cell lines; Concentration and purification of animal viruses by chemical agents, differential centrifugation, density gradient centrifugation, and ultra filtration, etc. Storage of animal viruses by freeze drying and ultra freezing. Biophysical and biochemical characterization of animal viruses; Molecular characterization of viral protein and nucleic acid. Immunoglobulin purification by salt precipitation and chromatographic techniques, anti-species antibody production, enzyme-linked immunosorbent assays for antigen and antibody detection, neutrophils and peritoneal macrophage isolation and demonstration of phagocytic activity, lymphocyte separation, lymphocyte proliferation assay, tuberculin-type delayed type hypersensitivity reaction.

### **Suggested Readings**

- Coligan JE, Kruisbeek AM, Margulies DH, Shevach EM & Strober W.2003. Current Protocols in Immunology. 3rd Ed. John Wiley & Sons.
- Detrick B & Hamilton RG. (Eds). 2006. Manual of Molecular and Clinical 7<sup>th</sup> Laboratory Immunology. Ed. American Society for Microbiology.
- Hay FC & Westwood OMR. 2002. Practical Immunology. 4th Ed. Blackwell.
- Mahy BWJ & Kangaro HO. 1996. Virology Methods Manual. Academic Press.
- Quinn PJ, Carter ME, Markey B & Carter GR. 1994. Clinical Veterinary Microbiology. Wolfe Publ.

**VMC 801      ADVANCES IN BACTERIOLOGY      2+1**

### **Objective**

To learn about the latest development in the field of bacteriology

### **Theory**

#### **UNIT I**

Advanced studies on cytology, biochemical activities, antigenic structure and molecular biology of bacteria

## **UNIT II**

Advanced studies on pathogenicity, immunology and serology of bacteria.

### **Practical**

Biochemical, physiological and pathogenesis studies of various bacterial diseases.

### **Suggested Readings**

Selected articles from journals

**VMC 802      ADVANCES IN MYCOLOGY      2+1**

### **Objective**

To learn about the latest development in the field of mycology.

## **Theory**

### **UNIT I**

Advanced studies on taxonomic genetics, physiology and antigenic characterization of pathogenic fungi.

### **UNIT II**

Advanced studies on molecular approaches for identification of fungi and immunology and serology of mycoses.

### **Practical**

Biochemical, physiological and pathogenesis studies of various fungal diseases.

### **Suggested Readings**

Selected articles from journals

**VMC 803      BACTERIAL GENETICS      2+1**

### **Objective**

To learn the basic aspects of bacterial genetics.

## **Theory**

### **UNIT I**

Prokaryotic and Eukaryotic genome. Replication of eukaryotic and prokaryotic DNA. Structure, classification and replication of plasmids. Molecular basis of mutations.

### **UNIT II**

Biochemical genetic and gene mapping by recombination, fine gene structure analysis. Gene transfer in bacteria through transduction, transformation and conjugation and gene mapping by these processes.

### **UNIT III**

Transposable elements. Gene cloning and gene sequencing. Regulation of gene expression.

### **Practical**

Mutagenesis of microorganisms by different methods. Production, isolation and characterization of mutants. Determination of mutation rate. Isolation, characterization and curing of plasmids. Transfer of plasmid by conjugation, electroporation. Tetrad and random spore analysis.

### **Suggested Readings**

Selected articles from journals.

**VMC 804      MICROBIAL TOXINS      2+1**

### **Objective**

To learn about the bacterial and fungal toxins.

### **Theory**

#### **UNIT I**

The role of microbial toxins in the pathogenesis of diseases; biochemical and biological characteristics of toxins produced by various bacteria. Toxin producing Gram positive and negative bacteria. Properties and clinical conditions produced by different bacterial toxins.

#### **UNIT II**

Production, characterization, and study of pathogenicity of various fungal toxins.

### **Practical**

Isolation of toxigenic strains of bacteria from suspected material, production of toxins in suitable media, purification and characterization of toxins; biological characterization in animal and in tissue culture; immunobiological studies of toxins.

### **Suggested Readings**

Selected articles from journals.

**VMC 805      MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS      2+1**

### **Objective**

To learn the molecular mechanisms of bacterial pathogenesis.

### **Theory**

#### **UNIT I**

Molecular structure, production and mode of action of bacterial adhesins, invasins, impedins, aggressins, modulins, capsule, flagella, enzymes, components of cell wall and siderophores.

#### **UNIT II**

The production, structure and molecular mechanism of actions of various exotoxins and endotoxins, siderophores and cytotoxins, and plasmids in causation of disease.

### **Practical**

To study the production and effects of exotoxins and endotoxins, LPS and various enzymes produced by the bacteria on various cell culture and live animals.

### **Suggested Readings**

Selected articles from journals.

**VMC 806      ADVANCES IN VIROLOGY**

**2+1**

**Objective**

Advanced study of virus structure, their nucleic acids and proteins; latest trends in animal virus research.

**Theory**

**UNIT I**

Biology of RNA and DNA virus replication.

**UNIT II**

Current concepts in animal virus research with respect to viral structure and architecture, viral virulence, viral pathogenesis, persistence and oncogenesis.

**UNIT III**

Latest trends in the development of antivirals.

**UNIT IV**

Cloning and expression in viral vectors.

**Practical**

Separation and characterization of viral proteins, and nucleic acid by polyacrylamide gel electrophoresis, column chromatography, blotting techniques. Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests. Screening and evaluation of antiviral agents for efficacy and toxicity.

**Suggested Readings**

Selected articles from journals.

**VMC 807      MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS      2+1**

**Objective**

To study molecular and genetic determinants of viral virulence and pathogenesis; animal models for studying viral pathogenesis.

**Theory**

**UNIT I**

Mechanisms of viral infection and spread through the body; detailed study of virus host interactions.

**UNIT II**

Host immune responses to viral infections; viral strategies to evade host immune responses.

**UNIT III**

Pathogenesis of viral diseases of various systems; animal models for studying viral pathogenesis; molecular and genetic determinants of viral virulence; mechanisms of viral virulence.

**UNIT IV**

Molecular and genetic determinants of viral persistence, viral oncogenesis, viral immunosuppression, and immunopathology. Animal models for studying viral pathogenesis.

**Practical**

Pathotyping of animal viruses using Newcastle disease virus as model; Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anemia virus; characterization of molecular determinants of viral virulence using variants, recombinants and reassortants; isolation and molecular characterization of viruses with varying virulence.

### **Suggested Readings**

Selected articles from journals.

### **VMC 808      STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES      3+0**

#### **Objective**

To understand the relationship between structure and function of DNA and RNA viruses of animals for the development of next generation viral vaccine and antivirals.

#### **Theory**

##### **UNIT I**

Methods of studying virus structure and architecture; methods of amplification of viral nucleic acids; molecular characterization of viral protein and nucleic acid, nucleotide sequencing, and its analysis by software programmes.

##### **UNIT II**

Detailed study of virus replication in various groups of animal viruses.

##### **UNIT III**

Understanding the relationship between structure and function of animal DNA and RNA viruses, development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses.

### **Suggested Readings**

Selected articles from journals.

### **VMC 809      ONCOGENIC VIRUSES      2+0**

#### **Objective**

To study mechanisms of viral oncogenesis.

#### **Theory**

##### **UNIT I**

General features of cell transformation and characterization of transformed cells; Oncogenic RNA and DNA viruses; expression of viral and cellular oncogenes.

##### **UNIT II**

Mechanisms of viral oncogenesis; Diagnosis of viral oncogenesis.

### **Suggested Readings**

Selected articles from journals.

### **VMC 810      SLOW VIRAL INFECTIONS AND PRIONS      2+0**

#### **Objective**

To study slow viral infections; properties and replication of prions, and diseases caused by them.

### **Theory**

#### **UNIT I**

Epidemiology, pathogenesis, diagnosis and control of slow viral infections.

#### **UNIT II**

Properties, replication and epidemiology of prions. Pathogenesis, immunity, diagnosis and control of various diseases caused by prions; recent trends in prion research.

### **Suggested Readings**

Selected articles from journals.

**VMC 811      MOLECULAR IMMUNOLOGY      2+1**

### **Objective**

To familiarize with advances in research on immune system molecules such as antigens, antibodies, complement, cytokines, surface molecules, etc.

### **Theory**

#### **UNIT I**

Pathogen associated molecular patterns and pattern recognition receptors in immunity. Advances in characterization of antigens and superantigens, epitope mapping. Novel functions of immunoglobulins and their fragments produced by rDNA technology.

#### **UNIT II**

Cytokines and cytokine receptors: structure and function. Complement components genes and polymorphism. MHC genes. Evolutionary aspects of recombination activating genes-mediated immunity in vertebrates.

#### **UNIT III**

Immunoinformatics as applied to MHC molecules-peptide complexes and other molecules. Immunomics.

### **Practical**

Purification of immunoglobulin classes and IgG subclasses, IgG fragments production by pepsin and papain digestion, cytokine quantitation and detection by ELISPOT assay, IgV gene amplification and sequencing, use of immunoinformatic tools to Ig genes.

### **Suggested Readings**

Selected articles from journals.

**VMC 812      ADVANCES IN CELLULAR IMMUNOLOGY      2+1**

### **Objective**

To learn advances in research on immune cell biology and cellular interactions in immune responses.

### **Theory**

### **UNIT I**

Hematopoietic stem cells and differentiation pathways of various leukocytes. B and T lymphocyte repertoires. Lymphocyte– endothelial cell interactions during lymphocyte emigration and recirculation. Antigen presenting cells, T cell subsets, regulatory T cells, memory B and T cells. NK cell biology.

### **UNIT II**

Cellular interactions during immune response development: microenvironments, antigen processing and presentation, activation of B and T cells, co–stimulatory molecules, cytokines in intercellular communication. Signal transduction pathways in B and T cell activation.

### **UNIT III**

Immunoregulation of B and T cell response. Mucosal immune system. Oral tolerance and its breakdown. Advances in transplantation immunology. SCID, gene–knockout and transgenic animals in immunobiology research.

### **Practical**

Fluorescence activated and magnetic cell sorting of lymphocyte subsets, Lymphocyte proliferation assays using non–radioisotope methods, adoptive transfer of lymphocyte subsets, cytotoxic T cell assays, ELISPOT assays for enumeration of lymphocyte subsets secreting cytokines.

### **Suggested Readings**

Selected articles from journals.

**VMC 813      CYTOKINES AND IMMUNOMODULATORS      2+0**

### **Objective**

To learn about structure and function of various cytokines and other immunomodulators.

### **Theory**

#### **UNIT I**

Cytokines and immunomodulators: definitions and classification. Cytokines structure and functions. Cytokine receptors: structural types and presence on different cells. Roles in activation, division and differentiation of immune cells, and immunoregulation.

#### **UNIT II**

Cytokine networks. cytokines in reproductive processes and neuro–endocrino–immunological interactions. Immunomodulators in control of diseases. Cytokines as adjuvants and immunomodulators. Colony stimulating factors and other cytokines in stem cell research.

### **Suggested Readings**

Selected articles from journals.

**VMC 814      ADVANCES IN VACCINOLOGY      2+0**

### **Objective**

To learn about advances in vaccine research and modern approaches to vaccine development.

### **Theory**

#### **UNIT I**

Advances in vaccine development research. Antigen identification and characterization employing newer molecular technologies such as microarrays, in vivo expression technology, signature-tagged mutagenesis and phage display technology, etc.

#### **UNIT II**

Immunoinformatics as applied to epitope mapping, T cell epitopes, identification of pathogenic epitopes, etc. Novel vaccines: nucleic acids, marker vaccines, mucosal vaccines, bacterial ghosts as vaccines, virus-like particles. Futuristic vaccines: anti-allergic, anti-autoimmune diseases, de-addiction vaccines, transplant survival/ prolonging vaccines etc.

### **Suggested Readings**

Selected articles from journals.

**VMC 815      ADVANCES IN IMMUNODIAGNOSTICS      1+1**

### **Objective**

To learn and employ modern approaches to immunodiagnosis.

### **Theory**

Newer methods of immunodiagnosis: simple, rapid, penside immunodiagnostic tests such as immunochromatofocussing, immunofiltration tests, etc. Development of highly sensitive enzyme immunoassays such as immuno-PCR, use of luminescent substrates, etc. Discriminant immunoassays for differentiating cross-reactive antigens. Antibodies in biosensors.

### **Practical**

Development of immunofiltration test using monoclonal antibody for diagnosis of any veterinary infectious disease. Blocking ELISA to differentiate cross-reactive antigens.

### **Suggested Readings**

Selected articles from journals.

**VMC 816      MODERN IMMUNOTECHNOLOGY      1+2**

### **Objective**

To provide training on production of monoclonal antibody and other immunobiologicals by various modern methods.

### **Theory**

#### **UNIT I**

Historical developments in modern immunotechnology. Hybridoma technology: advances in monoclonal antibody production. Chimeric and humanized monoclonal antibodies.

#### **UNIT II**

Recombinant DNA technology for expression of antibody fragments: Fab, scFv, bispecific antibody, nanobody and various other antibody formats. Modern uses of antibody fragments: biosensors, catalysis, therapeutics, in vivo imaging, microarrays, proteomics, etc.

#### **Practical**

Production of murine monoclonal antibody against antigens of infectious agents by hybridoma technique. Production of phage display library of scFv or camel nanobody. Selection of antigen-specific phage displayed antibody fragment by panning or other techniques.

#### **Suggested Readings**

Selected articles from journals.

### **VMC 817      CURRENT TOPICS IN INFECTION AND IMMUNITY      3+0**

#### **Objective**

Discussions on recent developments in the immunobiology of major viral, bacterial and fungal diseases of animals.

#### **Theory**

##### **UNIT I**

Introduction and historical developments. Host-pathogen relationship.

##### **UNIT II**

Effector mechanisms of specific and non specific immunity to different groups of microbes.

##### **UNIT III**

Immunobiology of major viral, bacterial and fungal diseases of animals. Types of vaccines in infectious diseases and current trends in vaccine development.

#### **Suggested Readings**

Selected articles from journals.

### **VMC 818      VETERINARY MICROBIAL BIOTECHNOLOGY      2+1**

#### **Objective**

To understand as to how microbial processes and activities can be used for development of medically and industrially important products and processes.

#### **Theory**

##### **UNIT I**

History of microbial biotechnology. Microbes in nature. Microbes as infectious agents of human and animals. Host-microbe relationships. Microbial metabolism and growth characteristics. Microbial genetics.

## **UNIT II**

Introduction to molecular biology of microorganisms: DNA, RNA and proteins structure and functions. DNA replication, RNA transcription, reverse transcription, protein translation, regulatory mechanisms. Bacterial extrachromosomal DNA elements.

## **UNIT III**

Genetic engineering: restriction enzymes, DNA ligases, DNA polymerases, RNases and DNases, other enzymes. DNA sequencing. Plasmids and phage-derived vectors, bacterial hosts for cloning and expression of transgenes. Genomic libraries and sequencing. Blotting of DNA, RNA and proteins. Polymerase chain reaction. Microarrays. Metagenomics.

## **UNIT IV**

Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. PCR and blotting techniques in infectious disease diagnosis. Nucleic acid vaccines. Vecteded viral and bacterial vaccines. Construction of defined mutants and marker vaccines using genetic manipulation techniques. Display technologies for production of immunobiologicals. Manipulation of microbial processes for production of industrially useful substances.

## **Practical**

Extraction of nucleic acids from viruses and bacteria. Restriction endonuclease digestion of DNA and resolution in agarose gel electrophoresis. PCR amplification of DNA. RT-PCR of RNA. Insertion of DNA fragments into plasmid/phagemid/phage vectors. Construction of competent E. coli host cells. Transformation and transfection of competent E. coli cells. Screening of transformants and isolation of clones. DNA sequencing of clones/PCR amplicons. Expression of genes of bacterial/viral antigens. Use of PCR for infectious disease diagnosis.

## **Suggested Readings**

Selected articles from journals.

**VMC 890 SPECIAL PROBLEM**

**0+2**

## **Objective**

To provide expertise in handling practical research problem(s).

## **Practical**

Short research problem(s) involving contemporary issues and research techniques.

## **List of Journals**

- \* Advances in Immunology
- \* Advances in Virus Research
- \* Annual Review of Immunology
- \* Current Topics in Microbiology and Immunology
- \* Immunology
- \* Indian Journal of Virology
- \* Infection and Immunity

- \* Journal of Bacteriology
- \* Journal of General Virology
- \* Journal of Immunology
- \* Journal of Virology
- \* Nature
- \* Nature Immunology
- \* Nature Reviews Immunology
- \* Science
- \* Trends in Biotechnology
- \* Trends in Immunology
- \* Vaccine
- \* Veterinary Immunology and Immunopathology
- \* Veterinary Microbiology
- \* Virology

#### **e-Resources**

- \* [www.virology.com](http://www.virology.com) (Virology Journal)
- \* [www.elsevier.com/locate/vetmic](http://www.elsevier.com/locate/vetmic) (Veterinary Microbiology)
- \* [www.jb.asm.org](http://www.jb.asm.org) (Journal of Bacteriology)
- \* [www.jac.oxford.journals.org](http://www.jac.oxford.journals.org) (Clinical Bacteriology)
- \* [www.bentham.org/open/tomycj](http://www.bentham.org/open/tomycj) (The Open Mycology Journal)
- \* [www.nature.com/nrmicro](http://www.nature.com/nrmicro) (Nature Review of Microbiology)
- \* [www.trends.com/tim](http://www.trends.com/tim) (Trends in Microbiology)
- \* [www.arjournals.annualreviews.org/loi/micro](http://www.arjournals.annualreviews.org/loi/micro) (Annual Reviews of Microbiology)
- \* [www.jcm.asm.org](http://www.jcm.asm.org) (Journal of Clinical Microbiology)
- \* [www.trends.com/it](http://www.trends.com/it) (Trends in Immunology)
- \* [www.arjournals.annualreviews.org/loi/immunol](http://www.arjournals.annualreviews.org/loi/immunol) (Annual Reviews of Immunology)
- \* [www.elsevier.com/locate/vaccine](http://www.elsevier.com/locate/vaccine) (Vaccine)
- \* [www.nature.com/immunol](http://www.nature.com/immunol) (Nature Review of Immunology)
- \* [www.iaac.asm.org](http://www.iaac.asm.org) (Infection and Immunity)
- \* [www.jaconline.com](http://www.jaconline.com) (Journal of Allergy and Clinical Immunology)
- \* [www.elsevier.com/locate/molimm](http://www.elsevier.com/locate/molimm) (Molecular Immunology)
- \* [www.blackwellpublishing.com/journals/pim](http://www.blackwellpublishing.com/journals/pim) (Parasite Immunology)
- \* [www.jleukbio.org](http://www.jleukbio.org) (Journal of Leucocyte Biology)
- \* [www.ocw.mit.edu](http://www.ocw.mit.edu) (MIT Open Course Ware/Health Sciences and Technology)

#### **Professional Course Ware Web Sites:**

- \* [www.jbpub.com](http://www.jbpub.com)
- \* [www.bact.wisc.edu](http://www.bact.wisc.edu)
- \* [www.textbookbacteriology.net](http://www.textbookbacteriology.net)
- \* [www.mhhe.com/Prescott5](http://www.mhhe.com/Prescott5)
- \* [www.Highwirepress.stanford.edu](http://www.Highwirepress.stanford.edu)
- \* [www.vibno/Epid/supercourseforvirology](http://www.vibno/Epid/supercourseforvirology)

#### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Isolation, identification and characterization of pathogenic bacteria for developing diagnostics and vaccines
- \* Development of genetically modified bacteria for improved vaccine and genetically modified signaturred bacteria for developing vaccine andidate that can differentiate vaccinated from infected animals
- \* Development of molecular tools for studying evolution, quick diagnosis and molecular epidemiology of microbes
- \* Molecular characterization and antigenic relationship of field isolates of important viruses of animals and poultry.
- \* Isolation and characterization of field isolates of important viruses of livestock and poultry with the aim of development of diagnostics and candidate vaccines
- \* Studies on immune responses and immunity to animal and poultry viruses
- \* Investigation of the roles of proinflammatory cytokines in ovarian activity of buffaloes
- \* Production of phage display libraries of bovine scFv for diagnostic and therapeutic uses
- \* Development of novel delivery systems for developing mucosal veterinary vaccines

## VETERINARY PARASITOLOGY

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
VPA 601	VETERINARY HELMINTHOLOGY-I	2+1
VPA 602	VETERINARY HELMINTHOLOGY-II	2+1
VPA 603	VETERINARY ENTOMOLOGY AND ACAROLOGY	2+1
VPA 604	VETERINARY PROTOZOOLOGY	2+1
VPA 605	PARASITOLOGICAL TECHNIQUES	0+2
VPA 606	CLINICAL PARASITOLOGY	1+1
VPA 607	TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES	1+1
VPA 608	IMMUNOPARASITOLOGY	2+1
VPA 609	PARASITIC ZOOZOSES	2+0
VPA 610	PARASITES OF ZOO AND WILD ANIMALS	2+1
VPA 611	MALACOLOGY	1+1
VPA 691	MASTER'S SEMINAR	1+0
VPA 699	MASTER'S RESEARCH	20
VPA 801	APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY	1+2
VPA 802	MOLECULAR DIAGNOSTICS AND VACCINE DEVELOPMENT IN PARASITOLOGY	2+1
VPA 803	HOST PARASITE INTERACTIONS	2+0
VPA 804	ADVANCES IN PROTOZOOLOGY	2+1
VPA 805	ADVANCES IN HELMINTHOLOGY-I	2+1
VPA 806	ADVANCES IN HELMINTHOLOGY-II	2+1
VPA 807	ADVANCES IN ENTOMOLOGY AND ACAROLOGY	2+1

VPA 808	IN VITRO CULTIVATION OF PARASITES	1+2
VPA 809	EMERGING AND RE-EMERGING PARASITIC DISEASES	2+0
VPA 810	BIONOMICS OF PARASITES	3+0
VPA 811	ENVIRONMENTAL PARASITOLOGY	1+1
VPA 890	SPECIAL PROBLEM	0+2
VPA 891	DOCTORAL SEMINAR I	1+0
VPA 892	DOCTORAL SEMINAR II	1+0
VPA 899	DOCTORAL RESEARCH	45

#### Course contents

**VPA 601 VETERINARY HELMINTHOLOGY - I 2+1**

#### **Objective**

To learn about various aspects of trematode and cestode parasites of veterinary importance.

#### **Theory**

##### **UNIT I**

Introduction, history, classification, general account and economic importance of platyhelminths.

##### **UNIT II**

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Dicrocoeliidae, Opisthorchiidae, Strigeidae and Fasciolidae.

##### **UNIT III**

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis 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 and control measures of trematodes belonging to families: Notocotylidae, Brachylemidae, Cyclocoelidae, Paramphistomatidae and Schistosomatidae.

##### **UNIT V**

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Mesocestoididae, Anoplocephalidae, Thysanosomidae, Dipylidiidae and Dilepididae.

## **UNIT VI**

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Davaineidae, Hymenolepididae, Taeniidae and Diphyllbothriidae.

### **Practical**

Identification of trematode and cestode parasites; their eggs and intermediate hosts. Observation on parasitic stages in host tissues and associated pathological lesions.

### **Suggested Readings**

Chowdhury N. and Tada I. 1994. Helminthology. Springer Verlag, Narosa Publishing House.

Dalton JP. 1999. Fasciolosis. CABI.

Gibson DI. 2002. Keys to the Trematoda, Vol.1. CABI.

Khalil LF, Jones A & Bray RA. 1994. Keys to the Cestode Parasites of Vertebrates. CABI.

Kumar V. 1998. Trematode Infections and Diseases of Man and Animals. Kluwer Academic Publishers.

Lapage G. 2000. Monnig's Veterinary Helminthology and Entomology. Greenworld Publ.

Mehlhorn H. 1988. Parasitology in Focus: Facts and Trends. Springer Verlag.

Singh G & Prabhakar S. 2002. *Taenia solium* Cysticercosis. CABI

Sood ML. 2003. Helminthology in India. International Book Distributors.

Soulsby E.J.L. 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. Bailliere Tindal.

**VPA 602 VETERINARY HELMINTHOLOGY – II**

**2+1**

### **Objective**

To learn about various aspects of nematodes, thorny-headed worms and leeches of veterinary importance.

### **Theory**

#### **UNIT I**

Introduction, history, classification, general account and economic importance of nematodes and thorny-headed worms

#### **UNIT II**

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Ascarididae, Anisakidae, Oxyuridae, Heterakidae and Subuluridae.

#### **UNIT III**

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Rhabditidae, Strongyloididae and Strongylidae.

#### **UNIT IV**

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichonematidae, Amidostomidae, Stephanuridae, Syngamidae and Ancylostomatidae.

#### UNIT V

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Metastrongylidae, Protostrongylidae, Filaroididae, Trichostrongylidae, Ollulanidae, Crenosomatidae and Dictyocaulidae.

#### UNIT VI

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis 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 and control measures of nematodes belonging to families: Trichinellidae, Trichuridae, Capillariidae, Dioctophymatidae, Polymorphidae, Oligacanthorhynchidae and Gnathobdellidae.

#### **Practical**

Identification of nematode parasites and thorny-headed worms; their eggs and intermediate hosts, differentiation, study of their stages in the tissues and associated pathological lesions.

#### **Suggested Readings**

- Andersen RC. 2000. Nematode Parasites of Vertebrates, their Development and Transmission. CABI.
- Kennedy MW & Harnett W. 2001. Parasitic Nematodes: Molecular Biology, Biochemistry and Immunology. CABI.
- Lapage G. 2000. Monnig's Veterinary Helminthology and Entomology. Greenworld Publ.
- Lee DL. 2002. The Biology of Nematodes. Taylor and Francis.
- Soulsby E.J.L. 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. Bailliere Tindal.

VPA 603

VETERINARY ENTOMOLOGY AND ACAROLOGY

2+1

#### **Objective**

To learn various aspects of arthropods of veterinary importance.

#### **Theory**

##### UNIT I

Introduction, history, classification and economic importance.

##### UNIT II

Distribution, life cycle, seasonal pattern, effect on the host, economic significance and control of arthropods belonging to the families: Culicidae, Ceratopogonidae, Simuliidae and Psychodidae.

#### **UNIT III**

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Tabanidae, Gasterophilidae, Muscidae, and Glossinidae.

#### **UNIT IV**

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Oestridae, Sarcophagidae, Calliphoridae and Hippoboscidae.

#### **UNIT V**

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Pediculidae, Haematopinidae, Linognathidae, Menoponidae, Philopteridae and Trichodectidae

#### **UNIT VI**

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Siphonapteridae, Cimicidae and Reduviidae,

#### **UNIT VII**

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Dermanyssidae, Argasidae and Ixodidae

#### **UNIT VIII**

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Sarcoptidae, Psoroptidae, Demodicidae, Trombiculidae, Cytoditidae and Linguatulidae.

#### **UNIT IX**

Strategic control measures of arthropods with special emphasis on improved versions of chemical, biological and immunological control and integrated pest management.

#### **Practical**

Collection, preservation, identification and differentiation of various arthropods and their developmental stages; associated pathological changes and lesions; skin scraping examination.

#### **Suggested Readings**

- Gupta SK & Kumar R. 2003. Manual of Veterinary Entomology and Acarology. International Book Distr. Co.
- Harwood RF & James MT. 1979. Entomology in Human and Animal Health. MacMillan.
- Kettle DS. 1995. Medical and Veterinary Entomology. CABI.
- Lehane M. 2005. The Biology of Blood Sucking Insects. 2nd Ed. Cambridge University Press.
- Marquardt WC. 2000. Parasitology and Vector Biology. Academic Press

Mullen G & Durben L. 2002 Medical and Veterinary Entomology. Academic Press  
Wall R & Shearer D. 1997. Veterinary Entomology. Chapman & Hall.

**VPA 604      VETERINARY PROTOZOLOGY      2+1**

**Objective**

To project the importance and to impart detailed knowledge on various aspects of protozoan parasites.

**Theory**

**UNIT I**

Introduction, history, classification, general account, economic importance of protozoan parasites.

**UNIT II**

Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Trypanosomatidae, Monocercomonadidae, Trichomonadidae, Hexamitidae and Endamoebidae.

**UNIT III**

Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Eimeriidae, Cryptosporidiidae and Sarcocystidae.

**UNIT IV**

Morphology, epidemiology, pathogenesis, clinical signs, diagnosis 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 like *Anaplasma*, *Ehrlichia* and *Haemobartonella*

**Practical**

Identification of protozoan parasites and observation on parasite stages in host tissues and the attendant pathological lesions. Diagnosis of protozoan parasites of veterinary importance.

**Suggested Readings**

- Bhatia BB & Shah HL. 2000. Protozoa and Protozoan Diseases of Domestic Livestock. ICAR.
- Bhatia BB. 2000. Textbook of Veterinary Protozoology. ICAR.
- Dobbelaere DAE & McKeever D. 2002. Theileria. Springer Verlag.
- Dubey JP & Beattie CP. 1988. Toxoplasmosis of Animals and Man. CRC Press.
- Dubey JP, Speer CA & Fayer R. 1989. Sarcocystosis of Animals and Man. CRC Press.
- Dubey JP, Speer CA & Fayer R. 1990. Cryptosporidiosis in Man and Animals. CRC Press.
- Krier JP. 1991–95. Parasitic Protozoa. Ed. JR Baker. Academic Press.
- Levine ND. 1985. Veterinary Protozoology. Iowa State Univ. Press.
- Lindsay DS & Weiss LM. 2004. Opportunistic Infections :Toxoplasma Sarcocystis and Microsporidia. Kluwer Academic Press.



### **UNIT III**

Animal sub-inoculation tests; blood and biopsy smear examination; histopathology of affected organs.

#### **Practical**

Identification, observation of parasitic stages in host tissues, excretions, secretions and associated pathological lesions.

#### **Suggested Readings**

Faust EC, Russell PF & Jung RC. 1971. Craig and Faust's Clinical Parasitology. Lea & Febiger.

Sloss MW, Kemp RL & Zajac AM. 1994. Veterinary Clinical Parasitology. Indian Ed. International Book Distr. Co.

Soulsby E JL. 1965. Textbook of Veterinary Clinical Parasitology. Blackwell.

### **VPA 607      TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES      1+1**

#### **Objective**

To learn about integrated approach for the control of helminths, arthropods and protozoan parasites of veterinary importance.

#### **Theory**

##### **UNIT I**

Conventional and novel methods of control of helminth – anthelmintics, their mode of action, characteristic of an ideal anthelmintic, anthelmintic resistance, spectrum of activity, delivery devices, integrated control method and immunological control  
Formulation of deworming schedule. Snail and other intermediate host control.

##### **UNIT II**

Conventional and novel methods of control of protozoan parasites – antiprotozoan drugs, their mode of action, integrated control method and immunological control.

##### **UNIT III**

Conventional and novel methods of control of insects – Insecticides / acaricides – methods of application, their mode of action, insecticide resistance , integrated control method and immunological control.

#### **Practical**

*In vivo* and *in vitro* detection of efficacy of and resistance to parasitocidal agents.

#### **Suggested Readings**

Kaufmann J. 1996. Parasitic Infections of Domestic Animals. Birkhauser Verlag.

Mehlhorn H (Ed). 2001. Encyclopedic Reference of Parasitology: Diseases, Treatment, Therapy. Springer Verlag.

### **VPA 608      IMMUNOPARASITOLOGY      2+1**

#### **Objective**

To impart knowledge about the immunology, immunodiagnosis and immunoprophylaxis of ecto- and endoparasites of veterinary importance.

## Theory

### UNIT I

Introduction, types of parasitic antigens and their characterization.

### UNIT II

Types of immunity in parasitic infections. Cellular and humoral immunity to parasites, hypersensitivity, regulation of the immune response.

### UNIT III

Evasion of immunity, immunomodulations and their uses.

### UNIT IV

Immune responses in helminths, arthropods and protozoa of veterinary importance.

### UNIT V

Immunodiagnostic tests and their techniques; application of biotechnological tools in the diagnosis and control of parasitic diseases.

### UNIT VI

Vaccines and vaccination against parasitic infections.

### UNIT VII

Genetic control of parasites.

## Practical

Preparation of various antigens (somatic, secretory and excretory) and their fractionation and characterization; raising of antisera and demonstration of various immunodiagnostic methods for the diagnosis of parasitic infections.

## Suggested Readings

- Behnkey JM. 1990. Parasites, Immunity and Pathology. Taylor & Francis.  
Boothroyd JC & Komuniecki R. 1995. Molecular Approaches to Cohen S & Sadun EH. 1976. Immunology of Parasitic Infections. Blackwell.  
Cox FEG. 1993. Modern Parasitology. Blackwell.  
Marr JJ, Nilsen TW & Komuniecki RW. 2003. Molecular Medical Parasitology. Elsevier. Parasitology. Wiley-Liss Publication, New York.  
Waklin D. 1996. Immunity to Parasites. Cambridge University Press.

VPA 609

PARASITIC ZONOSSES

2+0

## Objective

To provide the students with an in-depth knowledge of occurrence and importance of parasitic zoonoses and how these parasites are diagnosed and controlled.

## Theory

### UNIT I

Introduction to the concept of zoonotic infections, definitions, various classifications of zoonoses, host-parasite relationships, modes of infections, factors influencing prevalence of zoonoses.

