Approval for implementing Common Academic Regulations for the Post Graduate Programme from 2019-20 at NAU

:: પરિપત્ર ::

આથી સંબંધકર્તા સર્વેને જણાવવાનું કે, નવસારી કૃષિ યુનિવર્સિટીની **૪૧**મી વિદ્યા પરિષદની બેઠકના મુદ્દા નંબર **૪૧.૧૪** થી નીચે મુજબ થયેલ ઠરાવનો અમલ તાત્કાલીક અસરથી કરવાનો રહેશે.

"The Academic council resolved to accord approval for implementing Common Academic Regulations for the Post Graduate Programme from 2019-20 at Navsari Agricultural University, Navsari (Appendix – A)."

જા.નં.નકૃયુ/સંનિ/ટી-૩/ 758-808 /૨૦૨૦
તા. 03 /૦૨/૨૦૨૦

3.2.2020

સંશોધન નિયામક અને
અનુસ્નાતક વિદ્યાશાખાધ્યક્ષ
નવસારી કૃષિ યુનિવર્સિટી
નવસારી

<u>નકલ સવિનય રવાના :</u>
૧. વિદ્યા પરીષદના તમામ સભ્યશ્રીઓ તરફ.
૨. યુનિવર્સિટીના તમામ અધિકારીશ્રીઓ તરફ.
૩. તમામ આચાર્યશ્રીઓ તરફ
૪ તમામ યુનિટ /હેડ/ યુનિટ અધિકારીશ્રીઓ

<u>નકલ રવાના :</u>
૧. કુલસચિવશ્રીના રહસ્ય સચિવશ્રી, નવસારી કૃષિ યુનિવર્સિટી, નવસારી.
૨. સંશોધન નિયામકશ્રીના રહસ્ય સચિવશ્રી, નવસારી કૃષિ યુનિવર્સિટી, નવસારી.

APPENDIX-A

Common Academic Regulations for Post Graduate Programmes

COMMON ACADEMIC REGULATIONS (2019-20)	
FORPOST GRADUATE PROGRAMMES IN THE STATE AGRICULTURAL UNIVERSITIES OF GUJARAT	
In exercise of the powers conferred under Section-22 (viii), read with the Section-30 of the Gujarat Agricultural Universities Act, 2004 (Gujarat Act No. 5 of 2004), the Academic Councils of the State Agricultural Universities hereby make the following Common Academic Regulations, namely, '**Common Rules for the Post Graduate Programmes' i.e. Doctorate and Master Degree in the State Agricultural Universities (SAUs)** as recommended by Council of State Agricultural Universities of Gujarat.	
1.0	**Short Title**
	These Regulations may be called 'Common Regulations (2019-20) for Post Graduate Programmes of SAUs'.
2.0	**Commencement**
	These regulations shall come into force from the beginning of the first semester of the academic year 2019-20.
3.0	**Interpretation**
	If any question relating to the interpretation of the provision/s contained in the regulation arises, the Registrar of the University may issue necessary orders in consultation with the Dean Post Graduate Studies as and when needed, with prior approval of the Vice Chancellor under intimation to the Council of State Agricultural Universities.
4.0	**Definitions**
	In this Regulations, unless the context otherwise requires ❖ 'Academic year' means the year normally commencing from the month of July/August and ending in the month of June/July of the following calendar year and shall consist of two semesters. ❖ 'Act' means Gujarat Agricultural Universities Act, 2004 (Gujarat Act No. 5 of 2004). ❖ 'Advisory Committee' means a committee comprising of concerned major guide, minor guide and 2/3 other faculty members. ❖ 'Centre' means a place for imparting training for Post-Graduate Studies in a particular field of study and includes a Department/Centre of the University which carries out teaching/research/extension education in a discipline and is strong enough to undertake Post-Graduate Studies in the University. ❖ 'Course' means an organized subject matter in which instructions or a segment of subject matter carrying a specific number of credits in a semester is offered through a series of lectures, practical and skill orientation (work experience). It shall be an integral part of the curriculum. ❖ 'Course Content' means a concise outline of the subject-matter of a course, as may be laid by the Indian Council of Agricultural Research and approved by the Academic Council of SAUs from time to time. ❖ 'Course Credit' or 'Credit' means one hour theory lecture or minimum two hours of laboratory or field practical work per week. In taking a course, a student shall attend a series of lectures, do laboratory/field work and submit assignments and reports as required. Course credit is the quantitative measure of the content of a course of instruction, especially with reference to the value of the course in relation to the total requirements for a degree. ❖ 'Credit load' means the quantum of credits undertaken by a student in a semester. ❖ 'Credit Point' means Grade Point x Credit of a course. ❖ Cumulative Grade Point Average (CGPA)' means the quotient of the total grade points obtained by a student in courses during the degree programme, divided by the total number of credits successfully completed. ❖ 'Curriculum' means the aggregate of courses of study given in the University for a particular Field of study.

- ‘Field of Study’ means the specialized subject of knowledge for which Post Graduate Degree is offered by the University.
- ‘Grade Point (GP)’ means marks obtained in a particular course converted into 10 point scale up-to next single decimal place.

$$GP = \frac{\text{(Theory Marks x Theory credit)+ (Practical Marks x Practical credit)}}{\text{Total Credits of Course}}$$

- ‘Grade Point Average (GPA)’ means the weighted average of the grade point earned by a student for the courses registered during the semester.

Explanation: GPA is the sum of the products of credits of a course and the grade point obtained in the course divided by the total number of credits of the different courses registered in the semester i.e.

$$GPA = \frac{G_1C_1 + G_2C_2 + \ldots\ldots + G_nC_n}{C_1 + C_2 \ldots\ldots + C_n} = \frac{\text{Total Grade Points}}{\text{Total Course Credits}}$$

OR

$$GPA = \frac{\sum \text{(Course Credit x Course Grade Point)}}{\sum \text{Course Credits}}$$

- ‘Nodal Officer’ is an officer nominated by the State Council for overall monitoring of the academic activities of SAUs of Gujarat.
- ‘Non-Credit Compulsory Courses’ means courses of general nature as mentioned under item 39.2.1 and are compulsory for Post Graduate Programmes. However, Ph. D. students may be exempted from these courses if already studied during Master‘s degree.
- ‘Overall Grade Point Average (OGPA)’ means the quotient of the total credit points obtained by a student in all courses during the degree programme, divided by the total number of credits successfully completed.
- ‘Programme of Study’ means a series of coherent courses and research work assigned to a student to meet the requirements of a degree.
- ‘Rules’ means the rules promulgated for the Post Graduate Studies in the Agricultural Universities of Gujarat.
- ‘Semester’ means an academic period of 20 to 22 weeks (including semester-end examination) during which a course is completed. There are two semesters in an academic year. The academic calendar shall be decided by the Central Admission Committee and circulated by the Registrar of respective SAU. Suitable adjustment in a semester will be made to accommodate vacations and other holidays as notified by the University.
- ‘Statute’ means the statute made under the Gujarat Agricultural Universities Act, 2004 (Gujarat Act No. 5 of 2004).
- ‘State Council’ means the Council of State Agricultural Universities constituted under Section-25 of the Act.
- ‘Transcript’ is the consolidated report of list of courses completed by the student along with credit points, GPA of each semester and OGPA secured and issued by the University.
- ‘Website’ means the official website for the purpose of common admissions in SAUs to carry out admission process.

Note: Words and expressions used in the Act, Statutes and Regulations and not defined in these Regulations shall have the meaning assigned to them in the Act, Statutes and Regulations as the case may be.

5.0	**SAUs of Gujarat** Post Graduate Degrees shall be awarded by the following Agricultural Universities of Gujarat under their concerned different faculties as mentioned in Rule-10.3. (1) Anand Agricultural University, Anand (AAU) (2) Junagadh Agricultural University, Junagadh (JAU) (3) Navsari Agricultural University, Navsari (NAU) (4) Sardarkrushinagar Dantiwada Agricultural University, S.K.Nagar (SDAU)
6.0	**Central Admission Committee**
	As per the powers conferred to State Council in Section 25(7)(g) of the Gujarat Agricultural Universities Act-2004, Council of State Agricultural Universities constituted 'Central Admission Committee for Post Graduate programmes' to regulate the admission of candidates to all Post Graduate programmes in the SAUs as under;
6.1	**Members of Central Admission Committee**
	(1) The Registrars of SAUs (2) The Director of Research and Dean P.G. Studies of SAUs (3) Deans of Faculties of SAUs (4) Member Secretary of Council of State Agricultural Universities or a Representative of State Council nominated by Member Secretary. Provided that the State Council may nominate one of the SAUVice Chancellors on rotation basis as Nodal Officer (Academic) to supervise and co-ordinate centralized admissions till State Council becomes functional. The Committee has to carry out the admission process in a fair and transparent manner. The admission process has to be conducted by this Committee strictly on the basis of merit, provisions made in these rules and the preference of the candidate. The functions of the Committee are as follows; ❖ The Committee shall supervise, monitor and control the entire process of admission. ❖ The Committee shall prepare the merit list in accordance with the provisions of the Act and the Rules made there under. ❖ The Committee shall allocate the regular seats in accordance with the provisions of the Act and the Rules made there under. ❖ The Committee shall ensure that admission for the regular seats are made as per the merit list prepared. ❖ The Committee shall perform such other functions as may be assigned to it by the Council and the Government.
6.2	While preparing the merit list, the Committee will observe rules or instructions as laid down in this regard by the universities from time to time under the intimation to the State Council.
6.3	The Dean Faculty of SAUs shall verify physical fitness, original mark sheets, certificates, *etc*. of the candidates for their eligibility for admission to the said degree.
7.0	**Number of Students to be admitted**
	The number of students to be admitted (except In-service candidates)shall be decided by the Central Admission Committee for Post Graduate Programmes depending upon infrastructural facilities and faculty competence, which will be limited to 90 per cent of intake capacity of Under Graduate programme of the respective faculty.
8.0	**Invitation of Applications**
8.1	The Nodal Officer shall invite online applications for the Post Graduate programmes by an admission notice published in leading Gujarati and English Newspapers and on the web site of SAUs during month of May/June every year.
8.2	Foreign eligible students seeking admission to Post Graduate programmes shall have to route their applications through their respective embassy or respective Indian High Commission abroad to the Government of India to ICAR, New Delhi and their candidature shall be considered only if they are recommended by their respective

	National Government and / or by the Government of India / ICAR. The candidate will be admitted under reserve quota for Government of India / 'ICAR sponsored candidates' as under Rule-15.1.However, total number of admissions shall be decided by concerned University based on availability of infrastructural facilities and major guide.
9.0	**Post Graduate programmes**
	The Universities shall offer the following Post Graduate Programmes; (1) Doctorate Degree (2) Master Degree
10.0	**Doctorate Degree Programme**
10.1	The duration of the Doctorate Degree programme shall be six and eight semesters for fresh and in-service candidates, respectively.
10.2	(1) Gujarat domicile and pass out students of SAUs of Gujarat State/ICAR accredited SAUs of other states shall be eligible, further, pass-out students of SAUs of Gujarat and non-domicile of Gujarat State shall be considered for admission only for remaining vacant seats. (2) Candidate should have Master's degree in respective subject for admission to doctoral degree of SAUs of Gujarat State. (3) A candidate for admission to the Doctoral degree (Ph.D.) programmes (3 Years or 6 Semesters duration) should have minimum requirement of marks at the Master's degree level as under-

Sr. No.	Per cent / O.G.P.A. obtained in Qualifying Exam		Per cent / O.G.P.A(Out of)
	General/ EWS*	SEBC **/ST/SC	
1.	65 %	60 %	Traditional System out of 100 %
2.	6.50	6.0	10 Point

*Valid Economically Weaker Section certificate as per resolution no. EWS/122019/45903/A dated 25/1/2019 of Department of Social Justice & Empowerment, Government of Gujarat, Gandhinagar.

** Valid Non-creamy layer certificate for Gujarat domicile is required as per Government Resolution No.SSP/122015/455246/A dt.26/04/2016 of Department of Social Justice & Empowerment, Government of Gujarat, Gandhinagar.

10.3	The areas of Post Graduate Programmes shall be in the following faculties- (1) Agriculture (2) Horticulture (3) Forestry (4) Veterinary Science& Animal Husbandry (5) Dairy Science (6) Dairy Science & Food Technology (7) Agricultural Engineering& Technology (8) Renewable Energy and Environmental Engineering (9) Food Technology (10) Fisheries Science (11) Community Science (12) Basic Science & Humanities (13)Agri-Business Management (14) Agricultural Information Technology
10.4	Eligibility for Doctoral Degree Programme

Sr. No.	Faculties	Eligibility Qualifications
1	Agriculture	M. Sc. (Agri) in respective disciplines
2	Horticulture	M.Sc. (Horti.) in respective disciplines
3	Forestry	M.Sc. (Forestry) in respective

			disciplines
	4	Veterinary Science& Animal Husbandry	M.V.Sc. in respective disciplines
	5	Dairy Science	M.Tech.in respective discipline
	6	Agricultural Engineering and Technology	M.Tech. (Agril. Engg.) in respective discipline
	7	Food Technology	M.Tech. in Food Processing Technology/M.Tech in Food Technology in respective discipline
	8	Fisheries Science	M. F. Sc. in respective discipline
	9	Community Science	M. Sc. (Home Science/Community Science) in respective discipline
	10	Basic Science & Humanities	M. Sc. (Basic Science & Humanities) in respective discipline
	11	Agri-Business Management	Eligibility criteria as prescribed by respective SAUs.

Note: Disciplines of Doctoral Degree programmes shall be as per Prospectus published by Central Admission Committee every year.

11.0 Master Degree Programme

11.1 (1) Gujarat domicile and pass out students of SAUs of Gujarat State/ICAR accredited SAUs of other states shall be eligible, further, pass-out students of SAUs of Gujarat and non-domicile of Gujarat State shall be considered for admission only for remaining vacant seats.