### UNIT II

A detailed study of transmission, epidemiology, diagnosis and control of major protozoa of zoonotic importance.

#### **UNIT III**

A detailed study of transmission, epidemiology, diagnosis and control of major helminths of zoonotic importance.

#### **UNIT IV**

A detailed study of transmission, epidemiology, diagnosis and control of major arthropods of zoonotic importance.

#### **Suggested Readings**

Miyazaki 1991. Helminthic Zoonoses. International Medical Foundation of Japan.

Palmer SR, Soulsby EJJ & Simpson DIH. 1998. Zoonoses. Oxford

Parija SC. 1990. Review of Parasitic Zoonoses. AITBS Publ.

Rathore VS. 2005. Parasitic Zoonoses. Pointer Publishers.

Shakespeare M. 2002. Zoonoses. Pharmaceutical Press. University Press.

### **VPA 610 PARASITES OF ZOO AND WILD ANIMALS**

**2+1**

#### **Objective**

To learn about biological and control aspects of parasitic diseases of zoo and wild animals.

#### **Theory**

##### **UNIT I**

A detailed study of major protozoa of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

##### **UNIT II**

A detailed study of major 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 major helminth parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

#### **Practical**

Methods for investigating parasitic diseases in wild animals. Collection of parasites at post-mortem. Identification and quantification of parasites. Visit to Zoo and Wild Life Parks/ Sanctuaries.

#### **Suggested Readings**

Chowdhury N & Alonso Aquirre A. 2001. Helminths of Wild Life.

Friend M & Francon JC. 1999. Field Manual of Wildlife Diseases: General Field Procedures and Diseases of Birds. Free of charge at: [www.nwhc.usgs.gov/publications/field\\_manual/field\\_manual\\_of\\_wildlife\\_diseases.pdf](http://www.nwhc.usgs.gov/publications/field_manual/field_manual_of_wildlife_diseases.pdf)

NBII Wildlife Diseases Information Node can be reached at:<http://wildlifediseases.nbii.gov>  
Oxford & IBH Publishing Co. Pvt. Ltd.  
Samual W, Pybus M & Kocan A. (Eds). 2001. Parasitic Diseases of Wild Mammals. Iowa State Univ. Press.

**VPA 611 MALACOLOGY 1+1**

**Objective**

To learn about the details of various snails involved in diseases transmission.

**Theory**

**UNIT I**

Characters and classification of Mollusca.

**UNIT II**

Occurrence, distribution, ecology, life history, morphology and control of vector snails belonging to families, Planorbidae, Lymnaeiidae, Thiridae, Amnicolidae, Helicidae, Succineidae and Zonitidae.

**Unit III**

Examination of vector molluscs for parasitic infections.

**Unit IV**

Haematology, internal defense mechanisms, parasite-induced pathology and molluscan tissue culture.

**Practical**

Collection and identification of vector molluscs, study of their shells and internal organs. Breeding, rearing and maintenance of vector molluscs in the laboratory. Examination of molluscs for various developmental stages of parasites.

**Suggested Readings**

Malek EA & Cheng TC. 1974. Medical and Economic Malacology. Academic Press.  
Sturm CF, Pearce TA & Valdés A. 2006. The Mollusks: A Guide to Their Study, Collection and Preservation. American Malacological Society, Pittsburgh and Universal Publishers, Boca Raton.

**VPA 801 APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY 1+2**

**Objective**

To study the emerging applications of Remote Sensing and Geographic Information System in parasitology.

**Theory**

**UNIT I**

Basic principles of Remote Sensing, satellite and imagery sensor systems, spectral signatures, interpretation of satellite imagery, digital image processing.

## **UNIT II**

Fundamentals of GIS, raster data representation, vector data representation, GIS data management, data input, editing, analysis and modeling. GIS output as maps.

## **UNIT III**

Integration of RS and GIS. Applications of RS and GIS in parasitology, case studies related to vector and vector-borne parasitic diseases, soil transmitted helminths.

### **Practical**

Understanding maps and map projections, maps as models. IRS data products, visual interpretation of image, Digital image processing, contrast enhancements, spatial filtering techniques, image transformations, image classification. Applications of Remote Sensing in parasitology. Components of GIS, creation of digital database in a GIS, GIS operations, data analysis and modeling. Case studies of applications of GIS in parasitology. Application of GIS in modeling the spatial and temporal spread of parasites. Global Positioning System (GPS), its applications and hands-on practice. Hands-on practice on RS and GIS software's like ERDAS Imagine, ArcGIS, ILWIS etc. Internet as resource for RS data products.

### **Suggested Readings**

Selected articles from journals

## **VPA 802      MOLECULAR DIAGNOSTICS AND VACCINE DEVELOPMENT IN PARASITOLOGY**

**2+1**

### **Objective**

To understand the molecular analysis of parasites for diagnosis, disease control, drug development and vaccine production.

### **Theory**

#### **UNIT I**

Introduction and parasite genomics.

#### **UNIT II**

DNA and RNA technology, Gene expression and regulation.

#### **UNIT III**

Recombinant protein production.

#### **UNIT IV**

Hybridoma technology and its application in parasitology.

#### **UNIT VI**

Molecular diagnosis and Phylogeny. Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. Restriction Fragment Length Polymorphism (RFLP), Polymerase Chain Reaction, modified PCR and related

techniques, Random Amplified Polymorphic DNA (RAPD), Nucleic acid probe and Cleavage Length Fragment Polymorphism (CFLP).

#### **UNIT VII**

Types of immune responses produced by various parasites, novel and other antigens, proteases and cytokines in vaccine production.

#### **UNIT VIII**

Nucleic acid vaccines. Vectored parasitic vaccines.

#### **Practical**

Identification, characterization, and purification of antigens, analysis of parasite protein antigens, preparation of polyclonal antibodies. RAPD, RFLP, PCR, modified PCR and related techniques. DNA and RNA isolation protocols from blood, tissues and parasites and immuno- assays for studying the vaccine response.

#### **Suggested Readings**

Selected articles from journals.

**VPA 803      HOST PARASITE INTERACTIONS      2+0**

#### **Objective**

To understand the importance of host-parasite interactions.

#### **Theory**

##### **UNIT I**

Introduction, distribution of parasites on/in the host, morphological specializations for life on the host.

##### **UNIT II**

Behavioural defenses, host immune responses and genetic resistance to parasites.

##### **UNIT III**

Establishment of parasites in immuno-competent, susceptible, intermediate and abnormal hosts, chronicity of parasitic infections, immuno-evasive strategies of the parasites, host-parasite equilibrium.

##### **UNIT IV**

Pathology of host parasite interactions, host parasite interactions in relation to malnutrition and micronutrient metabolism.

#### **Suggested Readings**

Selected articles from journals.

**VPA 804      ADVANCES IN PROTOZOLOGY      2+1**

#### **Objective**

To discuss the latest scientific developments on various aspects of protozoan parasites.

#### **Theory**

### **UNIT I**

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of intestinal protozoa.

### **UNIT II**

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of haemoprotozoans.

### **UNIT III**

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of tissue and other protozoa

### **Practical**

Morphological, pathological and immunodiagnostic studies of various protozoan parasites.

### **Suggested Readings**

Selected articles from journals.

## **VPA 805      ADVANCES IN HELMINTHOLOGY - I**

**2+1**

### **Objective**

To discuss the latest scientific developments on various aspects of trematodes and cestodes.

### **Theory**

#### **UNIT I**

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of trematodes and their larval stages.

#### **UNIT II**

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of cestodes and metacestodes.

### **Practical**

Morphological, pathological and immunodiagnostic studies on various trematodes and cestodes.

### **Suggested Readings**

Selected articles from journals.

## **VPA 806      ADVANCES IN HELMINTHOLOGY - II**

**2+1**

### **Objective**

To discuss the latest scientific developments on various aspects of nematodes and thorny-headed worms.

### **Theory**

#### **UNIT I**

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of nematodes and their larval stages.

#### **UNIT II**

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of thorny-headed worms.

**Practical**

Morphological, pathological and immunodiagnostic studies on various nematodes and thorny-headed worms.

**Suggested Readings**

Selected articles from journals.

**VPA 807      ADVANCES IN ENTOMOLOGY AND ACAROLOGY      2+1**

**Objective**

To discuss latest scientific developments on various aspects of arthropods.

**Theory**

**UNIT I**

Origin, evolution, regional and seasonal distribution, forecasting insect and acarine population through biological modelling.

**UNIT II**

Population dynamics of insects and acarines in relation to biotic and abiotic factors.

**UNIT III**

Recent developments pertaining to insects of veterinary importance.

**UNIT IV**

Recent developments pertaining to arachnids of veterinary importance.

**UNIT V**

Chemical, biological, immunological control measures and in-depth study of integrated pest management. Modulation of vector competence to transmit parasitic infections using molecular genetics by developing transgenic vectors.

**Practical**

Identification of arthropods of veterinary importance in the region. Dissection of arthropods for recovery of infective stages of parasites. Immunopathological changes in the host tissues due to haematophagous arthropods.

**Suggested Readings**

Selected articles from journals.

**VPA 808      *IN VITRO* CULTIVATION OF PARASITES      1+2**

**Objective**

Development of skills for cultivation of various parasites in the laboratory for research and practical control.

**Theory**

**UNIT I**

Introduction, problems and goals.

## **UNIT II**

*In vitro* cultivation of genital flagellates, intestinal flagellates and intestinal ciliates.

## **UNIT III**

*In vitro* cultivation of intestinal and tissue protozoa.

## **UNIT IV**

*In vitro* cultivation of haemoprotozoans.

## **UNIT V**

*In vitro* techniques, media and tissue culture for cultivation of helminths and their larval stages.

## **UNIT VI**

*In vitro* mass rearing and colonization of ticks, flies and other insects.

### **Practical**

Preparation of media and cultivation of important parasites, raising and maintenance of cell-lines of important parasites.

### **Suggested Readings**

Selected articles from journals.

**VPA 809          EMERGING AND RE-EMERGING PARASITIC DISEASES          2+0**

### **Objective**

To study the emerging and re-emerging parasitic diseases.

### **Theory**

#### **UNIT I**

Emerging and re-emerging helminthic diseases.

#### **UNIT II**

Emerging and re-emerging protozoan diseases.

#### **UNIT III**

Emerging and re-emerging vector-borne diseases.

### **Suggested Readings**

Selected articles from journals.

**VPA 810          BIONOMICS OF PARASITES          3+0**

### **Objective**

To study ultrastructure, physiology, biochemistry and bionomics of important parasites.

### **Theory**

#### **UNIT I**

Ultrastructure, physiology, biochemistry and bionomics of trematodes and cestodes of veterinary importance.

#### **UNIT II**

Ultrastructure, physiology, biochemistry and bionomics of nematodes of veterinary importance.

**UNIT III**

Ultrastructure, physiology, biochemistry and bionomics of important arthropod parasites.

**UNIT IV**

Ultrastructure, physiology, biochemistry and bionomics of important protozoan parasites.

**Suggested Readings**

Selected articles from journals.

**VPA 811 ENVIRONMENTAL PARASITOLOGY 1+1**

**Objective**

To study the effect of environmental changes and ecological disturbances on the emergence, proliferation and transmission of parasitic diseases.

**Theory**

**UNIT I**

Environmental changes and ecological disturbances due to natural phenomenon and human interventions (demographic, societal and agricultural changes, global warming, floods, hurricanes and pollution etc.).

**UNIT II**

Effect of environmental changes and ecological disturbances on the proliferation and transmission of helminthic diseases

**UNIT III**

Effect of environmental changes and ecological disturbances on the proliferation and transmission of protozoan diseases.

**UNIT IV**

Effect of environmental changes and ecological disturbances on the proliferation of intermediate hosts and vectors and their role in transmission of diseases.

**Practical**

Examination of water, soil, meat and vegetables etc. to record the contamination with parasites due to environmental changes. Assessment of effect of temperature and humidity on the development of parasites. Use of rocess-based (mathematical) models to express the scientifically documented relationship between climatic variables and biological parameters e.g., vector breeding, survival and biting rates; parasite incubation rates.

**Suggested Readings**

Selected articles from journals.

**VPA 890 SPECIAL PROBLEM 0+2**

**Objective**

To provide expertise in handling practical research problem(s).

### **Practical**

Short research problem(s) involving contemporary issues and research techniques.

### **List of Journals**

- \* Advances in Parasitology
- \* Trends in Parasitology
- \* Veterinary Parasitology
- \* International Journal for Parasitology
- \* Journal of Helminthology
- \* Journal of Parasitic Diseases
- \* Journal of Protozoology
- \* Journal of Protozoology Research
- \* Journal of Veterinary Parasitology
- \* Medical and Veterinary Entomology
- \* Parasitology
- \* Parasitology International
- \* Experimental Parasitology

### **e-Resources**

- \* <http://www.sciencedirect.com/science/journal/03044017> (Veterinary. Parasitology)
- \* <http://www.sciencedirect.com/science/journal/14714922> (Trends in Parasitology)
- \* <http://www.sciencedirect.com/science/journal/00207519> (International Journal for Parasitology)
- \* <http://www.sciencedirect.com/science/journal/13835769> (Parasitology International )
- \* <http://www.sciencedirect.com/science/journal/00144894>(Experimental Parasitology)
- \* <http://journals. Cambridge.org> (Parasitology)
- \* <http://asp.unl.edu> (Journal of Parasitology)
- \* <http://www.bentham.org/open/toparaj> (The open Parasitology Journal)
- \* <http://www.springer.com/biomed/medical+microbiology>)Journal/436 Parasitology Research)
- \* <http://parasitologyindia.org> (Journal of Parasitic Diseases)
- \* <http://www.waap.org> (World Assoc. for Advancement of Vety. Parasitology)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Detection and management of antiparasitic drug resistance
- \* Studies on the efficacy of medicinal plants/herbal preparations against various parasites affecting domestic animals and poultry and the effect of these plants on pathogenicity and immunology of parasites
- \* Development of immunoprophylactic measures and immunodiagnostic techniques using modern molecular and biotechnological based tools for important parasitic diseases prevalent in the state
- \* Application of remote sensing and GIS for the management of parasitic diseases.

\* Studies on application of host's resistance as a part of integrated parasite management programme.

## VETERINARY PATHOLOGY

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
VPP 601	GENERAL PATHOLOGY	2+1
VPP 602	TECHNIQUES IN PATHOLOGY	1+1
VPP 603	ANIMAL ONCOLOGY	1+1
VPP 604	CLINICAL PATHOLOGY	1+2
VPP 605	NECROPSY PROCEDURES AND INTERPRETATIONS-I	0+1
VPP 606	NECROPSY PROCEDURES AND INTERPRETATIONS-II	0+1
VPP 607	SYSTEMIC PATHOLOGY	2+1
VPP 608	PATHOLOGY OF INFECTIOUS DISEASES OF DOMESTIC ANIMALS	2+1
VPP 609	TOXICOPATHOLOGY	2+1
VPP 610	AVIAN PATHOLOGY	2+1
VPP 611	PATHOLOGY OF LABORATORY ANIMALS, FISH AND WILD ANIMALS	2+1
VPP 612	VETEROLEGAL PATHOLOGY	1+0
VPP 691	MASTER'S SEMINAR	1+0
VPP 699	MASTER'S RESEARCH	20
VPP 801	PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES	2+1
VPP 802	ADVANCES IN TOXICOPATHOLOGY	2+1
VPP 803	ADVANCES IN DIAGNOSTIC PATHOLOGY	1+2
VPP 804	ULTRASTRUCTURAL PATHOLOGY	1+1
VPP 805	IMMUNOPATHOLOGY	2+1
VPP 806	PATHOLOGY OF IMPORTANT AND EMERGING DISEASES OF PETS AND LIVESTOCK	1+1
VPP 807	ADVANCES IN AVIAN PATHOLOGY	2+1
VPP 808	PATHOLOGY OF FUNGAL DISEASES	2+1
VPP 809	MOLECULAR PATHOLOGY OF CELL INJURY	2+1
VPP 810	EXPERIMENTAL PATHOLOGY	1+1
VPP 890	SPECIAL PROBLEM	0+2
VPP 891	DOCTORAL SEMINAR I	1+0
VPP 892	DOCTORAL SEMINAR II	1+0
VPP 899	DOCTORAL RESEARCH	45

### Course contents

**VPP 601          GENERAL PATHOLOGY**

**2+1**

**Objective**

To acquaint students with different types of degenerations, cell injuries caused by different types of irritants and inflammation.

### **Theory**

#### **UNIT I**

Introduction and history of pathology, principles of pathology including etiology, course and termination of disease.

#### **UNIT II**

Advanced study of various degenerations, infiltrations, necrosis, endogenous and exogenous pigmentations.

#### **UNIT III**

Circulatory and growth disturbances. Reversible and irreversible cell injury.

#### **UNIT IV**

Inflammation including vascular and cellular alterations with emphasis on chemical mediators. Hypersensitivity and immune mediated mechanisms, Mechanism of healing and fever.

### **Practical**

To study the gross and microscopic changes in degenerations, infiltrations, pigmentations, circulatory and growth disturbances and different types of necrosis in different tissues of domestic animals. Study of gross and histopathological features of different types of inflammation.

### **Suggested Readings**

McGavin MD & Zachary JF. 2006. Pathologic Basis of Veterinary Diseases. 4th Ed. Elsevier

Vegad JL. 2007. Text Book of Veterinary General Pathology. 2nd Ed. International Book Distr.

## **VPP 602      TECHNIQUES IN PATHOLOGY**

**1+1**

### **Objective**

To acquaint students with different techniques used frequently in Veterinary Pathology.

### **Theory**

#### **UNIT I**

Basic histopathological techniques, collection of tissues, fixation, processing and section cutting, staining by routine and special methods.

#### **UNIT II**

Principles of dark ground, phase contrast and fluorescent microscopy and micrometry.

#### **UNIT III**

Histochemical techniques for demonstration of fat, glycogen and fibrous connective tissue, mucopolysaccharides and common enzymes.

### **Practical**





## **Objective**

To teach the students about the different disease conditions of haemopoietic, circulatory, respiratory, digestive, urinary and genital systems, nervous, musculoskeletal, endocrine, glands and special senses.

## **Theory**

### **UNIT I**

An advanced study of pathological conditions affecting different organs of haemopoietic (bone marrow, blood, spleen, lymph node), circulatory (heart, blood vessels and lymph vessels). Respiratory (nasal cavity, larynx, trachea, bronchi, lung and pleura) systems. Study of etiology, pathology and pathogenesis of specific infectious and non-infectious diseases of domestic animals related to the above mentioned systems

### **UNIT II**

Advanced study of pathological conditions 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. Study of etiology, pathology and pathogenesis of specific infectious and non-infectious diseases of domestic animals related to the above mentioned systems.

### **UNIT III**

Advanced study of pathological conditions 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). Study of etiology, pathology and pathogenesis of specific infectious and noninfectious diseases of domestic animals related to the above mentioned systems/organs.

## **Practical**

To study the gross and histopathological changes in important conditions affecting various systems. Study of gross and microscopic lesions in specific diseases pertaining to above said systems.

## **Suggested Readings**

Jubb KVF & Kennedy PC. 2005. Pathology of Domestic Animals. Academic Press.

**VPP 608            PATHOLOGY OF INFECTIOUS DISEASES OF DOMESTIC ANIMALS            2+1**

## **Objective**

To teach the students about the important infectious disease conditions of domestic animals

## **Theory**

### **UNIT I**

Pathology of various viral diseases of domestic animals.

**UNIT II**

Pathology of various bacterial and fungal diseases of domestic animals.

**UNIT III**

Pathology of various rickettsial and parasitic diseases of domestic animals.

**Practical**

To study the slides, museum specimens including autopsy specimens concerned with specific diseases.

**Suggested Readings**

Jones TC, Hunt RD & King NW 1997. Veterinary Pathology. Blackwell Publishing.  
Jubb KVF & Kennedy PC 2005. Pathology of Domestic Animals. Academic Press.

**VPP 609      TOXICOPATHOLOGY      2+1**

**Objective**

To teach students about toxicity in livestock due to plants and extraneous poisons.

**Theory**

**UNIT I**

Introduction, mode of action, diagnosis and treatment of different poisons and their classification.

**UNIT II**

Pathogenesis, 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.

**Practical**

To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.

**Suggested Readings**

Jones TC, Hunt RD & King NW 1997. Veterinary Pathology. Blackwell Publishing.

**VPP 610      AVIAN PATHOLOGY      2+1**

**Objective**

To teach the students about the different disease conditions of poultry including pathology and diagnosis.

**Theory**

**UNIT I**

Pathology of infectious diseases of chickens, turkeys, ducks and other birds.

**UNIT II**

Pathology of non-infectious diseases of chickens, turkeys, ducks and other birds.

### **Practical**

Necropsy examination of the different species of poultry; study of gross and histopathological lesions in naturally occurring and artificially produced diseases of birds.

### **Suggested Readings**

Calnek BW. 1991. Diseases of Poultry. 9th Ed. Iowa State Univ. Press.  
Saif YM, Barnes FJ, Glisson JR, Fadly AM, Mc Dougald LR & Swayne D. 2008. Diseases of Poultry. 11th Ed. Blackwell Publishing.

## **VPP 611            PATHOLOGY OF LABORATORY ANIMALS, FISH AND WILD ANIMALS**

**2+1**

### **Objective**

To teach the pathology and diagnosis of different disease conditions of laboratory animals, fish and wild animals.

### **Theory**

#### **UNIT I**

Introduction, disease transmission and inter-phase.

#### **UNIT II**

Pathology of important infectious diseases (viz. bacterial, viral, fungal and parasitic) of fish, laboratory and wild/zoo animals.

#### **UNIT III**

Pathology of non-infectious diseases of fish, lab/ wild/zoo animals.

### **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 laboratory animals.

### **Suggested Readings**

Arora BM. 1984. Wildlife Diseases in India. Periodical Expert Book Agency.  
Fowler ME. 1978. Zoo and Wild Animal Medicine. WB Saunders.  
Beninchka K, Garner FM & Jones TC. 1978. Pathology of Laboratory Animals (Vols. I, II). Springer Verlag.  
Roberts RJ. 1979. Fish Pathology. Bailliere Tindall, London.

## **VPP 612            VETEROLEGAL PATHOLOGY**

**1+0**

### **Objective**

To educate the students about common veterolegal problems and legal writing of PM report.

### **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**

Common causes of violent death, criminal assault, cruelty to animals, malicious poisoning, snake bite, electrocution, gun shot wounds, automobile accidents, doping etc.

### **Suggested Readings**

- Gahlot AK, Sharma SN & Tanwar RA. 2003. Veterinary Jurisprudence. 5th Ed. NBS Publishers, Bikaner.
- Jones TC & Gleiser CA. 1954. Veterinary Necropsy Procedures. JB Lippincott.
- Lincoln PJ & Thomson J. 1998. Forensic DNA Profiling Protocols. Humana Press.
- Rudin N & Inman K. 2002. An Introduction to Forensic DNA Analysis. CRC Press.

## **VPP 801          PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES          2+1**

### **Objective**

To teach students about nutritional and metabolic disorders of livestock.

### **Theory**

#### **UNIT I**

Pathogenesis, gross and microscopic pathology of nutritional deficiencies viz. carbohydrate, protein, fats, vitamins and macro and microelements and their imbalances.

#### **UNIT II**

Different metabolic diseases namely milk fever, ketosis, tetany, azoturia. Downer's cow syndrome and post parturient hemoglobinuria in domestic animals.

### **Practical**

Estimation of certain minerals in sera of natural and experimentally induced deficiencies in domestic animals. To study the haematological, gross and microscopic pathological alterations caused by nutritional and metabolic disorders.

### **Suggested Readings**

Selected articles from journals.

## **VPP 802          ADVANCES IN TOXICOPATHOLOGY          2+1**

### **Objective**

To teach students about toxicity in livestock due to plants and extraneous poisons.

### **Theory**

#### **UNIT I**









Need for experimentation in research, animal experimentation techniques, preparation of experimental protocols, biochemical studies, pathological examination of clinical samples.

## **UNIT II**

Transplantation techniques, immune regulation, tissue culture, blood cell separation protocols, electrophoresis and chromatography, study of animal model and designing of experiment.

### **Practical**

Short research problems involving contemporary issues and research techniques.

### **Suggested Readings**

Selected articles from journals.

**VPP 890      SPECIAL PROBLEM**

**0+2**

### **Objective**

To provide expertise in handling practical research problem(s).

### **Practical**

Short research problem(s) involving contemporary issues and research techniques.

### **List of Journals**

- \* Advances in Veterinary Sciences
- \* American Journal of Veterinary Medical Association
- \* Avian Diseases
- \* Current Contents
- \* Indian Journal of Animal Sciences
- \* Indian Journal of Poultry Science
- \* Indian Journal of Veterinary Pathology
- \* Journal of Immunology and Immunopathology
- \* Veterinary Bulletin
- \* Veterinary Pathology

### **e-Resources**

- \* [www.iavp.org](http://www.iavp.org) (Indian Journal of Veterinary Pathology)
- \* [www.vetpathology.org](http://www.vetpathology.org) (Veterinary Pathology)
- \* [www.tandf.co.uk](http://www.tandf.co.uk) (Avian Pathology)
- \* [www.avdi.allenpress.com](http://www.avdi.allenpress.com) (Avian Diseases)
- \* [www.elsevier.com/locate/vetimm](http://www.elsevier.com/locate/vetimm) (Veterinary Immunology and Immuno pathology)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Effect of probiotics on pathogenesis and pathology of bacterial diseases
- \* Effect of antioxidants on pathogenesis and pathology of bacterial diseases
- \* Pathology of mixed infections in domestic animals
- \* Role of stress in pathogenesis and pathology of animal diseases





## Theory

### UNIT I

History and scope of pharmacology, Principles of drug absorption, distribution, metabolism and elimination. Drug bioavailability and routes of administration.

### UNIT II

Important pharmacokinetic parameters and their clinical significance.

### UNIT III

Pharmacodynamics: mechanism of action and the relationship between drug concentration and effect; signal transduction mechanism and drug receptors for physiological regulatory molecules.

### UNIT IV

Quantitation of drug-receptor interactions and elicited effects. Competitive and non-competitive antagonism. Factors affecting drug response. Adverse drug reactions.

## Suggested Readings

Brunton LL. (Ed). 2005. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. Veterinary Pharmacology and Therapeutics. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. Essentials of Veterinary Pharmacology and Therapeutics. 1st Ed. Kalyani Publishers.

## VPT 602      AUTONOMIC AND AUTACOID PHARMACOLOGY

2+1

### Objective

To study the pharmacodynamics of autonomic drugs.

### Theory

#### UNIT I

Anatomical and physiological considerations of autonomic nervous system (ANS).

#### UNIT II

Neurohumoral transmission in ANS.

#### UNIT III

Pharmacology of cholinergic agonists and antagonists.

#### UNIT IV

Pharmacology of adrenergic agonists and antagonists.

#### UNIT V

Ganglionic stimulants and blockers.

#### UNIT VI

Autacoids: Histamine, serotonin, kinins, eicosanoids and platelet activating factor.

### Practical

Pharmacological experiments on intact and isolated preparations for studying the effects of various prototype drugs on vascular, intestinal, respiratory, urinary and reproductive smooth muscles, autonomic ganglia, skeletal muscles; blood pressure, ECG, heart etc.





### **Suggested Readings**

- Brunton LL. (Ed). 2005. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 11th Ed. McGraw-Hill.
- Richard AH. (Ed). 2001. Veterinary Pharmacology and Therapeutics. 8th Ed. Iowa State Univ. Press.
- Sandhu HS & Rampal S. 2006. Essentials of Veterinary Pharmacology and Therapeutics. 1st Ed. Kalyani Publishers.

### **VPT 606          ENDOCRINE AND REPRODUCTIVE PHARMACOLOGY          2+0**

#### **Objective**

To study the pharmacology of drugs affecting endocrine functions.

#### **Theory**

##### **UNIT I**

Pharmacology of drugs affecting endocrine functions of pituitary, thyroid, adrenals and pancreas.

##### **UNIT II**

Hormonal regulation of calcium and phosphorus homeostasis.

##### **UNIT III**

Pharmacology of drugs affecting male reproductive organs, spermatogenesis.

##### **UNIT IV**

Pharmacology of drugs affecting female reproductive organs, ovulation, oestrus, conception, gestation and lactation.

##### **UNIT V**

Oxytocic and tocolytic drugs.

### **Suggested Readings**

- Brunton LL. (Ed). 2005. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 11th Ed. McGraw-Hill.
- Richard AH. (Ed). 2001. Veterinary Pharmacology and Therapeutics. 8th Ed. Iowa State Univ. Press.
- Sandhu HS & Rampal S. 2006. Essentials of Veterinary Pharmacology and Therapeutics. 1st Ed. Kalyani Publishers.

### **VPT 607          CHEMOTHERAPY          2+1**

#### **Objective**

To study the recent advances of chemotherapeutic agents with relevance to pharmacological and therapeutic aspects.

#### **Theory**

##### **UNIT I**

General consideration and principles of chemotherapy, classification of chemotherapeutic agents; development of microbial resistance to antimicrobials, combination therapy.

##### **UNIT II**

Systemic and gut acting sulfonamides, diaminopyrimidines, quinolones sulfones, nitrofurans.

**UNIT III**

Penicillins, cephalosporins, beta-lactam antibiotics.

**UNIT IV**

Chloramphenicol, tetracyclines, macrolides, polymixins, polypeptides.

**UNIT V**

Aminoglycosides and other antibiotics.

**UNIT VI**

Anti- protozoans, anthelmintics, ectoparasiticides.

**UNIT VII**

Antituberculosis, antifungal, antiviral and antineoplastic drugs.

**Practical**

General methods for assay of chemotherapeutic agents, antibiotic sensitivity tests, estimation of sulfonamides, penicillins, oxytetracyclines, trimethoprim and nitrofurans in biological fluids to study their kinetics and bioavailability.

**Suggested Readings**

Brunton LL. (Ed). 2005. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. Veterinary Pharmacology and Therapeutics. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. Essentials of Veterinary Pharmacology and Therapeutics. 1st Ed. Kalyani Publishers.

**VPT 608 TOXICOLOGY OF XENOBIOTICS**

**2+1**

**Objective**

To study the poisonings and their antidotal therapy in animals.

**Theory**

**UNIT I**

Principles and scope of toxicology, sources of poisoning.

**UNIT II**

General modes of action of poisons, detoxification, factors affecting toxicity, general principles of diagnosis and treatment of poisonings.

**UNIT III**

Toxicology of metals, agrochemicals, solvents and vapors, feed additives.

**UNIT IV**

Toxic effects of radiations and radioactive chemicals, genetic and developmental toxicology; forensic and regulatory aspects of toxicology.

**Practical**

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 tests.

### Suggested Readings

- Klassen CD, Amdure MO & Doull J. (Eds). 1996. Casarett & Doull's Toxicology: The Basic Sciences of Poisons. 5th Ed. McGraw Hill.
- Sandhu HS & Brar RS. 2000. Text Book of Veterinary Toxicology. 1st Ed. Kalyani Publishers.
- Stive KE & Brown TM. 2006. Principles of Toxicology. 2nd Ed. CRC Press.

### VPT 609 TOXICOLOGY OF PLANTS AND TOXINS 2+0

#### Objective

To impart knowledge of toxicity of poisonous plants & natural toxins.

#### Theory

##### UNIT I

Classification, identification and chemical constituents of poisonous plants. Plants containing cyanide, nitrate/nitrite, oxalate, lectins and cardiotoxic glycosides.

##### UNIT II

Plants producing lathyrism, thiamine deficiency and photosensitization.

##### UNIT III

Toxicology of mycotoxins: aflatoxins, rubratoxins, ochratoxins, trichothecenes, tremorgens and ergot.

##### UNIT IV

Animal bites and stings: snake venom, scorpion, spider and insect stings and toad poisoning. Bacterial toxins: botulism.

### Suggested Readings

- Chopra SR, Badhwar RL & Ghosh S. 1984. Poisonous Plants of India. 1st Ed., Academic Publishers, Jaipur.
- Klassen CD, Amdure MO & Doull J. (Eds). 1996. Casarett & Doull's Toxicology: Basic Sciences of Poisons. 5th Ed., McGraw Hill.
- Sandhu HS and Brar RS. 2000. Text Book of Veterinary Toxicology. 1st Ed., Kalyani Publishers.

### VPT 610 PHARMACOLOGICAL TECHNIQUES 1+1

#### Objective

To impart the knowledge of various basic pharmacological techniques and screening methods of drugs.

#### Theory

##### UNIT I

Principles of drug action and bioassay. Dose response curves and their analysis.

##### UNIT II

Techniques for setting up isolated and intact preparations.

##### UNIT III

Organization of screening programme of drugs; multidimensional screening procedures and gross observational methods.

## Practical

Setting up of isolated and intact preparations, recording of BP in dog/rat, recording of ECG in rat, experiments on drug potentiation, antagonism and tachyphylaxis. Construction of dose-response plots, calculation of EC<sub>50</sub>, dissociation rate constants, potency ratio, pA<sub>x</sub>, pD<sub>x</sub> and pD'<sub>x</sub> values. Specific tests for evaluation of tranquillizing, hypnotic, analgesic, anticonvulsant, general and local anesthetic, muscle relaxant, anti-inflammatory, antipyretic, antiarrhythmic, antihypertensive, antihyperglycemic and anticholesterimic activities. Determination of potency ratio, median effective, toxic or lethal doses. Bioassay techniques.