The duration for the Master Degree Programme shall be four semesters for the students who have obtained bachelors degree from the SAUs of Gujarat or ICAR recognized/approved college/university as given below-

No	Degree	Eligibility Qualifications	Subjects offered
1	M.Sc. (Agri.)	B.Sc.(Hons.) Agriculture/ B.Sc.(Hons.) Horticulture from SAUs of Gujarat State	1. Agronomy 2. Soil Science and Agricultural Chemistry 3. Biochemistry 4. Genetics and Plant Breeding 5. Plant Molecular Biology and Biotechnology 6. Plant / Crop Physiology 7. Entomology 8. Plant Pathology 9. Nematology 10. Agricultural Microbiology 11. Agricultural Extension & Communication 12. Agricultural Economics 13. Agricultural Meteorology 14. Agricultural Statistics 15. Seed Science & Technology
		Bachelor's degree in Agril. Info. Technology (AIT) from SAUs of Gujarat State	Eligible for M.Sc.(Agri.) 1.Agricultural Statistics 2.Agricultural Meteorology 3.Agricultural Economics 4.Agricultural Extension & Communication
		B.Sc. (Agril. Biotech.) from SAUs of Gujarat State	Eligible for M.Sc.(Agri.) 1. Biochemistry 2. Crop Physiology 3. Agricultural Microbiology 4. Plant Molecular Biology & Biotech. 5. Genetics & Plant Breeding

	2	M.Sc. (Horticulture)	B.Sc. (Hons.) Horticulture / B.Sc. (Hons.) Agriculture from SAUs of Gujarat State	1. Fruit Science 2. Vegetable Science 3. Floriculture & Landscape Architecture 4. Plantation, Spices, Medicinal & Aromatic Crops 5. Post Harvest Technology 6. Horticultural Entomology 7. Horticultural Pathology
		M.V.Sc.	B.V.Sc. & A.H. from SAUs of Gujarat State	1. Vet. Physiology 2. Vet. Biochemistry 3. Vet. Animal Husbandry Extension 4. Vet. Microbiology 5. Vet. Parasitology 6. Vet. Pathology 7. Vet. Public Health 8. Vet. Pharmacology & Toxicology 9. Vet. Surgery & Radiology 10. Animal Reproduction, Gynaecology & Obstetrics 11. Livestock Production & Management 12. Animal Nutrition 13. Animal Genetics & Breeding 14. Veterinary Clinical Medicine, Ethics & Jurisprudence 15. Veterinary Epidemiology & Preventive Medicine 16. Livestock Products Technology 17. Animal Biotechnology 18. Veterinary Anatomy & Histology 19. Poultry Science
	4	M.Tech.	B.Tech. (DT) / B.Tech. (DFT) from SAUs of Gujarat State	1. Dairy Technology 2. Dairy Engineering 3. Dairy Microbiology 4. Dairy Chemistry
	5	M.Tech. (Agril. Engg.)	B.Tech. (Agril. Engg.) from SAUs of Gujarat State	1. Soil and Water Conservation Engineering 2. Farm Machinery and Power Engineering 3. Processing and Food Engineering 4. Renewable Energy Engineering 5 Irrigation and Drainage Engineering
			B.Tech. (FPT) from SAUs of Gujarat State	Eligible for M.Tech. 1.Processing and Food Engineering
			B.Tech. (RE&EE) from SAUs of Gujarat State	Eligible for M.Tech. 1.Renewable Energy Engineering
	6	M.Tech. (RE&EE)	B.Tech. (Agril. Engg.) / B.Tech. (RE&EE) from SAUs of Gujarat State	1. Renewable Energy Engineering 2. Environmental Engineering

	7	M.Tech. (FT)	B.Tech. (FT) / B.Tech. (Agril. Engg.) / B.Tech. (DFT) / B.Tech.(DT) from SAUs of Gujarat State	1. Food Processing Technology 2. Food Process Engineering 3. Food Safety and Quality Assurance
	8	M.Sc. (Forestry)	B.Sc. (Hons.) Forestry from SAUs of Gujarat State	1. Silviculture & Agro forestry 2. Forest Biology and Tree Improvement 3. Forest Product and Utilization 4. Natural Resources Management 5. Wildlife Science
			B.Sc. (Agril. Biotech) from SAUs of Gujarat State	Eligible for M.Sc.(Forestry) 1.Forest Biology and Tree Improvement
	9	M.Sc. (Community Science / Home Science)	B.Sc. (Home Science) from SAUs of Gujarat State	1. Foods and Nutrition 2. Home science Extension 3. Human Development and Family Studies 4. Family Resource Management
	10	M.F.Sc.	B.F.Sc. from SAUs of Gujarat State	1. Fish Processing Technology 2. Fisheries Resource Management 3. Aquaculture
	11	MBA (Agri-Business Management)	Bachelor's degree in Agriculture & Allied Sciences from SAUs of Gujarat State	Agri-Business Management
	12	M.Sc. (Basic Science) Microbiology, Biochemistry Biotechnology	3 Years Bachelor's degree in Microbiology, Biochemistry and Biotechnology	Microbiology, Biochemistry Biotechnology

11.2 A candidate for admission to Masters' degree programme (as mentioned in 10.3) should have the minimum requirement of marks at the bachelor's degree level as under.

Sr. No.	Per cent / O.G.P.A. obtained in Qualifying Exam		Per cent / O.G.P.A(Out of)
	General/EWS*	SEBC **/ST/SC	
1.	60 %	55 %	Traditional System out of 100 %
2.	6.00	5.5	10 Point

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	Social Justice & Empowerment, Government of Gujarat, Gandhinagar.		
11.3	**Master Degree programme of Two Years (4 Semesters) duration**		
	Sr. No.	**Degree**	**Disciplines**
	1	M.Sc. (Agri.)	1. Agronomy 2. Soil Science and Agricultural Chemistry 3. Biochemistry 4. Genetics and Plant Breeding 5. Plant Molecular Biology and Biotechnology 6. Plant / Crop Physiology 7. Entomology 8. Plant Pathology 9. Nematology 10. Agricultural Microbiology 11. Agricultural Extension & Communication 12. Agricultural Economics 13. Agricultural Meteorology 14. Agricultural Statistics 15. Seed Science & Technology
	2	M.Sc. (Horti.)	1. Fruit Science 2. Vegetable Science 3. Floriculture & Landscape Architecture 4. Plantation, Spices, Medicinal & Aromatic Crops 5. Post Harvest Technology 6. Horticultural Entomology 7. Horticultural Pathology
	3	M.Sc. (Forestry)	1. Silviculture & Agro forestry 2. Forest Biology and Tree Improvement 3. Forest Product and Utilization 4. Natural Resources Management 5. Wildlife Science
	4	M.V.Sc.	1. Vet. Physiology 2. Vet. Biochemistry 3. Vet. Animal Husbandry Extension 4. Vet. Microbiology 5. Vet. Parasitology 6. Vet. Pathology 7. Vet. Public Health 8. Vet. Pharmacology & Toxicology 9. Vet. Surgery & Radiology 10. Animal Reproduction, Gynaecology & Obstetrics 11. Livestock Production & Management 12. Animal Nutrition 13. Animal Genetics & Breeding 14. Veterinary Clinical Medicine, Ethics & Jurisprudence 15. Veterinary Epidemiology & Preventive Medicine 16. Livestock Products Technology 17. Animal Biotechnology 18. Veterinary Anatomy & Histology 19. Poultry Science
	5	M.Tech.	1. Dairy Technology 2. Dairy Engineering 3. Dairy Microbiology 4. Dairy Chemistry
	6	M.Tech. (Agril.	1. Soil and Water Conservation Engineering 2. Farm Machinery and Power Engineering

		Engg.)	3. Processing and Food Engineering 4. Renewable Energy Engineering 5. Irrigation and Drainage Engineering
	7	M.Tech. (FT)	1.Food Processing Technology 2. Food Process Engineering 3. Food Safety and Quality Assurance
	8	M.F.Sc.	1.Fish Processing Technology 2. Fisheries Resource Management 3. Aquaculture
	9	M.Sc. (Community Science)	1. Foods and Nutrition 2. Home science Extension 3. Human Development and Family Studies 4. Family Resource Management
	10	M.Sc.	1. Microbiology, 2. Biochemistry 3. Biotechnology
	11	M.B.A. (ABM)	Agribusiness Management

12.0 Weightage of participation in sport s/ cultural activity of SAUs:

12.1 The sportsmen / women will be given weightage for the admissions in all the degrees as follows

No.	Level of Participation	Weightage
1.	Participation at the International Level	7%
2.	**Participation at the National Level/All India Inter-University Level**	**1 % for participation**
	(a) Secured 1st position	5%
	(b) Secured 2nd position	3%
	(c) Secured 3rd position	2%
3.	**Participation at the State Level**	
	(a) Secured 1st position	1 %
	(b)Secured 2nd position	0.5%

Note: The benefit of the highest level of the above weightage shall be given to the student only once during his/her university career.

13.0 Admission Procedure

13.1 Admissions shall be given at the beginning of odd semester only, subject to the intake capacity and other infrastructure facilities available at the respective university.

The Registrar NAU, Navsari shall give advertisement on website pg.gsauca.in mentioning key dates for common admission to PG degree programmes of SAUs of Gujarat State. The interested students of SAUs of Gujarat State shall submit prescribe fee online and duly filled-in admission form and also submit hard copy of the same to “The Registrar NAU, Navsari” on or before prescribed last dates. The DR & Dean PGS of the host institute shall appoint Dean/Principal of the concerned faculty as convener of the scrutiny committee. Thereafter, Convener of the faculty shall constitute a committee at college level for scrutinizing applications for Post Graduate admission and shall submit the list of eligible candidates to the Registrar NAU, Navsari for uploading on website pg.gsauca.in. The eligible candidates shall remain present on prescribed date, time and place for appearing in entrance test for common admission to PG degree programmes of SAUs of Gujarat State.

The entrance test shall be either computer based mode or OMR based and question papers shall comprise of 100 Multiple Choice Questions (MCQs) and duration of examination shall be 1 hour.

The basis of selection of candidate for the admission shall be the merit. The

	merit list shall be prepared by giving 50:50 weightages to the marks of OGPA (percentage marks) of the last degree and common entrance test, additionally the marks of sports/cultural activities shall also be added before preparing the merit list. Separate merit list for Gujarat domicile students pass-out from SAU's of Gujarat State and non domicile of Gujarat state students pass-out from SAU's of Gujarat shall be prepared for each degree/subject. The candidates shall remain present on prescribed date, time and venue for counseling. The aforesaid admission committee shall admit candidates as per his/her merit and availability of seats however; the admission shall be treated as confirmed on receipt of admission fee at the time of counseling. Therefore, all candidates must come well prepared for submission of prescribed fee at the time of counseling. Once the candidates are admitted, one may not be permitted for change of subject/college/university. The decision of the admission committee shall be final in all respect. Such admitted candidates shall have to report to respective college/university on prescribed date. All the post graduate seats (except ICAR Quota) shall be filled-up from the candidates of domicile of Gujarat, but if seats remain vacant from students of Gujarat origin, such vacant seats may be filled up by the candidates of other states and pass-out from SAUs of Gujarat State.	
13.2	Admissions shall be given at the beginning of odd semester only, subject to intake capacity available at respective university. The decision of Central Admission Committee shall be final.	
13.3	The admission to the MBA Degree programme is offered by SAUs of Gujarat separately and admission procedure and eligibility criteria varies with the university. Merit list for ABM shall be as follows- (1) Gujarat domicile students passed out from SAUs of Gujarat (2) Non-Gujarat domicile students passed out from SAUs of Gujarat The admission will be given as per aforesaid merit list order.	
13.4	For admission to Master's degree, entrance test paper (multiple choice questions) shall be drawn from syllabus of group of subjects at graduate level of the concerned faculty.	
	For admission to Doctoral degree, entrance test paper (multiple choice questions) shall be drawn from subjects taught at Masters levels of the concerned disciplines.	
	Duration of the entrance test will be of one hour and total marks will be 100 for master and doctoral degree programmes.	
13.5	Employees of the Agricultural Universities of Gujarat, in-service trainees as well as employees nominated by State or Central Government or ICAR or other Agricultural Universities or Institutes/other organizations shall not be required to appear in the entrance test.	
13.6	If an employee of any State Government, Government of India, ICAR or other Agricultural University or Public / Co-operative Organization, is permitted by respective organization to pursue his/her studies leading to Masters or Ph.D. shall be admitted; (1) on merit basis (2) subject to fulfillment of the minimum requirements. (3) Sponsored candidate should produce deputation letter/ sponsorship letter/study leave of 2/3 years duration letter from employer on or before counseling. (4) subject to intake capacity and infrastructure available.	
14.0	**Reservation of seats**	
	The University shall reserve seats for admission of the candidates as under;	
14.1	For the candidates nominated by the Indian Council of Agricultural Research, GOI, New Delhi	25%
14.2	For the candidates who are domicile from the Gujarat state	75%
	For the candidates nominated/sponsored by Government of Gujarat	
15.0	**General conditions regarding reservation**	
15.1	If sufficient number of candidates of reserve categories is not available, the vacant seats will be filled up by the candidates who are domicile of Gujarat in order of their	

	merit. Vacant seats of Scheduled Castes and Scheduled Tribes will be filled up by other general category candidates on merit basis.
15.2	SC/ST and SEBC candidates who are able to secure admission on merit in general quota shall not however, be counted against the seat reserved for them.
15.3	A candidate availing benefit of the reserved seats shall be required to produce the certificate of belonging to a particular group from the competent authority. In case of any doubts or discrepancy about the castes/classes/group, the decision of the competent authority or the admission committee shall be treated as final.
16.0	**Schedule Caste and Schedule Tribes (SC & ST)**
16.1	The total number of seats to be reserved for the Schedule Caste and Schedule Tribe candidates shall be as laid down by the State Government from time to time. The same at present is as follows; (1) Twenty two percent shall be reserved for backward class candidates. Out of 22% seats, 7% shall be earmarked for the candidates belonging to scheduled castes and remaining 15 % shall be earmarked for candidates belonging to schedule tribes. (2) Those candidates who are able to secure admission on general category merit shall not, however, be counted against the seat reserved for them, provided one has not availed any advantage of category.
16.2	If the need arises on account of vacant seats due to less number of applications in one group and shortage of seats due to more number of applications of eligible candidates in the other group, reciprocal adjustment in the above specified 7 % and 15 % seats between the two groups will be made.
16.3	If applications from backward class candidates are more than the reserved seats earmarked for them as above, admission will be given to them strictly on *inter* se merit within each of the two groups.
16.4	The admission of a student of a reserved category on a reserved seat shall be valid subject to the verification of cast certificate issued by the authority empowered by the State Government in this behalf. In case, the caste certificate is found invalid on verification, he/she shall not have right to claim his/her admission on reserved seat and if he/she has been already granted admission, such admission shall be cancelled at any point of time.
17.0	**Socially and Educationally Backward Communities (SEBC) & Economically Weaker Sections (EWS)**
17.1	Twenty seven percent (27%) of seats shall be reserved for the Socially and Educationally Backward Class of Gujarat State as laid down by the State Government at present. The reservation shall be subject to the following conditions and shall be modified as per the directive of the State Government from time to time. The reservation shall be subject to fulfillment of the following conditions-
	(1) A candidate under this category shall be required to produce a Certificate that he/she belongs to a particular group of backward class (Caste) from the competent authority of the state. The candidate belonging to SEBC should produce the Certificate issued from the competent authority. (2) The candidate belonging to SEBC should produce the Certificate issued from the competent authority, showing that he/she does not belong to creamy layer sections of the society. Such certificate should be issued on or after the 1st April of the academic year in which the candidate is seeking admission; otherwise he/she will not be considered under the SEBC category. (3) SEBC candidates, who are able to secure admission under open category merit shall not however, be counted against the seats reserved for them provided one has not availed any advantage of category. (4) The admission of a student of a reserved category on a reserved seat shall be valid subject to the verification of caste and non Creamy Layer certificate issued by the authority empowered by the State Government in this behalf. In case, the caste and non Creamy Layer certificate is found invalid on verification, he/she shall not have right to claim his/her admission on reserved seat and if he/she has been already granted admission, such admission shall be cancelled at any point of time.
17.2	Ten percent (10%) of seats shall be reserved for Economically Weaker Sections (EWS), and this shall be followed as per the directives of the Government from time to time.

	* Valid Economically Weaker Section certificate as per resolution no. EWS/122019/45903/A dated 25/1/2019 of Department of Social Justice & Empowerment, Government of Gujarat, Gandhinagar.
18.0	**Candidates Nominated by Indian Council of Agricultural Research (ICAR), New Delhi**
	Twenty Five percent (25%) of the total number of seats earmarked for out- state candidates shall be reserved for the candidates nominated by the Indian Council of Agricultural Research, New Delhi for Post Graduate courses on the basis of All India Entrance Test, subject to fulfilling minimum criteria laid down by SAUs of Gujarat.
19.0	**Differently abled (Physically Challenged) candidates**
	Five percent seats are reserved for the Differently abled (physically challenged) candidates of Gujarat State which are adjustable within the respective category and subject to the following conditions; (1) A candidate, having locomotors disability of one leg and partial arm, shall be eligible to apply for admission to a degree programme course, subject to the submission of a Certificate to that effect from the Civil Surgeon / Medical Superintendent of the Government Hospital based on the opinion of the concerned specialist, that the locomotors disabled candidate is in a position to undertake the degree programme and can perform the functions of the concerned field. The admissions will be on the basis of *inter se* merit only. (2) **Differently abled** (Physically) challenged candidate shall have to fulfill the academic and minimum requirements of marks at the qualifying examination of his/her category as mentioned in Rule-10.0 or 11.0. (3) The admission of a student of a reserved category on a reserved seat shall be valid subject to the verification of certificate issued by the authority empowered in this behalf. In case the certificate is found invalid on verification, he/she shall not have right to claim his/her admission on reserved seat and if he/she has been already granted admission, such admission shall be cancelled at any point of time. Candidates shall not be admitted to Post Graduate Programmes of any discipline, if he or she suffers the following disabilities, namely:- (a) Disability of total body including disability of chest or spine more than 50% (b) Disability of lower limb of more than 50% (c) Disability of upper limb (d) Visually handicapped candidates and those with hearing disability (e) Candidates with progressive diseases like myopathies, etc. (f) Disabilities which otherwise would interfere in the practical during study period.
20.0	**A. Foreign students**
	(1) Foreign students will be admitted as per ICAR, New Delhi guidelines issued from time to time. (2) The candidates admitted on Foreign student's seat, where seats are available for foreign candidate shall have to pay additional fee in US $ as may be prescribed by the University / ICAR from time to time. (3) The candidature for foreign students shall be considered only if they are sponsored/ recommended by their respective Government and / or by Government of India / ICAR. (4) However, the total number of seats for admitting foreign students will be decided by the concerned University looking to infrastructural facility and availability of major guide/discipline.
21.0	**Recognition of P.G. Teachers**
21.1	A teacher who desires to be recognized as post graduate teacher for P.G. Training and for guiding P.G. research will apply at appropriate time to the Dean of Post Graduate Studies.
21.2	All teachers holding Ph.D. degree shall be recognized for PG teaching.
21.3	All teachers of the rank of at least Assistant Professors holding Master degree and having minimum three years experience of undergraduate teaching /research/extension will be recognized for post graduate teaching only and the teacher who has at least three years research / teaching experience of post graduate teaching and who has published atleast two research papers in recognized research

	journals will be recognized for guiding masters students only.
21.4	Recognition for Ph.D. guide may only be given to a teacher holding Doctorate Degree and who has successfully guided at least five candidates for master‘s degree in the concerned discipline.
21.5	Nothing in these regulations shall affect the recognition of post graduate teachers already granted before the commencement of these regulations under the regulations then existing.
22.0	**Procedure of granting recognition of post graduate teachers**
22.1	The Dean of post graduate studies shall grant recognition on the recommendation of the Head of the Department/Professor in charge/coordinator and Dean Faculty in all cases where the academic attainment is in consonance with the prescribed standards as laid down in Rule-22.
22.2	In the cases of persons in respect of whom qualification or experience is not as per the prescribed standards as laid down in regulations, such cases may be treated as special cases.
22.3	There shall be a committee comprising of the following members for considering the special cases to grant recognition of post graduate teachers. (1) The Director of Research & Dean Post Graduate Studies (2) Deans of all Faculties
23.0	**Appointment of P.G.T. In-charge at college level**
	From amongst the recognized Post-Graduate guides at College, the Dean of Post-Graduate Studies will appoint a PGT In-charge for the purpose of Post- Graduate studies at the college level. PGT in-charge shall supervise the duties of allotment of courses to recognized PG teachers for major, minor or allied subjects, overall supervision of PG teaching/research, seminar, synopsis, preliminary examinations, PG examination, submission of thesis and thesis viva-voce examination at college level. He/she shall also coordinate the work related to PG Time-Table, Semester End Examinations, Correspondence related to PG studies *etc*.
24.0	**Registration**
24.1	A candidate selected for admission, shall report to the Principal of the concerned College on the date specified by the University for the purpose of First Registration.
24.2	The admission of the candidate, who failed to report to the concerned College on the specified date, shall be treated as cancelled.
24.3	A candidate, who is not in a position to report for first registration on the specified date due to unavoidable circumstances, may register by paying fee through post or by messenger on or before the date specified for registration.
24.4	A candidate, registered in the first semester by payment of fee must complete the registration of course within a period of ten days from the date of his/her registration.
24.5	The First Registration shall consist of the following;
	(1) Payment of Fee at the time of counseling / interview (2) Production of original documents, Migration / Transfer Certificate as per Rule 27.0 (3) Registration for courses (4) Submission of the course card within ten days
24.6	A student enrolled in the University shall be given a registration number, which shall be used along with his/her name in all the documents and correspondence pertaining to him.
24.7	If an enrolled P.G. Student joins a regular service before submitting thesis, his/her registration shall automatically be cancelled. The major guide will have to report this to the Registrar immediately. In any condition, if regular student does not report for study for a period of six months and above, even after repeated intimation by major guide to the student and his/her parents/guardians about his/her absence, his/her registration will be cancelled. Major Guide has to report the absence of such student to the registrar through Dean/Principal for necessary action.
24.8	If a student has not taken any course during any one semester without justification before completing course work, his/her registration will stand cancelled. Principal will report the same to Director of Research and Dean, Post-Graduate Studies and Registrar.
25.0	**Renewal of Registration**
25.1	Every enrolled student shall be required to register at the beginning of each semester till the completion of his/her degree requirements, unless otherwise permitted by the Dean / Principal, failing which his/her enrollment shall be cancelled.

	Re-registration in such cases shall be as per the University Norms.
25.2	For the subsequent semester Registration and renewal of registration, required fee shall have to be paid within a month from the commencement of the semester, failing which his/her registration shall stand cancelled.
25.3	The registration in person for subsequent semester should be completed within the first three days of beginning of the semester, failing which fine of `100/-per day (subject to revision from time to time), up to the permissible period of 30 days only, will have to be paid by the student who missed registration.
26.0	**Identity Card**
	An Identity Card shall be issued by the concerned Dean to each registered student on completion of first registration. The student shall carry it with him / her at all the times and should show the same when asked for. In case the Identity Card is lost, a new one shall be issued on payment of fee as prescribed by the University from time to time.
27.0	**Migration of Student**
	(1) Students migrating from SAUs of Gujarat shall not be required to apply for migration certificate. (2) Students migrating from other universities of the Gujarat State as well as the universities or statutory examining bodies outside the Gujarat State and seeking admission in the SAUs of Gujarat shall be required to produce Migration Certificate. No student from other University or statutory examining body shall finally be admitted to any Institute/College without production of migration certificate signed by the competent authority of the concerned University.
28.0	**Re-Registration**
28.1	A Post Graduate student in any degree programme who has successfully completed all the requirements of 1st year (Two semesters) of degree programme may be re-registered within a period of three years for the same semester from where one has discontinued studies, provided that no disciplinary action has been taken against such a student previously.
28.2	This period of absence will be calculated from the date on which he/she left the College.
28.3	Only one such chance will be given for re-registration to the students who discontinue the studies.
29.0	**Hostel Accommodation**
29.1	Staying in hostel is compulsory for a student except when permitted by the concerned Principal under exceptional circumstances. Hostel facility is available at constituent colleges, for which, student will have to apply for accommodation in the hostel. A student admitted in the hostel will have to abide by disciplinary rules and regulations. A student admitted in the hostel will be provided with a set of furniture for use and he/she shall be responsible for maintenance of such furniture. The general management of the hostel is vested with the Hostel Rector who works under the general directives of Dean / Principal of the concerned college.
29.2	Only the registered student shall be allowed to stay in the hostel during the stipulated period of Degree programme, except for the period as deemed fit by the concerned authority.
29.3	Any student working under contractual services and drawing HRA shall not be permitted to stay in hostels.
30.0	**Student Advisory System**
30.1	Allotment of Major Guide
	Each Post-graduate student shall have Student Advisory Committee to guide the student during the study programme. Only recognized teachers are eligible for teaching and guiding PG students. On registration of the student and payment of fee at college, he/she will be allotted to the recognized Guide by Dean PG studies as a Chairman (Major Guide) of the Advisory Committee who will be from his/her major field of studies. The nomination of the Major Guide shall be made by the Dean PGS on the recommendation of Dean of the respective college. The approved guides by the Dean PGS only can be the guides for the students. Generally, a teacher should have a minimum of three and two years of service before retirement for allotment of doctoral and masters students, respectively. Normally, there should not be more than four masters and two doctoral students at any one time under a particular guide.

30.2	Members of the Advisory committee
	For Masters students, the advisory committee shall comprise of a Major Guide, Minor Guide and two members. One member will be from the concerned subject and the other member from the related field of thesis research. The advisory committee for Ph.D. scholar shall comprise of a Major Guide, Minor Guide and three members. Two members will be from the respective subject and one member will be from other related field of thesis research. If thesis topics involve more of inter-disciplinary approach, the number of advisory committee members from other disciplines may be increased by one with prior approval of the Dean PGS. However, Dean PGS may approve advisory committee on the recommendation of Dean Faculty.
	A Proposal for the formation of the Advisory Committee of the students shall be submitted by Major Guide to the Dean PGS through the Dean of respective college for approval within one month from the commencement of the 1st semester. External experts may be included as Member in the advisory committee based on the need and expertise of the member, without any financial commitment from the university so as to improve the quality of the research and thesis. The external expert member proposed should meet the minimum qualification required and the proposal is to be approved by the Dean PGS.
30.3	For Doctoral Programme, the Advisory Committee Chairman preferably shall be of the cadre of Professor or Associate Professor. For Masters Programme, the Advisory Committee Chairman shall be of the cadre of Professor, Associate professor or Assistant Professor. Only the recognized faculty for PG teaching/guiding is eligible for guiding/teaching PG courses and becoming advisory committee members.
30.4	Changes in advisory committee
	The proposals for changes in the advisory committee are to be sent by respective Dean to the Dean PGS for approval, if it is felt absolutely necessary. The reason for such change should be indicated. The changes may be effected immediately when the existing members are transferred elsewhere or resigned or retired. Major Guide of the Advisory Committee who is transferred can continue to guide a student provided that the student has completed 75% of the total credits for Master and 75% of research credits for Ph.D. on the day of transfer. If a Major Guide goes abroad/ within India for more than 6 months, to attend any training or goes on leave for more than six months, the Chairman of the Advisory Committee has to be changed immediately. The same provisions shall apply to members also.
30.5	Absence of member during qualifying / final viva-voce examination
	Under extra-ordinary circumstances, if the preliminary viva-voce examination/ Thesis presentation/ final Thesis *viva-voce*/ of postgraduate student has to be conducted in the absence of Minor Guide or advisory committee member/s, permission to conduct the examination by co-opting another member/s with recommendation of Dean should be obtained from the Dean PGS in advance.
30.6	Duties and responsibilities of the advisory committee
	(1) Drawing the student‘s academic plan for post-graduate programme (2) Guidance throughout the PG programme of the student (3) Guiding the student in selecting a topic for thesis research and seminar topics (4) Continuous monitoring of thesis research and progress of the student (5) Evaluation of research and seminar (6) Correction and finalization of synopsis and thesis draft (7) The members should have regular meetings with the student for all the above purposes and sign the appropriate documents
31.0	**Synopsis of Research Project**
31.1	The Major Guide shall forward the Synopsis of the thesis in the prescribed format to the Director of Research and Dean P.G. for approval before the end of second semester through Dean faculty.
31.2	No change in the programme of studies shall normally be permitted. However, under special circumstances, Dean Post-Graduate Studies may, on the recommendation of the Advisory Committee, for reasons to be specified, permit a change in the programme of studies.