## Suggested Readings

Ghosh MN. (Ed). 2005. Fundamentals of Experimental Pharmacology. 3rd Ed. Hilton & Co.

Kulkarni SK (Ed). 2004. Handbook of Experimental Pharmacology. 3rd Ed. Vallabh Prakashan.

Laurance DR & Bacharach AL. (Ed). 1964. Evaluation of Drug Activities: Pharmacometrics. Vols. I, II. Academic Press.

Parmar NS & Shiv Prakash 2006. Screening Methods in Pharmacology. 1st Ed. Narosa.

Seth UK, Dadkar NK & Usha G Kamat (Eds). 1972. Selected Topics in Experimental Pharmacology. 1st Ed. Kothari Book Depot.

Tallarida RJ & Murray RB. 1987. Manual of Pharmacologic Calculations. 2nd Ed. Springer Verlag.

## VPT 611      TECHNIQUES IN TOXICOLOGY

1+1

### Objective

To understand the animal toxicity tests and assessment of various toxicants using specific tests.

### Theory

#### UNIT I

Animal models in toxicological studies.

#### UNIT II

Animal toxicity tests for acute, sub-acute and chronic toxicity.

#### UNIT III

Specific toxicity tests for neurotoxicity, immunotoxicity, developmental, behavioural, reproductive and inhalation toxicity, mutagenicity, carcinogenicity.

#### UNIT IV

Animal toxicological tests for the study of metabolism, synergism and antagonism.

### Practical

Tests for acute, sub-acute and chronic toxicity, protocols and various specific toxicity tests. Assay for marker enzymes, analysis of toxicant residues in biological materials.

### Suggested Readings



## UNIT II

G-protein coupled, ligand gated-ion channel and tyrosine kinase-linked receptors.

## UNIT III

Ligand binding study of receptors. Signal transduction system: introduction to signal transduction, receptor linked to ion channels.

## UNIT IV

G-proteins, second messengers: phospholipases, phosphokinases, intracellular calcium, protein kinase-C, IP<sub>3</sub>, diacylglycerol and cyclic nucleotides.

## UNIT V

Signal transduction through protein tyrosine kinases. Receptors as pharmaceutical targets.

### **Suggested Readings**

Selected articles from journals.

**VPT 802      AUTACOID PHARMACOLOGY      1+0**

### **Objective**

To study the pharmacodynamics of autacoids.

### **Theory**

#### UNIT I

Pharmacodynamics of histamine and antihistamines.

#### UNIT II

Pharmacodynamics of serotonin and its antagonists; eicosanoids, bradykinin, angiotensin, kallikrein and other kinins.

#### UNIT III

Platelet-activating factors, slow reacting substances.

#### UNIT IV

Putative neurohumoral transmission – purine nucleotides, peptides, amino acids and nitric oxide.

### **Suggested Readings**

Selected articles from journals.

**VPT 803      PHARMACOLOGY OF HERBAL DRUGS      2+1**

### **Objective**

To study the pharmacological, therapeutic and toxicological aspects of potential medicinal plants and herbal drugs.

### **Theory**

#### UNIT I

Historical aspect, chemical constituents of medicinal plants and their classification.

#### UNIT II

Identification, collection, preservation, purification, isolation, standardization and clinical validation of bioactive molecules from vegetable sources.

### **UNIT III**

Characterization of pharmacological, therapeutic and toxic effects of potential herbal drugs.

### **UNIT IV**

Strategies for development of herbal drugs.

### **Practical**

Extraction, detection, isolation and purifications of active chemical constituents from plant sources. Pharmacological effects of herbal drugs on intact and isolated preparations.

### **Suggested Readings**

Selected articles from journals.

**VPT 804      DRUG METABOLISM      2+0**

### **Objective**

To study the mechanisms and processes of drug biotransformation.

### **Theory**

#### **UNIT I**

Mechanisms and processes of drug biotransformation.

#### **UNIT II**

Synthetic and non-synthetic pathways of drug metabolism.

#### **UNIT III**

Chemical, biological, genetic and environmental factors. Species variations affecting drug biotransformation mechanisms.

#### **UNIT IV**

Hepatic microsomal and non-microsomal enzyme systems.

#### **UNIT V**

Enzyme induction and inhibition.

### **Suggested Readings**

Selected articles from journals.

**VPT 805      MOLECULAR PHARMACOLOGY      2+0**

### **Objective**

To study the identification and characterization of receptors and drug receptors interactions.

### **Theory**

#### **UNIT I**

Physicochemical properties of drugs, forces involved in binding of drugs to receptors.

#### **UNIT II**

Receptor conformation and configuration and structure activity relationship.

**UNIT III**

Theories of drug receptor interactions; analysis of dose response relationship and molecular mechanisms of drug actions.

**UNIT IV**

Methods of identification, isolation and characterization of receptors.

**Suggested Readings**

Selected articles from journals.

**VPT 806      PHARMACOKINETICS      2+1**

**Objective**

To study the absorption, distribution, biotransformation and excretion of drugs.

**Theory**

**UNIT I**

Routes of drug administration, factors modifying drug delivery; absorption, distribution, biotransformation and elimination.

**UNIT II**

Kinetics following single and multiple dosage; compartmental models of drug distribution, bioavailability, volume of distribution and protein binding of drugs.

**UNIT III**

Rates of absorption, distribution and elimination; absorption and elimination half-lives and rate of transfer of drugs between compartments.

**UNIT IV**

Renal clearance, dosage regimen; non-compartmental pharmacokinetic modeling.

**UNIT V**

Application of pharmacokinetic principles in therapeutics.

**Practical**

Analysis of pharmacokinetic data and determination of different pharmacokinetic parameters and bioavailability of drugs in normal and diseased animal models.

**Suggested Readings**

Selected articles from journals.

**VPT 807      PHARMACOGENOMICS      2+0**

**Objective**

To study the responses to drugs with respect to various aspects of genomics.

**Theory**

**UNIT I**

Introduction, species variations affecting drug responses, increased and decreased responsiveness to drug effects/toxicities & novel drug effects

**UNIT II**

Genetic polymorphism.

### UNIT III

Gene therapy: gene transfer technology, viral vectors, natural delivery strategies.

### UNIT IV

Drugs & gene therapy of inherited diseases, genetic repair and inactivation strategies; synthesis of therapeutic proteins and cancer gene therapy.

### UNIT V

Role of bioinformatics in pharmacogenomics.

### **Suggested Readings**

Selected articles from journals.

**VPT 808      IMMUNOPHARMACOLOGY      1+0**

### **Objective**

To study the pharmacological control of immune system.

### **Theory**

#### UNIT I

General aspect of immune system, chemical mediators of immune system.

#### UNIT II

Pharmacological control of immune responses. Immunomodulators; immunostimulants, immunosuppressant and tolerogens; immunological basis of drug allergy and drug tolerance.

#### UNIT III

Interaction of nervous system, endocrine system and immune system, immunotoxic effects of environmental and other pollutants.

#### UNIT IV

Xenobiotic-induced immune dysfunctions and immune deficiencies; autoimmune reactions to xenobiotics, immunoregulants and their therapeutic applications in asthma, arthritis, cancer, dermatology and organ transplant etc.

### **Suggested Readings**

Selected articles from journals.

**VPT 809      MOLECULAR TOXICOLOGY      2+0**

### **Objective**

To understand the mechanisms & targets of cellular/ molecular toxicity

### **Theory**

#### UNIT I

Cellular, subcellular and molecular targets of toxicity; mechanisms of toxicities.

#### UNIT II

Factors affecting toxicity, interactions of toxicants with target molecules.

#### UNIT III

Cellular dysfunctions, repair and dysrepair.

#### **UNIT IV**

Target organ directed toxicological effects of xenobiotics, detoxification, risk assessment.

#### **UNIT V**

Mechanism of chemical mutagenesis, carcinogenesis, teratogenesis and radiation toxicity.

#### **Suggested Readings**

Selected articles from journals.

### **VPT 810 CLINICAL PHARMACOLOGY**

**1+1**

#### **Objective**

To study the clinical pharmacological aspects of drugs.

#### **Theory**

##### **UNIT I**

Scope of clinical pharmacology.

##### **UNIT II**

Drug discovery and clinical trials. Pharmacovigilance. Pharmacoepidemiology and pharmacoconomics.

##### **UNIT III**

PK-PD relationship and its applications. Drug interactions and adverse drug reactions.

##### **UNIT IV**

Therapeutic drug monitoring. Rationale of drug use, drug regulations and acts.

#### **Practical**

Study on drug interactions and drug levels in diseased conditions. Study on plasma drug concentration-time profile and establishment of various pharmacokinetic parameters. Dosage adjustment in diseased conditions. Clinical trials of various drugs.

#### **Suggested Readings**

Selected articles from journals.

### **VPT 811 CLINICAL TOXICOLOGY**

**2+1**

#### **Objective**

To study the scope of clinical toxicology and management of poisonings including regulatory and forensic toxicology.

#### **Theory**

##### **UNIT I**

Scope of clinical toxicology. Toxicological investigation and management of poisonings.

##### **UNIT II**

Target organ directed toxicity, Antidotal therapy.

### **UNIT III**

Clinical aspect of poisoning due to specific toxicants viz. metals, pesticides, mycotoxins, animal and bacterial toxins, solvents and vapours, drugs and other food/feed contaminants.

### **UNIT IV**

Forensic and analytical toxicology.

#### **Practical**

Demonstration of poisonings and their antidotal treatment; use of biomarkers in the assessment of toxicity. GLP evaluation, analysis of poisons in biological samples.

#### **Suggested Readings**

Selected articles from journals.

### **VPT 812      ECOTOXICOLOGY**

**2+0**

#### **Objectives**

To impart knowledge regarding ecotoxicology for conservation of healthy eco-system.

#### **Theory**

##### **UNIT I**

Basic principles of ecotoxicology. Sources of contamination and effects of pollutants on eco-health.

##### **UNIT II**

Chemical contamination of air, water, soil and food by major agricultural and industrial chemicals – pesticides, hydrocarbons and metals. Fate of chemicals in the environment and target species.

##### **UNIT III**

Marine and wildlife as monitors of environmental quality.

##### **UNIT IV**

Contamination control and approaches to rehabilitating damaged ecosystems.

#### **Suggested Readings**

Selected articles from journals.

### **VPT 813      REGULATORY TOXICOLOGY**

**2+1**

#### **Objectives**

Introduction to general principles in toxicological risk assessment.

#### **Theory**

##### **UNIT I**

Principles of risk assessment. Test protocols for toxicity studies.

##### **UNIT II**

Interaction between toxicology and industry. Compounds under regulatory legislation demands. Regulatory essential dose levels in chemical risk assessment (NOEL, NOAEL, LOEL, LOAEL & AOEL).

### **UNIT III**

Risk assessment in practice. Classification and marking/branding of chemicals. Monitoring/surveillance of chemicals. Exposure assessment and modeling.

### **UNIT IV**

Quality control in safety research (GLP). Operation of product register.

#### **Practical**

Good laboratory practice in toxicological research. Screening procedures in regulatory toxicology. Mandatory toxicity testing protocols. Determination of ADI, NOEL, NOAEL, LOEL, LOAEL and AOEL.

#### **Suggested Readings**

Selected articles from journals.

**VPT 890      SPECIAL PROBLEM**

**0+2**

#### **Objective**

To provide expertise in handling practical research problem(s).

#### **Practical**

Short research problem(s) involving contemporary issues and research techniques.

#### **List of Journals**

- \* American Journal of Veterinary Research
- \* Annual Review of Pharmacology
- \* Annual Review of Pharmacology and Toxicology
- \* Drugs
- \* Environmental Toxicology and Pharmacology
- \* European Journal of Pharmacology
- \* Indian Journal of Pharmacology
- \* Journal of American Medical Association
- \* Journal of Ethnopharmacology
- \* Journal of Pharmacology and Experimental Therapeutics
- \* Journal of Veterinary Pharmacology and Therapeutics
- \* Pharmacological Reviews
- \* Pharmacology, Biochemistry and Behaviour
- \* Toxicology
- \* Toxicology and Applied Pharmacology
- \* Toxicology International
- \* Trends in Pharmacological Sciences
- \* Veterinary and Human Toxicology

### **e-Resources**

- \* [www.elsevier.com](http://www.elsevier.com) (Environmental Toxicology and Pharmacology)
- \* [www.blackwellpublishing.com](http://www.blackwellpublishing.com) (Journal of Vet. Pharmacology & Therapeutics)
- \* [www.elsevier.com](http://www.elsevier.com) (Comparative Biochem. & Physiol.–Part C: Toxicol. & Pharma.)
- \* [www.clinicalneuropharm.com](http://www.clinicalneuropharm.com) (Clinical Neuropharmacology)
- \* [www.arjournals.annualreviews.org](http://www.arjournals.annualreviews.org) (Annual Review of Pharma. & Toxicology)
- \* [www.aac.aron.org](http://www.aac.aron.org) (Antimicrobial agents and chemotherapy)
- \* [www.nature.com/big/index.html](http://www.nature.com/big/index.html) (British Journal of Pharmacology)
- \* [www.dmd.aspetijournals.org](http://www.dmd.aspetijournals.org). (Drug metabolism and disposition)
- \* <http://jpet.aspetijournals.org> (The Journal of Pharmacology & Experimental Therapeutics)
- \* <http://modpharm> (Molecular Pharmacology)
- \* <http://Pharmet.org> (Pharmacological Reviews)
- \* [www.nature.com/tpj/index.html](http://www.nature.com/tpj/index.html) (The Pharmacogenomics Journal)
- \* [www.informaworld.org](http://www.informaworld.org) (International Journal of Toxicology)
- \* [www.toxici.oxfordjournals.org](http://www.toxici.oxfordjournals.org) (Toxicological Science)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Neuro- and Behavioural Toxicology of Agrochemicals
- \* Pharmacokinetics and Pharmacodynamics of Newer Drugs
- \* Ethnopharmacology
- \* Autonomic Pharmacology of Ruminants
- \* Autonomic Pharmacology of Poultry
- \* Clinical Pharmacology
- \* Clinical Toxicology



## **UNIT II**

Definition of veterinary public health administration; organisation, administration and implementation of veterinary public health services and programmes.

## **UNIT III**

Public health team, administration and functions; place of veterinarian in the public health team; veterinary public health agencies and institutions in India and abroad.

### **Practical**

Collection of information about set up of veterinary public health in different countries.

### **Suggested Readings**

Schwabe CW. 1969. Veterinary Medicine and Human Health. Williams & Wilkins.  
Sherikar AT, Bachchil VN & Thapliyal DC. 2004. Textbook of Elements of Veterinary Public Health. ICAR.

## **VPH 602 BACTERIAL AND RICKETTSIAL AGENTS OF PUBLIC HEALTH SIGNIFICANCE**

2+1

### **Objective**

To impart knowledge about importance and characteristic features of bacterial and rickettsial pathogens of public health significance.

### **Theory**

#### **UNIT I**

Importance of microbes in relation to veterinary public health; cultural, biochemical and other identification characters; ecology, transmission and survivability of bacteria in nature.

#### **UNIT II**

Description of Bacillus, Listeria, Mycobacterium, Clostridium, Staphylococcus, Enterococcus, Brucella and Leptospira

#### **UNIT III**

Description of Vibrio, Salmonella, Escherichia, Campylobacter, Yersinia, Lactobacillus, Pseudomonas and Micrococcus.

#### **UNIT IV**

Description of Coxiella, Rickettsia and Chlamydia.

### **Practical**

Isolation and identification methods for important bacterial and rickettsial agents of public health significance from host, vehicle and environment.

### **Suggested Readings**

Holt JG, Krieg NR, Sneath PHA, Staley JT & Williams ST. 1994. Bergey's Manual of Determinative Bacteriology. Williams & Wilkins.

## **VPH 603 VIRAL, FUNGAL AND PARASITIC AGENTS OF**

2+1

## PUBLIC HEALTH SIGNIFICANCE

### Objective

To impart knowledge about importance and characteristic features of viral, fungal and parasitic pathogens of public health significance.

### Theory

#### UNIT I

Systematic study of viral agents of Japanese encephalitis, encephalomyelitis, rabies, influenza, KFD, Rift valley fever, and enteroviruses; their morphological and other characters, ecology, transmission and survivability in nature.

#### UNIT II

Description of fungal agents of public health importance belonging to genera: Aspergillus, Penicillium, Fusarium, Mucor, Histoplasma, Microsporium, Trichophyton and Sporotrichum.

#### UNIT III

Description of parasites of public health importance: Taenia, Echinococcus, Trichinella, Toxoplasma, Diphyllbothrium, Fasciola, and Cryptosporidium.

### Practical

Isolation and identification methods for important fungal, viral and parasitic agents of public health significance from host, vehicle and environment.

### Suggested Readings

Ananthanarayan R & Panikar J. 1997. Textbook of Microbiology. Orient Longman.  
Pathak KML. 1991. Fundamentals of Parasitic Zoonoses. Kalyani.

## VPH 604 ZONOSSES AND PUBLIC HEALTH

2+1

### Objective

To impart knowledge of epidemiology, prevention and control of important zoonotic diseases.

### Theory

#### UNIT I

Concept and classification of zoonoses; comprehensive description of etiology, host range, epidemiology, diagnosis and management of zoonotic diseases.

#### UNIT II

Bacterial diseases: anthrax, brucellosis, tuberculosis, salmonellosis, yersiniosis, leptospirosis, listeriosis, plague, tularaemia, glanders, malidiosis, staphylococcosis, streptococcosis, tetanus, botulism, infections due to Clostridium perfringens, E. coli, Aeromonas hydrophilla, Bacillus cereus, Vibrio parahaemolyticus, cat scratch disease, chlamydiosis, Lyme disease, borreliosis (relapsing fever).

#### UNIT III

Detailed description of viral zoonoses: food-borne viruses viz. rota, tick-borne encephalitis, FMD, hepatitis A & E, Norwalk, entero, parvo, adeno, cytomegalo, astro, calci and corona viruses, influenza, rabies, vector-borne viruses viz. Japanese

encephalitis, Kyasanur forest disease, chickengunya, Crimean–Congo haemorrhagic fever, dengue fever, West–Nile viruses, yellow fever, rift–valley fever, equine encephalitis, louping ill, and some rare and potential zoonotic viruses such as Newcastle and pox viruses.

#### **UNIT IV**

Q fever and other rickettsiosis, fungal infections viz. dermatophytosis, blastomycosis, coccidioidomycosis, cryptococcosis, histoplasmosis, aspergillosis, candidiasis, rhinosporidiosis and sporotrichosis. Attributes and impact of parasitic zoonoses; description, etiology, host range, epidemiology, diagnosis and disease management of echinococcosis, taeniasis and cysticercosis, toxoplasmosis, trichinellosis, cryptosporidiosis, dracunculosis, fasciolopsiosis, sarcocystosis, liver fluke diseases, cutaneous and visceral larva migrans, schistosomiasis, leishmaniasis, trypanosomosis.

#### **Practical**

Isolation and identification of zoonotic agents, diagnostic procedures of zoonotic diseases.

#### **Suggested Readings**

Thapliyal DC. 1999. Diseases of Animals Transmissible to Man. International Book Distr. Co.

### **VPH 605      PRINCIPLES OF FOOD HYGIENE AND SAFETY      2+1**

#### **Objective**

To acquaint the students about principles of food hygiene and quality improvement practices.

#### **Theory**

##### **UNIT I**

Relation between veterinary public health and food hygiene; concept of food hygiene, impact of environmental sanitation and other factors on food quality.

##### **UNIT II**

Food spoilage, safety and preservation methods.

##### **UNIT III**

Microbiological standards and quality control (biological and other indicators of hygienic quality and spoilage) of foods to prevent food–borne infections.

##### **UNIT IV**

General principles of prevention of food–borne illnesses, GMP, HACCP, risk analysis.

#### **Practical**

Procedures of evaluation of hygienic/microbiological quality of raw and processed foods especially of animal origin by detection of biological and other indicators.

#### **Suggested Readings**

Jay JM. 1996. Modern Food Microbiology. CBS.

**VPH 606      FOOD-BORNE INFECTIONS AND INTOXICATIONS      2+1**

**Objective**

To impart knowledge about major illnesses due to foods.

**Theory**

**UNIT I**

Food-borne bacterial infection and intoxications due to Salmonella, Campylobacter, Clostridium, Staphylococcus, Listeria, Vibrio, E. coli, Bacillus cereus, bacterial toxins.

**UNIT II**

Food-borne viral infections: infectious hepatitis, poliomyelitis, gastroenteritis etc, natural toxic substances in foods.

**UNIT III**

Health problems due to food additives, biocides, bacterial toxins.

**UNIT IV**

Heavy metals, antibiotics, hormones etc. in food.

**Practical**

Detection and quantitation of food-borne pathogens, toxins, antibiotics, pesticides and additives in foods.

**Suggested Readings**

Jay JM. 1996. Modern Food Microbiology. CBS.

**VPH 607      MEAT AND MILK HYGIENE      2+1**

**Objective**

To educate regarding general methods of food hygiene.

**Theory**

**UNIT I**

Principles of food hygiene with special reference to foods of animal origin, human health and economics, nature and problem of food supply in India.

**UNIT II**

Meat hygiene and public health, abattoir hygiene.

**UNIT III**

Milk hygiene and public health, in place cleaning.

**UNIT IV**

Egg, food legislation, meat and milk adulteration.

**Practical**

Milk and meat inspection, quality control tests of meat, milk and fish.

**Suggested Readings**

Gracey JF, Collins DS & Huey RJ. 1999. Meat Hygiene. WB Saunders. WHO. 1962. Milk Hygiene. WHO.

Jay JM. 1996. Modern Food Microbiology. CBS.

**VPH 608 ENVIRONMENTAL POLLUTION AND SAFETY**

**3+1**

**Objective**

To impart education about pollutants in the environment and control.

**Theory**

**UNIT I**

Introduction to environmental hygiene, environment and health, microbial aspects of pollution.

**UNIT II**

Soil pollution, air pollution, water pollution and health.

**UNIT III.**

Genetic risk from environmental agents, health problems from nuclear energy and radiation pollution, environmental estrogens and pesticides–pollution.

**UNIT IV**

Dissemination of excreted pathogens, animal–waste and human risk, principles of safe disposal of waste. UNIT V Heavy metals, pesticides, veterinary drug residues and human health.

**Practical**

Determination of potability of drinking water, estimation and detection of pathogenic microbes in water, air, soil, animal products, sewage, and animal waste, inspection of sewage and waste disposal plants/sites.

**Suggested Readings**

Trieff NM. 1980. Environment and Health. Ann Arbor Science Publ.

**VPH 609 FISH, FISH PRODUCTS AND SEAFOOD HYGIENE**

**1+1**

**Objective**

To impart knowledge regarding fish hygiene and fish borne diseases

**Theory**

**UNIT I**

Fisheries and resources, fish preservation, hygienic quality control

**UNIT II**

Hygienic disposal and utilization of byproducts of fish, hygienic handling, transportation and marketing of fish.

**UNIT III**

Fish borne diseases in relation to human health.

**Practical**

Study of physical and biological indicators of wholesome fish to determine hygienic status of raw and processed fish. Residue analysis in fish.

**Suggested Readings**

Nollet Leo ML (Ed.). 2007. Handbook of Meat, Poultry and Seafood Quality. Blackwell publishing, Oxford.

**VPH 610      BIOTERRORISM AND DISASTER MANAGEMENT**

**1+1**

**Objective**

To update knowledge of disaster, biological weapons, biological hazards and remedial measures bioterrorism and biomedical hazards and their prevention

**Theory**

**UNIT I:**

Natural and man made disaster, impact analysis and classification of disaster scale, essential preparations to manage disaster, role and sequence of emergency medical services by veterinarians.

**UNIT II**

Effect of natural disasters like floods, prolonged draughts, forest fires, earthquakes, sunami and tidal damages, storms etc. on animal population both domestic and wild, post-disaster disease susceptibility, emergency control and remedial measures.

**UNIT III**

Biomedical hazards and biosafety, occupational health risk management. Major agents and their characteristics which have been used in the past and those which can be used in future as biological weapons.

**UNIT IV**

Biological weapons, hazard analysis and combating bioterrorism. Bio- ethics and social ethics, advisory role of veterinarians.

**Practical**

Detection of biohazards during disaster, detection and characterization of various organisms used as biological agents, use of disinfectants for their destruction.

**Suggested Readings**

Singh SK. 1998. Disaster Management. Mittal Publications, New Delhi.

**VPH 801      CURRENT TOPICS IN VETERINARY PUBLIC HEALTH**

**2+1**

**Objective**

To acquaint with contemporary issues concerning VPH.

**Theory**

**UNIT I**

Contemporary status of Veterinary Public Health administration, organisation and functions of veterinary public health agencies in India and abroad.

**UNIT II**

Advanced studies on principles, diagnostic methods of emerging public health problems, advances in zoonotic diseases.

**UNIT III**

Role of biotechnology in food hygiene, Hazard Analysis Critical Control Point System (HACCP).

**Practical**

Special problems related to field investigations of outbreaks of food poisoning and zoonotic diseases in a community.

**Suggested Readings**

Selected articles from journals.

**VPH 802      EMERGING AND RE-EMERGING ZOOSES      2+1**

**Objective**

To acquaint with emerging and re-emerging zoonotic diseases.

**Theory**

**UNIT I**

Concept of emerging and re-emerging zoonotic infections, international interests in zoonoses, measurement and economics of zoonoses, latest diagnostic and management planning for zoonoses.

**UNIT II**

Current challenges and strategies, euzoonoses, xenozoonoses, nosocomial zoonoses, newer zoonotic agents viz. cat-scratch disease, rat bite fever, Creutzfeld-Jacob disease, Ebola, Marburg, Lassa, Nipah, Menangle, Herpes B, SARS.

**UNIT III**

Simian and human immunodeficiency, bovine spongiform encephalopathy, hepatitis A & E, toro, H5N1 influenza virus; re-emerging zoonoses with new pathology viz. neurocysticercosis, campylobacteriosis, rabies, Guillan-Barre Syndrome, tuberculosis.

**Practical**

Special problems related to emerging/re-emerging prevalent zoonotic diseases in India.

**Suggested Readings**

Selected articles from journals.

**VPH 803      QUALITY CONTROL OF ANIMAL FOOD PRODUCTS      2+1**

**Objective**

To provide expertise to student in food quality control.

**Theory**

**UNIT I**

Microorganisms influencing food quality and food safety, principles of microbiological quality control of foods.

**UNIT II**

Major food-borne pathogens and spoilage organisms; their significance in consumer safety.

**UNIT III**

Detection of microorganisms in foods of animal origin.

**Practical**

Special problems on microbiological quality of foods of animal origin; detection, enumeration and identification of important food-borne pathogens.

**Suggested Readings**

Selected articles from journals.

**VPH 804 OCCUPATIONAL HEALTH HAZARDS**

**2+1**

**Objective**

To acquaint with occupational health hazards

**Theory**

**UNIT I**

Health/diseases associated with various occupations

**UNIT II**

Transportation, spread, maintenance and control of diseases affecting various occupational groups in contact with animals and their public health significance

**Practical**

Diagnosis of various occupational diseases of public health significance, identification and characterization of causative agents

**Suggested Readings**

Selected articles from journals.

**VPH 805 DISPOSAL AND RECYCLING OF WASTE**

**2+1**

**Objective**

To educate about safe and economic disposal of waste.

**Theory**

**UNIT I**

Concept of 'reduce, reuse and recycle' in environmental management, role of holistic environmental biotechnology and microbial control of pollution.

**UNIT II**

Safe disposal of animal waste and food plant waste, utilization/recycling of livestock waste.

**UNIT III**

Pollutants due to sewage, sewage treatment systems, solid waste and its management.

**Practical**

To study the role of microorganisms and chemicals in degrading waste, to study the factors influencing biodegradation.

### **Suggested Readings**

Selected articles from journals.

**VPH 806      BIOHAZARDS, BIOSECURITY AND DISASTER MANAGEMENT      2+0**

### **Objective**

To update knowledge on biological hazards and their prevention.

### **Theory**

#### **UNIT I**

Biohazards and bioterrorism: case studies.

#### **UNIT II**

Innovative biosecurity approaches.

#### **UNIT III**

Regulations for safety in laboratories, hospitals, biological plants.

#### **UNIT IV**

Case studies of natural and man made disasters. Approaches for management of disasters. Formation of teams/ groups. Equipments required for managing such disasters.

### **Suggested Readings**

Goel SL. 2007. Disaster Administration and Management: Text and Case Studies. Deep & Deep Publ., New Delhi.

Pinnkowski J. (Ed.). 2008. Disaster Management Handbook. CRC Press, Boca Raton.

**VPH 807      FOOD PLANT SANITATION      2+1**

### **Objective**

To impart basic knowledge of sanitation in food plants.

### **Theory**

#### **UNIT I**

Importance and maintenance of abattoir and meat plant sanitation.

#### **UNIT II**

Dairy plant sanitation.

#### **UNIT III**

Food plant waste disposal.

### **Practical**

Evaluation of sanitation and disinfection procedures in food plants, evaluation of efficacy of disinfectants.

### **Suggested Readings**

Selected articles from journals.

**VPH 808      ADVANCES IN ENVIRONMENTAL POLLUTION CONTROL      2+1**

**Objective**

To update knowledge on modern environmental pollution problem and control.

**Theory**

**UNIT I**

Advanced studies on problems pertaining to environmental hygiene, air, soil and water pollution, disinfection procedures, impact of global environmental problems on human/animal health; ecophilosophy, environmental ethics and environmental economics, environmental conflicts and cooperation.

**UNIT II**

Environmental risks and management, environmental risk assessment and reporting, modern global information, surveillance and monitoring systems, decision making and public awareness.

**UNIT III**

International environmental management efforts, participatory international organizations and their selected programmes and selected legislations.

**Practical**

Detection and estimation of air, soil and water pollution; detection of pathogens in environmental sources.

**Suggested Readings**

Selected articles from journals.

**VPH 890      SPECIAL PROBLEM      0+2**

**Objective**

To provide expertise in handling practical research problem(s).

**Practical**

Short research problem(s) involving contemporary issues and research techniques.

**VETERINARY PUBLIC HEALTH**

**List of Journals**

- \* Abstracts on Hygiene and Communicable Diseases
- \* Applied and Environmental Microbiology
- \* Emerging Infectious Diseases
- \* Food Science and Technology Abstracts
- \* Journal of Food Protection
- \* Journal of Food Science and Technology
- \* Journal of Veterinary Public Health
- \* Letters in Applied Microbiology

**e-Resources**

- \* [www.who.int/zoonoses/vph/en](http://www.who.int/zoonoses/vph/en) (W.H.O. website related to Zoonotic diseases)
- \* [www.fao.org](http://www.fao.org) (Website of Food and Agriculture Organization)
- \* [www.cdc.gov](http://www.cdc.gov) (website of CDC publications)

**Suggested Broad Topics for Master's and Doctoral Research**

- \* Prevention and control of emerging and re-emerging food-borne infections and intoxications
- \* Prevention and control of major zoonotic diseases of local importance
- \* Environmental pollution and health problems
- \* Food safety, risk analysis
- \* Shelf life
- \* Food adulteration and food safety

## ANIMAL REPRODUCTION, GYNAECOLOGY & OBSTETRICS

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
VOG 601	GENERAL GYNAECOLOGY	3+1
VOG 602	FEMALE INFERTILITY	3+1
VOG 603	VETERINARY OBSTETRICS	2+2
VOG 604	ANDROLOGY & MALE INFERTILITY	3+1
VOG 605	SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION	2+1
VOG 606	REPRODUCTIVE BIOTECHNOLOGY	2+1
VOG 607	CLINICAL PRACTICE I	0+3
VOG 608	CLINICAL PRACTICE II	0+3
VOG 691	MASTER'S SEMINAR	1+0
VOG 699	MASTER'S RESEARCH	20
VOG 801	ADVANCES IN GYNAECOLOGY	2+1
VOG 802	ADVANCES IN OBSTETRICS	2+1
VOG 803	ADVANCES IN ANDROLOGY	2+1
VOG 804	ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY	1+1
VOG 805	ADVANCES IN SEMEN PRESERVATION	1+1
VOG 806	CLINICAL PRACTICE I	0+3
VOG 807	CLINICAL PRACTICE II	0+3
VOG 890	SPECIAL PROBLEM	0+2
VOG 891	DOCTORAL SEMINAR I	1+0
VOG 892	DOCTORAL SEMINAR II	1+0
VOG 899	DOCTORAL RESEARCH	45

### Course contents

#### **VOG 601 ..... GENERAL GYNAECOLOGY**

**3+1**

#### **Objective**

To understand hormonal regulation of female reproduction and therapeutic management of infertility.

#### **Theory**

##### **UNIT I**

Puberty and sexual maturity, role of hypothalamic-pituitary-gonadal axis in attainment of puberty and sexual maturity, onset of postpartum ovarian activity, Endocrine regulation of estrous cycle.

##### **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. Pseudo-pregnancy and its treatment.

#### **UNIT VI**

Factors affecting reproduction – seasonality, nutrition, stress, environment, management, suckling and diseases.

#### **UNIT VII**

Lactation and artificial induction of lactation.