32.0	**Fee, Deposits, *etc*.**
32.1	The kind of fee and deposits for Post Graduate Programmes shall be as under: (A) Fee and deposits for all new student to be paid once at the time of Registration (1) Caution Money Deposit (2) Hostel Deposit (for resident students) (3) Mess Deposit (4) Identity Card (5) Test fee for thalassemia (6) Electricity Deposit
	(B) Fee to be paid annually in the beginning of each odd semester by all students (1) University Medical Exam (2) Magazine (3) Student Aid Fund (4) General Amenities
	(C) Semester fee to be paid at the beginning of each semester (1) Registration (2) Tuition (3) Library (4) Examination (5) Gymkhana (6) Cultural Activities (7) Laboratory (8) Hostel (9) Evaluation Report
32.2	The rate of fee shall be as determined by the State Council from time to time.
32.3	The girl students having Indian citizenship shall be exempted from paying the tuition fee and hostel fee, as per the policy of the State Government laid down.
33.0	**Refund of Fee**
	If the student desires to cancel admission, fee paid shall not be refunded. However, if a student takes admission in other Agricultural University of the Gujarat State, he/she shall be entitled for refund of the amount of all fee paid by him after deducting Rs. 500 (Rupees five hundred) as processing charges.
34.0	**Curricula and Courses**
34.1	The details of the courses, credits and curriculum of the course shall beas per ICAR syllabus and/or approved by the Academic Council in consultation with faculty and the Boards of Studies of Post Graduate Studies from time to time. The distribution of courses for each semester shall be such, as may be decided by the University from time to time.
34.2	Major Courses
	The core courses are essential courses, which are mandatory for a student at the Masters'/Doctoral level. These courses should be in the respective discipline in which the candidate takes degree.
34.3	Minor Courses
	The Minor courses are courses chosen by the students from the other disciplines in consultation with the Advisory committee, based on their specialization.
34.4	Supporting/ Allied Courses
	The supporting/ Allied courses are those other relevant courses offered by disciplines other than major and minor disciplines.
34.5	Addition, substitution and deletion of course(s) shall be permitted by the Dean, P.G. Studies on the recommendation by the advisory committee / Deans of the concerned College with due justification.
34.6	Dropping of a course in a semester shall be permitted by the Dean, P.G. Studies on the recommendation by Major Guide and the advisory committee, with due justification within six weeks from the commencement of a semester under the intimation to the Registrar.
34.7	A student shall be deemed to have cleared and completed a course, if he/she has attended the lectures and laboratory / field work and has completed all such other necessary requirements for the course and has obtained a requisite grade point.
34.8	The Re-registration of a particular course shall be allowed only twice (1 regular + 2 trials) to obtain the minimum required grade point. Failing on this, registration of the student will be cancelled automatically.

35.0	**System of Evaluation**
35.1	A student securing less than 6.0 grade point (60 percent marks) for the course of Master & Doctorate degree programmes shall be considered as fail; such student shall have to repeat the course as and when offered.
35.2	The different types of examination and weightage for each shall be as under:

No.	Examination	Theory	Practical
1	Self Study (Assignments)	20	-
2	Internal Tests	30	40
3	Semester-end Examination	50	60
	Total Marks	100	100

35.3 The Grade Point shall be calculated as below-

$$GP = \frac{\text{(Theory Marks x Theory credit)+ (Practical Marks x Practical credit)}}{\text{Total Credits of Course}}$$

35.4 The following marking shall be shown by the teachers / examiners in the Student's Performance Report.

6.00 and above	Pass	—
Below 6.0	Fail	—
Ab	Absent	—
I	Incomplete	—
W	Withdrawn	—
S	Satisfactory	For Non-credit courses, Industrial Training(ABM), Qualifying Examinations and thesis credits
US	Unsatisfactory	

35.5 Grade Point Average (GPA) is the sum of the products of credits of courses and the grade points obtained in those courses divided by the total number of credits of the different courses offered in the semester.

35.6 The Cumulative Grade Point Average (CGPA) obtained by the student upto the end of a particular semester shall be calculated by dividing the sum of the products of the grade point average and the credits in respective semester by the total credits completed up to the end of that semester.

35.7 A grade point below 6.00 in a course shall be counted in working GPA for that semester. However, on revision of the grade point after repeating that course, the earlier grade point shall be replaced by the revised grade point average and CGPA/OGPA shall be recalculated.

35.8 The revised grade point shall substitute the original grade point and the same will be counted in working out the OGPA/CGPA for the purpose other than the award of the scholarship / fellowship or for competing for a Certificate of honor or of a position.

35.9 The course, cleared by more than one trial shall be shown as repeat course in the transcript as well as evaluation report of that semester.

35.10 A student shall have to appear at the examination announced by the teachers concerned for the course(s) in which he/she has registered. Absence from the test examination on account of valid reason with prior permission of major guide, course teacher and Dean of the faculty shall be considered to award 'W' grade and the student shall have to clear that course in the subsequent semesters.

However, absence from the final or Semester-end examination without valid reason and without prior permission of Dean shall be considered to award 'Ab' grade and the student shall have to clear that course in the subsequent semesters as a repeat course.

35.11 For Seminar, if a student is unable to clear seminar during the semester, shall be considered to award "W" grade/ ''I'' grade on recommendation of Major /Minor Guide with due justification, and shall have to clear that course during next semester after re-registration.

35.12 A teacher shall be responsible for evaluating the student's performance and maintaining the records/ materials concerned with the course with regards to tests, term papers, skill orientation, practical, assignments.

36.0	**Academic Probation**
36.1	A student shall be required to maintain the CGPA of not less than 6.50 in order to be eligible for continuing as regular enrolled student of the University.
36.2	If the CGPA of a student is less than 6.50 at the end of a semester, he/she shall be placed on the Academic Probation.
36.3	If the CGPA of student at the end of a semester in which he/she was on academic probation is 6.50 or higher, he/she shall be removed from the academic probation and shall be allowed to continue as a regular enrolled student. Otherwise, he/she will continue to be on academic probation till he/she obtains the OGPA of 6.50 or above by taking additional courses even after the successful completion of the prescribed courses.
37.0	**Award of Class**
	The award of a class to a student shall be based on OGPA (Overall Grade Point Average) obtained by him/her and shall be indicated in the degree certificate. The basis of the award of class shall be as under:

OGPA	**Class**
8.00 and above	First class with Distinction
7.00 to 7.99	First class
6.50 to 6.99	Second class

38.0	**Requirements for Master's Degree**
38.1	The minimum course credit requirement for a student enrolled for Master's Degree programme is as under;

(A) For all the Faculties other than Forestry and Veterinary Science

Courses	**Minimum Credit Requirements**
Major	20
Minor	09
Allied	05
Seminar	01
Research (Thesis)	20
Total:	**55**

Note: There shall be six non-credit compulsory courses as indicatedin Rule 39.2.1.

(B) Forestry

Courses	**Minimum Credit Requirements**
Major (Core)	22
Minor (Specialization)	12
Allied	05
Seminar	01
Research (Thesis)	20
Total:	**60**

Note: There shall be six non-credit compulsory courses as indicated in Rule 39.2.1.

(C) Veterinary Science

Courses	**Minimum Credit Requirements**
Major	28
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11
Seminar	01
Research (Thesis)	20
Total:	**60**

Note: There shall be four non-credit compulsory courses as specified in Rule 39.2.1.

38.2	A student enrolled for a degree of Master‘s Degree has…
38.2.1	To pass compulsorily Non Credit Compulsory courses of one credit each, as given below which are to be graded as Satisfactory/ Un-satisfactory. (a) For Veterinary faculty, only four courses i.e., at(1),(2),(3), &(6) are compulsory. (b) For M.B.A. Faculty, four courses i.e.,at(1),(2), (3),and (6) are compulsory. Non Credit Compulsory Courses: (1) PGS-501 - Library and Information Services (0+1) (2) PGS-502 - Technical writing and communication skills (0+1) (3) PGS-503 - Intellectual property and its management in Agriculture (e-course) (1+0) (4) PGS-504 - Basic concepts in Laboratory Techniques (0+1) (5) PGS-505 - Agricultural research, research ethics and rural development programmes (e-course) (1+0) (6) PGS-506 - Disaster Management (e-course) (1+0)
38.2.2	To clear the preliminary examination.
38.2.3	To submit an acceptable *Pakka* bound thesis based on an approved research work conducted satisfactorily as adjudged by the examiner shall be required for the award of degree. Once the thesis (unbound) is submitted by the student, no fee should be charged even though the *thesis viva* is not completed as all the other requirements are over on submission of thesis. However, minimum residential requirement of the student with registration and payment of fee must have been completed.
38.3	The minimum residential requirement is of 4 semesters for students having graduation in concerned faculty. The credit restriction is applicable as per Rule 43.7 for the in-service candidates and students working as JRF/SRF in the research project. The minimum residential requirement is of 6 semesters for in-service candidate. (Students with ICAR-JRF are exempted from credit restriction).
38.4	The maximum duration for Master‘s degree is 8 semesters for fresh candidates and 10 semesters for in-service students.
39.0	**Requirements for Doctorate Degree**
39.1	The minimum course credit requirements for a student enrolled for Doctorate programme is as under;

(A) For all the Faculties other than Forestry and Veterinary Science

Courses	Minimum Credit Requirements
Major	15
Minor	08
Allied	05
Seminar (One each from major and minor field)	02
Research (Thesis)	45
Total:	**75**

(B) Forestry

Courses	Minimum Credit Requirements
Major (Core)	15
Minor (Specialization)	08
Allied	05
Seminar (One each from major and minor field)	02
Research (Thesis)	45
Total:	**75**

(C) Veterinary Science

Courses	Minimum Credit Requirements

	Major Minor + Supporting (minimum 6 for minor & 3 for Supporting) Seminar (One each from major and minor field) Research (Thesis)	17 11 02 45
	Total:	**75**
	Note : Ph.D. students shall be exempted from respective compulsory non-credit courses (PGS 501 to PGS 506), if already studied during Master‘s Degree.	
39.2	The Ph.D. student has to earn a total of minimum30 credits other than already earned in Master‘s degree and minor/Pre- requisite and/or supporting courses as decided by the advisory committee. In addition to this 30 minimum course credits, student has to earn 45 credits of thesis.	
39.3	A student enrolled for a degree of Doctorate of Philosophy has…	
	(1) To pass as per Rule 38.2.1 Non-Credit compulsory courses of one credit each compulsory, if not cleared at Master‘s level. (2) To clear the preliminary examination. (3) To submit an acceptable thesis based on original research work conducted satisfactorily as adjudged by the examiners. Once the thesis (unbound) is submitted by the student, no fee should be charged even though the *thesis viva* is not completed. However, minimum residential requirement of the student with registration and payment of fee must have been completed.	
39.4	Minimum residential requirement of Ph.D. programme is of 6 semesters and 8 semesters for the student working in project with fellowship and for the in-service candidates because of credit restrictions. The candidates receiving ICAR-SRF or INSPIRE or other fellowships shall be exempted.	
39.5	Maximum duration for Doctorate degree is 10 semesters for fresh students and 12 semesters for in-service candidates.	
40.0	**Requirement for MBA (Agribusiness management)**	
40.1	For MBA (Agribusiness)/ (ABM) students have to earn minimum of 45/50 (for AAU 45/51) credit hours (core courses 28/27 (for AAU 28/28) credits, a seminar 01 credit, basic supporting courses 06 credits, elective courses 10/16 credits minimum). The elective courses will be offered to the students in second year of the programme. The institute may club together similar elective courses to form specialized elective areas. In addition to 45/50 (for AAU 45/51) minimum course credits, student has to earn 10 credits of project work (Total :45/50+10=55/60 Credits) (for AAU Total :45/51 + 10 = 55/61Credits).	
40.2	The students of MBA (ABM) have to take summer training / Industrial attachment of minimum 4 weeks after the completion of second semester at his/her own cost. The students have to submit training report with certificate given by organization / industry to the Principal of the institute and it will be graded as Satisfactory / Unsatisfactory.	
41.0	**Attendance Requirement**	
41.1	Every student shall attend all lectures, practical, library work, extension education visits, study tours and the meetings with respective course teachers and advisory committee.	
41.2	Each course teacher shall maintain a record of student‘s attendance of each course taught by him in a semester.	
41.3	The attendance shall be counted from the date of commencement of the semester. All candidates are required to attend at least75% of the lectures/practical/seminar. If a student fails to attend 75% of the total number of lectures/practical/seminar held during a semester, he/she shall not be eligible to appear at the semester-end examination and shall repeat the course(s) when offered. Dean Faculty shall grant ‘I’ grade on recommendation of course teacher under intimation to Registrar.	
41.4	In case of shortfall in attendance up to 5% in any given course, only upon unavoidable circumstances, the shortage may be condoned by the concerned Dean/Principal of the College.	
41.5	An additional 5% grace in attendance may be allowed by the Vice Chancellor on the	