#### **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.

#### **Suggested Readings**

Cupps PT. 1991. Reproduction in Domestic Animals. Academic Press.

Hafez ESE. 2000. Reproduction in Farm Animals. Lippincott, Williams & Wilkins.

Pubedam MH & Pubedam MH. 2003. McDonald's Veterinary Endocrinology and Reproduction. Iowa State Press.

Noakes DE, Parkinson DJ & England GCW. 2001. Arthurs Veterinary Reproduction and Obstetrics. Saunders Harcourt India.

Roberts SJ. 1986. Veterinary Obstetrics and Genital Diseases. Scientific Book Agency.

### **VOG 602 FEMALE INFERTILITY**

**3+1**

#### **Objective**

To impart knowledge and training in diagnosis and treatment of infertility in female domestic animals.

#### **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.

### **UNIT III**

Managerial and environmental causes of infertility. Out of season breeding.

### **UNIT IV**

Infectious causes of female infertility, specific and non-specific infections.

### **UNIT V**

Ovarian dysfunction: anoestrus, cystic ovarian degeneration, anovulation, delayed ovulation and luteal insufficiency.

### **UNIT VI**

Repeat breeding: its causes, diagnosis and treatment.

### **UNIT VII**

Early embryonic death (EED): causes, diagnosis and therapeutic management.

### **UNIT VIII**

Abortion: infectious and non-infectious causes, diagnosis and prevention of abortion.

### **UNIT IX**

Interactions in Immunological mechanisms and infertility.

### **Practical**

Record keeping, herd fertility assessment and management, diagnosis and treatment of infertility in female animals, use of uterine swabs for bacterial and fungal culture, histo-pathological evaluation of uterine biopsy, exfoliated vaginal cytology and hormone assay. Use of ultrasonography in diagnosis of infertility. Immuno diagnostic techniques.

### **Suggested Readings**

Laing JA. 1989. Fertility and Infertility in Domestic Animals. English Language Book Soc. & Bailliere Tindall.

Morrow DA. 1986. Current Therapy in Theriogenology. WB Saunders.

Noakes DE, Parkinson DJ & England GCW. 2001. Arthurs Veterinary Reproduction and Obstetrics. Saunders Harcourt India.

Roberts SJ. 1986. Veterinary Obstetrics and Genital Diseases. Scientific Book Agency.

## **VOG 603 VETERINARY OBSTETRICS**

**2+2**

### **Objective**

To impart knowledge and training on problems of pregnancy and parturition and their management in domestic animals.

### **Theory**

#### **UNIT I**

Parturition: stages of parturition, mechanism of initiation of parturition, hormonal profiles associated with parturition.

#### **UNIT II**

Principles of handling of dystocia, obstetrical procedures: mutations, fetotomy, caesarean section. Obstetrical anesthesia and analgesia, epidural anesthesia.

#### **UNIT III**

Fetal and maternal dystocia: causes, diagnosis and management.

#### **UNIT IV**

Uterine torsion: causes, diagnosis and its correction.

#### **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.

#### **Practical**

Pelvimetry of different species of farm animals. Diagnosis and correction of abnormal fetal presentation, position and posture in phantom box. Epidural anesthesia, ovariohysterectomy and caesarean operation. Fetotomy exercises. Detorsion of uterus. Management of prolapse. Handling of clinical cases of dystocia.

#### **Suggested Readings**

Arthur GH, Pearson H & Noakes DE. 2000. Veterinary Reproduction and Obstetrics. English Language Book Society & Bailliere Tindall.  
Roberts SJ. 1986. Veterinary Obstetrics and Genital Diseases. Scientific Book Agency.  
Sloss V & Dufty JH. 1980. Handbook of Bovine Obstetrics. Williams & Wilkins.

### **VOG 604 ANDROLOGY AND MALE INFERTILITY**

**3+1**

#### **Objective**

To impart knowledge and training about male reproduction and treatment of male infertility in domestic animals.

#### **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, (formation, migration, maturation and ejaculation of semen), fine structure of spermatozoa, semen and its composition.

#### **UNIT IV**

Diseases transmitted through semen.

#### **UNIT V**

Factors affecting semen quality, semen culture, tests for assessment of sperm motility, sperm survival and fertilizing capacity of spermatozoa.

#### **UNIT VI**

Causes of infertility: hereditary, congenital, infectious, nutritional and normal. Pathological and functional disturbances of epididymis, vas deferens and accessory sex glands.

#### **UNIT VII**

Impotentia cocundi and impotentia generandi. Testicular hypoplasia and degeneration: causes and affect on semen and fertility.

#### **UNIT VIII**

Coital injuries and vices of male animals.

#### **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. Computer assisted semen analysis (CASA), Microbiological load of semen. Examination, diagnosis and treatment of infertile male animals.

#### **Suggested Readings**

Hafez ESE. 2000. Reproduction in Farm Animals. Lippincott, Williams & Wilkins.  
Mann T & Lutwak-Mann C. 1981. Male Reproductive Function and Semen. Springer-Verlag.  
Morrow DA. 1986. Current Therapy in Theriogenology. WB Saunders.  
Roberts SJ. 1986. Veterinary Obstetrics and Genital Diseases. Scientific Book Agency  
Salisbury GW, VanDemark NL & Lodge JR. 1988. Physiology of Reproduction and Artificial Insemination of Cattle. WH Freeman & Co.

### **VOG 605 SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION 2+1**

#### **Objective**

To impart knowledge and training about collection, evaluation and preservation of semen and artificial insemination (AI) in domestic animals.

#### **Theory**

##### **UNIT I**

History of artificial insemination.

##### **UNIT II**

Methods of semen collection.

##### **UNIT III**

Semen evaluation: macroscopic, microscopic, biochemical and microbiological tests, Computer assisted semen analysis (CASA).

##### **UNIT IV**

Semen preservation. Extenders for preservation of semen at different temperatures. Semen additives for enhancement of motility and fertilizing capacity of spermatozoa.

##### **UNIT V**

Cryopreservation of semen. Effects of cryopreservation on spermatozoa, semen quality and fertility.

##### **UNIT VI**

Thawing protocols of frozen semen. Factors affecting post-thaw semen quality.

##### **UNIT VII**

Ideal protocol for AI in different species of animals. Factors affecting success of AI.

#### **Practical**



Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCSC.

**Practical**

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Maintenance of case records. Presentation on selected /assigned cases.

**Suggested Readings**

Morrow DA. 1986. Current Therapy in Theriogenology. WB Saunders.

**VOG 608 CLINICAL PRACTICE – II**

**0+3**

**Objective**

Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCSC.

**Practical**

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Maintenance of case records. Presentation on selected /assigned cases.

**Suggested Readings**

Morrow DA. 1986. Current Therapy in Theriogenology. WB Saunders.

**VOG 801 ADVANCES IN GYNAECOLOGY**

**2+1**

**Objective**

To learn about advances in endocrine, ovarian and uterine functions and effect of nutrition, season and immunological factors on female fertility.

**Theory**

**UNIT I**

Neuro-endocrine control of reproduction, follicular development, ovulation fertilization and implantation. Embryonic and fetal development.

**UNIT II**

Maternal recognition of pregnancy, Advances in early diagnosis of pregnancy.

**UNIT III**

Embryonic losses, abortion and their prevention.

**UNIT IV**

Seasonal breeders, synchronization and induction of estrus and ovulation in seasonal breeders, Assisted reproductive technology (ART) to increase reproductive efficiency in farm animals.

**UNIT V**

Effect of stress, nutrition and immunological factors on fertility.

**UNIT VI**

Onset of postpartum ovarian activity and factors affecting it.

**UNIT VI**

Diagnostic & therapeutic approaches in infertility: Principles of hormone therapy in reproductive disorders, Laparoscopy, ultrasonographic diagnosis of ovarian/uterine

dysfunction, RIA/ELISA techniques for hormones assay in reproductive disorders, vaginal and uterine cytology

#### **Practical**

Clinical examination of female animals. Use of ultrasonography in ovarian function (follicular image pattern, follicular dynamics) and in early pregnancy diagnosis and infertility. Utility of uterine culture, uterine cytology and uterine biopsy (histopathological examination) in infertility investigation. Laparoscopy in diagnosis of ovarian and uterine dysfunction. ELISA/RIA of hormones and interpretation of results. Use of Assisted reproductive technology (ART) to enhance reproductive efficiency in farm animals.

#### **Suggested Readings**

Selected articles from journals.

### **VOG 802      ADVANCES IN OBSTETRICS**

**2+1**

#### **Objective**

To learn current developments in diagnosis and management of dystocia, accidents of gestation and peri-parturient disorders in domestic animals.

#### **Theory**

##### **UNIT I**

Conceptus and its development. Factors influencing gestation period and birth weight.

##### **UNIT II**

Anomalies of conceptus, teratogens and effect of stress on conceptus development.

##### **UNIT III**

Mechanism of initiation of parturition. Use of tocolytic drugs in management of uterine inertia.

##### **UNIT IV**

Induction of parturition and termination of abnormal pregnancies. Obstetrical analgesia and anaesthesia.

##### **UNIT V**

Pre-treatment evaluation of the dam suffering from dystocia. Management of maternal and fetal dystocia, hydrallantois, hydramnion, fetal mummification, fetal maceration, uterine inertia and uterine torsion.

##### **UNIT VI**

Fetotomy, caesarean section and ovario-hysterectomy.

##### **UNIT VII**

Neo-natal physiology and post-natal adaptations.

##### **UNIT VIII**

Involution of uterus, post-partum ovarian dysfunction and their manipulation.

#### **Practical**

Obstetrical operations in fetal dystocia: Mutations, fetotomy, caesarean section, ovario-hysterectomy; induction of parturition, use of tocolytic drugs in dystocia, obstetrical analgesia and anaesthesia.

### **Suggested Readings**

Selected articles from journals.

### **VOG 803      ADVANCES IN ANDROLOGY**

**2+1**

#### **Objective**

To learn advances in male reproduction and treatment of male infertility in domestic animals

#### **Theory**

##### **UNIT I**

Spermatogenesis, spermatogenic waves, sperm passage in male genitalia, biochemical milieu of male genitalia. Correlation between motility and fertilizing capacity of spermatozoa.

##### **UNIT II**

Separation of motile and immotile spermatozoa. Sexing and separation of male and female determining spermatozoa.

##### **UNIT III**

Sperm plasma membrane and its permeability and binding properties: acrosome and lysosomal enzymes, sperm nucleus and nuclear proteins. Mitochondria and their role in sperm metabolism. Flagellum and the mechanochemical basis of motility and cyclic nucleotides.

##### **UNIT IV**

Biochemistry of seminal plasma and accessory sex gland secretions. Electrolytes, proteins, enzymes and amino acids in seminal plasma. Fructose and other sugars, lipids, cholesterol, steroid hormones and prostaglandins in seminal plasma.

##### **UNIT V**

Fructolysis index. Aerobic and anaerobic metabolism of spermatozoa.

##### **UNIT VI**

Biochemical markers of fertility in males, sperm chromatin structure assay, Anti-sperm antibodies.

#### **Practical**

Breeding soundness evaluation of bulls, biochemical tests of semen for evaluation of fertility, semen culture for diagnosis of venereal diseases, diagnosis and treatment of genital pathological condition. Computer assisted semen analysis (CASA), Semen evaluation for assessment of fertilizing capacity of spermatozoa: cervical mucus penetration test, sperm capacitation test, hypo osmotic swelling test and zona free hamster egg penetration test. Anti-sperm antibody assay.

### **Suggested Readings**

Selected articles from journals.

### **VOG 804      ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY**

**1+1**

#### **Objective**

To learn advances in recent developments in biotechnology in reproduction for the production of desired elite animals.

#### **Theory**

### UNIT I

Embryo transfer technology and its application in farm animals.

### UNIT II

Selection and management of donor and recipient animals. Superovulation, surgical and non-surgical collection, evaluation of embryos and transfer of embryos.

### UNIT III

In vitro fertilization and maturation of oocytes.

### UNIT IV

Micromanipulation, sexing and cryopreservation of embryos.

### UNIT V

Sexing of sperm and embryos.

### UNIT VI

Transgenic animals. Chimeras.

### UNIT VII

Stem cell biotechnology

### UNIT VIII

Immuno-neutralization of hormones. Immunomodulation of fertility.

### **Practical**

Evaluation of superovulatory hormonal regimens in donors and synchronization of estrus in recipients. 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.

### **Suggested Readings**

Selected articles from journals.

## **VOG 805      ADVANCES IN SEMEN PRESERVATION**

**1+1**

### **Objective**

To learn advances in processing and cryopreservation of semen and insemination techniques to obtain high fertility.

### **Theory**

#### UNIT I

Transmission of venereal diseases through semen and their prevention.

#### UNIT II

Factors affecting motility and fertilizing capacity of spermatozoa. Semen collection, extension and cryopreservation of semen, damages to spermatozoa caused by cryopreservation.

#### UNIT III

Use of semen additives for promotion of sperm motility and fertilizing capacity.

#### UNIT IV

Thawing protocols for frozen semen. Post-thaw evaluation of motility and fertilizing capacity of spermatozoa.

**Practical**

Collection of preputial washings and semen for bacterial load and venereal pathogens. Preparation of semen extenders with different additives. Use of different freezing protocols for preservation of semen. Evaluation of fertility with frozen semen. Enzymatic changes in semen following cryopreservation.

**Suggested Readings**

Selected articles from journals.

**VOG 806      CLINICAL PRACTICE – I      0+3**

**Objective**

Hands-on training on diagnosis and treatment of reproductive disorders in animals.

**Practical**

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy, maintenance of case records, presentation on selected/ assigned cases

**Suggested Readings**

Selected articles from journals.

**VOG 807      CLINICAL PRACTICE – II      0+3**

**Objective**

Hands-on training on diagnosis and treatment of reproductive disorders in animals

**Practical**

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy.

**Suggested Readings**

Selected articles from journals.

**VOG 890      SPECIAL PROBLEM      0+2**

**Objective**

To expose students to research techniques related to sub discipline of the subject and submission of written project with references.

**Practical**

Student will carry out research on allotted project and submit the project along with research papers for publication in scientific journals.

### **List of Journals**

- \* American Journal of Obstetrics and Gynaecology
- \* Animal Reproduction
- \* Animal Reproduction Science
- \* Animal Science Journal
- \* Bibliography of Reproduction
- \* Biology of Reproduction
- \* Equine practice
- \* Equine Veterinary Journal
- \* Fertility and Sterility
- \* Indian Journal of Animal Reproduction
- \* Indian Journal of Animal Sciences
- \* Indian Journal of Experimental Biology
- \* Indian Veterinary Journal
- \* Journal of American Veterinary Medical Association
- \* Journal of Animal Science
- \* Journal of Dairy Science
- \* Journal of Endocrinology
- \* Journal of Reproduction and Development
- \* Journal of Reproduction and fertility
- \* Reproduction in Domestic Animals
- \* Research in Veterinary Science
- \* Theriogenology
- \* Veterinary Record

### **e-Resources**

- \* [www.anirgyep.elsevier.com](http://www.anirgyep.elsevier.com) (Animal Reproduction Science)
- \* [www.blackwellpublilshing.com](http://www.blackwellpublilshing.com) (International Journal of Andrology)
- \* [www.bioreprod.org](http://www.bioreprod.org) (Biology of reproduction)
- \* [www.domesticanimalendo.com](http://www.domesticanimalendo.com) (Domestic Animal Andocrinology)
- \* [www.reproduction-online.org](http://www.reproduction-online.org) (Journal of Andrology)
- \* [www.reproduction-online.org](http://www.reproduction-online.org) (Reproduction)
- \* [www.interscience.wiley.com](http://www.interscience.wiley.com) (Reproduction in domestic animals)
- \* [www.theriojournal.com](http://www.theriojournal.com) (Theriogenology)
- \* [www.buffaloresearch.com](http://www.buffaloresearch.com) (Buffalo Journal)
- \* [www.eje-online.org](http://www.eje-online.org) (European journal of Endocrinology)
- \* [www.sciencedirect.com](http://www.sciencedirect.com) (The Veterinary Journal)
- \* [www.blackwellpublishing.com](http://www.blackwellpublishing.com) (Asian journal of Andrology)
- \* [editorijar@yahoo.co.in](mailto:editorijar@yahoo.co.in) (Indian Journal of Animal Reproduction)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Anoestrus: Endocrinological investigations
- \* Reproductive biotechnology
- \* Investigations into andrological problems

\* Management of obstetrical problems

## VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
VCM 601	RUMINANT CLINICAL MEDICINE -I	2+0
VCM 602	RUMINANT CLINICAL MEDICINE -II	2+0
VCM 603	EQUINE CLINICAL MEDICINE	2+0
VCM 604	CANINE AND FELINE CLINICAL MEDICINE	2+0
VCM 605	SWINE CLINICAL MEDICINE	1+0
VCM 606	AVIAN MEDICINE	1+0
VCM 607	ZOO WILD & LABORATORY ANIMAL MEDICINE	2+0
VCM 608	CLINICAL DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE *	1+0
VCM 609	PRODUCTION DISEASES	2+0
VCM 610	DISEASES OF ANIMALS CAUSED BY TOXICANTS	1+0
VCM 611	VETERINARY FORENSIC MEDICINE	1+1
VCM 612	CLINICAL DIAGNOSTIC TECHNIQUES	0+2
VCM 613	VETERINARY EMERGENCY MEDICINE	0+2
VCM 614	CLINICAL PRACTICE I	0+3
VCM 615	CLINICAL PRACTICE II	0+3
VCM 691	MASTER'S SEMINAR	1+0
VCM 699	MASTER'S RESEARCH	20
VCM 801	ADVANCES IN GASTROENTROLOGY	2+0
VCM 802	ADVANCES IN CARDIOPULMONARY MEDICINE	2+0
VCM 803	ADVANCES IN NEUROLOGICAL AND UROLOGICAL DISORDERS	2+0
VCM 804	ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS	2+0
VCM 805	ADVANCES IN PRODUCTION DISEASES	2+0
VCM 806	ADVANCES IN PAEDIATRICS AND GERIATRICS	1+0
VCM 807	ADVANCES IN VETERINARY DIAGNOSTICS	1+2
VCM 808	ADVANCES IN VETERINARY THERAPEUTICS	1+2
VCM 809	ADVANCED CLINICAL PRACTICE I	0+2
VCM 810	ADVANCED CLINICAL PRACTICE II	0+2
VCM 811	ADVANCED CLINICAL PRACTICE III	0+2
VCM 890	SPECIAL PROBLEM	0+2
VCM 891	DOCTORAL SEMINAR I	1+0
VCM 892	DOCTORAL SEMINAR II	1+0
VCM 899	DOCTORAL RESEARCH	45

\*Domestic animals of regional importance e.g. Camel in Haryana, Yak in Eastern India, Elephant in South India

### Course contents

**VCM 601 RUMINANT CLINICAL MEDICINE – I 2+0**

**Objective**

Study of diseases of various body systems of bovine, sheep and goats.

**Theory**

**UNIT I**

General systemic states.

**UNIT II**

Diseases of alimentary system, liver and urinary system.

**UNIT III**

Diseases of respiratory and nervous system.

**Suggested Readings**

Chakrabarti A. 1998. Text Book of Clinical Veterinary Medicine. Kalyani.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. Veterinary Medicine. WB Saunders.

**VCM 602 RUMINANT CLINICAL MEDICINE – II 2+0**

**Objective**

Study of diseases of various body systems of bovine, sheep and goats.

**Theory**

**UNIT I**

Diseases of cardiovascular system, blood and blood forming organs.

**UNIT II**

Diseases of musculoskeletal system and skin

**UNIT III**

Diseases of eyes, ears, nose

**Suggested Readings**

Chakrabarti A. 1998. Text Book of Clinical Veterinary Medicine. Kalyani.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. Veterinary Medicine. WB Saunders.

**VCM 603 EQUINE CLINICAL MEDICINE 2+0**

**Objective**

Study of diseases of various body systems of horses, donkeys and mules.

**Theory**

**UNIT I**

General systemic states and diseases of alimentary system and liver.

**UNIT II**

Diseases of respiratory, cardiovascular system, blood and blood forming organs

**UNIT III**

Diseases of urinary and nervous systems

**UNIT IV**

Diseases of musculoskeletal system and skin.

**Suggested Books**

Wintzer H. 1986. Equine diseases. Verlag Paul Parey.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. Veterinary Medicine. WB Saunders.

**VCM 604      CANINE AND FELINE CLINICAL MEDICINE      2+0**

**Objective**

Study of diseases of various body systems of dogs and cats.

**Theory**

**UNIT I**

Specific needs of canine and felines, Pet psychology; pet behavior and adaptation needs; General systemic states. and

**UNIT II**

Diseases of digestive system, liver and pancreas, cardiovascular system, blood and blood-forming organs,.

**UNIT III**

Diseases of respiratory system, urogenital and nervous systems.

**UNIT IV**

Diseases of musculoskeletal system and skin.

**UNIT V**

Diseases of endocrine system, diseases of new borne animals.

**Suggested Books**

Dunn JK. 1999. Text Book of Small Animal Medicine. WB Saunders

Ettinger SJ & Feldman EC. 2000. Text Book of Veterinary Internal – Medicine. Vols. I, II. Saunders.

Gorman NT. 1998. Canine Medicine and Therapeutics. Blackwell.

**VCM 605      SWINE CLINICAL MEDICINE      1+0**

**Objective**

Study of diseases of various body systems in swine.

**Theory**

**UNIT I**

General systemic states and diseases of digestive system

**UNIT II**

Diseases of cardiovascular and respiratory system.

**UNIT III**

Diseases of urogenital and nervous system and skin.

**UNIT IV**

Diseases of endocrine system and of newborn animals.

**Suggested Readings**

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. Veterinary Medicine. WB Saunders.

Straw BF. (Eds.). 1999. Diseases of Swine. 8th Ed. Iowa State Univ. Press.

**VCM 606 AVIAN MEDICINE 1+0**

**Objective**

Study of non-infectious diseases of avian species.

**Theory**

**UNIT I**

Diseases due to deficiency of vitamins (vitamins A, B complex, C, D, K) ; minerals (calcium, phosphorus, manganese, zinc) and sodium chloride.

**UNIT II**

Miscellaneous diseases/conditions/ vices (cage layer fatigue, blue comb disease, beak necrosis, round heart disease, kerato-conjunctivitis, ascites, urolithiasis, fatty liver, kidney hemorrhagic syndrome, heat stroke, cannibalism, vent picking)

**Suggested Readings**

Gordon RF & Jordan ETW. 1982. Poultry Diseases. ELBS.

Leeson S, Diaz G & Summers JD. 2001. Poultry Metabolic Disorders and Mycotoxins. IBDC Publ.

**VCM 608 ZOO, WILD AND LABORATORY ANIMAL MEDICINE 2+0**

**Objective**

Study of diseases and health management of zoo, wild and laboratory animals

**Theory**

**UNIT I**

Etiology, symptoms, diagnosis and management of various diseases of zoo,wild and laboratory animals. – Diseases of urinary system.

**UNIT II**

Diseases, restraint, feeding and health management of exotic animals kept as pets

**Suggested Readings**

Baker HJ. 1988. Pathology of Laboratory Animals. Springer, New York.

Fowler ME. 1986. Zoo and Wild Animal Medicine. 2nd Ed. W. B. Saunders.

Fox JG, Anderson LC, Loew FM & Quimby FW. (Eds.). 2004. Laboratory Animal Medicine. 2nd Ed.

Hafez ESE. (Ed.). Reproduction and Breeding Techniques for Laboratory Animals. Lea & Fabiger.

Hrapkiewicz K. 2008. Clinical Laboratory Animal Medicine– An Introduction. 3rd Ed. Blackwell Publ.

Joshi BP. 1991. Wild Animal Medicine. Kalyani.

Sirois M. 2005. Laboratory Animal Medicine: Principles and Procedures. 2nd Ed. Elsevier.

**VCM 608 CLINICAL DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE 1+0**

**Objective**

Study of non-infectious diseases of important regional animal species.

### **Theory**

The animal species, to be studied/ taught is to be decided by the individual institution. For Veterinary College at CCS HAU Hisar, camel diseases will be covered.

#### **UNIT I**

Non-infectious/miscellaneous diseases of camels (satyriasis, kumri, allotriophagia, diseases of various body systems, nutritional deficiency disorders).

#### **UNIT II**

Diagnostic tests related to various non-infectious diseases of camels.

### **Suggested Readings**

Gahlot TK. 2000. Selected Topics on Camelids. The Camelid Publishing House, Bikaner.  
Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. Veterinary – Medicine. WB Saunders.

### **VCM 609      PRODUCTION DISEASES      2+0**

#### **Objective**

Study of metabolic, production and deficiency diseases of domestic animals.

#### **Theory**

##### **UNIT I**

General aspects, production diseases (parturient paresis, downer cow syndrome, ketosis, post-parturient haemoglobinuria, hypomagnesemic tetany, pregnancy toxemia).

##### **UNIT II**

Lactation tetany of mares, eclampsia of bitches, osteodystrophia fibrosa, azoturia of equines, rheumatism-like syndrome in buffaloes, hypothyroidism, diabetes mellitus and diabetes insipidus in dogs.

##### **UNIT III**

Deficiency diseases (calcium, phosphorus, vitamin-D3, vit-A, vit B- complex, vit-C and vit-K).

##### **UNIT IV**

Deficiency diseases (iron, copper, cobalt, zinc, manganese, iodine, vitamin E and selenium).

#### **Suggested Readings**

Dunn JK. 1999. Text Book of Small Animal Medicine. WB Saunders.  
Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. Veterinary Medicine. WB Saunders

### **VCM 610      DISEASES OF ANIMALS CAUSED BY TOXICANTS      1+0**

#### **Objective**

Study of diseases caused by various toxicants in domestic animals.

#### **Theory**

##### **UNIT I**

Diseases caused by physical agents and poisoning of organic and inorganic compounds.

**UNIT II**

Diseases caused by farm chemicals and phytotoxins

**UNIT III**

Diseases caused by mycotoxins and zootoxins

**UNIT IV**

Diseases caused by poisonous plants, snake and insect bites.

**Suggested Readings**

Kahn CM. (Ed.). 2005. The Merck Veterinary Manual. Merck & Co.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. Veterinary Medicine. WB Saunders.

**VCM 611 VETERINARY FORENSIC MEDICINE**

**1+1**

**Objective**

To familiarize students with various aspects of veterinary forensic medicine.

**Theory**

**UNIT I**

Veterolegal aspects of ante mortem and post mortem examination.

**UNIT II**

Examination of wounds, blood, offenses, frauds in animals and their products, animal cruelty and welfare. DNA analysis of clinical samples

**UNIT III**

Study of common laws related to veterolegal aspects.

**Practical**

Ante mortem and post mortem examination, examination of wounds, blood, offenses, frauds in animals and their products, collection, dispatch and examination of veterolegal samples.

**Suggested Readings**

Sharma SN, Gahlot AK & Tanwer RK. 2003. Veterinary Jurisprudence. 5th Ed. Camel Publ. House.

**VCM 612 CLINICAL DIAGNOSTIC TECHNIQUES**

**0+2**

**Objective**

Study the diagnostic protocols and procedures for various diseases of farm and companion animals.

**Practical**

**UNIT I**

Clinical tests and their interpretation related to diseases of alimentary tract, liver, cardio vascular system, blood and blood-forming organs of various species of animals.

**UNIT II**

Clinical tests and their interpretation related to respiratory, urinary, nervous, endocrine, musculoskeletal and integumentary systems of various species of animals.

### **Suggested Readings**

Kaneko JJ. 2008. Clinical Biochemistry of Domestic Animals. 6th Ed. Elsevier. Kelly WR. 1984. Veterinary Clinical Diagnosis. 3rd Ed. Eastbourne Balliere-Tindall.

## **VCM 613 VETERINARY EMERGENCY MEDICINE 0+2**

### **Objective**

Diagnosis and therapeutic management of various medical emergencies in farm and companion animals.

### **Practical**

#### **UNIT I**

Diagnosis and therapeutic management of various emergencies of cardiovascular, respiratory, gastrointestinal, urinary and nervous systems,

#### **UNIT II**

Diagnosis and therapeutic management of various emergencies of toxicities, sting bites and burns of farm and companion animals.

#### **UNIT III**

Monitoring critical ill patient, application of emergency care procedures for resuscitation of critically ill patient

### **Suggested Reading**

Kirk RW. 1995. Handbook of Veterinary Procedures and Emergency Treatment. 6th Ed. WB Saunders.  
Sattler FP & Knowles W. 2001. Veterinary Critical Care. Lea & Febiger.

## **VCM 614 CLINICAL PRACTICE – I 0+3**

### **Objective**

Application of the theoretical concepts in practice

### **Practical**

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals. Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

## **VCM 615 CLINICAL PRACTICE – II 0+3**

### **Objective**

Application of the theoretical concepts in practice

### **Practical**

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals. Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

## **VCM 801 ADVANCES IN GASTROENTEROLOGY 2+1**

**Objective**

Study of contemporary advancements in gastro–enterology

**Theory****UNIT I**

Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of farm animals.

**UNIT II**

Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of companion animals.

**Practical**

Advanced clinical procedures for the diagnosis of diseases of gastrointestinal system and associated organs of farm and companion animals

**Suggested Readings**

Selected articles from journals.

**VCM 802      ADVANCES IN CARDIOPULMONARY MEDICINE      2+0****Objective**

Study of recent advances in the field of cardiopulmonary medicine

**Theory****UNIT I**

Advances in diagnosis and therapeutic management of diseases of circulatory system

**UNIT II**

Advances in diagnosis and therapeutic management of diseases of respiratory system

**UNIT III**

Advances in diagnosis and therapeutic management of diseases of blood and blood forming organs in animals

**Suggested Readings**

Selected articles from journals.

**VCM 803      ADVANCES IN NEUROLOGICAL AND UROLOGICAL DISORDERS      2+0****Objective**

Study of recent advances in the field of neurological and urological disorders.

**Theory****UNIT I**

Advances in diagnosis, therapy and control of diseases of nervous system

**UNIT II**

Advances in diagnosis, therapy and control of diseases of urogenital system

**UNIT III**

Advances in diagnosis, therapy and control of diseases of locomotor system

**Suggested Readings**

Selected articles from journals.

**VCM 804      ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS      2+0**

**Objective**

Study of recent advances in endocrine and dermatological disorders.

**Theory**

**UNIT I**

Advances in diagnosis, therapy and control of diseases of skin and integumentary system

**UNIT II**

Advances in diagnosis, therapy and control of diseases of endocrine system.

**Suggested Readings**

Selected articles from journals.

**VCM 805      ADVANCES IN PRODUCTION DISEASES      2+0**

**Objective**

Study of recent advances in production diseases.

**Theory**

**UNIT I**

Latest advances in diagnosis, therapy and prophylaxis of metabolic diseases of farm and companion animals.

**UNIT II**

Latest advances in diagnosis, therapy and prophylaxis of nutritional diseases of farm and companion animals.

**UNIT III**

Latest advances in diagnosis and treatment of various poisonings and toxicities

**Suggested Readings**

Selected articles from journals.

**VCM 806      ADVANCES IN PAEDIATRICS AND GERIATRICS      1+0**

**Objective**

Study of recent advances in paediatrics and geriatrics

**Theory**

**UNIT I**

Recent advances in diagnosis, therapy and control of diseases and management of emergencies of neonates

**UNIT II**

Recent advances in diagnosis, therapy and control of diseases and management of emergencies of geriatric animals

**Suggested Readings**

Selected articles from journals.

**VCM 807      ADVANCES IN VETERINARY DIAGNOSTICS      1+2**

**Objective**

Study of recent advances in diagnostics

**Theory**

### **UNIT I**

Blood and serum biochemical and hematological analyses.

### **UNIT II**

Imaging techniques for the diagnosis of animal diseases (x-ray, contrast radiography, CT, MRI, Scintigraphy, Echocardiogram etc).

### **UNIT III**

Electrocardiography, ophthalmoscopy, ultrasonography, EEG, CVP, GFR assessment, pulse-oxymetry etc.

### **Practical**

Assignments on advanced diagnostic techniques for various diseases of domestic animals. Use of above mentioned advanced diagnostic techniques where ever possible. Collection of CSF, Gastric / rumen /intestinal fluid, absorption and digestion tests, water withheld, low and high dose dexamithasone test, ACTH stimulation, Hormone prolile, enzyme profile.

### **Suggested Readings**

Selected articles from journals.

### **VCM 808      ADVANCES IN VETERINARY THERAPEUTICS**

**1+2**

#### **Objective**

Study of recent advances in Veterinary Therapeutics.

#### **Theory**

### **UNIT I**

Fluid and electrolyte imbalance and therapy.

### **UNIT II**

Antimicrobial, antineoplastic and hormonal therapy.

### **UNIT III**

Blood transfusion and Emergency critical care, Peritoneal dialysis / hemodialysis, Gastric lavage, fluid therapy, parenteral total nutrition, nebulization, oxygen therapy, paracentesis, thoracenetsis.

### **Practical**

Assignments on advanced therapeutic approaches in various diseases of domestic animals.

### **Suggested Readings**

Selected articles from journals.

### **VCM 809      ADVANCED CLINICAL PRACTICE – I**

**0+2**

#### **Objective**

Application of the theoretical concepts in practice

### **Practical**

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals. Note: This course shall be conducted in TVCSC where students shall participate in diagnosis and treatment of diseased animals).

<b>VCM 810</b>	<b>ADVANCED CLINICAL PRACTICE – II</b>	<b>0+2</b>
<b>Objective</b>		
Application of the theoretical concepts in practice		
<b>Practical</b>		
Diagnostic and therapeutic protocol application, specimen collection,examination and management of sick farm and companion animals. Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).		
<b>VCM 811</b>	<b>ADVANCED CLINICAL PRACTICE – III</b>	<b>0+2</b>
<b>Objective</b>		
Application of the theoretical concepts in practice.		
<b>Practical</b>		
Diagnostic and therapeutic protocol application, specimen collection,examination and management of sick farm and companion animals. Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).		
<b>VCM 890</b>	<b>SPECIAL PROBLEM</b>	<b>0+2</b>
<b>Objective</b>		
A short-term project work on some aspect of etio-pathogenesis, diagnosis and therapy of diseases of domestic animals.		

### **List of Journals**

- \* Indian Journal of Poultry Science
- \* Indian Journal of Veterinary Medicine
- \* Indian Journal of Veterinary Research
- \* Indian Veterinary Journal
- \* Journal of American Veterinary Medical Association
- \* Research in Veterinary Science
- \* Veterinary Medicine
- \* Veterinary Medicine and Small Animal Clinician
- \* Veterinary Record
- \* Veterinary Research Communications

### **e-Resources**

- \* [www.uni-sz.bg/bjvm/bjvm.htm](http://www.uni-sz.bg/bjvm/bjvm.htm) (Bulgarian Journal of Veterinary Medicine)
- \* [www.jarm.com](http://www.jarm.com) (International Journal of Applied Research in Vety. Medicine)
- \* [www.ispub.com/ostia/index..php?xmlFilePath=journals/ijvm/front.xml](http://www.ispub.com/ostia/index..php?xmlFilePath=journals/ijvm/front.xml) (Internet Journal of Veterinary Medicine)
- \* [Isrvma.org/journal.htm](http://Isrvma.org/journal.htm). (Israel Journal of Veterinary Medicine)
- \* [www.medwellonline.net/java/fp.html](http://www.medwellonline.net/java/fp.html) (Journal of Animal & Veterinary Advances)
- \* [www.jstage.jst.go.jp/browse/jes/-char/en](http://www.jstage.jst.go.jp/browse/jes/-char/en) (Journal of Equine Science)
- \* [www.stage.jst.go.jp/browse/jpsa](http://www.stage.jst.go.jp/browse/jpsa) (Journal of Poultry science)
- \* [www.vesci.org](http://www.vesci.org) (Journal of Veterinary Science)
- \* [www.sasas.co.za](http://www.sasas.co.za) (South African Journal of Animal Science)
- \* [journals.tubitak.gov.tr/veterinary/index.php](http://journals.tubitak.gov.tr/veterinary/index.php) (Turkish Journal of Veterinary and Animal Sciences)
- \* [vetmed.vri.cz](http://vetmed.vri.cz) (Veterinary Medicine)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Clinico-therapeutic aspects of bovine mastitis
- \* Hepatic, respiratory and skin disorders in animals
- \* Metabolic/nutritional deficiency disorders in animals with emphasis on hypophosphatemia, hypocupremia and hypomagnesemia

## VETERINARY EPIDEMIOLOGY AND PREVENTIVE MEDICINE

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
VEP 601	PRINCIPLES OF EPIDEMIOLOGY	2+0
VEP 602	APPLIED EPIDEMIOLOGY	1+1
VEP 603	LIVESTOCK AND POULTRY DISEASE INVESTIGATION	0+2
VEP 604	VETERINARY CLINICAL EPIDEMIOLOGY	1+1
VEP 605	BIOSECURITY PRACTICES IN DISEASE PREVENTION	1+1
VEP 606	INFECTIOUS DISEASES OF RUMINANTS-I	2+1
VEP 607	INFECTIOUS DISEASES OF RUMINANTS -II	2+1
VEP 608	INFECTIOUS DISEASES OF EQUINES	1+1
VEP 609	INFECTIOUS DISEASES OF CANINES AND FELINES	2+1
VEP 610	INFECTIOUS DISEASES OF POULTRY	2+1
VEP 611	INFECTIOUS DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE	2+1
VEP 612	INFECTIOUS DISEASES OF LABORATORY AND ZOO ANIMALS	1+0
VEP 691	MASTER'S SEMINAR	1+0
VEP 699	MASTER'S RESEARCH	20
VEP 801	RECENT CONCEPTS IN EPIDEMIOLOGY AND DISEASE FORECASTING	2+1
VEP 802	HERD HEALTH MANAGEMENT	2+1
VEP 803	DATA COLLECTION MANAGEMENT AND PRESENTATION	2+1
VEP 804	SURVEY AND SURVEILLANCE	2+1
VEP 805	EMERGING AND RE-EMERGING ANIMAL DISEASES	2+0
VEP 806	ECOLOGY OF DISEASES	2+0
VEP 807	MOLECULAR APPROACHES IN EPIDEMIOLOGY	2+1
VEP 808	ADVANCES IN PREVENTION & CONTROL OF INFECTIOUS DISEASES OF RUMINANTS	2+1
VEP 809	ADVANCES IN PREVENTION AND CONTROL OF INFECTIOUS DISEASES OF EQUINES	2+1
VEP 810	ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN PET ANIMALS	2+1
VEP 811	ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN POULTRY	2+1
VEP 812	ADVANCES IN INFECTIOUS DISEASES OF LABORATORY AND ZOO ANIMALS	1+0
VEP 813	ADVANCES IN DIAGNOSIS AND MANAGEMENT OF TOXICOLOGICAL CONDITIONS	1+1
VEP 890	SPECIAL PROBLEM	0+2
VEP 891	DOCTORAL SEMINAR I	1+0
VEP 892	DOCTORAL SEMINAR II	1+0



### **Practical**

Design proforma questionnaires for collection of information on health and diseases in populations, sero-surveys for important diseases of livestock and poultry, investigation of outbreaks, use of computer software in epidemiology.

### **Suggested Readings**

Martin SW, Meek AH & Willeberg P. 1993. Veterinary Epidemiology: Principles and Methods. IBH.

Thrusfield M. 2004. Veterinary Epidemiology. 8th Ed. Blackwell.

Thomas B. (Ed.). Applied Veterinary Epidemiology. Elsevier.

### **VEP 603          LIVESTOCK AND POULTRY DISEASE INVESTIGATION          0+2**

#### **Objective**

To expose students to actual field based investigations of diseases in livestock and poultry.

#### **Practical**

To attend outbreaks of infectious diseases and toxicological conditions in livestock and poultry in the field and at farms. Recording and analysis of data. Investigation and diagnosis on dead and live diseased animal(s) and poultry. Collection, preservation and transport of material in the face of disease outbreak, and processing of material in the laboratory for diagnosis; screening of animal herds and poultry flocks for certain important diseases. Formulating and advising treatment and control measures. Extraction and isolation of nucleic acid of field isolates and vaccine strains, and their characterization by PCR and other techniques.

#### **Suggested Readings**

Vihan VS. 2002. Modern Veterinary Laboratory Techniques in Clinical Diagnosis. CBS.

### **VEP 604          VETERINARY CLINICAL EPIDEMIOLOGY          1+1**

#### **Objective**

To familiarize students with various epidemiological approaches for solving field problems.

#### **Theory**

##### **UNIT I**

Definitions and epidemiological approaches, measuring frequency of clinical events, incidence, prevalence, occurrence etc., principles of accuracy, precision, linearity, diagnostic sensitivity and specificity.

##### **UNIT II**

Uses of diagnostic tests, evaluation of diagnostic tests, cohort and case control studies.

##### **UNIT III**

Design and evaluation of clinical trials, cost of disease, cost benefit analysis.

#### **Practical**

Diseases of multiple etiology: mastitis, diarrhea, abortions and their diagnosis and prevention. Sampling, isolations and antibiotic/ culture sensitivity etc. statistical evaluation of diagnostic assays.

#### **Suggested Readings**





## **UNIT II**

African horse sickness, infectious equine anaemia, equine influenza, equine encephalomyelitis, rabies, equine viral rhinopneumonitis, equine viral arteritis vesicular stomatitis, ulcerative lymphangitis.

## **UNIT III**

Trypanosomiasis/ dourine, babesiosis, parasitic pneumonia.

## **UNIT IV**

Cutaneous eczema, cutaneous acne, cutaneous pustular dermatitis, candidiasis, histoplasmosis, coccidiomycosis, dermatophytosis.

### **Practical**

Diagnostic tests and serological tests for study of epidemiology of infectious diseases of equines.

### **Suggested Readings**

Robison NE. 1998. Current Therapy in Equine Medicine. WB Saunders.

Wintzer HJ. 1986. Equine Diseases, a Text Book for Students and Practitioners. Verlag Paul Parcey.

## **VEP 609            INFECTIOUS DISEASES OF CANINES AND FELINES**

**2+1**

### **Objective**

Learning of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of infectious diseases of dogs and cat.

### **Theory**

#### **UNIT I**

Bacterial diseases: salmonellosis, campylobacteriosis, mycobacteriosis, actinomycosis, nocardiosis, streptococcosis, leptospirosis, borreliosis, tetanus, botulism. Viral diseases: canine distemper, infectious canine hepatitis, parvovirus infection, rabies, infectious tracheo-bronchitis, corona virus infection.

#### **UNIT II**

Feline diseases: feline pan-leucopaenia, feline infectious peritonitis, feline herpesvirus, feline spongiform encephalopathy, feline calici virus, feline immunodeficiency virus (FIV)

#### **UNIT III**

Toxoplasmosis, neosporosis, sarcoptic mange, demodectic mange, hookworm and toxocara canis infections, leishmaniasis, canine babesiosis, ehrlichiosis, hepatozoonosis.

### **Practical**

Assignments, recent diagnostic/ serological tests for the diagnosis of important diseases of dogs and cats. Vaccination schedule for various diseases. Collection of material from clinical cases.

### **Suggested Readings**

Dunn JK. 1999. Text Book of Small Animal Medicine. WB Saunders.

Ettinger SJ & Feldman EC. 2000. Text book of Veterinary Internal Medicine. 5th Ed. WB Saunders.

Gormann NT. 1998. Canine Medicine and Therapeutics. Blackwell.



Swine diseases: Swine influenza, hog cholera, African swine fever, swine pox, vesicular exanthema, vesicular stomatitis, rabies.

#### **UNIT IV**

Porcine enteroviruses, pseudorabies, listeriosis, leptospirosis, brucellosis, anthrax, salmonellosis, swine erysipelas, pasteurellosis, tuberculosis mange etc.

#### **Practical**

Recent diagnostic tests and preventive measures for the control of infectious diseases of swine and camel. Investigations of outbreaks. Visits to organized farms.

#### **Suggested Readings**

Dunne HW & Lemman AD. (Eds.). 1988. Diseases of Swine. Iowa State Univ. Press.  
Gahlot TK & Singh J. 2002. Selected Topics on Camelids. Camel Publishing House.  
Kohler I, Rollfeson E & Evelyn M. 2001. Field Manual of Camel Diseases: Traditional and Modern Health Care of Dromedary.  
Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. Veterinary Medicine: A Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses. Book Power.  
Wernery U & Kaden M. 2002. Infectious Diseases of Camelids. Blackwell.

### **VEP 612            INFECTIOUS DISEASES OF LABORATORY AND ZOO ANIMALS            1+0**

#### **Objective**

Learning of specific diseases of laboratory and zoo animals which will help in understanding, and managing them in good health and employing good sanitation and bio-security measures.

#### **UNIT I**

Specific diseases of laboratory animals caused by bacteria, viruses, fungi and parasites..

#### **UNIT II**

Specific diseases of zoo (captive) animals caused by bacteria, viruses, fungi and parasites.

#### **Suggested Readings**

Joshi BP. 1991. Wild Animal Medicine. Kalyani.  
Fowler ME. 1986. Zoo and Wild Animal Medicine. 2nd Ed. WB Saunders.  
Fox JG, Anderson LC, Loew FM & Quimby FW. (Eds.). 2004. Laboratory Animal Medicine. 2ndEd.  
Baker HJ. 1988. Pathology of Laboratory Animals. Springer, New York  
Hafez ESE. (Ed.). Reproduction and Breeding Techniques for Laboratory Animals. Lea and Fabiger, Philadelphia.  
Sirois M. 2005. Laboratory Animal Medicine: Principles and Procedures. 2nd Ed. Elsevier.  
Hrapkiewicz K. 2008. Clinical Laboratory Animal Medicine – An Introduction. 3rd Ed. Blackwell Publ.  
Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. Veterinary Medicine: A Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses. Book Power.

### **VEP 801            RECENT CONCEPTS IN EPIDEMIOLOGY AND DISEASE FORECASTING 2+1**

#### **Objective**

To learn about different epidemiological aspects of major diseases and to develop suitable disease forecasting system.

**Theory**

**UNIT I**

Review of epidemiological concepts and applications, recent concepts.

**UNIT II**

Epidemiology of economically important diseases in the region (haemorrhagic septicemia, foot and mouth disease, surra, brucellosis, PPR, swine fever, IBD and fowl typhoid)

**UNIT III**

Geographical Information System and its applications in epidemiology, various expert systems and their role in epidemiology.

**UNIT IV**

Modeling and application of various models in disease forecasting. Epidemiological software.

**Practical**

Epidemiology exercises of economically important diseases in the region, use of Geographical Information System in epidemiology, various expert systems, modeling and various models used in disease forecasting, use of various epidemiological softwares.

**Suggested Readings**

Noordhuizen JPTM, Franklin K, Thrusfield MV & Graat EAM. 2003.  
Application of Quantitative Methods in Veterinary Epidemiology. IBD.

**VEP 802      HERD HEALTH MANAGEMENT**

**2+1**

**Objective**

Adoption of holistic approach to address issues of herd health without affecting production.

**Theory**

**UNIT I**

General principles, interactions between health and production.

**UNIT II**

Dairy cattle: mastitis control and health management of dairy cows and calves.

**UNIT III**

Health and production in swine, sheep, goats and poultry.

**Practical**

Visit to farms, assessment of their problems, systematic programme or control of a specific disease and its impact.

**Suggested Readings**

Radostits & Blood DC. 1996. Herd Health. Book Power.

**VEP 803      DATA COLLECTION, MANAGEMENT AND PRESENTATION**

**2+1**

**Objective**

To apprise the students of importance of data collection, analysis and interpretation for effective disease control.

### **Theory**

#### **UNIT I**

Classification of data, sources of data, data collection, questionnaires.

#### **UNIT II**

Data storage, computerized and non-computerized recording techniques.

#### **UNIT III**

Application of computing and internet based records. Veterinary recording schemes, veterinary information systems and databases.

#### **UNIT IV**

Presenting numerical data: some basic definitions. Displaying numerical data.

### **Practical**

Collection, storage and analysis of data of Disease Investigation Laboratories of department, Veterinary hospitals, livestock and poultry farms etc. Development of suitable software for the same. Pie charts, graphs and maps for presentation of data.

### **Suggested Readings**

Noordhuizen JPTM, Frankena K, Thrusfield MV & Gruat EAM. 2003.

Application of Quantitative Methods in Veterinary Epidemiology. International Book Distr. Co.

## **VEP 804 SURVEY AND SURVEILLANCE**

**2+1**

### **Objective**

To demonstrate different methodologies and procedures involved in conducting survey and surveillance.

### **Theory**

#### **UNIT I**

Over-view of concepts of survey and surveillance, purpose and method of sampling, size of sample, questionnaires.

#### **UNIT II**

Goals and types of surveillance, difference from monitoring, mechanism of surveillance and surveillance network.

#### **UNIT III**

Disease/data recording and reporting.

### **Practical**

Develop questionnaires on selective topics, Survey among livestock and poultry farmers to find out usefulness/effectiveness of vaccination/ artificial insemination/ other practices, surveillance of important diseases in different parts of state.

### **Suggested Readings**

Selected articles from journals.

## **VEP 805 EMERGING AND RE-EMERGING ANIMAL DISEASES**

**2+0**

### **Objective**

To create awareness about emerging and reemerging diseases and surveillance methods.

## Theory

### UNIT I

General concepts for emergence of new diseases and re-emergence of old diseases.

### UNIT II

Epidemiology of globally and nationally important emerging/re-emerging diseases and designing of strategies for their prevention and control.

### **Suggested Readings**

Selected articles from journals.

## **VEP 806 ECOLOGY OF DISEASES**

**2+0**

### **Objective**

To make the students aware about ecology, ecological systems and impact of global warming.

## Theory

### UNIT I

Basic ecological concepts, distribution and regulation of population size, the niche with examples.

### UNIT II

Ecosystems, biotope, landscape epidemiology, nidality.

### UNIT III

Patterns of disease, epidemic curves (Reed-Frost-model, Kendall's waves, trends in temporal and spatial distribution of disease.

### UNIT IV

Global warming, its impact on animal health, pathogens/vectors and changing disease patterns.

### **Suggested Readings**

Selected articles from journals.

## **VEP 807 MOLECULAR APPROACHES IN EPIDEMIOLOGY**

**2+1**

### **Objective**

Learning of recent advanced molecular techniques for establishing disease diagnosis.

## Theory

### UNIT I

The concept of molecular basis of a disease, molecular determinants of pathogenicity of infectious agents and their transmissibility to susceptible populations of livestock and poultry.

### UNIT II

Laboratory biosafety, antigenic, genetic and biological characterization of field isolates of pathogens incriminated in field outbreaks, differentiation of field and vaccine strains, the concept of marker vaccines, and correlation of pathotypes and genotypes of a pathogen.

### UNIT III

Immunological tests, immunoblotting techniques and use of monoclonal antibodies in different ELISAs for antigenic analysis. Application of nucleic acid based assays





To impart knowledge about latest advancements made in the field of prevention and control of important infectious diseases of poultry.

**Theory**

**UNIT I**

Bacterial diseases of economic importance in poultry.

**UNIT II**

Viral diseases of economic importance in poultry.

**UNIT III**

Fungal diseases of economic importance in poultry.

**UNIT IV**

Parasitic diseases of economic importance in poultry.

**Practical**

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by bacteria, viruses, fungi and other parasites.

**Suggested Readings**

Selected articles from journals.

**VEP 890      SPECIAL PROBLEM**

**0+2**

**Objective**

To provide expertise in handling practical research problems.

**Practical**

Short research problems involving contemporary issues and research techniques.

### **List of Journals**

- \* Avian Diseases
- \* Avian pathology
- \* British Poultry Science
- \* British Veterinary Journal
- \* Epidemiology and Infection
- \* Indian Journal of comparative Microbiology, Immunology and Infectious diseases
- \* Infection and Immunity
- \* Infection and Immunity
- \* Journal of General Virology
- \* Journal of Poultry Science
- \* Quarterly Bulletin of O.I.E.
- \* Tropical Animal Health and Production
- \* Veterinary Medicine
- \* Veterinary Microbiology
- \* Veterinary Record
- \* World Animal Health
- \* World Poultry Science Journal

### **e-Resources**

- \* <http://www.jarvm.com/> (International Journal of Applied Research in Veterinary Medicine)
- \* <http://calvados.c3sl.ufpr.br/ojs2/index.php/veterinary/> (Archives of Veterinary Science)
- \* <http://www.pjbs.org/ijps/ijps.htm> (International Journal of Poultry Science)
- \* <http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ijvm/front.xml> (Internet Journal of Veterinary Medicine)
- \* <http://www.medwellonline.net/java/fp.html> (Journal of Animal and Veterinary Advances)
- \* <http://www.jstage.jst.go.jp/browse/jpsa> (Journal of Poultry Science)
- \* <http://www.jstage.jst.go.jp/browse/jvms/-char/en> (Journal of Veterinary Medical Science)
- \* <http://www.cipav.org.co/lrrd/> (Livestock Research for Rural Development)
- \* <http://vetmed.vri.cz/> (Veterinarni Medicina)
- \* <http://isrvma.org/journal.htm> (Israel Journal of Veterinary Medicine)
- \* <http://www.jstage.jst.go.jp/browse/jpestics> (Journal of Pesticide Science)
- \* <http://www.vetsci.org> (Journal of Veterinary Science)
- \* <http://journals.tubitak.gov.tr/veterinary/index.php> (Turkish Journal of Veterinary and Animal Sciences)
- \* <http://www.uni-sz.bg/bjvm/bjvm.htm> (Bulgarian Journal of Veterinary Medicine)
- \* <http://www.ecology.kee.hu/> (Applied Ecology and Environmental Research)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Molecular epidemiological studies on infectious diseases of livestock
- \* Molecular epidemiological studies on infectious diseases of poultry
- \* Surveillance of economically important diseases of farm animals
- \* Surveillance of economically important diseases of poultry
- \* Development of immunodiagnostic/ sero-diagnostic tests for field application
- \* Monitoring of protective immunity induced by vaccines under different schedules

- \* Diagnostic assay for milk adulterants
- \* Diagnostic assays and epidemiological studies in respect of toxicants in livestock and poultry feeds.



### **UNIT III**

Biomaterials, surgical immunity, pre-operative assessment of the surgical patient, post-operative care of the surgical patient. Chemotherapy of tumors.

### **UNIT IV**

Operating room emergencies, cardio-pulmonary embarrassment and resuscitation, monitoring of surgical patient.

### **UNIT V**

Principles of laser surgery, cryosurgery, electrosurgery, lithotripsy and endoscopy, physiotherapy, stem cell therapy etc.

### **Suggested Readings**

Fossum TW. (Ed.). 2002. Small Animal Surgery. Mosby.

Slatter DH. (Ed.). 2002. Textbook of Small Animal Surgery. WB Saunders.

## **VSR 602 CLINICAL PRACTICE – I**

**0+3**

### **Objective**

To impart practical training in anaesthesia, diagnostic imaging techniques and surgery.

### **Practical**

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments, disaster management.

### **Suggested Readings**

Auer JA. (Ed.). 2006. Equine Surgery. WB Saunders.

Fossum TW. (Ed.). 2002. Small Animal Surgery. Mosby.

Fubini SL & Ducharme NG. (Ed.). 2004. Farm Animal Surgery. WB Saunders.

Slatter DH. (Ed.). 2002. Textbook of Small Animal Surgery. WB Saunders.

## **VSR 603 CLINICAL PRACTICE – II**

**0+3**

### **Objective**

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

### **Practical**

Client management, animal welfare and rehabilitation, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel, disaster management.

### **Suggested Readings**

Auer JA. (Ed.). 2006. Equine Surgery. WB Saunders.

Fossum TW. (Ed.). 2002. Small Animal Surgery. Mosby.

Fubini SL & Ducharme NG. (Ed.). 2004. Farm Animal Surgery. WB Saunders.

Slatter DH. (Ed.). 2002. Textbook of Small Animal Surgery. WB Saunders.

**VSR 604      SMALL ANIMAL ANAESTHESIA**

**2+1**

**Objective**

To impart the basic and practical knowledge of principles of companion animal anaesthesia.

**Theory**

**UNIT I**

General considerations for anaesthesia, peri-operative and post-operative pain and its management.

**UNIT II**

Sedation: analgesia and pre-medication, anaesthetic agents (injectable anaesthetics, dissociative anaesthetics, inhalation anaesthetics), muscle relaxants, neuromuscular blocking agents and local analgesia.

**UNIT III**

Anaesthetic techniques, anaesthetic equipments, artificial ventilation.

**UNIT IV**

Anaesthesia of small animals, pediatric and geriatric patients, birds.

**UNIT V**

Monitoring of anaesthesia, anaesthetic emergencies, complications and their management, euthanasia.

**Practical**

Anaesthetic equipments and instrumentation, artificial ventilation, use of various preanaesthetic and anaesthetic agents in small animals, anaesthetic triad, balanced anaesthesia, total intravenous anaesthesia.

**Suggested Readings**

Hall LW & Clarke KW. (Eds.). 1991. Veterinary Anaesthesia. Bailliere Tindall.

Paddleford RR. (Ed.). 1999. Manual of Small Animal Anesthesia. 2nd Ed. WB Saunders.

Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. Lumb and Jone's Veterinary Anaesthesia. Williams & Wilkins.

Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1999. Essentials of Small Animal Anesthesia and Analgesia. Lippincott Williams & Wilkins.

**VSR 605      LARGE ANIMAL ANAESTHESIA**

**2+1**

**Objective**

To impart the basic and practical knowledge of principles of farm animal anaesthesia and mechanism of pain.

**Theory**

**UNIT I**

General considerations for anaesthesia, peri-operative pain, and post-operative pain and its management.

**UNIT II**

Pre-anaesthetic and anaesthetic adjuncts, injectable anaesthetics, dissociative anaesthetics, inhalation anaesthetics.

### **UNIT III**

Local anaesthetics, neuromuscular blocking agents.

### **UNIT IV**

Anaesthetic techniques, anaesthetic machines, breathing systems, artificial ventilation.

### **UNIT V**

Monitoring of anaesthesia, anaesthetic emergencies and complications, anaesthesia of pediatric and geriatric patients, euthanasia.

### **Practical**

Anaesthetic equipments and instrumentation, artificial ventilation, use of various preanaesthetic and anaesthetic agents in large animals, anaesthetic triad, balanced anaesthesia, total intravenous anaesthesia.

### **Suggested Readings**

Hall LW & Clarke KW. (Eds.). 1991. Veterinary Anaesthesia. Bailliere Tindall.

Muir WW & John AE. (Eds.). 1991. Equine Anesthesia. Mosby.

Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. Lumb and Jone's Veterinary Anaesthesia. Williams & Wilkins.

## **VSR 606            DIAGNOSTIC IMAGING TECHNIQUES**

**2+1**

### **Objective**

To impart the basic and practical knowledge of principles of diagnostic imaging techniques and interpretation of radiographs, ultrasonograph/CT/ MRI and other imaging techniques.

### **Theory**

#### **UNIT I**

Conventional and digital X-ray machine, quality of radiation, formation of radiograph technique chart, artifacts and their prevention, special diagnostic radiographic procedures, radiographic quality, radiographic accessories, differentiation of radiographic densities in relation to clinical diagnosis.

#### **UNIT II**

Principles of radiographic interpretation, plain and contrast radiographic techniques of small and large animals, image intensification.

#### **UNIT III**

Principles of radiation therapy, medical radioisotope curves, radiation laws and regulations.

#### **UNIT IV**

Principles of ultrasound, basic physics, transducers, equipment controls, display models, terminology of echotexture and artifacts, application of ultrasound in small and large animals.

#### **UNIT V**

Doppler techniques echocardiography and its application, introduction to MRI, CT scan, nuclear medicine, xeroradiography, positron emission tomography technique and other imaging techniques.

#### **UNIT VI**

Electromagnetic radiations, hazards of electromagnetic radiations and protection and bio-safety.

### **Practical**

Acquaintance with imaging equipments, dark room processing techniques and X-ray film handling, formulation of technique chart with fixed kVp and variable mAs, basics of radiographic interpretation of diseases, computer aided image acquisition and retrieval, radiographic positioning of different regions in domestic animals, angiography, cardiac catheterization and other contrast radiographic techniques of different types, interpretation of ultrasonographs, MRI, CT scans etc.

### **Suggested Readings**

- Bargai U, Bharr, JW & Morgan JP. (Eds.). 1989. Bovine Radiology. Iowa State University Press, Ames.
- Bushong SC. (Ed.). 1985. Radiologic Science for Technologists. CV Mosby.
- Gillette EL, Thrall DE & Lebel JL. (Eds.). 1988. Carlson's Veterinary Radiology. Lea & Febiger.
- Goddard PJ. (Ed.). 1995. Veterinary Ultrasonography. CABI.
- Kealy JK. (Ed.). 1988. Diagnostic Radiology and Ultrasonography in Dogs and Cats. 2nd Ed. Saunders, Philadelphia.
- Morgan JP. (Ed.). 1982. Radiology in Veterinary Orthopaedics. Lea & Febiger.
- Singh AP & Singh J. (Eds.). 1994. Veterinary Radiology. CBS.
- Thrall DE. (Ed.). 2008. Textbook of Veterinary Diagnostic Radiology. 5th Ed. Saunders, Philadelphia.

## **VSR 607          VETERINARYOPHTHALMOLOGY AND DENTISTRY          1+1**

### **Objective**

To impart the basic and practical knowledge of diagnosis and treatment of diseases of eye and teeth in domestic animals.

### **Theory**

#### **UNIT I**

General Anatomical and physiological considerations for ophthalmic surgery.

#### **UNIT II**

Ophthalmic examination and diagnosis, local anaesthesia of eye, ocular therapeutics, diagnostic instruments.

#### **UNIT III**

General consideration for eye surgery, diseases and surgery of eye lids, lacrimal apparatus, naso-lacrimal duct.

#### **UNIT IV**

Diseases of conjunctiva, cornea, sclera, iris, orbit, lens, vitreous and aqueous humor, retina and optic nerve.

#### **UNIT V**

Ocular manifestation of systemic diseases.

#### **UNIT VI**

Anatomy of teeth, examination of teeth. Diseases of teeth- congenital anomalies (retained deciduous teeth, impacted teeth, abnormalities in the shape of teeth). Diseases of teeth- acquired diseases (dental caries, fracture of teeth, endodontic

disease, dental materials and dental radiography). Restorative dentistry, periodontal disease, tooth extraction, gum diseases. Current techniques in dentistry.

### **Practical**

Ophthalmic instrumentation, examination of the eye and its adnexa, preparation of patient for eye anaesthesia and surgery, canthotomy, tarsorrhaphy, transplantation of cornea, keratoplasty, anterior chamber paracentesis, flushing of naso-lacrimal duct, iridectomy, lens extraction/implantation. Dentistry instrumentation, dental radiography, teeth cleaning, tooth extraction.

### **Suggested Readings**

Gelatt KN. (Ed.). 1981. Veterinary Ophthalmology. Lea & Febiger.

Gelatt KN. (Ed.). 2008. Atlas of Veterinary Ophthalmology. 4th Ed. Blackwell Publ.

Gelatt KN. (Ed.). 2000. Essentials of Veterinary Ophthalmology. Blackwell.

Lavach JD. (Ed.). 1990. Large Animal Ophthalmology. CV Mosby.

Oehme FW & Prier JE. (Eds.). 1984. Textbook of Large Animal Surgery. Williams & Wilkins.

Slatter DH. (Ed.). 1981. Fundamentals of Veterinary Ophthalmology. WB Saunders.

WB

Tyagi RPS & Singh J. (Eds.). 1993. Ruminant Surgery. CBS.

## **VSR 608 SMALL ANIMAL SOFT TISSUE SURGERY**

**2+1**

### **Objective**

To familiarize with various surgical affections of different body systems and their treatment in small animals.

### **Theory**

#### **UNIT I**

Skin and adnexa– the integument, management of skin wounds, principles of plastic and reconstructive surgery, pedicle grafts, skin grafts, burns, electrical chemical and cold injuries.

#### **UNIT II**

Surgical approaches/ affections of ear, oral cavity and pharynx, abdomen, thorax, the salivary glands, oesophagus, stomach, intestines, rectum and anus, liver and biliary system, pancreas.

#### **UNIT III**

Hernias– abdominal hernia, diaphragmatic hernia, perineal hernia, inguinal, scrotal, and umbilical hernia etc. Surgical approaches to thoracic wall, Pleura.

#### **UNIT IV**

Respiratory system– functional anatomy, diseases of upper respiratory system and lower respiratory system.

#### **UNIT V**

Surgical anatomy of the cardiovascular system, cardiovascular physiology, diagnostic methods, cardiac disorders, principles of vascular surgery, basic cardiac procedures, hypothermia, basic peripheral vascular procedures, peripheral vascular disorders, portacaval shunts and anomalies. Haemolymphatic system, bone marrow, spleen, tonsils, lymph nodes and lymphatics, thymus.

#### **UNIT VI**

Male reproductive system– anatomy of the male genital organs, diagnostic and biopsy techniques, surgical affections of male genital organs; female reproductive system– anatomy, diagnostic techniques, surgical affections of female genital organs.

#### **UNIT VII**

Urinary system– anatomy of the urinary tract, principles of urinary tract surgery, kidneys, ureters, surgery of the bladder, surgical diseases of the urethra, medical dissolution and prevention of canine uroliths, feline urologic syndrome.

#### **UNIT VIII**

Endocrine system– pituitary, adrenals, thyroid, parathyroid, surgical affections of mammary glands and tail. Surgical affections of nervous system, special sense organs.

#### **Practical**

Practice of various surgical techniques of skin and adnexa, alimentary system, hernias, respiratory system, cardiovascular system, male and female reproductive systems, urinary system, mammary glands and tail.

#### **Suggested Readings**

Fossum TW. (Ed.). 2002. Small Animal Surgery. Mosby.

Slatter DH. (Ed.). 2002. Textbook of Small Animal Surgery. WB Saunders.

### **VSR 609      LARGE ANIMAL SOFT TISSUE SURGERY**

**2+1**

#### **Objective**

To familiarize with various surgical affections of different body systems and their treatment in large animals.

#### **Theory**

##### **UNIT I**

Abdominal wall, integumentary system – skin and appendages; mammary gland, tail, affections of oral cavity.

##### **UNIT II**

Surgical affections of respiratory system, cardiovascular and lymphatic system.

##### **UNIT III**

Surgical affections of digestive system, urinary and genital system.

##### **UNIT IV**

Surgical affections of nervous system, special sense organs.