	recommendation of the Dean/Principal of the college concerned. The decision of the Vice Chancellor shall be final.
42.0	**In-service Admission Procedure**
42.1	The terms and conditions of In-service Training of the University employees are as under; (1) The employee who has completed probation period of service in the University or completed bond period of previous degree if any, shall be considered for the training. (2) The age of the candidate for Master / Ph.D. degree should not be more than 50 years as on 30th June of the year concerned. (3) The minimum requirements of the marks at the Bachelor degree / Master degree shall be as per P.G. Regulations No.10 and 11. However, five percent relaxation will be given in case of the SAUs' employee of Gujarat who have completed three years of service. (4) The in-service trainee shall be treated as on duty during the entire period of his/her training and shall draw his / her pay & allowances as usual in the scheme where he/she is working. (5) In-service trainee shall have to perform his/her duties of service efficiently in addition to his/her post-graduate studies. Post-graduate studies should not be in any case hindrance in performance of his/her legitimate duties/ services to the University. (6) He/she shall have to pay the tuition fee as prescribed by the University and the entire expenditure on the study, as per requirements of the degree course, shall be borne by the trainee concerned. (7) Before starting the in-service training, trainee shall give an undertaking, and Agreement Bond in writing, in the prescribed form on non judicial stamp paper as prescribed by the University(Cost of the stamps to be borne by the trainee) to the respective Agricultural University that he/she shall serve the respective Agricultural University for a period of not less than three years in case of Master degree and five years in case of Ph.D. degree after completion of his/her training provided by the University to improve his/her qualifications and in case of default, he/she shall have to pay the amount of bond as suggested by the concerned SAUs. However, the amount of Bond may be changed from time to time. (8) He/she may avail the benefit of any fellowship, assistantship, scholarship or any other financial benefit with the permission of the University with the conditions as may be prescribed by the Vice Chancellor. (9) Such training will not be a matter of right to claim increase in salary or promotion on account of improvement in qualification or experience due to his/her training. (10) The training shall be counted from the date of his/her joining to the course to the date of submission of *Kaccha* bound thesis. (11) No stipend and expenditure on account of thesis or any emoluments shall be granted to the in-service candidateexcept as prescribed in Rule 43.1(8). (12) The in-service candidate has to complete his/her Master degree or Ph.D. degree in a minimum of six semesters and eightsemesters and maximum eight semesters and ten semesters, respectively which can be extended as per Rule 43.2. (13) If the in-service candidate is not able to complete the course / thesis successfully during the prescribed period, his/her registration will be cancelled immediately, and he / she will have to pay the amount of bond. Moreover, he/she shall not be given further opportunity for higher studies as In-service candidate during his/her service career. (14) The in-service candidates shall not claim as a matter of right for transfer at the main campus of the University and they may be transferred within the University area in the interest of the University. (15) No T.A. / D.A. will be paid to the candidate for attending the Interview for

	admission. (16) No T.A. / D.A. will be paid to the candidate for any work related to his/her PG studies. (17) During the training period, he/she shall have to submit his/her periodical report of his/her progress of training at the end of each semester duly certified by his/her major guide to the Registrar. (18) Those employees who were given opportunity to earn one degree either under faculty improvement scheme or any other scheme and he / she did not join or left the studies incomplete will not be given second opportunity. (19) If the employee does not submit the application in spite of inviting it by the University, it will be presumed that he/she does not wish to avail the facilities of in-service training and his/her name shall be removed from the list of eligible candidates for two years. (20) The employees undertaking the study will have to attend the classes at other campus/centre/department at their own cost. (21) The in-service candidates shall abide by the P.G. Regulations during the study period. (22) The in-service candidate will have to follow the students' discipline rules. (23) The in-service candidates shall abide by all other terms and conditions of training laid down by University from time to time.
42.2	Extension to in-service/regular PG students
	In-service or regular post graduate candidates requiring extension up to two semesters in addition to the normal period [8 (in-service)or 6(regular) semesters for masters and 10 (in-service)or 8 (regular) semesters for doctoral students, respectively] shall be granted by the Dean/Principal of the concerned college on recommendation of the Advisory Committee. For further extension, cases shall be forwarded to the Registrar with recommendation of the Advisory Committee and the Dean/Principal of respective college. Registrar will scrutinize and put up all such cases with the remarks to the Dean P.G. Studies for consideration and approval. Such extension up to maximum period of two semesters in either case may be granted by Dean PGS on merit of the case. For further extension, cases with documents of work done/progress shall be forwarded to the Vice Chancellor with recommendation of Registrar and Dean P.G. for consideration and approval of maximum 2 more semesters' extension.
42.3	The maximum duration with extended period is 12 semesters for regular and 14 semesters for in-service Ph.D. students and 10 semesters for regular and 12 semesters for In-service masters' students. If the In-service student does not complete the study within the maximally permitted extended period, then he/she shall have to complete the remaining requirements of study by proceeding on leave due to him (limited to 3 months only). Amount of Bond along with interest will be recovered from the In-Service candidate for failure of completion of study in time.
42.4	The progress of the candidates shall be reviewed after 4 semesters by the major guide who will report to the Dean of the concerned faculty about taking courses during each semester. Dean/Principal will report the same to Dean, Post-Graduate Studies and Registrar.
43.0	**Programme of Study**
43.1	For uniformity in the PG Academic calendar, the odd semester will generally begin on 1st August and even semester will begin on 21st January in all the faculties, except MBA and FPT where the even semester will begin on 1st January, or as per the academic calendar decided by the central admission committee every year.
43.2	Every student shall have a Major guide from his/her Major Field of study. Major guide shall be the Chairman of Advisory Committee with minimum three/four members from his/her Major, Minor and Allied fields of study.
43.3	The major guide will propose Advisory Committee. Dean PGS will approve the committee on recommendation of Dean of faculty.
43.4	The committee shall draw out the programme of study keeping in view the student's academic background, within ten days of commencement of the first semester, and

	the report to this effect will be sent to the Dean of Postgraduate Studies, through the Dean/Principal.
43.5	For MBA (Agribusiness Management) and project evaluation committee shall consist as follows- (1) Project Chairman (Advisor) (2) One associated faculty from recognized PG teacher (3) One faculty (recognized PG teacher) nominated by Dean PGS (4) One external expert (Company/SAUs/Other organizations) The committee suggested by Principal and approved by Dean PGS will be responsible for evaluation of the project work of the student.
43.6	The research problem of the student shall be decided by the Major guide in consultation with the advisory committee members. The outline of the thesis work (synopsis) shall be presented and discussed in the presence of teachers of major field of study in addition to the committee members and be communicated to the Dean of Post-Graduate studies for approval before the end of second semester.
43.7	A regular student shall not normally be allowed to take more than 18 (20 for Veterinary) credits in a semester excluding Non Credit Compulsory Courses. A recipient of an assistantship/fellowship of project and in-service candidates shall not be allowed to take more than 9 (10 for Veterinary) credits (for Masters) / 6 credits (for Doctorate) in a semester excluding Non Credit Compulsory Courses.
44.0	**Preliminary Examination (Masters' and Doctorate Programme)**
44.1	After having successful completion of atleast 80% of approved course work (excluding Thesis work) with a CGPA of not less than 6.50/10.00, postgraduate student shall be eligible for applying for the **Preliminary** Examination.
44.2	Only those post graduate students who successfully completed the **Preliminary** ~~qualifying~~ examination will be admitted to candidacy of the degree. The **Preliminary** examination consists of written and oral examination (*viva-voce*).
44.3	The major advisor shall monitor and coordinate the conduct of the **Preliminary** examinations.
44.4	Written Examination
	(1) The Major Guide shall apply for conducting qualifying examinations of the Master student on the prescribed form to Dean Faculty for approval. Whereas, application of Doctoral student in prescribed format shall be forwarded through Dean Faculty and Registrar to Dean PGS for necessary approval. (2) The qualifying examination shall normally be completed within 60 days from the date of issue of permission from office of the Dean, Postgraduate studies. (3) For master and doctoral degrees, there shall be two papers one in major field including allied courses of the study and another paper in minor field of the study. It shall cover all aspects of the major discipline of study in which the degree is to be awarded. (4) The question paper of major (70 marks) and minor (30 marks) fields of study shall be drawn and evaluated by major and minor guide, respectively. The qualifying marks for written examination will be 60% for both the degrees. (5) The question papers for the written examination will be of 3 hours duration and comprising of descriptive and objective type questions from prescribed syllabus. (6) If a student secures unsatisfactory grade in major or minor written comprehensive examination, then he/she shall be re-examined for maximum two more trials for major or minor examination after the interval of at least 15 days and not more than 2 months. (7) A student, securing at least 60% marks in the written Qualifying Examinations, shall be eligible for *viva-voce* exam (preliminary).
44.5	*Viva-Voce*
	(1) The Preliminary *viva-voce* examination of Masters' and doctoral students shall be conducted by the Advisory Committee (One additional external expert for Ph.D.).

	(2) The Oral Comprehensive Examination for Masters and Ph.D. shall cover both the major and minor/allied fields and shall be conducted by the Advisory Committee for Masters' students. (3) For Ph.D. **Preliminary** examination, Registrar will issue necessary permission order including the advisory committee members and one external examiner as nominated by the Dean of Post Graduate Studies. For masters students, concerned Faculty Dean will issue necessary order for conducting the Qualifying Examination.
44.6	The candidate shall be declared successful only if the decision of the Advisory Committee (with external examiner in case of Ph.D.) is unanimous and satisfactory.
44.7	The Major Guide shall be responsible for communicating the results of the examination to the Registrar with a copy to the Dean Post-Graduate Studies in the prescribed format.
44.8	A candidate failing to pass the oral **Preliminary** examination will be eligible to reappear in the said examination for a maximum of two additional trials only spaced at interval of not less than 1 month.
44.9	The student may be granted for transfer of credits from one institution to another in case of unavoidable migration as per the prescribed syllabus and relevant rules. Migration of students admitted through ICAR quota would not be allowed.
45.0	**Submission of Thesis**
45.1	*Kaccha* bound Thesis can be submitted after successfully clearing the Thesis seminar presented before the advisory committee and completing all other requirements of PG studies.If the Thesis work and all requirements of the PG study are completed by the end of 3rd semester (Master degree) and 5th semester (doctorate degree) for regular students, and by the end of 5th semester (Master degree) and 7th semester (doctorate degree) for In-service or fellowship students, thesis can be submitted during the last semester after registration,however, degree/notification will be awarded/issued not before completion of minimum residential requirements.
45.2	A student is required to successfully complete the preliminary examinations (written and viva-voce both) at least one month before the submission of *Kachcha* bound thesis.
45.3	A postgraduate student shall prepare his/her thesis as per the guidelines approved by the Academic Council from time to time.
45.4	A student can submit his/her draft thesis (*Kachcha* bound) for Master's programme (one copy) and for Doctoral degree programme (two copies) in person to the office of the concerned Dean, after fulfilling norms on the prescribed Academic Forms duly recommended by the Advisory Committee. The Dean will send the *kachcha* bound thesis to the external examiner along with required proforma after obtaining permission from the office of the Registrar. Dean PGS will nominate the external examiner (one for Masters and Two for Doctoral) on file presented by the office of Registrar.
45.5	For Doctoral Programme, at least one research paper should have been submitted / accepted or a patent should have been filed out of the thesis work before the *Pakka* bound thesis submission.
45.6	If a candidate fails to submit the thesis within a semester, he/she shall have to register in the next semester for submission of thesis.
45.7	No registration is required for the conduct of Thesis (Final) *viva-voce* examination, if it is held in the next semester.
45.8	*Pakka* bound thesis should be submitted within 30 days after completion of thesis *viva-voce* examination. Failing this, his/her registration may be cancelled by competent authority based on recommendation by the concerned Major Guide and Dean of Faculty.
46.0	**Thesis Evaluation**
46.1	SAUs shall prepare a list of experts in different disciplines for evaluation of thesis

	for Master and Doctoral degree programmes approved by concerned Boards of Studies once in three years and finally approved by the Dean PGS/BoS for PG Faculty.
46.2	At least one month before the submission of draft thesis, Major Guide of the student shall suggest a panel of three names for Master programme and five names for Ph.D. for evaluation of thesis in prescribed Form with their latest contact numbers/e-mail IDs to the Dean PGS. However, Dean, PGS may nominate any competent and qualified examiner for the same over ruling the suggested panel.
46.3	Thesis for evaluation shall be sent to one examiner in case of Masters' programme and two examiners in case of Doctoral programme. For Ph.D., one of the two evaluators may be called for viva-voce examination. In case, the Examiner does not reply within 15 days, the offer given to him may stand cancelled and another examiner may be called for viva-voce examination from the approved panel.
46.4	The report of thesis evaluation shall be in the Prescribed Performa approved by the Academic Council from time to time.
46.5	The actual report and queries raised by external referee should be thoroughly discussed in the *viva-voce* exam of thesis and should be complied, if required.
46.6	Master's Degree
	(1) The thesis submitted in partial fulfillment of the Master's degree shall be evaluated by the external referee from outside the University who shall be appointed by the Dean of Post-Graduate Studies from a panel of three persons suggested by Major guide. However, Dean PGS may nominate any other examiner over ruling the submitted panel. (2) The external referee shall examine the thesis and send his/her report to the Dean of Post Graduate studies and Registrar under intimation to the Major guide normally within 4 weeks from the date of receipt of the thesis. He/she shall send the evaluated thesis directly to the Dean Faculty under intimation to the Major Guide. (3) On receipt of the report from the external referee, the candidate will be examined orally on the thesis giving due weightage to the report of external referee, by the major and minor guides and one teacher from the Major field nominated by the Dean of Post Graduate Studies as external examiner, and the Major Guide will submit their final report on thesis examination to the registrar & copy toDean of Post-Graduate Studies through the Dean faculty. However, the decision of DR & Dean PGS will be final.
46.7	The project work of MBA shall be approved by the committee constituted by Dean PGS as per 43.5. This project report (dissertation) is to be submitted to the Registrar office.
46.8	Doctorate Degree
	(1) Requirement for the Ph.D. degree shall include successful completion of scientific investigation and creditable research to be submitted in the form of a thesis, which must be an original contribution to knowledge as evidenced either by the discovery of facts and their significance or by a new interpretation of facts or theories. In either case, it should evince the candidate's capacity for critical examination and sound judgment. (2) The thesis submitted in partial fulfillment of Ph.D. degree shall be examined by the two external referees appointed by the Dean of Post-Graduate Studies from a panel of five experts suggested by the Major guide. The Chairman of Student Advisory Committee shall be the Chairman of the Examining Committee. The external referees shall be from outside the University. (3) The referees shall evaluate the thesis and shall submit their reports to the Dean of Post-Graduate Studies and Registrar under intimation to the Major guide normally within 6 weeks from the date of receipt of the thesis.He/she shall send the evaluated thesis directly to the Dean Faculty under intimation to the Major Guide.

	(4) In case, the reports of both the external examiners are favorable, the thesis shall be considered for the award of the degree. (5) If in case, one of the external referees does not recommend the acceptance of the thesis, a third external referee from the same panel shall be appointed. If third referee also does not recommend the thesis for acceptance, the candidate shall be declared to have failed and no oral examination shall be conducted. If both the external referees recommend acceptance of the thesis, the final oral examination shall be conducted by committee comprising of Major Guide, Minor Guide and two external examiners (one external examiner who has evaluated the thesis and other external examiner from major field/subject of study) appointed by the Dean of Post-Graduate Studies. Under exceptional circumstances, if any of the two external referees are unable to attend the *Thesis Viva*, then Dean PGS can nominate any competent/qualified expert to conduct the Thesis-Viva and the decision of Dean, PGS in this regard shall be final.
47.0	**Remarks of Examiners**
47.1	After favorable evaluation of thesis by External Examiner(s), the Registrar shall issue necessary order for conducting *Thesis-Viva*.Head of the Department concerned shall arrange for thesis *viva-voce* examination in consultation with the Major Guide.
47.2	In case an External Examiner does not recommend a thesis for the award of Master degree, External Examiner next in order of the approved panel, shall be contacted for evaluation of thesis. If the second Examiner recommends the thesis for acceptance, this recommendation may be accepted. If, the thesis is rejected by the second Examiner as well, the degree shall not be awarded. In such cases, the student on proper registration in the following semester shall have the option to continue the work, re-write the thesis and re-submit the same after a lapse of at least four months from registration. If the thesis is again rejected by the External Examiner, student will be debarred/dropped from the University.
47.3	In case both the External Examiners reject a Ph.D. thesis, the same shall not be considered for award of the degree. In such cases, the student may be permitted to continue the work in the subsequent semester on proper registration. He/she shall be allowed to re-submit the thesis after the lapse of at least one semester after re-registration. No student shall be eligible to submit the thesis for the third time and thereafter, he will be debarred/dropped from the University.
48.0	**Thesis *Viva-Voce* Examination**
48.1	The candidate is expected to defend the thesis work at the examination. The degree shall be awarded on unanimous recommendation of the examiners in respect of the thesis itself and the performance of the student in the oral examination. The recommendation of the examiners shall be forwarded by the Major guide to the Dean Post-Graduate Studies through the Dean/Principal of the College.
48.2	After the receipt of full report from the External Examiner recommending the acceptance of thesis, in respect of Master student, theMajor Guideshall in consultation with the External Examiner, fix the date and place for holding the thesis *viva-voce* examination. The report of the External Examiner shall be considered by the Committee at the time of examination.
48.3	The *thesis viva-voce* of Ph.D. student shall be conducted by the Examining Committee comprised of Major Guide, Minor Guide and two external examiners (one external examiner who has evaluated the thesis and other external examiner from major field/subject of study) appointed by the Dean of Post-Graduate Studies on receipt of full reports from both the external examiners and not on the basis of intimation of approval of thesis. The report of the dissent from External examiners, if any, shall also be considered at the time of *thesis viva-voce* examination, which shall be conducted on a date fixed by the Major Guide.
48.4	Only under unavoidable circumstances, permission for substituting committee member(s) will be given by the Dean, Postgraduate Studies.

48.5	The performance in the *thesis viva-voce* will be graded by the Committee as satisfactory/unsatisfactory on the basis of quality of thesis and performance of the student in the prescribed viva-voce examination Form. In case of any disagreement among the members, the decision of the External referee shall be final. The report of the Committee shall be forwarded by the Major Guide to the Dean Faculty who shall forward the same to the Registrar, and the Dean, Postgraduate Studies for declaration of the result.
48.6	A postgraduate student, who fails to show satisfactory performance in the thesis viva-voce examination, may apply again to the Dean, Postgraduate Studies with the recommendation of the Major Guide for permission to appear second time. Permission to appear second time may be given, but re- examination shall take place after one month from the date of the first thesis *viva-voce* examination. A student failing second time in the *viva-voce* examination shall be debarred/dropped from the University.
48.7	As far as possible, the *thesis viva-voce* of a postgraduate student for the second time shall be conducted by the same Committee.
48.8	The student (both Master & Ph.D.) shall submit four copies of bound thesis (five copies in case of scholarship/fellowship holder) to major guide and forwarded through Head of Department to Dean of the faculty along with soft copy (CD) for further approval. The student (both Master & Ph.D.) shall submit prescribed NO DUES certificates at the time of submission of Pakka bound thesis.
49.0	**Remuneration for External Examiner**
	An External Examiner who is appointed to examine the thesis and/or conduct the oral comprehensive/*thesis viva-voce* examination of the postgraduate student shall be paid the remuneration as prescribed by the university from time to time.
50.0	**Notification of Master and Ph.D. degree**
	The Dean will forward copy of the reports on thesis *viva voce* to the Registrar. A notification containing the enrolment Number, name of the candidate, eligible degree, name of Major Guide, title of thesis, subject of specialization, OGPA and division/class obtained shall be issued by the Registrar on approval of the Dean PGS.
51.0	**Prevention and Prohibition of Ragging**
	In view of the directions of the Honorable Supreme Court in SLP No. 24295 of 2006 dated 16-05-2007 and in Civil Appeal number 887 of 2009, dated 08-05-2009, following provisions will be effective to prohibit, prevent and eliminate the scourge of ragging including any conduct by any student or students whether by words spoken or written or by an act which has the effect of teasing, treating or handling with rudeness a fresher or any other student, or indulging in rowdy or undisciplined activities by any student or students which causes or is likely to cause annoyance, hardship or psychological harm or to raise fear or apprehension thereof in any fresher or any other student or asking any student to do any act which such student will not in the ordinary course do and which has the effect of causing or generating a sense of shame, or torment or embarrassment so as to adversely affect the physique or psyche of such fresher or any other student, with or without an intent to derive a sadistic pleasure or showing off power, authority or superiority by a student over any fresher or any other student, in all higher education institutions in the country, and thereby, to provide for the healthy development, physically and psychologically, of all students.
51.1	What Constitutes Ragging
	Ragging constitutes one or more of any of the following acts: (1) Any conduct by any student or students whether by words spoken or written or by an act which has the effect of teasing, treating or handling with rudeness a fresher or any other student; (2) Indulging in rowdy or undisciplined activities by any student or students which causes or is likely to cause annoyance, hardship, physical or psychological harm or to raise fear or apprehension thereof in any fresher or any other

	student; (3) Asking any student to do any act which such student will not in the ordinary course do and which has the effect of causing or generating a sense of shame, or torment or embarrassment so as to adversely affect the physique or psyche of such fresher or any other student; (4) Any act by a senior student that prevents, disrupts or disturbs the regular academic activity of any other student or a fresher; (5) Exploiting the services of a fresher or any other student for completing the academic tasks assigned to an individual or a group of students; (6) Any act of financial extortion or forceful expenditure burden put on a fresher or any other student by students; (7) Any act of physical abuse including all variants of it: sexual abuse, homosexual assaults, stripping, forcing obscene and lewd acts, gestures, causing bodily harm or any other danger to health or person; (8) Any act or abuse by spoken words, emails, posts, public insults which would also include deriving perverted pleasure, vicarious or sadistic thrill from actively or passively participating in the discomfiture to fresher or any other student; (9) Any act that affects the mental health and self-confidence of a fresher or any other student with or without an intent to derive a sadistic pleasure or showing off power, authority or superiority by a student over any fresher or any other student.
51.2	Mandatory Discloser
	(1) Ragging is totally banned and anyone found guilty of ragging and/or abetting ragging is liable to be punished. (2) The affidavit-I should be filled up and signed by the candidate to the effect that he / she is aware of the law regarding prohibition of ragging as well as the punishments, and that he/she, if found guilty of the offence of ragging and / or abetting ragging, is liable to be punished appropriately. (3) The affidavit-II should be signed by the parent/guardian of the applicant to the effect that he/she is also aware of the law in this regard and agrees to abide by the punishment meted out to his/her ward in case the latter is found guilty of ragging and / or abetting ragging. (4) A student seeking admission to the hostel shall have to submit another affidavit-III along with his/her application for hostel accommodation that he / she is also aware of the law in this regard and agrees to abide by the punishments meted out if he / she is found guilty of ragging and / or abetting ragging. (5) The first year students should desist from doing anything against their will even if ordered by the seniors, and that they have nothing to fear as the institution cares for them and shall not tolerate any atrocities against them. (6) A student securing admission to a particular institute shall have to submit concern affidavits to the Dean/Principal of institute.
51.3	Actions to be taken against students for indulging and Abetting Ragging in SAUs.
	(1) The punishment to be meted out to the persons indulged in ragging has to be exemplary and justifiably harsh to act as a deterrent against recurrence of such incidents. (2) Every single incident of ragging, a First Information Report (FIR) must be filed without exception by the institutional authorities with the local police authorities. (3) The Anti-Ragging Committee of the institution shall take an appropriate decision, with regard to punishment or otherwise, depending on the facts of each incident of ragging and nature and gravity of the incident of ragging. (4) Depending upon the nature and gravity of the offence as established the possible punishments for those found guilty of ragging at the institution level shall be any one or any combination of the following, (a) Cancellation of admission

	(b) Suspension from attending classes (c) Withholding/withdrawing scholarship/fellowship and other benefits (d) Debarring from appearing in any test/examination or other evaluation process (e) Withholding results (f) Debarring from representing the institution in any regional, national or international meet, tournament, youth festival, *etc*. (g) Suspension/expulsion from the hostel (h) Rustication from the institution for a period ranging from 1 to 4 semesters (i) Expulsion from the institution and consequent debarring from admission to any other institution (j) Collective punishment: when the persons committing or abetting the crime of ragging are not identified, the institution shall resort to collective punishment as a deterrent to ensure community pressure on the potential raggers.
	An appeal against the order of punishment by the Anti-Ragging Committee shall lie,
	(1) In case of an order of an institution affiliated to or constituent part of the University, to the Vice Chancellor of the University;
	(2) In case of an order of a University, to its Chancellor;
	(3) In case of an institution of national importance created by an Act of Parliament, to the Chairman or Chancellor of the institution, as the case may be.
	The institutional authorities shall intimate the incidents of ragging occurred in their premises along with actions taken to the Council from time to time.
52.0	**Unlawful Activities**
	In case of students found involved in any unlawful activities either within or outside the Hostel / College Campus, besides, expulsion both from the Hostel and College at the discretion of the Dean, the matter will be reported to the Police of the jurisdiction to be dealt with, in accordance with the appropriate law in force.
53.0	**Repeal & Savings**
	The regulations for the award of Post Graduate Degree in concerned University and amended from time to time and in force on the date this regulation comes into effect are hereby repealed.

NEW AND RESTRUCTURED POST-GRADUATE CURRICULA & SYLLABI

Basic Veterinary Subjects

Veterinary Anatomy & Histology
Veterinary & Animal Husbandry Extension
Veterinary Biochemistry
Veterinary Physiology

भाकृअनुप
ICAR

Education Division
Indian Council of Agricultural Research
New Delhi

January 2009

Contents

PREAMBLE

Veterinary sciences have helped in reducing animal sufferings, minimizing risk of zoonotic diseases threatening human health and ensuring food security. There have been unprecedented advancements in all the branches of veterinary sciences. The futuristic requirements of the society such as integrated casualty management, public health, food security and safety, healthy eco-system, containing bio-terrorism, productivity, profitability and stability of livestock farming systems etc., have posed greater challenges for veterinary academics and scientific community. Veterinarians with higher qualifications are increasingly being involved in devising means and methods of developing diagnostics against prevalent and emerging pathogens, prevention and control of animal diseases and zoonoses, eco-health stewardship, monitoring and surveillance of diseases of livestock and poultry, combating bio-terrorism, genetic engineering to optimize production and develop disease resistant breeds of animals. Bio-medical research, being heavily dependent upon animal experimentation, demands deeper scientific knowledge of veterinary sciences. Temporal aspirations of knowledge seekers ought to be addressed through building knowledge and skill portfolio suiting the job market and thus enhancing the marketability of the veterinary post graduates

In this perspective, it is important that the veterinary profession responds to the futuristic societal needs to remain relevant and purposeful. Recent advances in veterinary medical sciences have led to wide spread use of animal disease surveillance and prediction system, 3-D holographic animal models, robotic tele-surgery, globe-wide virtual class rooms and demonstration centers, sensor diagnostic facilities etc. The dominant forces shaping the Veterinary-Business and Veterinary-education are global and virtual with a large number of specialists offering tele-veterinary services from off-shore locations like India. The ever changing and demanding public service sector has necessitated re-look into the veterinary higher education.

At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in-depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance. Detailed study of the course curricula and syllabi, being implemented by veterinary colleges in India, revealed that there was enormous heterogeneity in the course structure, nomenclature and contents. Informal discussions amongst veterinary academicians, over

the years, referred to the need to train good teachers and researchers with comprehensive subject knowledge rather than narrow sub-specialization of a discipline at Master's level. In view of the above, the task of formulating need based contemporary post graduate courses and syllabi for implementation of post graduate education uniformly at national level was initiated.