#### **Practical**

Practice of various surgical techniques of skin, alimentary system, hernias, respiratory system, cardiovascular system, male and female reproductive system, urinary system, mammary glands and tail. Surgical affections of nervous system, special sense organs.

#### **Suggested Readings**

Auer JA. (Ed.). 2006. Equine Surgery. WB Saunders.

Fubini SL & Ducharme NG. (Eds.). 2004. Farm Animal Surgery. WB Saunders.



<b>VSR 802</b>	<b>CLINICAL SURGICAL PRACTICE – II</b>	<b>0+3</b>
<b>Objective</b>		
To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.		
<b>Practical</b>		
Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel.		
<b>VSR 803</b>	<b>CLINICAL SURGICAL PRACTICE – III</b>	<b>0+3</b>
<b>Objective</b>		
To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.		
<b>Practical</b>		
Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel..		
<b>VSR 804</b>	<b>ANAESTHESIA OF WILD AND LABORATORY ANIMALS</b>	<b>1+1</b>
<b>Objective</b>		
To impart the basic and practical knowledge of chemical immobilization, sedation and anaesthesia of laboratory animals, captive and free ranging wild animals.		
<b>Theory</b>		
<b><u>UNIT I</u></b>		
General considerations in chemical restraint of captive and free ranging wild animals.		
<b><u>UNIT II</u></b>		
Methods of administration of anaesthesia in captive, free ranging animals and laboratory animals.		
<b><u>UNIT III</u></b>		
Local and general anaesthesia in exotic species, wild animals, zoo animals and laboratory animals.		
<b><u>UNIT IV</u></b>		
Anaesthetic emergencies and complications.		
<b>Practical</b>		
Familiarization with capture equipments, local anaesthetic techniques, use of various preanaesthetic and anaesthetic agents in laboratory animals, monitoring of patient during general anaesthesia.		
<b>Suggested Readings</b>		
Selected articles from journals.		
<b>VSR 805</b>	<b>ADVANCES IN ANAESTHESIOLOGY</b>	<b>2+1</b>

## **Objective**

To impart the advanced knowledge of animal anaesthesia.

## **Theory**

### **UNIT I**

Considerations for general anaesthesia, drug interactions in anaesthesia, perioperative pain and distress, effects of anaesthetics on CNS function.

### **UNIT II**

Pharmacology of preanaesthetics and anaesthetic adjuncts; injectable anaesthetics; dissociative anaesthetics; inhalation anaesthetics; local anaesthetics; muscle relaxants and neuromuscular blocking agents.

### **UNIT III**

Anaesthetic machines and breathing system, airway management and ventilation, acid-base physiology and fluid therapy during anaesthesia, monitoring of anaesthetized patients, anaesthetic emergencies and accidents.

### **UNIT IV**

Anaesthesia for selected diseases (cardiovascular dysfunction, pulmonary dysfunction, neurologic diseases, renal diseases, hepatic diseases, gastrointestinal diseases, endocrine diseases, airway diseases).

### **UNIT V**

Anaesthesia for special patients (ocular patients, heart patients, caesarian section patients, trauma patients, neonatal and geriatric patients), euthanasia.

## **Practical**

Various procedures for catheterization of heart and great vessels, haemodynamic changes and pulmonary function tests during trials of anaesthetics, electrocardiographic, encephalographic evaluation of central nervous system activity, cybernetics, data acquisition and retrieval.

## **Suggested Readings**

Selected articles from journals.

## **VSR 806      ADVANCES IN DIAGNOSTIC IMAGING TECHNIQUES**

**2+1**

### **Objective**

To impart the advanced theoretical and practical knowledge of diagnostic imaging techniques and their interpretations.

## **Theory**

### **UNIT I**

Biological effects of radiations (alpha, beta, X-ray and gamma rays) in vivo and in vitro cellular response following radiation as an immunosuppressive agent.

### **UNIT II**

Isotopes (natural and man-made); cyclotron reactor, half-life, decay pattern, storage and handling of radioactive material, fluoroscopy, magnetic resonance imaging and computerised axial tomography, xeroradiography, doppler techniques, indications for ultrasound diagnosis.

### **UNIT III**

Methods in the detection of isotopes, Geiger–Mullar tubes, photo–multiplier tube, medical use of isotope, dosimetry, nuclear medicine and its use in diagnosis of thyroid, kidney, bone and liver function studies.

### **UNIT IV**

Labelling of isotope and biological uses, detonation and fission products.

### **UNIT V**

Radiation therapy in cancer patients, biological effects of radiation physics, physics of radiation.

### **UNIT VI**

Doppler techniques echocardiography and its application, MRI, CT scan, nuclear medicine, xeroradiography, positron emission tomography technique etc.

### **UNIT VII**

Electromagnetic radiations, hazards of electromagnetic radiations and protection and bio–safety.

### **Practical**

Radiation safety measures, handling radioactive material, measurement of thyroid function and cardiac output, demonstration of advanced radiological techniques.

### **Suggested Readings**

Selected articles from journals.

**VSR 807**

**NEUROSURGERY**

**2+1**

### **Objective**

To impart theoretical and practical knowledge of treatment of surgical affections of nervous system in animals.

### **Theory**

#### **UNIT I**

Nervous system– anatomy and physiology.

#### **UNIT II**

Clinical neurology, pathogenesis of disease of the central nervous system.

#### **UNIT III**

Diagnostic methods– electrodiagnostic methods, neuroradiology.

#### **UNIT IV**

Fundamentals of neurosurgery, surgical approaches to brain, surgical diseases of peripheral nerves, surgical approaches to the spine, diseases of the spinal column, intervertebral disc diseases.

#### **UNIT V**

Intracranial surgery.

### **Practical**

Instrumentation, neurological examination, imaging the spine; skull and brain, surgical approach to the cervical spine; thoracolumbar spine and brain.

### **Suggested Readings**

Selected articles from journals.

**VSR 808**

**EXPERIMENTAL SURGICAL TECHNIQUES IN ANIMALS**

**1+1**

**Objective**

To familiarize with designing of experiments and various surgical models for research.

**Theory****UNIT I**

General considerations and protocols for designing experiments.

**UNIT II**

Surgical models of various systems. Care and feeding of genobiotic experimental animals.

**UNIT III**

Rumen and intestinal fistulae, production of experimental peritonitis and ascitis, nephrectomy, adrenalectomy.

**UNIT IV**

Cannulation of various blood vessels and lymphatics, portacaval shunt.

**UNIT V**

Principles of transplantation of organs and use of prosthetic material.

**UNIT VI**

Tissue engineering–in vitro, in vivo, ex vivo techniques, regenerative therapy.

**Practical**

Various experimental surgical techniques and special problems related to veterinary surgery, radiology and anaesthesiology, transplantation of skin, fascia, tendon and blood vessels.

**Suggested Readings**

Selected articles from journals.

**VSR 889      SPECIAL PROBLEMS IN ANAESTHESIA      0+2****Objective**

To impart practical exposure to experimental models related to anaesthesia for research.

**Practical**

Investigative anaesthetic problems in clinical or experimental models. Didactic and interpersonnel learning–teaching, problem solving self–learning strategies in problems related to anaesthesia.

**VSR 890      SPECIAL PROBLEMS IN SURGERY      0+2****Objective**

To impart practical exposure to experimental models related to surgery for research.

**Practical**

Investigative surgical problems in clinical or experimental models. Didactic and interpersonnel learning–teaching, problem solving self–learning strategies in problems related to surgery.

### **List of Journals**

- \* American Journal of Veterinary Research
- \* Canadian Veterinary Journal
- \* Compendium of continuing Education for the practicing Veterinarian
- \* Cornell Veterinarian
- \* Equine Practice
- \* Indian Journal of Veterinary Surgery
- \* Journal of American Veterinary Medical Association
- \* Journal of American Animal Hospital Association
- \* Journal of Bone and Joint Surgery –A & B
- \* Journal of Camel Practice and Research
- \* Journal of Veterinary Emergency and Critical Care
- \* Journal of Small Animal Practice
- \* Journal of Veterinary Dentistry
- \* Journal of Veterinary Medicine – Series A
- \* Veterinary Anaesthesia and Analgesia
- \* Veterinary clinics of North America – Small animal practice
- \* Veterinary clinics of North America – Equine practice
- \* Veterinary clinics of North America – Exotic animal practice
- \* Veterinary clinics of North America – Large animal practice
- \* Veterinary clinics of North America – Food animal practice
- \* Veterinary Ophthalmology
- \* Veterinary Radiology and Ultrasound
- \* Veterinary Record
- \* Veterinary Research Communication
- \* Veterinary Surgery

### **e-Resources**

- \* [www.blackwellpublishing.com/journal.asp](http://www.blackwellpublishing.com/journal.asp) (Veterinary Surgery)
- \* [www.blackwellpublishing.com/summit.asp](http://www.blackwellpublishing.com/summit.asp) (Veterinary anesthesia and Analgesia)
- \* [www.blackwellpublishing.com/journal.asp](http://www.blackwellpublishing.com/journal.asp) (Veterinary Radiology and Ultrasound)
- \* [www.blackwellpublishing.com/journal.asp](http://www.blackwellpublishing.com/journal.asp) (Veterinary Ophthalmology)
- \* [www.indianjournal.com/ijor.aspx](http://www.indianjournal.com/ijor.aspx) (Indian Journal of Veterinary Surgery)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Evaluation of preanaesthetics and anaesthetics in domestic animals
- \* Management of pain in animals
- \* Surgical Management of gastrointestinal tract disorders in bovines
- \* Management of fractures in animals
- \* Ultrasonography of soft organs of large and small animals

## COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 601	LIBRARY AND INFORMATION SERVICES	0+1
PGS 602	TECHNICAL SKILLS WRITING AND COMMUNICATIONS	0+1
PGS 603	(e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 604	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 605	(e-Course) AGRICULTURAL RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 606	(e-Course) DISASTER MANAGEMENT	1+0

### Course contents

**PGS 601 LIBRARY AND INFORMATION SERVICES 0+1**

#### **Objective**

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

#### **Practical**

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

**PGS 602 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1**

#### **Objective**

To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

#### **Practical**

Technical Writing -Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in

scientific write-ups; Editing and proof-reading; Writing of a review article. Communication Skills –Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

### **Suggested Readings**

- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.  
Collins' Cobuild English Dictionary. 1995. Harper Collins.  
Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.  
Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.  
James HS. 1994. Handbook for Technical Writing. NTC Business Books.  
Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.  
Mohan K. 2005. Speaking English Effectively. MacMillan India.  
Richard WS. 1969. Technical Writing. Barnes & Noble.  
Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.  
Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.  
Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

## **PGS 603 (e-Course) 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**

- Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.

Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw–Hill.

Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.

Ministry of Agriculture, Government of India. 2004.

State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.

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; National Biological Diversity Act, 2003.

#### **PGS 604 BASIC CONCEPTS IN LABORATORY TECHNIQUES**

**0+1**

##### **Objective**

To acquaint the students about the basics of commonly used techniques in laboratory.

##### **Practical**

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; 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**

Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.

Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

#### **PGS 605 AGRICULTURAL RESEARCH, RESEARCH ETHICS**

**1+0**

##### **AND RURAL DEVELOPMENT PROGRAMMES (e-course)**

##### **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**

- Bhalla GS & Singh G. 2001. Indian Agriculture – Four Decades of Development. Sage Publ.
- Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.
- Rao BSV. 2007. Rural Development Strategies and Role of Institutions Issues, Innovations and Initiatives. Mittal Publ.
- Singh K.. 1998. Rural Development –Principles, Policies and Management. Sage Publ.

## **PGS 606          DISASTER MANAGEMENT**

**1+0**

**(e-Course)**

### **Objectives**

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

## **Theory**

### **UNIT I**

Natural Disasters– Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions,

Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

**UNIT II**

Man Made Disasters– Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water

## ANIMAL BIOTECHNOLOGY

### Course structure at a glance

CODE	COURSE TITLE	CREDITS
ABT601*	Basic and applied biotechnology	3 + 0
ABT 602**	Fundamentals of cell and molecular biology	3 + 0
ABT 603*	Applied molecular biology	2 + 1
ABT 604**	Animal cell culture: principles and applications	1 + 2
ABT 605**	Molecular diagnostics	1 + 2
ABT 606	Vaccine biotechnology	2 + 1
ABT 607	Immunology applied to biotechnology	1 + 1
ABT 608	Introduction to bioinformatics	2 + 1
ABT 609**	Animal genomics	2 + 1
ABT 610**	Reproductive biotechnology	2 + 1
ABT 611**	Techniques in molecular biology and genetic engineering	0 + 3
ABT 612	Biodiversity, biosafety and bioethics	2 + 0
ABT 613	Molecular forensics	2 + 1
ABT 614	Industrial biotechnology	2 + 1
ABT 615*	Probiotics and feed biotechnology	3 + 0
ABT 616	Animal biotechnology	3 + 0
ABT 691	Master's Seminar	1 + 0
ABT 699	Master's Research	0 + 20

\* Courses may also be taken as Minor/Supporting

\*\* Compulsory for Master's programme

Of the 28 credits for M.V.Sc., 18 credits are compulsory. The rest 10 credits may be taken either from \* or non-star courses

CODE	COURSE TITLE	CREDITS
ABT 801	Gene cloning and expression	1 + 1
ABT 802*	Functional genomics and proteomics	2 + 1
ABT 803	Advances in reproductive biotechnology	2 + 1

ABT 804	Trends in vaccinology	3 + 1
ABT 805	Advances in animal cell culture	2 + 1
ABT 806	Transgenic animal technology	2 + 0
ABT 891	Doctoral Seminar I	1 + 0
ABT 892	Doctoral Seminar II	1 + 0
ABT 899	Doctoral Research	45

\* Courses may also be taken as Minor/Supporting

### Course contents

#### **ABT 601      BASIC AND APPLIED BIOTECHNOLOGY      3+0**

##### **Objective**

Understanding the fundamental principles of biotechnology and its application in agriculture, veterinary sciences, medical sciences, industry and environment.

##### **Theory**

##### **UNIT I**

History of biotechnology, scope of biotechnology, introduction of genetic engineering, plant and animal tissue culture.

##### **UNIT II**

Fermentation technology, immobilized enzymes, vaccines, antibodies and hybridoma technology, diagnostics, embryo transfer technology, sexing of embryo, transgenics.

##### **UNIT III**

Genome, genome mapping, physical maps, genetic maps, different types of DNA markers and their applications.

##### **UNIT IV**

Application of biotechnology in agriculture, veterinary sciences, pharmaceutical industry, food industry, chemical industry and environment.

##### **Suggested Readings**

Becker JM, Cold Well GA & Zachgo EA. 2007. *Biotechnology a Laboratory Course*. Academic Press.

Brown CM, Campbell I & Priest FG. 2005. *Introduction to Biotechnology*. Panima.

Singh BD. 2006. *Biotechnology Expanding Horiozon*. Kalyani.

**Objective**

Molecular structure and functions of cells and molecules such as DNA, RNA and proteins

**Theory****UNIT I**

Evolution of cells, Introduction to molecular interactions, thermodynamics, and equilibrium in molecular recognition and biological functions. Energy production: Structure of mitochondria, and chloroplasts, respiratory chain, ATP synthesis, photosynthesis, genomes of mitochondria and chloroplasts, cellular compartments and intercellular sorting of proteins: endoplasmic reticulum, lysosome, peroxisomes, synthesis and shorting of proteins (lysosomal proteins, membrane proteins, secretory proteins, lipoproteins, glycolipids. Lipid synthesis and transport

**UNIT II**

Cytoskeleton: Mechanism of muscle contraction, actin filaments and cell cortex, ciliary movements and cytoplasmic microtubules and intermediate filaments. Cell signaling: Endocrine, exocrine and synaptic signaling molecules, surface and intracellular receptors, G proteins and generation of secondary messengers, mode of action of cAMP and Ca<sup>++</sup> calmodulin, target cell adaptation. Cell growth and divisions: Cell cycle, cell division controls and transformation, growth factors, genes for social control of cell division, mechanism of cell division, cell adhesion, cell junctions and the extra cellular matrix, growth, development and differentiation.

**UNIT III**

History of molecular biology, nucleic acid as hereditary material, structure of DNA, chromatin, rRNA, tRNA and mRNA, proteins. DNA replication, transcription, translation, genetic code, operon, positive and negative control of gene expression, important enzymes such as RNA replicase, reverse transcriptase, ligase, polymerase, ribozyme, etc.

**UNIT IV**

Molecular mechanism of mutation. Molecular organization of cell, structure of genomes, synthetic chromosomes. RNA processing and alternative splicing, molecular biology of photosynthesis, nitrogen fixation and stress tolerance, development and differentiation and molecular evolution, RNAi and application

**Suggested Readings**

Lewin B. 2008. *Gene IX*. Jones & Bartlett.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific

**Objective**

Understanding the principle and application of recombinant DNA in biotechnology.

**Theory****UNIT I**

Enzymes used in molecular biology and recombinant DNA research, cloning and expression vectors, gene identification, construction of gene libraries, gene mapping and DNA structure analysis.

**UNIT II**

Methods of DNA sequencing, synthesis of double stranded DNA and complementary DNA, cDNA library identification and enrichment of recombinant clones.

**UNIT III**

Methods for transfer of cloned DNA, analysis and expression of recombinant DNA, site directed DNA alterations and gene manipulations, cloning in bacteria, yeast, plant and animal cells.

**UNIT IV**

Genetics of tumourigenic region of agrobacteria and its applications in agriculture, veterinary and medical sciences, biotechnology applications for production of high value and industrial products, safety aspects of genetic manipulations.

**Practical**

- i. Extraction of DNA and RNA.
- ii. Polyacrylamide gel electrophoresis (PAGE).
- iii. Agarose gel electrophoresis.
- iv. Restriction endonuclease analysis of DNA.
- v. Isolation and purification of plasmid.
- vi. Polymerase chain reaction. Cloning of gene.
- viii. Expression of cloned gene.
- ix. Purification of recombinant protein.
- x. Blotting
- xi. RFLP
- xii. RAPD.

**Suggested Readings**

- Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
- Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
- Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific

**Objective**

Understanding the principles of animal cell culture and its application

**Theory****UNIT I**

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture etc.

**UNIT II**

Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application.

**UNIT III**

Behavior of cells in culture conditions, division, their growth pattern, metabolism of estimation of cell number.

**UNIT IV**

Development of cell lines, characterization and maintenance of cell lines, stem cells, cryopreservation, common cell culture contaminants.

**Practical**

- i. Packing and sterilization of glass and plastic wares for cell culture.
- ii. Preparation of reagents and media for cell culture.
- iii. Primer culture technique chicken embryo fibroblast.
- iv. Secondary culture of chicken embryo fibroblast.
- v. Cultivation of continuous cell lines.
- vi. Quantification of cells by trypan blue exclusion dye.
- vii. Isolation of lymphocytes and cultivation of lymphocytes
- viii. Study of effect of toxic chemicals on cultured mammalian cells
- ix. Study of effect of virus on mammalian cells.
- x. Suspension culture technique
- xi. Cryopreservation of cell primary cultures and cell lines.
- xii. Effect of viruses on cultured mammalian cells.

**Suggested Readings**

Freshney RI. 2005. *Culture of Animal Cells*. Wiley Liss.

Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.

**Objective**

Understanding the molecular techniques involved in diagnosis of diseases

## **Theory**

### **UNIT I**

Introduction, importance and historical perspective of development of molecular diagnostic technology, 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**

Application of restriction endonuclease analysis for identification of pathogens, principle of development of pathogen specific DNA probes, Southern and Northern hybridization.

### **UNIT III**

Theoretical background of development of PCR and Real time PCR and its variations, application of PCR for diagnosis of infectious diseases of animals and poultry, nucleic acid sequence based diagnostics.

### **UNIT IV**

Advancements in diagnostic technology including DNA array technology, biosensors and nanotechnology. OIE guidelines in development of diagnostics.

## **Practical**

- i. Preparations of buffers and reagents.
- ii. Collection of clinical and environmental samples from animal and poultry farms for molecular detection of pathogens.
- iii. Isolation of bacterial pathogens from the samples.
- iv. Extraction of nucleic acids from bacteria and clinical specimens.
- v. Restriction endonuclease digestion and analysis in agarose electrophoresis.
- vi. Development of animal pathogen specific nucleic acid probes.
- vii. Southern blotting for detection of pathogens.
- viii. Polymerase chain reaction for detection of pathogens in blood and other animal tissues.
- ix. RT-PCR for detection of RNA viruses.
- x. Real time PCR for detection of pathogens in semen and other animal tissues.
- xi. DNA fingerprinting for identification of animal species.
- xii. PCR based detection of meat adulteration in processed and unprocessed meats.
- xiii. Detection of food borne pathogenic organisms in vegetables and fruits using PCR technology.
- xiv. PCR based detection of potential pathogens in milk, eggs and meat.

## **Suggested Readings**

- Elles R & Mountford R. 2004. *Molecular Diagnosis of Genetic Disease*. Humana Press.
- Rao JR, Fleming CC & Moore JE. 2006. *Molecular Diagnostics*. Horizon

Bioscience. in seed lot systems.

**ABT 606 VACCINE BIOTECHNOLOGY**

**2+1**

**Objective**

Understanding different approaches of vaccine development and production.

**Theory**

**UNIT I**

History of vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems.

**UNIT II**

Instruments related to monitoring of temperature, sterilization, environment, quality assurance and related areas. Production techniques, growing the microorganisms in maximum titre, preservation techniques to maintain good antigen quality, freeze drying.

**UNIT III**

Introduction to newer vaccine approaches namely sub-unit vaccines, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines, edible vaccines, Nano particles in vaccine delivery systems, etc.

**UNIT IV**

Introduction to pharmacopeal requirement, disease security and biosecurity principles and OIE guidelines such as seed management, method of manufacture, in-Process control, batch control, tests on final product.

**Practical**

- i. Inoculation of embryonated chicken eggs for cultivation of virus.
- ii. Harvesting of virus from inoculated embryos.
- iii. Inactivation of harvested viruses.
- iv. Safety and sterility testing of inactivated vaccine.
- v. Inoculation of tissue culture for propagation of virus.
- vi. Harvesting and production of inactivated virus vaccine.
- vii. Isolation and cloning of genes encoding immunogenic proteins.
- viii. Expression of cloned gene.
- ix. Purification of recombinant immunogenic protein.
- x. Immunogenicity studies of recombinant protein
- xi. Immunization of laboratory animals.
- xii. Titration of antibodies against the recombinant protein.

**Suggested Readings**

Barry R Bloom, Paul-Henri Lambert 2002. *The Vaccine Book*. Academic Press.  
Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.



**ABT 608 INTRODUCTION TO BIOINFORMATICS**

2+1

**Objective**

To impart an introductory knowledge about the subject of Bioinformatics to the students studying any discipline of science.

**Theory****UNIT I**

Introduction, biological databases – primary, secondary and structural, Protein and Gene Information Resources – PIR, SWISSPROT, PDB, genbank, DDBJ. Specialized genomic resources.

**UNIT II**

DNA sequence analysis, cDNA libraries and EST, EST analysis, pairwise alignment techniques, database searching, multiple sequence alignment.

**UNIT III**

Secondary database searching, building search protocol, computer aided drug design – basic principles, docking, QSAR.

**UNIT IV**

Analysis packages – commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools.

**Practical**

- i. Usage of NCBI resources
- ii. Retrieval of sequence/structure from databases
- iii. Visualization of structures
- iv. Docking of ligand receptors
- v. BLAST exercises.

**Suggested Readings**

Attwood TK & Parry-Smith DJ. 2003. *Introduction to Bioinformatics*. Pearson Education.

Rastogi SC, Mendiratta N & Rastogi P. 2004. *Bioinformatics: Concepts, Skills and Applications*. CBS.

**ABT 609 ANIMAL GENOMICS**

2+1

**Objective**

Understanding structural, functional and comparative genomics of farm animals and its application for livestock improvement

**Theory****UNIT I**

Historical perspective, genome organization in eukaryotes, satellite DNA including mini and microsatellites and their various families, long and short interspersed nucleotide elements, DNA markers– RAPD, STR, SSCP, RFLP, DNA fingerprinting, SNP, EST etc.

#### **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**

Genetic distance analysis, breed characterization on the basis of DNA markers, genetic markers for quantitative traits loci, marker assisted selection for incorporation of desirable traits DNA markers with economic traits, restriction fragment length polymorphism (RFLP) of different structural genes.

#### **UNIT IV**

Current status of gene maps of livestock, MHC and its relevance to disease resistance and immune response, genes influencing production traits, mitochondrial DNA of farm animals, evolutionary significance, applications of genome analysis of animals in breeding.

#### **Practical**

- i. Chromosome preparation (normal karyotyping, different types of banding) in farm animals.
- ii. Isolation and purification of animal genomic DNA from blood lymphocytes.
- iii. Analysis of DNA by agarose or polyacrylamide gel electrophoresis. Checking the quality and quantity of genomic DNA.
- v. Restriction digestion and analysis.
- vi. Southern hybridization
- vii. DNA fingerprinting.
- viii. Techniques for revealing polymorphism–DNA fingerprinting, RFLP, SSCP, AFLP, STRP etc.
- ix. Genomic DNA cloning or cDNA cloning.
- x. Differentiation of tissues of different species by mitochondrial genome analysis.

#### **Suggested Readings**

- Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.  
Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.  
Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II. Wiley– CVH.

**ABT 610**

**REPRODUCTIVE BIOTECHNOLOGY**

**2+1**

#### **Objective**

Understanding *in-vitro* reproductive techniques for ovum and embryo manipulation.

#### **Theory**

#### **UNIT I**

History, importance of assisted reproductive biotechnology in man and animal, introduction to embryo biotechnology, endocrine therapeutics.

#### **UNIT II**

Biotechnological approaches to reproduction, methodology of super ovulation, *in vitro* fertilization, embryo culture and micromanipulation, preparation of sperm for IVF.

#### **UNIT III**

Different method of gene transfer and their limitations, embryo splitting, embryo sexing by different methods, production of transgenic livestock by nuclear transfer and its application, regulatory issues.

#### **UNIT III**

Cloning of domestic animals. Conservation of endangered species.

Characterization of embryonic stem cells. Different applications of embryonic stem cells.

#### **Practical**

- i. Synchronization and superovulation protocols.
- ii. Collection of embryos using non-surgical procedures.
- iii. Transferring embryos using non-surgical procedures.
- iv. Embryo freezing protocols.
- v. Oocyte collection and evaluation from slaughterhouse ovaries.
- vi. In vitro fertilization protocols.
- vii. Micromanipulation of early embryos.

#### **Suggested Readings**

- Ball PJH & 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.

### **ABT 611      TECHNIQUES IN MOLECULAR BIOLOGY AND GENETIC ENGINEERING    0+3**

#### **Objective**

To provide comprehensive hands-on training on techniques of molecular biology and genetic engineering

#### **Practical**

##### **UNIT I**

Isolation of bacterial plasmids and chromosomal DNA. Isolation of DNA from mammalian cells. Isolation of mRNA/RNA. Quantitation of nucleic acids.

##### **UNIT II**

Plasmid minprep; Restriction endonuclease digestion of plasmid and chromosomal DNA. Agarose gel electrophoresis of RE digested DNA; Isolation of DNA; cDNA synthesis

### UNIT III

Polymerase Chain Reaction using random primers as well as specific primers. Different types of PCR, Real time polymerase chain reaction

### UNIT IV

Cloning of bacterial and viral genes into plasmid vectors. DNA ligation and transformation; Confirmation of insert by RE digestion and touch PCR; Transformation of yeast; Synthesis of nucleic acid probes; Nucleic acid hybridization

### Suggested Readings

Kun LY. 2006. *Microbial Biotechnology*. World Scientific.

Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.

Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

## ABT 612      BIODIVERSITY, BIOSAFETY AND BIOETHICS

2+0

### Objective

Understanding the basis of genetic diversity and its maintenance, biosafety procedures.

### Theory

#### UNIT I

Historical and geographical causes of diversity, genetic diversity, molecular taxonomy, species and population biodiversity. Quantifying biodiversity, maintenance of ecological biodiversity, biodiversity and centres of origin of animals, biodiversity hotspots in India.

#### UNIT II

Collection and conservation of biodiversity, conservation of animal genetic resources, assessing, analyzing and documenting biodiversity. Morphological and molecular characterization of biodiversity, vulnerable and extinction of biodiversity, introduction to biodiversity database, global biodiversity information system, bioethics, CBD.

#### UNIT III

Biosafety and Risk assessment issues; Health aspects; toxicology, allergenicity; Ecological aspects; Regulations; National biosafety policy and law. The Cartagena Protocol on biosafety. The WTO and other international agreements; Cross border movement of germplasm; Risk management issues; Monitoring strategies and methods for detecting transgenics; Risks, benefits and impacts of transgenics to human health, society and the environment.

#### UNIT IV

Bio-safety and bio-hazards; general principles for the laboratory and environmental bio-safety; Environment Impact Assessment; Gene flow in natural and artificial ecologies;

Sources of gene escape; Ecological risks of genetically modified plants. Implications of intellectual property rights on the commercialization of biotechnology products.

### **Suggested Readings**

Arya R. 2005. *Biodiversity*. Deep & Deep.

Gaston KJ. 2004. *Biodiversity: an Introduction*. Blackwell.

Kannaiyan S & Gopalam A. 2007. *Biodiversity in India: Issues and Concerns*. APC.

## **ABT 613            MOLECULAR FORENSICS**

**2+1**

### **Objective**

Understanding the application of DNA based techniques in animal forensics.

### **Theory**

#### **UNIT I**

General history of forensic science, introduction to DNA forensics, scope and application of DNA forensics in animal and human criminal investigations in variety of situations.

#### **UNIT II**

Isolation methods and techniques such as DNA finger-printings, PCR, nucleic acid hybridization, restriction endo-nuclease analysis and sequencing, Individual Animal Identification using DNA fingerprinting

#### **UNIT III**

Animal species identification in religious disputes, adulteration of meat, theft of farm animals and pets etc., advantages, disadvantages and limitations of DNA forensics.

#### **UNIT III**

Mass spectroscopy, protein detections methods, immunological techniques including ELISA, immunoelectrophoresis and immunofluorence.

### **Practical**

- i. Collection of material for forensic analysis.
- ii. Dispatch of material for forensic investigations.
- iii. Storage and processing of forensics material.
- iv. Preparation of different bio-reagents.
- v. Isolation and extraction of nucleic acid from samples.
- vi. Isolation and extraction of nucleic acid from wild animal scat.
- vii. Isolation of nucleic acid from blood, skin, meat, milk, hair and cooked and putrefied meat.
- viii. Designing of primers.
- ix. Polymerase chain reaction (PCR).
- x. Randomly amplified polymorphic DNA (RAPD)
- xi. Restriction fragment length polymorphism (RFLP).
- xii. Multiplex PCR for species identification.

xiii. Detection of adulteration in meat by PCR & nucleic acid hybridization assay.

### **Suggested Readings**

Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*.

Humana Press.

Rudin N & Inman K. 2002. *An Introduction to Forensic DNA Analysis*. 2nd

Ed. CRC Press.

## **ABT 614 INDUSTRIAL BIOTECHNOLOGY**

**2+1**

### **Objective**

Understanding the concept of bioprocessing of products and their production at commercial scale.

### **Theory**

#### **UNIT I**

Introduction, scope and historical development; isolation, screening and genetic improvement of industrially important microorganisms, fermentation: introduction, historical perspective of development of bioprocessing technology.

#### **UNIT II**

Emerging new technologies for processing and production of recombinant products, isolation, preservation. Media designs, sterilization, down stream processing, important fermentation process.

#### **UNIT III**

Immobilization of enzymes and cells, and their application, growth rate analysis, estimation of biomass, batch and plug flow cultures, chemostate cultures. Production of vaccines and diagnostics.

#### **UNIT IV**

Fermented beverages, production of single cell protein, steroid transformation, silage production, waste water treatment. Industrial application of Nanobiotechnology. Computer simulations, energy requirement and product formation in microbial culture, fed-batch and mixed cultures, scale-up principles.

### **Practical**

- i. Isolation of industrially important microorganisms.
- ii. Maintenance and improvement.
- iii. Production of industrial compounds such as alcohol, beer, citric acid, lactic acid.
- iv. Recovery of alcohol, beer, citric acid, lactic acid.
- v. Study of bio-reactors and their operations.

- vi. Production of biofertilizers.
- vii. Experiments on microbial fermentation process.
- viii. Harvesting purification and recovery of end products.
- ix. Immobilization of cells and enzymes.
- x. Studies on enzyme kinetic behavior, growth analysis, biomass estimation, determination of mass transfer co-efficients.

### **Suggested Readings**

Alberghina L. 2000. *Protein Engineering for Industrial Biotechnology*.  
Routledge.

Kun LY. 2006. *Microbial Biotechnology*. World Scientific.

Singh, R & Ghosh SK. 2004. *Industrial Biotechnology*. Global Vision Publ.  
House.

Thomson J. 2006. *Your Guide to Industrial Biotechnology*. Abhishek Publ.

## **ABT 615 PROBIOTICS AND FEED BIOTECHNOLOGY**

**3+0**

### **Objective**

Understanding the concept of probiotics and applications of new tools of biotechnology for quality feed/food production.