Three BSMA committees, constituted by ICAR for restructuring of masters and doctorate course curricula and syllabi, worked in unison to formulate common basic format. The BSMA committees consisted of [1]Basic Veterinary Sciences (Anatomy and Histology; Veterinary & Animal Husbandry Extension; Biochemistry and Physiology); [2]Veterinary Para-clinical Sciences (Microbiology, Parasitology, Pathology, Pharmacology & Toxicology, Public Health) and [3]Veterinary Clinical Sciences (Animal Reproduction, Gynaecology & Obstetrics; Clinical Medicine, Ethics and Jurisprudence; Epidemiology & Preventive Medicine and Surgery & Radiology).

The Master's programme in basic veterinary subjects aims at providing cutting edge concepts as well as practical applications of these exciting fields. The new and restructured Post-Graduate curricula and syllabi in respect of basic, paraclinical and clinical veterinary sciences documents contain several innovative and practically applicable courses and extensively revamped course contents viz. inclusion of imaging techniques, ultra-structural studies and clinical applications in the curricula of veterinary anatomy; emphasis on cell membrane dynamics, receptor biology and proteomics in relation to various animal diseases in veterinary biochemistry; focus on rumen microbiology and metabolism, immuno-physiology and physiology of stress in veterinary physiology; framing of courses on social psychology, group dynamics, gender and livestock development, planning and monitoring, organizational management and information and communication technology in the veterinary and animal husbandry extension.

Para-clinical veterinary subjects, which provide essential support by employing disease diagnostics technologies for prevention and control of animal diseases, directing efforts for Green Earth, maintenance of biodiversity etc., have been redesigned in the light of general recommendations of the BSMA committees on veterinary sciences. Courses have been re-designed in such a manner that an MVSc student in Microbiology studies all aspects of bacteriology, virology, mycology and immunology. The contents of 17 courses of microbiology and 14 courses of immunology have been reshaped and encapsulated into 9 mandatory courses of 600 series and 18 optional courses of 700 series have been carved

in veterinary microbiology. In veterinary parasitology, new courses on malacology, remote sensing and GIS have been introduced. In veterinary pathology, courses on veterolegal pathology and toxico-pathology have been introduced. A new course on ethno-pharmacology has been introduced in veterinary pharmacology while courses on fish, fish products and seafood hygiene; disaster management and bioterrorism; emerging and reemerging zoonoses; occupational health hazards; disposal and recycling of waste; biohazards and bio-security have been introduced in veterinary public health.

The new approach encompassed the latest knowledge for development of advanced diagnostics, clinical management, clinical epidemiology, bio-security, prevention and control of diseases of livestock and poultry including zoonoses like Bird Flu, Rabies, Tuberculosis, Brucellosis etc. New courses on 'Herd Health management', 'Ecology', 'Forensic Medicine', 'Emergency Medicine', 'Diagnostic Imaging Techniques,' 'Survey and Surveillance', 'Diseases of Zoo, Wild and Laboratory Animals' etc. have been framed and contents of other courses were heavily revised to include the latest developments. To encourage clinical practice in the veterinary clinics, courses of Clinical Practice each at MVSc and PhD level have been made mandatory. To focus on learning of research methodology, scientific thinking, planning and experimentation, a course for special problems has been introduced in all the subjects.

Teaching Veterinary Clinical Service Complex, along with clinical departments and diagnostic laboratories, provides yeoman's service to stake holders in the field of animal health. The up-gradation of the clinical services will go a long way in meeting the expectations and demands for advanced diagnosis, therapeutics and prophylaxis. The state of infra-structure, manpower (both technical and support staff) and contingencies attached to clinical service units in veterinary colleges in India, requires immediate attention of policy planners to support and supplement in terms of liberal financial grants.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stake holders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

Dharmeshwar Das, Convener, BSMAC (Basic Veterinary Sciences)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in veterinary science disciplines have been prepared in the light of PG programmes in vogue at different veterinary colleges in India and contemporary developments in veterinary sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each MVSc student should register for all the courses offered by the major department, e.g. an MVSc student in microbiology should study all basic courses of bacteriology, virology and immunology instead of opting for courses of 1 or 2 sub-disciplines only. However, flexibility has been retained at Ph.D. level.

II. Credit Requirements

Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the veterinary students as given below.

- The total course work of 40 credit hours has been proposed at M.V.Sc. level instead of minimum requirement 35 credit hours, keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in Table-1) and supporting subjects together (as per requirement) -11 credits.
- At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subject (specified in Table-1) and supporting subject together (as per requirement) -11 credits.
- Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credit should be taken from minor subject and courses with a minimum of 3 credit hours from supporting subject should be taken Thus students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- It is proposed that clinical practice of 0+3 credit hours should be made compulsory in the two semesters for all MVSc students in departments of Clinical Medicine, Ethics & Jurisprudence, Surgery & Radiology, and Animal Reproduction, Gynaecology & Obstetrics.
- Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.

- The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for MVSc and 700 for Ph. D. programme.

III. Major additions and alterations in the existing PG courses

Veterinary Anatomy and Histology

To enhance the comprehension, the courses have been redesigned to teach system-wise detailed anatomical structures, besides facilitating learning of regional anatomy. Latest anatomical, histological, histochemical and histoimmunochemical techniques in vogue, have been earmarked for practical classes to encourage hands on training to PG students. Major emphasis in re-designed courses has been clinical application of the basic knowledge of anatomy and histology. All the masters' and doctoral courses have been improved significantly to include the latest development in the field e.g. basics of bio-mechanics of the locomotor system, radiography of normal and developing bones; surgical sites for various operations and clinically significant areas for performing clinical examination. Ultra structural studies of organs and tissues have been incorporated where-ever required.

- VAN 606 (General histology and ultrastructure) and VAN 607 (Systemic histology and ultrastructure) courses have included ultrastructural studies on General Histology.
- VAN 701 [Myology, angiology, neurology and anesthesiology of equine, canine and porcine]; VAN 706 [Theory and applications of electron microscope]; VAN 707 [Histoenzymology and immunocytochemistry]; VAN 708 [Applied embryology and teratology] and VAN 710 [Gross anatomy of laboratory animals] are newly designed doctoral courses.

Veterinary and Animal Husbandry Extension

To ensure that academic and scientific developments in all fields of veterinary sciences and Animal Husbandry get translated into adoption by the beneficiaries, framing of contemporary courses in VAHE became essential.

- The course AHE 607 [Social psychology and group dynamics] is redesigned to focus on social psychology and addition of group dynamics as an essentiality of today's work environment.
- The course AHE 609 [Developments in the concept of extension] is a new course designed to acquaint students with recent developments in extension education.
- The course AHE 611 [Gender and livestock development] is a new course designed to acquaint the students with the concept of gender, its importance in livestock development, livestock development policies and the government programmes to empower women.

- The course AHE 612 [Information and communication technology in livestock development] is a new course designed to apprise the students about information system, networking and use of various ICT tools.
- AHE 702 [Farm journalism and public relations] designed to sensitize students about the role of mass media, news papers, magazines, radio, T.V. and internet for promoting animal husbandry.
- AHE 705 [Policies & regulations in livestock sector] designed to sensitize the students about policies and regulations in animal husbandry sector.
- AHE 706 [Educational technology] designed to acquaint students with different concepts of education technology.
- AHE 708 [Organizational communication] designed to sensitize the students towards communication and networking to increase the efficiency of an organization.

Veterinary Biochemistry

- VBC 601 [Chemistry of animal cell] is refabricated to emphasize the application of organic chemistry principles to clinical diseases of animals
- VBC 603 [Applications of genomics and proteomics in molecular biology] is largely re-formatted to lay greater emphasis on clinical and industrial application of proteins and genome, e.g. drug resistance, regulation of pathogen pathways etc.
- VBC 605 [Enzyme catalysis, kinetics, inhibition and regulation] redesigned to lay more emphasis on animal disease control by regulation and inhibition mechanisms.
- VBC 608 [Metabolism-iii: integration and regulation] designed to highlight disorders due to failed integration and regulation, e.g. Obesity, diabetes, cancer, poisoning, stress, apoptosis, liver and renal diseases, acid base imbalance etc.
- VBC 613 [Biochemical basis of animal production] designed to teach biochemistry of draft capacity, meat production and dairy chemistry.
- VBC 701 [Advances in biochemistry of ruminant disorders] designed to give exposure to developments in ruminant disorders associated with metabolism.
- VBC 705 [Methods in protein analysis] designed to teach latest advances in characterization of proteins in health & disease.

Veterinary Physiology

- VPY 610 [Research techniques in veterinary physiology] designed to train students in recording of ECG, EMG, Physiograph, GLC, Electrophoresis, body composition using radio-isotopes, *in vitro* and *in sacco* rumen studies, ELISA.
- VPY 709 [Advances in rumen microbiology and metabolism] designed to teach rumen ecosystem and symbiotic relationship of flora and fauna, their structure and functions, rumen manipulation techniques etc.
- VPY 710 [Advances in immunophysiology] designed to study cells and organs of immune system, its development and role in physiological functions and immunomodulation.
- VPY 711 [Physiology of stress] designed to teach the mechanism and effect of stress on production and reproduction in domestic animals.

ORGANIZATION OF COURSE CONTENTS
&
CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	**60**	**75**
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given in Table 1.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Table 1. Suggested list of specified minor subjects (Departments)

Major Subject	Minor Subjects*
Veterinary Anatomy and Histology	Veterinary Pathology, Veterinary Surgery and Radiology, Veterinary Physiology, Veterinary Biochemistry
Veterinary and Animal Husbandry Extension	Veterinary Epidemiology and Preventive Medicine, Veterinary Public Health, Animal Reproduction Gynecology & Obstetrics, Livestock Production and Management. Animal Nutrition, Animal Genetics & Breeding, Poultry Science
Veterinary Biochemistry	Veterinary Physiology, Veterinary Microbiology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Animal Nutrition, Animal Genetics & Breeding
Veterinary Physiology	Veterinary Anatomy and Histology, Veterinary Biochemistry, Veterinary Pharmacology & Toxicology, Animal Nutrition, Animal Reproduction Gynaecology and Obstetrics, Livestock Production and Management, Animal Genetics & Breeding

* The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the Department and Dean, Post Graduate Studies

VETERINARY ANATOMY AND HISTOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VAN 601	COMPARATIVE OSTEOLOGY AND ARTHROLOGY	1+2
VAN 602	COMPARATIVE SPLANCHNOLOGY	2+2
VAN 603	MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX	1+3
VAN 604	GROSS ANATOMICAL TECHNIQUES	0+2
VAN 605	THEORY AND PRACTICE OF HISTOLOGICAL AND HISTOCHEMICAL TECHNIQUES	1+2
VAN 606	GENERAL HISTOLOGY AND ULTRASTRUCTURE	3+1
VAN 607	SYSTEMIC HISTOLOGY AND ULTRASTRUCTURE	3+1
VAN 608	DEVELOPMENTAL ANATOMY	3+1
VAN 691	MASTER'S SEMINAR	1+0
VAN 699	MASTER'S RESEARCH	20
VAN 701	MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF EQUINE, CANINE AND PORCINE	0+3
VAN 702	PRINCIPLES AND APPLICATIONS OF BIOMECHANICS	2+0
VAN 703	AVIAN ANATOMY	1+2
VAN 704	NEUROANATOMY	3+1
VAN 705	ENDOCRINE ANATOMY	2+1
VAN 706	THEORY AND APPLICATIONS OF ELECTRON MICROSCOPE	2+1
VAN 707	HISTOENZYMOLOGY AND IMMUNOCYTOCHEMISTRY	2+1
VAN 708	APPLIED EMBRYOLOGY AND TERATOLOGY	1+2
VAN 709	FUNCTIONAL VETERINARY ANATOMY	2+0
VAN 710	GROSS ANATOMY OF LABORATORY ANIMALS	1+1
VAN 790	SPECIAL PROBLEM	0+2
VAN 791	DOCTORAL SEMINAR I	1+0
VAN 792	DOCTORAL SEMINAR II	1+0
VAN 799	DOCTORAL RESEARCH	45

VETERINARY ANATOMY AND HISTOLOGY

Course Contents

VAN 601 COMPARATIVE OSTEOLOGY AND ARTHROLOGY 1+2

Objective

To make a student well versed with the bones and joints of different domestic animals.

Theory

UNIT I

Technical terms, structure, chemical composition and classification of bones.

UNIT II

Bones of appendicular skeleton of ox as a type and their comparison with those of horse, 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 overview of different systems constituting splanchnology.

Theory

UNIT I

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, mammectomy, 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.

Schummer A, Nickel R & Sack WO. 1979. *The Viscera of the Domestic Mammals*. Verlag Paul Parey.

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

Schummer A, Wickens H & Vollmerhaus B. 1981. *Circulatory System, Skin and Skin Organs of Domestic Mammals*. Verlag Paul Parey.

Seiferle E. 1975. *Nervous System, Sensory Organs, Endocrine Glands of Domestic Mammals*. Verlag Paul Parey.

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

VAN 604 GROSS ANATOMICAL TECHNIQUES 0+2

Objective

Hands-on training for preparation of gross anatomical specimens**.**

Practical

Embalming fluids, embalming of animals, maceration and preparation of skeletons. Gross staining of brain sections. Demonstration of sites of ossifications. Preparation of transparent specimens, preparation of casts of various organs, blood vessels and ducts etc.

Suggested Readings

Luna LG. 1968. *Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology*. McGraw-Hill.

Tompsett DH & Wakeley SC. 1956. *Anatomical Techniques*. E & W Living Stone.

VAN 605 THEORY AND PRACTICE OF HISTOLOGICAL AND HISTOCHEMICAL TECHNIQUES 1+2

Objective

To give exposure to methods of processing the tissues for research and teaching purposes.

Theory

UNIT I

Preparation of tissues for light microscopy using different fixatives.

UNIT II

Different staining methods for routine light microscopy.

UNIT III

Frozen sectioning techniques and staining methods for enzymes, carbohydrates, lipids, proteins, pigments etc.

UNIT IV

Silver staining techniques for nervous tissue.

Practical

Study of different techniques for collection, fixation and processing of animal tissues; preparation of paraffin and frozen sections; handling and care of microtomes. Demonstration of staining of carbohydrates, lipids, proteins, nucleic acids and enzymes.