### **Theory**

#### **UNIT I**

Introduction, history of probiotics, normal microflora of GI tract, methods for analysis of intestinal microflora, microorganisms and proteins used in probiotics, genetic modification of intestinal lactobacilli and bifidobacteria, recombinant probiotics. Mechanism of action of probiotics, immune response to probiotics, anti-mutagenic and anti-tumor activities of lactic acid bacteria, probiotics and immune system, lactic acid bacteria as live vaccines.

#### **UNIT II**

Application of probiotics for humans, farm animals and poultry, probiotics and intestinal infections, lactose mal-digestion, probiotics regulatory issues. Symbiotics, traditional probiotic products, probiotics industrial perspectives, contradictions, precautions and adverse reactions.

#### **UNIT III**

Introduction, feed processing and preservation, microbial bioconversion of lignin and cellulose rich feeds, factors affecting delignification. Diversity of organisms involved, fermentation techniques, large scale bioconversion of substrates, pre-treatment of feeds, chemical vs. microbial treatment of feeds, anti-nutritional factors present in feeds, microbial detoxification of aflatoxins, mimosine and other anti-metabolites present.

#### **UNIT IV**

Genetic manipulation of organisms to enhance bioconversion ability, manipulation of rumen fermentation by selective removal of protozoa and fungi, effect of feed additives like antibiotics, methane inhibitors, genetic manipulation of rumen microflora to improve feed utilization, single cell protein as animal feed.

### **Suggested Readings**

Fuller R. 1997. *Probiotics 2: Applications and Practical Aspects*. Springer.

Huffnagle GB & Wernick S. 2007. *The Probiotics Revolution: The Definitive Guide to Safe, Natural Health*. Bantam Books.

Kalidas S, Paliyath G, Pometto A & Levin RE. 2004. *Functional Foods and Biotechnology*. CRC Press.

Perdigón G & Fuller R. 2000. *Probiotics 3: Immunomodulation by the Gut Microflora and Probiotics*. Springer.

Roger A. 1989. *Food Biotechnology*. Cambridge Univ. Press.

Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.

Trenev N. 1998. *Probiotics: Nature's Internal Healers*. Avery.

**ABT 616      ANIMAL BIOTECHNOLOGY**

**3+0**

### **Objective**

Intended to provide an overview and current developments in different areas of animal biotechnology.

### **Theory**

#### **UNIT I**

Structure of animal cell, history of animal cell culture, cell culture media and reagents, culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

#### **UNIT II**

Introduction to immune system, cellular and humoral immune response, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology, phage display technology for production of antibodies, antigen-antibody based diagnostic assays including radioimmunoassays and enzyme immunoassays, immunoblotting, nucleic acid based diagnostic methods, commercial scale production of diagnostic antigens and antisera, animal disease diagnostic kits, probiotics.

### UNIT III

Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation for conservation endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, *in utero* testing of foetus for genetic defects, pregnancy diagnostic kits, anti-fertility animal vaccines, gene knock out technology and animal models for human genetic disorders.

### UNIT IV

Introduction to different breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry, genetic characterization of livestock breeds, marker assisted breeding of livestock, introduction to animal genomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance, Transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including bones, hair, blood, skin and other parts confiscated by anti-poaching agencies.

#### Suggested Readings

- Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI. 46  
Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.  
Kun LY. 2006. *Microbial Biotechnology*. World Scientific.  
Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.  
Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.  
Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.  
Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.  
Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

### ABT 801 GENE CLONING AND EXPRESSION

1+1

#### Objective

Understanding the concept of gene cloning and expression.

#### Theory

### UNIT I

Cloning vectors- plasmids, phages, cosmids, BAC, YAC, expression vectors- viral, baculo and yeast vectors, shuttle vectors

## **UNIT II**

Restriction, ligation, transformation and recombinant selection methods, construction of genomic and cDNA library, construction of full length cDNA.

## **UNIT III**

Linkers, adapters and cassettes, screening the library.

## **UNIT IV**

Expression of genes, prokaryotic and eukaryotic expression, identity of protein, purification of expressed protein.

## **Practical**

- i. Preparation of vector.
- ii. Restriction enzyme digestion of vector.
- iii. Purification of DNA.
- iv. DNA ligation.
- v. Transformation.
- vi. Calculation of transformation efficiency.
- vii. Preparation of electro competent cells.
- viii. Screening by PCR.
- ix. Cloning of PCR products in vectors.
- x. Induction of expressed protein
- xi. PAGE and western blotting.

## **Suggested Readings**

Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. Wiley.

**ABT 802          FUNCTIONAL GENOMICS AND PROTEOMICS**

**2+1**

## **Objective**

Understanding gene expression at different conditions/organs.

## **Theory**

### **UNIT I**

Transcriptome and different methods to study gene expression, single gene analysis, northern blots, quantitative PCR, SAGE, MPSS and Microarray.

### **UNIT II**

Introduction to basic microarray technology, Design of experiments, Types of microarray, nanoarray, Customised microarray design, Image processing and quantification, Normalization and filtering, Exploratory statistical analysis, gene expression databases.

### UNIT III

SAGE and Microbeads, massive parallel signature sequencing, Microbial transcriptome. Role of functional genomics to study cancer and various clinical applications, Development, physiology, and behavior, evolutionary and ecology.

### UNIT IV

Proteomics technology, identification and analysis of proteins by 2D analysis, mass spectrophotometry, NMR and X-ray crystallography, MALDI-TOF, Differential display proteomics, Protein-protein interaction, yeast two hybrid system and phage display.

### Practical

- i. Northern blotting
- ii. Quantitative PCR.
- iii. Design of microarray experiments.
- iv. Microarray image processing.
- v. Basic statistical methods.
- vi. Clustering methods to study gene expression.
- vii. Analytical software related to genomics and proteomics

### Suggested Readings

Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.  
Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.  
Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II Wiley- CVH.

**ABT 803**

**ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY**

**2+1**

### Objective

Understanding the new developments in reproductive technology.

### Theory

#### UNIT I

Reproductive cloning, somatic cell nuclear transfer and transgenic animal production, cryopreservation of gametes.

#### UNIT II

Preimplantation genetic diagnosis (PGD), genomic imprinting and assisted reproduction, receptors of different hormones and their estimation.

#### UNIT III

Introduction to stem cells, types, identification, characterization and development of stem cells, transfection of gene in embryonic blastomeres. cells.

#### UNIT IV

Stem cell therapeutics, social, ethical religious and regulatory issues.

### **Practical**

- i. Embryo micromanipulation.
- ii. Microinjection.
- iii. Intra-cytoplasmic sperm injection.
- iv. ICSI Embryo biopsy for PGD and sexing.
- v. Culture of embryonic stem cell.
- vi. Characterization of embryonic stem cells.

### **Suggested Readings**

Selected articles from journals.

**ABT 804**

**TRENDS IN VACCINOLOGY**

**3+1**

### **Objective**

Understanding the latest developments in vaccine production technologies.

### **Theory**

#### **UNIT I**

Molecular approaches to development of vaccines including: recombinant peptide vaccines, vectored vaccines, DNA vaccines, genetically manipulated live vaccines.

#### **UNIT II**

Plant expression system based vaccines, idiotype and synthetic peptide based vaccines, reverse genetic approach and computational vaccinology.

#### **UNIT III**

Immunomodulators including cytokines and new adjuvants, Immunomodulation, innovative methods of delivery of immunogens through liposomes, microspheres, ISCOMS, etc.

#### **UNIT IV**

Large scale production technology and quality control, regulatory issues, environmental concerns with the use of recombinant vaccines.

### **Practical**

- i. Preparation of gene construct for recombinant and nucleic acid vaccine.
- ii. Expression of gene encoding immunogenic protein in prokaryotic/ yeast/ animal cell culture system.
- iii. Study of immune response against recombinant vaccine.
- iv. Protection and evaluation studies.
- v. Use of modern adjuvants in vaccines.
- vi. Vaccine delivery systems including use of nanoparticles

### **Suggested Readings**

Selected articles from journals.

**ABT 805      ADVANCES IN ANIMAL CELL CULTURE**

**2+1**

### **Objective**

Understanding the latest developments in cell culture techniques.

### **Theory**

#### **UNIT I**

Development of cell lines, characterization of cell lines by morphology, chromosome analysis, DNA content, enzyme activity and antigenic markers, differentiation.

#### **UNIT II**

Cultivation requirements of different types of cells, flow cytometry, DNA transfer by calcium phosphate co-precipitation, lipofection, electroporation.

#### **UNIT III**

Expression of recombinant proteins in mammalian and avian cell lines.

#### **UNIT IV**

Up-scaling of cells for production of vaccines, diagnostic antigens and other pharmaceutical agents, up-stream and downstream processing, cell culture fermentors.

### **Practical**

- i. Primary and secondary mammalian cell culture.
- ii. Development of transformed cell lines.
- iii. Characterization of cell lines.
- iv. Transfection of cells with recombinant DNA.
- v. Expression of recombinant proteins.
- vi. Scaling-up of cultures.
- vii. Flowcytometry**
- viii. Immunization of mice**
- ix. Maintenance of myeloma cell lines**
- x. Fusion**
- xi. Characterization of Mabs.**

### **Suggested Readings**

Selected articles from journals.

**ABT 806      TRANSGENIC ANIMAL TECHNOLOGY**

**2+0**

### **Objective**

Understanding the latest developments in transgenic technology.

## **Theory**

### **UNIT I**

Concept of transgenics, techniques of gene transfer, microinjection of recombinant DNA into fertilized eggs/stem cells, transfection of DNA totipotent keratocarcinoma cells, electroporation, gene transfer into cultured cells.

### **UNIT II**

Suitable promoters for expression of transgenes, eukaryotic expression vectors, detection of transgenes in the new born.

### **UNIT III**

Principles of animal cloning, application of transgenic and cloning technologies for improvement of livestock. Transgenic animals as bioreactors.

### **UNIT IV**

Social, ethical, religious, environmental and other regulatory issues related to transgenic animal technology.

### **Suggested Readings**

Selected articles from journals.

## WILDLIFE SCIENCE

### COURSE STRUCTURE AT A GLANCE

CODE	COURSE TITLE	CREDITS
WLS 601	Wildlife Biology and Ecology	2+0
WLS 602	Ethology of Wildlife	1+1
WLS 603	Wildlife Management	2+0
WLS 604	Capture and Immobilization of Wildlife	1+1
WLS 605	Wildlife Pathology	2+1
WLS 606	Special Medicine– Birds, Reptiles, Amphibians and Fishes	1+1
WLS 607	Special Medicine– Mammals	2+1
WLS 608	Zoological Park Clinical Training	0+2
WLS 609	Epidemiology and Population Health	1+1
WLS 610	Wildlife Nutrition	1+1
WLS 611	Wildlife Genetics and Breeding	2+0
WLS 612	Wildlife Parasitology	2+1
WLS 613	Clinical Training – Aves and Reptiles	0+1
WLS 691	MASTER'S SEMINAR	1+0
WLS 699	MASTER'S RESEARCH	0+20

### COURSE CONTENTS

**WLS 601: WILDLIFE BIOLOGY AND ECOLOGY 2+0**

#### **Objective**

To understand on biology and ecology pertaining to wildlife and various related components.

#### **Theory**

##### **UNIT I**

Introduction– Review of biology of major groups with emphasis on species of importance in wildlife– Indian Wildlife and Distribution– Definitions, Concept of endangered species

##### **UNIT II**

Biography– Zoogeography– Wildlife habitats– Components and related concepts– Human Wildlife conflict and its mitigation– Age and Sex determination.

##### **UNIT III**

Ecology– Biotic Environmental factors– Ecological Succession– Communities and Populations– Population dispersion– emigration, Immigration, Migration– Extinction. Ecosystem– Biomass– structure and functioning of ecosystems– Food Chain– ecological Pyramids.

#### **Suggested Readings**

1. Prater, S.H. 1971. The book of Indian Animals. Bombay Natural History Society. Oxford University Press, U.K.
2. Singh, S.K. 2005. Text book of Wildlife Management, International book Distributing co.
3. Odum.P.E., 1996., Fundamentals of Ecology. 3<sup>rd</sup> edn. Nataraj publishers, India

## **WLS 602: ETHOLOGY OF WILDLIFE (1+1)**

### **Objective**

To disseminate knowledge on various behavioral patterns and related features in different species of wild animals belonging to both captive and free ranging areas.

### **Theory**

#### **UNIT I**

Introduction– Animal Behavior– Systems of perception– Kinds of behavior– Habituation– Conditioning– Learning– Communication– Methods and adaptive ness

#### **UNIT II**

Aggression– Sexual and reproductive behavior– Behavior disorders– Effect of captivity on the behavior– Adaptations– Aquatic –Volant– Desert adaptation. Parental Care–

#### **UNIT III**

Environmental Enrichment. Animal Identification– Pug marks– Marking techniques– Wildlife Census– Radio Collaring, Radio telemetry and monitoring– Identification of hoof prints.

### **Practical**

Visit to Zoo and observing behavior patterns– Behavioral disorders– Gadgets for Environmental enrichments. Identification by hoof prints– Pug marks– Preparation of wax and plaster cast of pug marks– Identification of scats, dung pellets etc.

### **Suggested Readings**

1. Arora.M.P 1995. Animal Behaviour. Himalaya Publishing House, India.
2. Desmond Morris, 1990, Animal Watching– a field guide to animal behaviour.Jonathan cape. London
3. Fowler, M.E.1986. Zoo and Wild Animal Medicine, 6th edn. W.B. Saunders Company, HongKong.

## **WLS 603: WILDLIFE MANAGEMENT (2+0)**

### **Objective**

To disseminate knowledge on conservation strategies and various managerial practices pertaining to wild animals.

### **Theory**

## **UNIT I**

Definition of Wildlife- Wildlife natural resources- Objective of Conservation- History of Conservation in India and in the World- State Conservation Strategy and National Conservation Strategy- State and Zoological and Botanical gardens in Conservation.

## **UNIT II**

Introduction of species- Translocation- Reintroduction- Management of small populations- Transport of Wild animals by rail, road, ship and air- Designing of crates for transport- Designing barriers and enclosures- Management of rare and endangered species- Wild animal damage problems and remedies.

## **UNIT III**

Exhibit presentation- Display methods- use of natural and artificial objects- Multiple species exhibits- Pest management- National Wildlife administration- IUCN and Indian definitions- Wildlife census- Wildlife acts and regulations.

## **UNIT IV**

Project Tiger and Project Elephant- Funding agencies for Wildlife Conservation.- NGOs in India for Wildlife Conservation. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – Purpose and Categories; Trade Record Analysis of Flora and Fauna in Commerce (TRAFFIC) – Functions

### **Suggested Readings**

1. Gopal.R., 1992. Fundamentals of Wildlife management. Justice home, Allahabad
2. Hosetti. B.B., 2003. Wildlife Management in India, Aavishkar Publishers, India.
3. Krausman,P.R., 2002. Introduction to Wildlife management-the Basics, Pearsons education.

## **WLS 604: CAPTURE AND IMMOBILIZATION OF WILDLIFE (1+1)**

### **Objective**

To disseminate knowledge on various capture and restraint related techniques pertaining to multiple species of wild animals.

### **Theory**

#### **UNIT I**

Physiology of capture stress – Physical restraints – Equipments – Techniques – Chemical restraining of animals – Purpose of chemical restraints – Physical and chemical properties of various drugs – Pharmacodynamics of immobilization drugs – Drug classification.

#### **UNIT II**

Tranquilizing drugs – Dosage – Precautions to be taken – Various equipments used – Drug delivery systems – Immobilization of Ungulates – Carnivores – Birds – Reptiles

#### **UNIT III**

Planning of capture operation – Post capture care and revival – Veterinary emergencies – Human safety – Legal aspects of wildlife capture and restraining.

## **Practical**

Immobilization equipments and its study – techniques – Practical demonstration of restraining on animal models – capture of wild animals – First aid.

## **Suggested Readings**

1. Nielsen.L., 1999. Chemical immobilization of wild and exotic animals. 1<sup>st</sup> edn. Iowa State University Press, USA.
2. Fowler, M.E.1995. Restraint and handling of wild and domestic animals . 2<sup>nd</sup> edn. Iowa State University Press, Ames.
3. West,G. *et al.* 2007. Zoo animal and Wildlife Immobilization and Anesthesia. Blackwell publishing, U.K.

## **WLS 605: WILDLIFE PATHOLOGY (2+1)**

### **Objective**

To disseminate knowledge on various pathological conditions and related techniques pertaining to various diseases of wild animals.

### **Theory**

#### **UNIT I**

##### **Infectious Diseases**

###### **Bacterial Diseases**

Tuberculosis, Paratuberculosis, Anthrax, Haemorrhagic septicemia/ Pasteurellosis, Brucellosis, Corynebacterial infections, Clostridium infections, enteric infections, Strangles, Glanders, Leptospirosis & Mycoplasmosis.

###### **Viral Diseases**

Rabies, Food and Mouth Disease, Rinderpest, Bovine Viral Disease, Peste Des Petitis, African Horse Sickness, Equine Infectious Anemia, Herpes Virus Infection, Malignant Catarrhal Fever, Feline Panleukopenia, Canine Distemper, Blue Tongue, Canine Parvo Viral Infection, Infectious Hepatitis, Pox, Kyasanaur forest disease, Ranikhet disease, Marek's disease, Lymphoid Leucosis, Japanese encephalitis, Infectious Bronchitis, Infectious Laryngotracheitis, Infectious Bursal Disease and Avian Influenza.

#### **UNIT II**

##### **Mycotic Diseases**

Dermatomycosis, Aspergillus, Aflatoxicosis, Candidiasis, Cryptococcosis, Coccidiomycosis and Blastomycosis.

##### **Rickettsial diseases**

Psittacosis and Ornithosis.

##### **Parasitic diseases**

Common parasitic diseases of wild animals.

#### **UNIT III**

##### **Non infectious diseases**

Neoplastic Diseases – Pathology of environmental pollutants, toxicants, and their hazards – Forensic science techniques – Types of wounds.

#### **UNIT IV**

Management of Infectious Diseases

#### **Practical**

Post mortem examinations – Collection, preservation, and dispatch of postmortem materials – Processing of tissue for histopathological and gross pathological lesions for specific diseases – Stains and staining techniques.

#### **Suggested Readings**

1. Arora, B.M., 2003 Indian Wildlife diseases and disorders, Association of Indian Zoo and Wildlife Veterinarians, Bareilly.
2. Vegad, J.L., 2007, A Text book of Veterinary General Pathology, International Book Distributing co.

### **WLS 606: SPECIAL MEDICINE – BIRDS, REPTILES, AMPHIBIANS & FISHES (1+1)**

#### **Objective**

To disseminate knowledge on special features and treatment protocols for various species of wild birds, reptiles, amphibians and reptiles.

#### **Theory**

##### **UNIT I**

Comparative study of Anatomical and Physiological features of major class of birds, reptiles, amphibians, and fishes –Variation from the standard domestic animals and fowl

##### **UNIT II**

Administration of medicaments – Drugs – Poisoning – Physical and Chemical immobilization – important specific diseases (Viral, Bacterial, Protozoan and Mycotic) – Non specific diseases – Diseases of Zoonotic importance.

##### **UNIT III**

Principles of isolation of causative agent – Haematology – Care and management of sick animals – Critical care.

#### **Practical**

Behavioural studies – Clinical examination – Diagnosis of Diseases – Collection of clinical materials for laboratory examination – Principles of isolation of causative agents – Ultrasonography – Administration of medicaments.

#### **Suggested Readings**

1. Walter, 1996, Diseases of cage and Aviary birds, 3rd edn. Williams and Wilkins publication
2. Mader, 1996, Reptile medicine and surgery, W.B. Saunders Company

3. Fowler, M.E.1986. Zoo and Wild Animal Medicine, 6th edn. W.B. Saunders Company, HongKong.
4. Gill.F.B. 1995. Ornithology 2<sup>nd</sup> ed. W.H.Freeman and Company, New york

### **WLS 607: SPECIAL MEDICINE – MAMMALS (2+1)**

#### **Objective**

To disseminate knowledge on special features and treatment protocols for various species of wild mammals.

#### **Theory**

##### **UNIT I**

Comparative studies of Anatomical and Physiological feature of major class mammals – Variation from the standard domestic animals

##### **UNIT II**

Metabolic diseases– Nutritional diseases – Poisoning and Clinical examinations – Treatment of specific diseases (important Viral, Bacterial, Rickettsial, Protozoan) of Zoonotic importance.

##### **UNIT III**

Principles of isolation of causative agent – Haematology and interpretation of results – care and management of sick animals – Critical care.

#### **Practical**

Behavioural changes – Clinical examination of major class of animals in the Zoological garden – Diagnosis of diseases – Ultrasonography – Collection of Clinical materials for laboratory examination and interpretation of results – Administration of medicaments

#### **Suggested Readings**

1. Fowler, M.E.1986. Zoo and Wild Animal medicine, 6th edn. W.B. Saunders Company, HongKong.
2. Wallach,J.D. and Boever, W.J.1983. Diseases of exotic animals – medical and surgical management. W.B. sounders company, Tokyo
3. Rosenthal, K.L.,1997, Practical exotic animal medicine–the Compendium. Veterinary Learning Systems, New Jersey.

### **WLS 608: ZOOLOGICAL PARK – CLINICAL TRAINING (0+2)**

#### **Objective**

To disseminate knowledge on identification of special features, clinical examination of major class of wild mammals –Drug administration and treatment procedures

## **Practical**

Visit to wildlife sanctuary, National Park – Clinical examination of major class of Zoo animals – Identification of specialized features in wild animals – Health care check up – Immobilization techniques – Administration of drugs – treatment procedures.

## **Suggested Readings**

1. Fowler, M.E.1995. Restraint and handling of wild and domestic animals. 2<sup>nd</sup> ed. Iowa state University Press, Ames.
2. Fudge AM: 1986. Laboratory Medicine Avian and Exotic Pets. Philadelphia, W.B.Saunders company.
3. Hoefler, H.L.,1997. Practical Avian Medicine the compendium Collection. Veterinary Learning Systems Co. Inc., Trenton
4. Burr,E.W. 1987. Companion Bird Medicine. Iowa state university press, U.S.A.

## **WLS 609: EPIDEMIOLOGY AND POPULATION HEALTH (1+1)**

### **Objective**

To understand various features of epidemiology and population health related features in wild animals

### **Theory**

#### **UNIT I**

Epidemiological concepts – Sampling methods – Simple random Sampling – Systematic Sampling – Stratified Random Sampling – Cluster Sampling – Multistage sampling and Surveys.

#### **UNIT II**

Measurement of disease frequency and production – Descriptive epidemiology – disease causation – Monitoring of diseases occurrence.

#### **UNIT III**

Notification and Quarantine screening – Quarantine Laws – Prophylactic Measures – Surveys and Analytical epidemiology – Designs of field trials – Theoretical epidemiology – Rationals – Strategies and concepts of animal diseases control.

## **Practical**

Techniques of Survey – Mapping of Specific and non-specific diseases – Sero-epidemiology – Surveillance – Procedures for disease control. Analysis of internal and external cost benefits – Assessment of discounting and shadow pricing.

## **Suggested Readings**

1. Thrusfield, M. 1995., Veterinary Epidemiology, 2<sup>nd</sup> edn. Blackwell Science Ltd., U.K.

2. Martin, S.W., Meek, A.H. and Willeberg, P. 1987., Veterinary Epidemiology– Principles and Methods, International Book Distributing Co., India

## **WLS 610: WILDLIFE NUTRITION (1+1)**

### **Objective**

To disseminate knowledge on various feeding pattern in both captive and free ranging wild animals and nutrition related features

### **Theory**

#### **UNIT I**

Digestive systems and nutritional principles in feeding wild animals and birds in captivity – Feeding of reptiles – Nutritional requirements – Feeds and feeding habits of captive animals and wild animals – Feeding of Herbivores – Carnivores – Omnivores.

#### **UNIT II**

Predation – Seasonality of food supply – Nutritional deficiency diseases – Management of natural and artificial water supply and salt licks – Fire as a management tool – Management of vegetation as cover and food supply – Grazing control.

#### **UNIT III**

Diet sheet for mammals, birds, reptiles, adapted in the Zoological parks – Identification of nutritional problems in captive animals – rearing of orphan young wild animal – milk substitutes.

### **Practical**

Collection of data on feeds and feeding practice at Zoological gardens – Calculation on nutritional energy – Protein – Carbohydrate – Fat – Minerals and Vitamins – Fiber in the diet supplied to categories of animals and assessment of the nutritional status – Analysis of uncommon local feeds for their proximate composition – Preparation of diet sheet for optimum nutrition – Vegetational data – Collection and identification.

### **Suggested Readings**

1. Pond *et al.*, 2006, Basic Animal Nutrition and Feeding 5<sup>th</sup> edn. Wiley–India Edition
2. Mc Donald, *et al.*, 1995, Animal nutrition, 5<sup>th</sup> edn. Longman scientific technology .U.K.
3. Kleiman, D.G., Allen, M.E., Thompson, K.V. and Lumpkin, S. 1996. Wild Mammals in Captivity–Principles and Techniques , University of Chicago Press, London.

## **WLS 611 WILDLIFE GENETICS AND BREEDING**

**2+0**

### **Objective**

To understand evaluation, breeding strategies, cryopreservation and related features in wildlife breeding and genetics.

### **Theory**

## **UNIT I**

Evaluation and diversity – Adaptation and natural selection – Species and speciation – Variation – Loss of genetic Variation – Hardy–Weinberg equilibrium – Effective population size – Demographic bottlenecks.

## **UNIT II**

Inbreeding – Inbreeding depression–Wild animal breeding in nature and captivity – Captive breeding programmes and principles

## **UNIT III**

Cryopreservation of semen and embryos of endangered species.  
Genetic markers – Application of molecular genetic techniques – Role of cytogenetics in wildlife breeding – Genetic Engineering in wildlife.

### **Suggested Readings**

1. Mc Cholas, E.W., 1991, Veterinary Genetics .Oxford science publication, U.K.
2. Kleiman, D.G., Allen, M.E., Thompson, K.V. and Lumpkin, S. 1996. Wild Mammals in Captivity–Principles and Techniques , University of Chicago Press, London.

**WLS 612      WILDLIFE PARASITOLOGY**

**2+1**

### **Objective**

To disseminate knowledge on the occurrence of various parasitic conditions and their diagnosis in wild animals.

### **Theory**

#### **UNIT I**

Trematode infection (Fasciolosis, Paramphistomosis, Schistosomosis, Paragonimosis)–  
Cestode infections (Taeniosis, Monieziosis, Anaplocephalosis, Dipylidiosis, Diphyllbothriosis, Spirometrosis, Echinococcosis.

#### **UNIT II**

Nematode infection (Ascariosis, Toxocariosis, Toxascariosis, Syngamosis, Strongyloidosis, Strongylosis, Ancylostomosis, Bunostomosis, Kalicephalosis, Spirocercosis, Gnathostomosis, Filariidosis, Trichuriasis, Capilloriosis) –Acanthocephala infections

#### **UNIT III**

Protozoan diseases (Trypanosomosis, Babesiosis, Theileriosis, Anaplasmosis, Coccidiosis, Haemogregarines, Plasmodiosis, Balantidiosis and Haemoproteus infection)

#### **UNIT IV**

Arthropods and arthropod borne diseases

### **Practical**

Collection and preservation of materials from wild animals– Fecal examination, egg count, fecal culture – Fixation and staining of blood smears – Skin scraping examinations – Identification of parasites and lesions caused by them.

### **Suggested Readings**

**Soulsby,E.J.**1982, Helminths, Arthropods and Protozoa of domestic animals. 7<sup>th</sup> ed., ELBS, Bareilley Tindall, London

**Urquhart, G., Armour, J., Duncan, J.L., Dunn,A.M and Jennings, F.W.**1987. Veterinary Parasitology. Longman Scientific and technical, U.K.

**Fowler, M.E.**1986. Zoo and Wild Animal Medicine. 2<sup>nd</sup> ed. W.B.Saunders Company, Hong Kong.

**WLS 613            CLINICAL TRAINING– AVES AND REPTILES**

**0+1**

**Objective**

To disseminate practical information about the clinical approach to aviary species and reptilian species, in addition to the treatment procedures and to understand about the enrichment measures.

**Practical**

Visit to captive aviaries, bird sanctuary and reptilian places – Identification of characteristic features– Collection and examination of clinical materials– Clinical examination of birds and reptiles –Preparation of records and investigation reports– Identification of enrichment measures in aviaries–Health care check up in Aviary species and Reptiles–Restraining Techniques–Common diseases of captive birds and reptiles–Administration of drugs and treatment procedures– Prophylactic measures–hygiene, sanitary measures and vaccination schedule .

**Suggested Readings**

**Fowler, M.E.**1995. Restraint and handling of wild and domestic animals . 2<sup>nd</sup> ed. Iowa state University Press, Ames.

**Hoefler, H.L.**,1997. Practical Avian Medicine the compendium Collection. Veterinary Learning Systems Co. Inc., Trenton

**Mader, D:**(1996) Reptiles medicine and Surgery. W.B.Saunders Company, Philadelphia.

## ANIMAL HUSBANDRY ECONOMICS

### Course Structure at a Glance

Code	Course Title	Credits
AHC 601	Introduction to Economic Analysis	2+1
AHC 602	Macro Economics	2+0
AHC 603	Micro Economics	2+0
AHC 604	Farm Production and Business Management	2+1
AHC 605	Livestock Marketing and Price Analysis	2+1
AHC 606	Animal Husbandry Project Analysis	1+1
AHC 607	Quantitative Methods and Analysis	2+1
AHC 608	Economic Development and Growth	2+0
AHC 609	Animal Husbandry Development and Policy	1+0
AHC 610	Linear Programming	1+1
AHC 611	Livestock Credit and Co-operation	1+0
AHC 612	Natural Resource Economics	1+0
AHC 613	Environmental Economics	3+0
AHC 691	Master's Seminar	1+0
AHC 699	Master's Research	0+20
AHC 801	Advanced Economic Analysis	3+0
AHC 802	Advanced Production Economics	2+1
AHC 803	Advanced Econometrics	2+1
AHC 804	Advances in Livestock Marketing and Price Analysis	2+1
AHC 805	Programming Techniques	3+0
AHC 806	Natural Resource Management	1+1
AHC 891	Doctoral Seminar - I	1+0
AHC 892	Doctoral Seminar - II	1+0
AHC 899	Doctoral Research	0+45

**AHC 601      INTRODUCTION TO ECONOMICS ANALYSIS      2+1**

#### **OBJECTIVE**

The objective of this course is to provide knowledge on basic mathematical and analytical concepts applied to Livestock Economic Research

#### **THEORY**

##### **UNIT I**

Variables and functions; limit and continuity. Specific functions in economic theory.

##### **UNIT II**

Differentiation, theorems of differentiation, differentiation of logarithmic, trigonometric, exponential and inverse functions, function of a function, derivative of higher order, partial derivatives. Application of derivatives to determine average and

marginal values in economic analysis; determination of elasticities; points of inflexion; linear homogeneous production functions; derivation of average and marginal curves.

#### UNIT III

Maxima and minima and their economic applications for optimization problems of cost, production, demand and supply – Constrained maxima and minima – Lagrangian multiplier.

#### UNIT IV

Integration as a reverse process of differentiation, methods of integration, reduction formulae, definite integral, use of integration to determine relation between average and marginal value. Capitalisation over time, estimation of returns from capital goods over time.

#### UNIT V

Set theory–set operations, finite and infinite sets, operations of set, function defined in terms of sets.

#### UNIT VI

Determinants evaluation and properties of determinants. Vectors and vector spaces. Matrices, notations, and operations, laws of matrix algebra; transpose and inverse of matrix; application of determinants and matrices in solution of equation for economic analysis. Functional relationship and parameters.

#### **PRACTICALS**

Differentiation and its applications, Integration and its applications, Maxima and Minima – Optimisation, Solving problems through Matrices, Linear Simultaneous Equations.

#### **SUGGESTED READINGS**

Bose .D., An Introduction to Mathematical Economics, Himalaya Publishing House

**AHC 602      MACRO ECONOMICS**

**2+0**

#### **OBJECTIVE**

Macro economics and Policy course is intended to expose the students to macroeconomic concepts and theory, the application of the macro economic theory, and implication of the macroeconomic policies.

#### **THEORY**

##### UNIT I

Concepts of macro economics, macro economic variables; functional relationships and parameters, economic models; static and dynamic equilibrium. National income and its measurement.

##### UNIT II

Says's law and quantity theory of money. Consumption function, simple theory of income determination, multiplier, accelerator; investment function, interest rate and factors affecting investment. Wage price flexibility and the level of employment (The Keynes Pigou

Controversy.). Demand and supply of money. General equilibrium in product and money market. Integration of theory of value and the theory of money (Don Patinkin's Model vis-à-vis the classical position). Supply side Economics, Laffer curve.

### **UNIT III**

Theories of inflation, inflationary gap, stabilization policies for control of inflation. Theory of trade cycles, sources of disturbances.

### **UNIT IV**

International trade and level of income-mechanism of adjustment, exchange rate variation. Balance of payment. Inter-regional trade agreement. Principle of comparative advantage. Factor endowment theory. Problems of international monetary system. Foreign trade payments.

### **UNIT V**

Public finance-general principle of public finance, principle of maximum social advantage. Public revenue. Incidence of taxation. Monetary policy. Fiscal policy-public expenditure and economic development.

## **SUGGESTED READINGS**

Ahuja HL. 2007. *Macroeconomics: Theory and Policy*. S. Chand & Co.

Gardner Ackely 1987. *Macro Economic: Theory and Policy*. Collier Macmillan.

Dornbusch. 2006. *Macroeconomics*. McGraw Hill Publication

**AHC 603      MICRO ECONOMICS**

**2+0**

## **OBJECTIVE**

This course is intended to provide an overview of microeconomic theory and its applications. It intends to provide fundamental concepts and models in the theory of production and costs and sets out to provide a basic understanding of price and / or output determination under different types of market structures including factor markets. This course will also expose the students to the theory of general equilibrium and welfare economics.

## **THEORY**

### **UNIT I**

Nature and scope of microeconomics. Theory of demand - demand schedule; demand function; price, income and cross elasticity of demand; shift in demand; marginal utility and indifference curve analysis, consumer's equilibrium; income and substitution effect, Slutsky theorem; elementary revealed preference theory.

### **UNIT II**

Theory of firm-production function and productivity curve; optimising behaviour of the firm; factor demand function; cost function; returns to scale; short run and long run supply functions and their derivation; nature of supply function for livestock products.

### **UNIT III**

Market equilibrium and price determination – concept of market; perfect competition, monopoly and price discrimination; duopoly, oligopoly and kinked demand curve; product differentiation and monopolistic competition, effect of taxes on prices and output under different markets.

### **UNIT IV**

Marginal productivity theory of distribution in perfectly competitive market; income distribution and factor markets.

### **SUGGESTED READINGS**

Dewitt KK. 2002. *Modern Economic Theory*. Sultan Chand & Co.

Henderson JM & Quandt RE. 2000. *Microeconomic Theory: A Mathematical Approach*. McGraw-Hill.

Koutsoyiannis A. 2003. *Modern Microeconomics*. The Macmillan Press.

## **AHC 604 FARM PRODUCTION AND BUSINESS MANAGEMENT**

**2+1**

### **OBJECTIVE**

To expose the students to the concept, significance and uses of agricultural production economics. To develop skills in managing a farm and maximizing profits.

### **THEORY**

#### **UNIT I**

Concept, nature and scope of farm management, characteristics of livestock farming as a business, systems and types, farm business decision making process, decision under risk and uncertainty, identification of management parameters and their measurement.

#### **UNIT II**

Production function – total product, marginal product, average product, elasticity of production, stages of production; simple resource – product relationships in livestock production, forms of production function and their characteristics; use of production function in decision making and allocation of resources.

#### **UNIT III**

Economic efficiency – necessary and sufficient conditions; choice indicator and price ratios; effect of change in factor product price ratio on optimal level of inputs; value productivity and profit maximization. Different methods of measuring efficiency – Technical, Allocative and Economic Efficiency

#### **UNIT IV**

Resource substitution and factor relationships–isoproduct curve, isocline, ridgelines, scaleline, expansion path, marginal rate of substitution and elasticity of substitution, least–cost combination of inputs. Total factor productivity.

#### **UNIT V**

Enterprise combination–joint products, competitive, complementary and supplementary enterprises; production possibility curves, isorevenue line, isocline and ridgelines; profit maximisation and enterprise combination.

#### **UNIT VI**

Returns to scale–physical and economic returns to scale; farm size and productivity relationship in livestock enterprises.

#### **UNIT VII**

Risk and uncertainty–types of uncertainty; measures to reduce risk and uncertainty; adjustment of production and resource use to uncertainty. Profit function and cost function.

#### **UNIT VIII**

Supply functions – derivation of cost and supply functions from production functions, aggregate production and supply functions.

#### **PRACTICAL**

Collection and analysis of input– output data of different livestock enterprises– Cost analysis and resource substitutions in various livestock enterprises– Depreciation– Farm business analysis – Budgeting– Balance sheet preparation.

#### **SUGGESTED READINGS**

Gardner BL & Rauser GC. 2001. *Handbook of Agricultural Economics*. Vol. I. *Agricultural Production*. Elsevier.

Heady EO. *Economics of Agricultural Production and Resource Use*. Prentice–Hall.

Sankayan PL. 1983. *Introduction to Farm Management*. Tata Mc Graw Hill.

### **AHC 605 LIVESTOCK MARKETING AND PRICE ANALYSIS**

2+1

#### **OBJECTIVE**

To impart adequate knowledge and analytical skills in the field of livestock marketing issues, and enhance expertise in improving the performance of the marketing institutions and the players in marketing of livestock products.

#### **THEORY**

##### **UNIT I**

Concept, nature and scope of marketing, process and functions, analytical approach. Marketing management, process, environment, consumer behavior. Market opportunities and research, measurement and forecasting, market segmentation.

##### **UNIT II**

Product life cycle, new product development; marketing–mix optimisation, product–mix, brand, packaging, pricing channels, warehouse location, advertisement and sale promotion. Forward trading and speculation.

### **UNIT III**

Demand and supply – Consumption and demand for farm products, demand projections; production and supply of livestock products, marketable surplus, supply projections.

### **UNIT IV**

Market organization and efficient – market functionaries and their role, marketing channels in organized and unorganized sectors, market integration, co-operative marketing. Marketing efficiency, cost, margins and price–spread, practices in marketing of livestock products.

### **UNIT V**

Introduction to international economics – internal trade vs international trade – classical theory of trade – Adam Smith. David Ricardo – Neo Classical trade theory – offer curves and terms of trade – factor endowments and the Heckscher–Ohlin theory. Estimation of comparative advantage in production.

### **UNIT VI**

Estimation of demand – Price analysis – objective and importance; nature and causes of price variations, whole sale and retail prices, temporal and spatial price relationships and equilibrium models; price discrimination, parity prices: administered pricing: price stabilisation measures, price policy for livestock products in India.

### **UNIT VII**

Study of factors affecting prices of livestock products– Long term, cyclical, seasonal and other price movements – Sources of information relating to production and demand factors – Government activities as they relate to prices of livestock products – Forecasting methods– Index numbers.

### **UNIT VIII**

Forecasting – time series and econometric forecasting.– Export trends in Livestock products.

### **PRACTICAL**

Marketing research– Marketing costs and marketing margins– Functionaries– Visit to various marketing institutions such as cooperatives and grading centres.

Collection and analysis of time series price data of livestock products, estimation of demand and supply, forecasting.

Estimation of seasonal and cyclic variations and trends in prices of livestock products.

### **SUGGESTED READINGS**

Rhodes VJ. 1978. *The Agricultural Marketing System*. Grid Publ., Ohio.

Shepherd SG & Gene AF. 1982. *Marketing Farm Products*. Iowa State Univ.Press.

Singhal AK. 1986. *Agricultural Marketing in India*. Annual Publ., New Delhi.

**AHC 606      ANIMAL HUSBANDRY PROJECT ANALYSIS**

**1+1**

### **OBJECTIVE**

The Course Objective of the course is to impart knowledge on issues related to lending to priority sector credit management and financial risk management. The course would bring in the various appraisal techniques in project – investment of Animal Husbandry projects.

## **THEORY**

### **UNIT I**

Project Concepts–Advantages–Disadvantages – along with financial and economic aspects. Pay back period. Risk management is not covered.

### **UNIT II**

Decision tree, option pricing–Project cycle – Project analysis – six aspects – technical, social, commercial, organizational / institutional aspects – Financial aspects of project analysis –Economic aspects of project analysis

### **UNIT III**

Measures of project worth – Pay back period

### **UNIT IV**

Formulation of schemes for animal Husbandry development for financing by various credit institutions.

### **UNIT V**

Study of Economic criteria of livestock health projects appraisal – Risk Management.

## **PRACTICAL**

Various Animal Husbandry Project preparation – Undiscounted measures of project worth– calculation of time value of money– Discounted measures of project worth– B C Ratio, NPW, IRR– Evaluation. Writing a business plan.

## **SUGGESTED READINGS**

Dhubashi PR. 1986. *Policy and Performance – Agricultural and Rural Development in Post Independent India*. Sage Publ.

Gittinger JP 1982. *Economic Analysis of Agricultural Projects*. The Johns Hopkins Univ. Press.

Gupta SC. 1987. *Development Banking for Rural Development*. Deep & Deep Publ.

Little IMD & Mirlees JA. 1974. *Project Appraisal and Planning for Developing Countries*. Oxford & IBH Publ.

Muniraj R. 1987. *Farm Finance for Development*. Oxford & IBH Publ.

**AHC 607      QUANTITATIVE METHODS AND ANALYSIS**

**2+1**

## **OBJECTIVE**

The Course Objective of the course is to impart knowledge on econometric tools to the students of livestock economics. Training in econometrics will help the student to analyze the economic problem by applying quantitative techniques.

## **THEORY**

## **UNIT I**

Concept of Econometrics, relationship among economic variables; parameters and estimates, use and importance of econometrics in economic analysis.

## **UNIT II**

Linear Model – specification of variables, regression coefficient; constant term, least-squares and its assumptions; estimation of parameters of the model;

## **UNIT III**

Properties of least-square estimates; Gauss-Markov Theorem; simple correlation; fixed and stochastic regressors, method of estimation, error variance, standard error of regression coefficient. Coefficient of determination. Test of significance and prediction. Non-linear models.

## **UNIT IV**

Extension of two variable linear regression model – estimation of parameters, partial correlation coefficients, coefficient of multiple determinations, test of significance of least squares estimates.

## **UNIT V**

Regression analysis and analysis of variance. Testing the overall significance of regression, improvement of fit from additional regressors. Chow test. Consequences of left out variables. Limited Dependant variables – logit volset.

## **UNIT VI**

Heteroscedasticity– sources, tests, consequences and solutions. Autocorrelation– sources, consequences, Durbin Watson test; method of estimation and prediction. Solutions for the case of auto-correlation.

## **UNIT VII**

Multicollinearity – tests, consequences and possible remedies. Dummy variables and its applications.

## **UNIT VIII**

Logistic regression analysis – Binary – Multinomial and Nested Logit. Introduction to distributed Lag Models – Koyck's Geometric lag scheme. Simultaneous equation models, introduction to Multi variate analysis.

## **PRACTICAL**

Identification of research problems–Formulation of hypothesis and specification of objectives–Questionnaire formulation–Field survey–Estimation of parameters of the different types of regression equations–Using least square technique– exercise pertaining to distributed lags, dummy variables, Simultaneous equations and discriminant function.

## **SUGGESTED READINGS**

Gujarati DN. 2003. *Basic Econometrics*. McGraw Hill.

Johnson AG Jr., Johnson MB & Buse RC. 1990. *Econometrics – Basic and Applied*. MacMillan.

Koutsoyianis A. 1997. *Theory of Econometrics*. Barner & Noble.

Maddala GS. 1992. *Introduction to Econometrics*. MacMillan.

Maddala GS. 1997. *Econometrics*. McGraw Hill.

## **OBJECTIVE**

The objective of the course is to provide orientation to the students regarding the concepts and measures of economic development and to provide orientation on theories of economic growth and relevance of theories in developing countries.

## **THEORY**

### **UNIT I**

Concept of Economic Development and Growth.

### **UNIT II**

Character of developing countries- Measuring Economic growth - Demographic Characteristics- Population policies.

### **UNIT III**

Development index - poverty - issues in a developing economy - equity and inclusive growth - social safety net - food and nutritional security - growth opportunities in a developing world - human capital and development

### **UNIT IV**

Theories and models of Economic growth including recent contributions- Development strategies.

### **UNIT V**

Balanced Vs Unbalanced Growth.

### **UNIT VI**

Policies to promote growth- Financing Development.

## **SUGGESTED READINGS**

Chakaravathi RM. 1986. Under Development and Choices in Agriculture. Heritage Publ., New Delhi.

Diwett KK. 2002. Modern Economic Theory. S. Chand & Co.

Jhingan ML. 1998. The Economics of Development and Planning. Vrinda Publ.

Naqvi SNH. 2002. Development Economics - Nature and Significance. Sage Publ.

**AHC 609      ANIMAL HUSBANDRY DEVELOPMENT AND POLICY**

**1+0**

## **OBJECTIVE**

The objective of the course is to make them to understand the livestock policies and its effect on sustainable livestock development and to make them to understand the globalization and its impact on livestock development.

## **THEORY**

### **UNIT I**

Role of livestock in economic / rural development – Need for sound livestock policies – Policy Frame Work–goals, values and beliefs – Technology Mission in Livestock – Operation Flood – Blue Revolution.

## **UNIT II**

Animal Husbandry Development Programmes – their consequences and welfare effects– Effect on income and employment level–Alternate policies for animal husbandry development –

## **UNIT III**

Current policy problems and future of Animal husbandry development policies. – Credit policy.

## **UNIT IV**

Policy planning and programming for resource use and environmental quality.

## **UNIT V**

New economic policy and livestock development–GATT – Origin, utility and success, WTO / AoA/ SPS and Indian livestock development.

## **UNIT VI**

*Planning in India–Five year plans and Livestock development– Relationship between Animal husbandry and other sectors.*

## **UNIT VII**

*Role played by Animal Husbandry sectors in economic development – process of modernization in Animal Husbandry– policies for accelerating Animal Husbandry development.*

## **SUGGESTED READING**

Frank E. 1992. *Agricultural Policies in Developing Countries*. Cambridge Univ. Press.  
Chatak S & Ingersent K. 1984. *Agriculture and Economic Development*. Select Book Service Syndicate, New Delhi.

## **AHC 610      LINEAR PROGRAMMING**

**1+1**

### **OBJECTIVE**

The Course Objective of the course is to impart knowledge of Linear programming techniques.

### **THEORY**

#### **UNIT I**

Basic concepts of optimization – Method of differential calculus– Its implications– Mathematical programming–Concepts, Theory and principles–Algebraic –Linear programming – Transportation problem – Assignment – Game Theory – Waiting line problems – Project evaluation – PERT – CPM – Inventory models.

## **UNIT II**

Problem formulation and solution–data requirement; preparation of input–output coefficients; objective function; constraint equations;

## **UNIT III**

Simplex method of solution of problem; basic and feasible solutions; use of slack surplus activities; artificial activities;

## **UNIT IV**

Degeneracy; cycling; inconsistency; infeasible and unbounded solutions; primal–dual solutions. Economic interpretation of primal and dual solutions.

## **PRACTICAL**

Formulation of model – Graphical method–Simplex methods– Use of artificial variables–Big M Method–Two phase method– Sensitivity Analysis – Shadow Prices – MOTAD – Bounded Variables.

## **SUGGESTED READINGS**

Dorfman R. 1996. *Linear Programming & Economic Analysis*. McGraw Hill.

Shenoy G. 1989. *Linear Programming–Principles & Applications*. Wiley Eastern Publ.46

Vaserstein. 2006. *Introduction to Linear Programming*. Pearson Education Publication

## **AHC 611 LIVESTOCK CREDIT AND CO–OPERATION**

**1+0**

## **OBJECTIVE**

The Course Objective of the course is to impart knowledge on issues related to lending to priority sector credit management and financial risk management.

## **THEORY**

### **UNIT I**

Scope of farm finance, role of credit for livestock and rural development. Classification and sources of credit. Principles of credit management – returns from investment, repaying capacity and risk bearing ability.

### **UNIT II**

Estimation of credit needs. Interest rate and cost of credit. Use of financial statements and ratios in farm credit. Methods of repayment of loans, supervised credit system. Structure, organisation functions and principles of banking. Negotiable instruments – their collection and payment.

### **UNIT III**

Commercial banks and co–operative credit institutions. Objectives and role of Reserve Bank of India, National Bank for Agriculture and Rural Development (NABARD), Lead Banks and Regional Rural Banks – Role of private banks – CRR – SLR and other policies – contract farming and insurance. Internal and external credit rationing. Farm credit policies in India.

#### **UNIT IV**

Objectives and Principles of co-operation. Genesis of co-operative movement. Types of co-operative societies – structure and functions. Management of co-operatives at different levels. Role of co-operatives in livestock development. Operation Flood Programme.

#### **SUGGESTED READINGS**

Gupta SC. 1987. *Development Banking for Rural Development*. Deep & Deep Publ.  
Muniraj R. 1987. *Farm Finance for Development*. Oxford & IBH Publ.

### **AHC 612      NATURAL RESOURCE ECONOMICS**

**1+0**

#### **OBJECTIVE**

The Course Objective of the course is to introduce economics principles related to natural resource and environmental economics and too explore the concept of efficiency and the efficient allocation of natural resources

#### **THEORY**

##### **UNIT I**

Natural resources and economic growth – resource scarcity and environmental degradation – optimum management of resources; land, water, forestry, fisheries and minerals.

##### **UNIT II**

Role of institutions and suitability of technologies – management of energy resources – allocation of natural resources over time – common property resources – concept of capacity sharing.

##### **UNIT III**

Investment decisions related to resource development – relationship between conservation, extraction and exploration of resources

##### **UNIT IV**

Economic efficiency and maximum social well being – social welfare function and criteria for economic policy.

#### **SUGGESTED READINGS**

Hartwick JM & Olewiler ND. 1998. *The Economics of Natural Resource Use*. 2<sup>nd</sup> Ed. Addison-Wesley Educational Publ.  
Kerr JM, Marothia DK, Katar Singh, Ramasamy C & Bentley WR. 1997. *Natural Resource Economics: Theory and Applications in India*. Oxford & IBH.  
Kolstad CD. 2000. *Environmental Economics*. Oxford Univ. Press.  
Pearce DW & Turner K. 1990. *Economics of Natural Resources and the Environment*. John Hopkins Univ. Press.

**OBJECTIVE**

The Course Objective of the course is to understand the economics of why environmental problems occur and to explore the concept of efficiency and the efficient allocation of pollution control and pollution prevention decisions and to understand the environmental policy issues and alternative instruments of environmental policies

**THEORY****UNIT I**

Economic growth and its impact on natural resource use- conflict between exploitation and ecological balance- Problems of over exploitation- Environmental degradation- problems of deforestation, soil erosion, pollution and their effects such as floods, drought, scarcity of fuel-

**UNIT II**

Methodology for estimating environmental degradation- Need of project environmental qualities- Contribution of technology for ecological projection- Concept of sustainability- Strategies for prospective resource use planning

**UNIT III**

Concept of externalities and internalization of externalities to maximize social welfare- need for building awareness, motivation and collective social action plan and implement strategies for environmental management.

**UNIT IV**

Social benefit and Social Cost- Use of B-C Ratio- A review of programmes and policies.

**UNIT V**

Global environmental issues - Climate change and environment - causes - impact on livestock sector - adaptation and mitigation strategies.

**SUGGESTED READINGS**

Sankar U. 2001. Environmental Economics. Oxford Univ. Press.

Sengupta R. 2000. *Ecology and Economy, an Indian Perspective*. Oxford Univ. Press.

Tietenberg T. 2003. *Environmental and Natural Resource Economics*. 6th Ed. Addison Wesley

**OBJECTIVE**

The Course Objective of this course is to introduce the theoretical models and applications of microeconomic theory, to understand the macroeconomic theory, to examine the macroeconomic Policy issues and to analyze the macroeconomic Policy implications

## **THEORY**

### **UNIT – I**

Theory of firm – Profit maximization–Duality dynamic supply functions–Theory of market competition–Cournot–Nash equilibrium–General equilibrium – General equilibrium theory and dynamics – Walrasian equilibrium.

### **UNIT – II**

Welfare economics–Social choice theory–Social welfare conditions–Measurement of economic welfare–Applied welfare–theory–Optimal pricing – Edgeworth box and Pareto optimality, Social Accounting Matrix – income and expenditure flows across sectors and policy analysis.

### **UNIT – III**

Income and product accounting–Capital market and money market equilibria – Walras’s law – Portfolio adjustment–Shift in investment demand–Fiscal and monetary policies– Neoclassical economic growth theory–Money and economic–Exchange rate systems.

### **UNIT – IV**

Rational expectations in macro economics policy making under certainty – New Keynesian–macro economic models – Basic Neoclassical growth model– basic model extended –Kaldar Saving function – Ando Modigliani consumption function – Golden rule and optimal growth model –Phelps Golden rule of accumulation –stock adjustment dynamics.

### **UNIT – V**

Foreign sector and Balance of payments – International trade and market – Economics of liberalization.

## **SUGGESTED READINGS**

Henderson JM & Quandt RE. *Microeconomic Theory: A Mathematical Approach*. McGraw–Hill.  
Koutsoyiannis A. 2003. *Modern Microeconomics*. The Macmillan Press.  
Froben RT. 1999. *Macro Economic: Theory and Policies*. 6th Ed. Prentice Hall.  
Samuelson PA & Nordhaus WD. 2004. *Economics*. McGraw–Hill.

**AHC 802      ADVANCED PRODUCTION ECONOMICS**

**2+1**

## **OBJECTIVE**

To expose the students to the concept, significance and uses of advance production economics.

## **THEORY**

### **UNIT – I**

Role of production economics under dynamic farming situations, methodology of production function analysis; CES production function; profit and cost function – flexible

functional forms – homogeneous functions and Euler’s theorem; Frontier production function – technology change and production function.

#### **UNIT – II**

Decomposition analysis; choice between products and resource use; multiple products and discontinuous opportunity; short term and long term planning curves; price variability in production and resource adjustment – Decision tree analysis.

#### **UNIT – III**

Classification and aggregation problems; economic decisions overtime for production process; planning horizon and expectation model.

#### **UNIT – IV**

Economic efficiency – estimation methods – factor shares – Total Factor Productivity analysis – optimal control theory.

#### **UNIT – V**

Optimization under uncertainty; method of analysis for risk and uncertainty in livestock production; capital and investment, replacement problems; multi-period planning; resource valuation.

#### **PRACTICAL**

Production function with perfect and imperfect knowledge– Estimation of production functions using farm level and experimental data–optimum input use– estimation of utility functions– Functions with stochastic dominance – Stochastic Frontier Production functions. Estimation of risk preference – Risk programming models – MOTAD, Quadratic programming, Simulation models.

#### **SUGGESTED READINGS**

Chambers RG. 1988. *Applied Production Analysis*. Cambridge Univ. Press.

Gardner BL & Rausser GC. 2001. *Handbook of Agricultural Economics*. Vol. IA *Agricultural Production*. Elsevier.

Palanisami KP, Paramasivam & Ranganathan CR. 2002. *Agricultural Production Economics: Analytical Methods and Applications*. Associated Publishing Co.

**AHC 803      ADVANCED ECONOMETRICS**

**2+1**

#### **OBJECTIVE**

The Course Objective of the course is to impart knowledge on advanced econometric tools to the Research Scholars of livestock economics. Training in advanced econometrics will help the Research Scholars to analyze the economic problem by applying quantitative techniques.

#### **THEORY**

#### **UNIT – I**

Mixed estimation; use of instrumental variables in regression analysis; distributed lag models; principal adaptive expectation and partial adjustment models;

#### **UNIT – II**

Restricted least squares; linear constraints on coefficients; jointly dependent and predetermined variables.

#### **UNIT – III**

Simultaneous equation models–basic rationale; identification problem; single equation methods of estimation; reduced form equation; indirect least squares; two–stage least squares and k–class estimators; limited information maximum likelihood; three–stage and full information likelihood; recursive models; relative merits of these methods and their small and large sample properties.

#### **UNIT – IV**

Simulation analysis for dairy economic problems; spectral analysis.

#### **UNIT – V**

Pooling of cross–section and time series data, estimation with different data and dummy variables. Component analysis and Multivariate analysis – Zellners Seemingly Unrelated Regression Analysis (ZSURE) – Survival analysis – Input – Output analysis (Social Accounting Matrix)

#### **PRACTICAL**

Estimation of multiple regression model– GLS Estimation methods– Estimation in multicollinearity and heteroskedasticity and autocorrelation–testing misspecification errors– estimation of LPM, Logit, probit and tobit models–Comparing two regressions–chow test– Estimation of distributed lag models and simultaneous equation models–method of indirect least squares–the method of 2 SLS–Estimation of SURE model – Estimation of variance components models– estimation of switching regression, adaptive regression, stochastically convergent parameter and pure random coefficient models– Computer packages used in Econometrics – Estimation of econometric equations using PC Splice functions and estimation.

#### **SUGGESTED READINGS**

Greene WH. 2002. *Econometric Analysis*. Pearson Edu.

Johnston J & Dinardo J. 2000. *Econometric Methods*. McGraw–Hill.

Kelejan HH & Oates WE. 2001. *Introduction to Econometrics Principles and Applications*. Harper & Row.

Maddala GS. 2002. *Econometrics*. McGraw Hill.

**AHC 804      ADVANCES IN LIVESTOCK MARKETING AND PRICE ANALYSIS      2+1**

#### **OBJECTIVE**

The main Course Objective of this course is to critically analyze the important marketing concepts, models, properties of livestock product prices and forecasting, data collection and analysis using current software etc., in order to make them policy decisions in the field of livestock marketing.

#### **THEORY**

#### **UNIT – I**

Marketing systems analysis and simulation–consumer and industrial buying models– Marketing strategy formulation– Factor analysis, Discriminant analysis and Markov chains process in marketing problems– Discrete optimisation techniques in market analysis.

#### UNIT – II

Distributive allocative and equilibrating function of prices.

#### UNIT – III

Demand models– Duality models of demand, derived demand– Inventory demand– Separability and aggregation of flexible functional forms and demand system– Factor demand– Demand elasticities and coefficients– supply models– uncertainty, risk aversion and supply– Supply response models.

#### UNIT – IV

Aggregate price, output and income determination for agriculture –spatial equilibrium– Cobweb model–price forecasting with a structural econometric–model Non parametric price analysis.

#### UNIT – V

Agricultural price policy– Marketed supply versus total supply– Price support and input subsidies model– Seasonal stabilization – Effects of changes in seasonal price pattern on consumer and producer welfare. Fourier Analysis, ARIMA. Forecasting volatility–Value at risk (VaR), GARCH and ARCH models.

#### **PRACTICAL**

Paradigms and models for application to field problems in livestock marketing with the use of computer. Estimation of demand models– Estimation of supply models– Supply response of livestock products – Estimation of cobweb models– Simulation and estimation of commodity models– application of Regression analysis on time series data– Application of price forecasting models– ARMA–ARIMA – Estimation of effect of input subsidy on livestock Economy– Estimation of changes in seasonal price pattern on consumer and producer welfare.

#### **SUGGESTED READINGS**

- Ferris JN. 1998. *Agricultural Prices and Commodity Market Analysis*. McGraw–Hill.  
Goodwin JW. 1994. *Agricultural Price Analysis and Forecasting*. Wiley.  
Hallam D. 1990. *Econometric Modeling of Agricultural Commodity Markets*. New Routledge.  
Martimort D. (Ed.). 1996. *Agricultural Markets: Mechanisms, Failures, and Regulations*. Elsevier.  
Schrimper RA. 2001. *Economics of Agricultural Markets*. Pearson.  
Timmer CP. 1986. *Getting Prices Right*. Cornell University Press.  
Tomek WG & Robinson KL. 2003. *Agricultural Product Prices*. 4th Ed. Cornell University Press.

**AHC 805 PROGRAMMING TECHNIQUES**

**3+0**

#### **OBJECTIVES**

The main Course Objective of this course is to impart knowledge of Linear programming techniques and other programming techniques applied to Livestock Economics.

## **THEORY**

### **UNIT – I**

Post optimality analysis of linear programming problem. Sensitivity analysis– discrete change in the requirement vector, cost vector and coefficients matrix; structural changes of addition or deletion of activities and constraints. Parametric programming– parameterisation on the cost vector and requirement vector.

### **UNIT – II**

Integer programming–need for pure and mixed integer programming–integer solution of linear programming problem using Gomory’s constraint method, branch and bound algorithm.

Vehicle scheduling model–need for vehicle scheduling model, saving concept, steps involved for solution of the problem subject to different conditions and constraints.

### **UNIT – III**

Transportation model–special case of linear programming. Steps used in the solution of a transportation problem, north–west corner rule, Vogel’s approximation method, inspection method; transportation problems with difference in total capacity and total requirement; degenerate solution.

### **UNIT – IV**

Assignment model– a special case of the transportation problem. Mathematical formulation of the problem, the assignment algorithm.

### **UNIT – V**

Dynamic programming–recursive relationships, Bellman’s principle of optimality, optimal replacement, relationship between linear and dynamic programming.

### **UNIT – VI**

Non–linear programming–objective functions, constraints, Lagrange multiplier and Kuhn–Tucker conditions, quadratic programming format of the problem, technique and dual of the quadratic programming problem.

### **UNIT – VII**

Separable programming–definition, linear approximation of non–linear function, reduction of separable problem to linear programming problem, algorithm. Theory of games–characteristics of games, minimax (Maximin) criterion and optimal strategy; saddle point, optimal strategies, value of game; solution of game with saddle point.

### **UNIT – VIII**

Simulation technique–introduction, random numbers, frequency distribution, sampling from frequency distribution, solution. Systems analysis–definition and terminology, closed and open system, model and solutions.

## **SUGGESTED READINGS**

Dorfman R. 1996. *Linear Programming & Economic Analysis*. McGraw Hill.

Shenoy G. 1989. *Linear Programming–Principles & Applications*. Wiley Eastern Publ.46

Vaserstein. 2006. *Introduction to Linear Programming*. Pearson Education Publication

**OBJECTIVES**

This is an applied economics course that focuses on the economic analysis of natural resources, and seeks to identify and solve natural resource management problems via mathematical approach using dynamic optimization techniques.

**THEORY****UNIT – I**

Natural resources – Factors influencing use of natural resources; ownership and control.

**UNIT – II**

Optimization of natural resource use– objectives of social welfare – equity and efficiency

**UNIT – III**

Methods of resource management – conservation, discovery and rejuvenation– dynamics of resource use planning for economic growth and sustainability.

**UNIT – IV**

Policy support – Institution – Programmes and incentives

**UNIT – V**

Policy analysis for NRM and environmental economics. Livestock sector growth and NRM –Sustainability – measurement, issues and remedial measures – Analytic Hierarchy Process

**PRACTICAL**

Assessment of India's natural resource situation. Forecasting future natural resources– Time series analysis in natural resources– Identifying resource problems – Assessment of land, water and forest degradation through visit to case areas – Marginal analysis of livestock production and analysis of space and market with illustration – Public and private investments – Evaluation of cost and benefits of public and private investment– Review of mathematical and simulation models in analysing natural resource problems – Programming natural resource management.

**SUGGESTED READINGS**

Baland J–M & Platteau JP. 1996. *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Clarendon Press and FAO.

Carlson GA, Miranowski J & Zilberman D. 1998. *Agricultural and Environmental Resource Economics*. Oxford Univ. Press.

Chiang AC. 1992. *Elements of Dynamic Optimization*. Waveland Press.

Clark CW. 1976. *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*. John Wiley and Sons.

- Conrad JM & Clark CW. 1997. *Natural Resource Economics: Notes and Problems* Cambridge Univ. Press.
- Conrad JM. 1999. *Resource Economics*. Cambridge University Press.
- Fisher AC. 1981. *Resource and Environmental Economics*. Cambridge Univ. Press.
- Prato T. 1998. *Natural Resource and Environmental Economics*. Iowa State Univ. Press.
- Stern T. 2003. *Policy Instruments for Environmental and Natural Resource Management*. Resources for the Future, Washington DC.

## A.H. Statistics and Computer Applications

**AHS 601 Applied Statistics**

**2+1**

**Theory:** Theory of Sampling, Need for Sampling, Advantages of Sampling Properties of Estimators and concept of Standard Error, Use of various parameters and statistics, Parametric and non-Parametric test – Statistics parametric Test based on  $\chi^2$ , 't' and 'F' distribution, Non – parametric tests based on  $\chi^2$  Sign test, Run test and Rank test. Use and construction of Confidence Interval, Path Analysis and Multiple Regression Analysis, Principles of Experimental Design, Analysis of variances based on One way, Two – way and Three – way classification. Missing Plot Techniques, Factorial Experiments in CRD and RBD, analysis of Covariance for correlated variables.

**Practical:** Unbiased property of Sample Mean and Sample Variance Simple Random Sampling. Stratified Random Sampling, Large Sample Tests for single mean and difference of means, small sample tests based on 't' distribution, tests based on  $\chi^2$  tests based on 'F' Distribution Non – Parametric tests. Path Analysis, Multiple Regression Analysis, Completely Random Design, Randomized Block Design, Factorial Experiments in CRD and RBD – Missing Plot Techniques – Analysis of Covariance.

**AHS 602 COMPUTER APPLICATIONS IN ANIMAL SCIENCES**

**1 + 1**

Theory :

Evolution (History) of Computers – Computer Application in Animal Sciences – Classification of Computers and Computer Generations – Computer Hardware – Main Memory – Central Processing Unit – Secondary Memory – Input – Output devices – Computer Software – Language Processors – Operating System – Utility software – Special purpose and Applications software – Disk Operating System (DOS) – File naming conventions and concept of directories – Database Management on Computers – Introduction to Windows Operating System – Introduction to Window based word processing (MS word), Spreadsheet operations (MS Excel) and presentation Software (MS PowerPoint) – Geographical Information System (GIS) – GIS application on resource mapping – Basics of Computer Network – LAN, WAN – Internet and E-mail applications.

Practical: DOS commands – Windows applications – Exercises in MS Word, MS Excel and MS Power Point – Software for statistical applications in animal sciences (Descriptive statistics, Student's 't' test, 'F' test,  $\chi^2$  test, correlation and regression analyses) – Internet and E-mail.