Suggested Readings

Bancroft JD & Stevens A. 1977. *Theory and Practice of Histological Techniques*. Churchill Livingstone.

Durry RAB & Wallington EA. 1967. *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. 1983. *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. 1976. *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 701 MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF EQUINE, CANINE AND PORCINE 0+3

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 702 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 703 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 704 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 705 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 706 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 707 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 708 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 709 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 710 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 790 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 ANATOMY AND HISTOLOGY

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:http:www.interscience.wilety.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 701	ORGANIZATIONAL MANAGEMENT	3+0
AHE 702	FARM JOURNALISM AND PUBLIC RELATIONS	2+1
AHE 703	ADVANCED RESEARCH TECHNIQUES IN SOCIAL RESEARCH	3+1
AHE 704	TRAINING FOR HUMAN RESOURCE DEVELOPMENT	2+1
AHE 705	POLICIES AND REGULATIONS IN LIVESTOCK SECTOR	2+0
AHE 706	EDUCATIONAL TECHNOLOGY	2+1
AHE 707	DYNAMICS OF CHANGE	2+0
AHE 708	ORGANIZATIONAL COMMUNICATION	2+1
AHE 790	SPECIAL PROBLEM	0+2
AHE 791	DOCTORAL SEMINAR I	1+0
AHE 792	DOCTORAL SEMINAR II	1+0
AHE 799	DOCTORAL RESEARCH	45

VETERINARY AND ANIMAL HUSBANDRY EXTENSION

Course Contents

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

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 COMMUNICATION FOR LIVESTOCK DEVELOPMENT 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 HUSBANDRY EXTENSION 2+1

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 ANIMAL HUSBANDRY 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*. 5th 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 polices 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
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 701 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 702 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 703 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 704 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 705 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 706 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 707 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 708 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 790 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 AND ANIMAL HUSBANDRY EXTENSION

List of Journals

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

e-Resources

* www.informaworld.com (Journal of Agricultural Education and Extension)
* www.blackwellpubllishing.co (International Journal of Training & Development)
* www.blackwellpubllishing.co Educational Measurement: Issue and Practices
* www.academicjournals.net (International Journal of Dairy Science)
* www. cipav.org.co (Livestock Research for Rural Development)
* www.joe.org Journal of Extension

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

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 701	ADVANCES IN BIOCHEMISTRY OF RUMINANT DISORDERS	2+0
VBC 702	ADVANCES IN ENZYMOLOGY	2+0
VBC 703	ADVANCES IN CLINICAL BIOCHEMISTRY	0+2
VBC 704	MEMBRANE DYNAMICS AND SIGNAL TRANSDUCTION IN ANIMAL CELL	2+0
VBC 705	METHODS IN PROTEIN ANALYSIS	2+1
VBC 706	NUTRITIONAL BIOCHEMISTRY	2+0
VBC 707	ADVANCES IN INTERMEDIARY METABOLISM	2+0
VBC 708	ENDOCRINE CONTROL OF FUEL METABOLISM	2+0
VBC 709	DIAGNOSTIC ENZYMOLOGY-I	2+0
VBC 710	DIAGNOSTIC ENZYMOLOGY-II	2+0
VBC 711	BIOCHEMISTRY OF DEVELOPMENT AND DIFFERENTIATION	2+0
VBC 712	ADVANCES IN TECHNIQUES IN BIOCHEMISTRY	1+1
VBC 713	ADVANCES IN MINERAL AND VITAMIN METABOLISM AND RELATED DISEASES	2+0
VBC 790	SPECIAL PROBLEM	0+2
VBC 791	DOCTORAL SEMINAR I	1+0
VBC 792	DOCTORAL SEMINAR II	1+0
VBC 799	DOCTORAL RESEARCH	45

VETERINARY BIOCHEMISTRY

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. ΔG 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 co-efficient, 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 and molecular weight determination. Densitometry procedures and quantitative assays. Immunoelectrophoresis, its applications. Isoelectrofocussing and isotacophoresis. 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, high order structures, cohesions 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. RELP, Gene and gene products. Genetic changes in hereditary diseases, cancer and detection ion DNA probes. Gene Therapy DNA vaccines, anti-tumor 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 LIPIDS AND MEMBRANE'S STRUCTURE 2+0

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, Ruminal 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 (Na+ - K+) ATPases, Ca^{2+}, Ion–gradient, Gap Junction, Cl--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 carbohydrates and lipids 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. ΔG, ATP and phosphoryl group transfer, coupled reactions, thioesters, NAD+ 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. 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.

Glasel 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, proteosome, 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 anti-cancer agents, interfering with purine and pyramidine 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^{2+}, 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 inter-relationships 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 dimmer, microtubules dynamics, kinensins, dyeins.

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.

Jurisica 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 immuno-deficiency.

UNIT IV

Hepatic insufficiencies and its laboratory assessment. Pancreatitis and insuffiency. 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 harmone 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.

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

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

VBC 701 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 702 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 703 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 ad chromatogram of macromolecules.

Suggested Readings

Selected articles from journals.

VBC 704 MEMBRANE DYNAMICS AND SIGNAL TRANSDUCTION IN ANIMAL CELL 2+0

Objective

Discussions on recent developments in membrane function.

Theory

UNIT I

Developments in physical & chemical features of biological transport.

UNIT II

Developments in membrane dynamics.

UNIT III

Developments in solute transport across membrane.

UNIT IV

Developments in molecular mechanisms of signal transduction, regulation by steroid hormone, protein kinases.

UNIT V

Developments in signaling in microorganisms, special senses.

Suggested Readings

Selected articles from journals.

VBC 705 METHODS IN PROTEIN ANALYSIS 2+1

Objective

Discussions on contemporary information on techniques in protein research.

Theory

UNIT I

Separation, purification and characterization of proteins in ECF and membrane.

UNIT II

Subcellular organization of proteins fused with green fluorescent protein. High throughput methodologies for determining protein structure.

Investigating protein with mass spectrometry. Method of determining three dimensional structure of protein. Use of atomic force microscopy in visualizing protein complexes and membrane surfaces.

UNIT III

Use of FRET (fluorescence resonance energy transfer) to measure transient changes in second messenger or protein kinase activity in living cell. Proteomics.

Practical

Proteomics, protein quantification.

Suggested Readings

Selected articles from journals.

VBC 706 NUTRITIONAL BIOCHEMISTRY 2+0

Objective

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^+, FAD and ATP.

UNIT III

Analytical approaches in studies on intermediary metabolism.

Suggested Readings

Selected articles from journals.

VBC 708 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.

VBC 709 DIAGNOSTIC ENZYMOLOGY - I 2+0

Objective

To expose students about use of enzymes in diagnostics.

Theory

UNIT I

History, development, validation of clinical enzyme assay.

UNIT II

Assay of enzymes in clinical cases. Enzyme urea. Enzymes in pathogenesis.

UNIT III

Enzyme histochemistry and cytochemistry, immobilized enzymes. Enzyme immuno diagnostics, molecular genetics.

Suggested Readings

Selected articles from journals.

VBC 710 DIAGNOSTIC ENZYMOLOGY - II 2+0

Objective

To provide in-depth knowledge about enzymes in diagnosis of diseases of animals and poultry.

Theory

UNIT I

Phosphatases, creatine kinase in diagnosis of diseases of animals and poultry.

Unit.II

Amino transferases, trypsin in diagnosis of diseases of animals and poultry.

UNIT III

Dehydrogenases in diagnosis of diseases of animals and poultry.

Unit.IV

Cholinesterase, lipase, amylase, GGT, GTPx, arginase, AST, ALT & SDH in diagnosis of diseases of animals in poultry. Enzymes in pathogenesis.

Suggested Readings

Selected articles from journals.

VBC 711 BIOCHEMISTRY OF DEVELOPMENT AND DIFFERENTIATION 2+0

Objective

To develop understanding of biochemical basis of embryo development in mammals and aves.

Theory

UNIT I

Molecular basis of reproductive events including gametogenesis, fertilization, embryo development and differentiation, gene knock out

UNIT II

Homeotic gene maintenance and repair of body tissue.

UNIT III

Biochemical basis of chick and fetal development

Suggested Readings

Selected articles from journals.

VBC 712 ADVANCES IN TECHNIQUES IN BIOCHEMISTRY 0+2

Objective

To expose students about current developments in techniques used in animal biochemistry.

Practical

Tracer methodologies as applied to problems in biochemistry. Electrophoresis, HPLC, GLC & TLC, spectrometry as applied to problems in biochemistry. X-Ray-Crystallography, NMR Spectrometry. Atomic absorption spectrophotometry as applied to problems in biochemistry. Ultracentrifugation as applied to problems in biochemistry.

Suggested Readings

Selected articles from journals.

VBC 713 ADVANCES IN MINERAL AND VITAMIN METABOLISM AND RELATED DISEASES 2+0

Objective

To expose students to latest class material to be given on recent trends in research on cofactor and mineral metabolism disorders in animals.

Theory

UNIT I

Biochemical basis of conditions related to nutrient deficiency & excess

UNIT II

Metabolism of Ca, P, Mg, Na, K and the related diseases in animals and poultry.

UNIT III

Minerals and B Vitamins as cofactors and their metabolism in livestock and poultry.

UNIT IV

Biochemical mechanisms of fat soluble and water soluble vitamins and their metabolism in livestock and poultry.

Suggested Readings

Selected articles from journals.

VBC 790 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 BIOCHEMISTRY

List of Journals

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

e-Resources

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

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 701	APPLIED PHYSIOLOGY OF BODY FLUIDS AND ELECTROLYTES	2+1
VPY 702	PHYSIOLOGY OF ANIMAL BEHAVIOUR	2+0
VPY 703	COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION	2+1
VPY 704	ADVANCES IN NEURO-ENDOCRINOLOGY	2+1
VPY 705	MYOPHYSIOLOGY AND KINESIOLOGY	2+1
VPY 706	AVIAN PHYSIOLOGY	2+1
VPY 707	PHYSIOLOGY OF LACTATION	2+1
VPY 708	ADVANCES IN ENVIRONMENTAL PHYSIOLOGY AND GROWTH	2+1
VPY 709	ADVANCES IN RUMEN MICROBIOLOGY AND METABOLISM	2+1
VPY 710	ADVANCES IN IMMUNOPHYSIOLOGY	2+1
VPY 711	PHYSIOLOGY OF STRESS	2+1
VPY 790	SPECIAL PROBLEM	0+2
VPY 791	DOCTORAL RESEARCH I	1+0
VPY 792	DOCTORAL RESEARCH II	1+0
VPY 799	DOCTORAL RESEARCH	45

VETERINARY PHYSIOLOGY

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 spirometery, 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 Endocrionology*. 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.

VPY 608 NEUROMUSCULAR PHYSIOLOGY 2+1

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.

VPY 609 CHEMICAL BIOREGULATION IN PHYSIOLOGICAL FUNCTIONS 3+0

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 701 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 indictors 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 702 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 703 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 704 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, adrenocorticotropic 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 T_3 and T_4 in blood.

Suggested Readings

Selected articles from journals.

VPY 705 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 706 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 707 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 708 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 709 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 710 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 711 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, endurances 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.

VPY 790 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 PHYSIOLOGY

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.annualreviewes.org (Annual Review of Physiology)
* www.jneurosci.org (Journal of Neuroscience)
* 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.

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills **-** Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

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 503 (e-Course) **INTELLECTUAL PROPERTY AND ITS MANAGEMENT** **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 animal varieties and farmers' rights and bio-diversity 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 506 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 pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

Annexure

BSMA Committee on Basic Veterinary Sciences

(Vety. Anatomy, Basic Physiology, Biochemistry, Stat., Extension, Economics)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR dated January 14, 2008)

Name	Address	Specialization
Dr. Dharmeshwar Das ***Convenor***	IVRI, Izatnagar	Genetics
Dr. V. K. Kansal Head	Animal Biochemistry Division, NDRI, Karnal	Biochemistry
Dr. S. D. Singh Prof. & Head	CIFE, Mumbai	
Dr. Geetha Ramesh Prof. & Head	Dept. of Vety. Anatomy & Histology, Madras Vety. College, Chennai	Anatomy & Histology
Dr. S. K. Rastogi Prof. & Head	Dept. of Vety. Physiology, GBPUAT, Pantnagar	Physiology
Dr. S.V.N. Rao Prof. & Head	Dept. of VAHE, Rajiv Gandhi College of Vety. & Animal Sciences, Podicherry	Extension
Dr. Rajesh Nigam Registrar	Dept. of Vety. Biochemistry, Vety. College, Mathura	Biochemistry
Dr. J. S. Bhatia Prof. & Head	Dept of Vety. Physiology, Appolo College of Vety. Medicine, Jaipur	Physiology
Dr. S.K. Nagpal Dean ***Member Secretary***	College of Vety. Sciences, CCS HAU Hisar	Anatomy

NEW AND RESTRUCTURED POST-GRADUATE CURRICULA & SYLLABI

Veterinary Para-clinical Subjects

Veterinary Microbiology
Veterinary Parasitology
Veterinary Pathology
Veterinary Pharmacology and Toxicology
Veterinary Public Health

Education Division
Indian Council of Agricultural Research
New Delhi

January 2009

Contents

PREAMBLE

Veterinary sciences have helped in reducing animal sufferings, minimizing risk of zoonotic diseases threatening human health and ensuring food security. There have been unprecedented advancements in all the branches of veterinary sciences. The futuristic requirements of the society such as integrated casualty management, public health, food security and safety, healthy eco-system, containing bio-terrorism, productivity, profitability and stability of livestock farming systems etc., have posed greater challenges for veterinary academics and scientific community. Veterinarians with higher qualifications are increasingly being involved in devising means and methods of developing diagnostics against prevalent and emerging pathogens, prevention and control of animal diseases and zoonoses, eco-health stewardship, monitoring and surveillance of diseases of livestock and poultry, combating bio-terrorism, genetic engineering to optimize production and develop disease resistant breeds of animals. Bio-medical research, being heavily dependent upon animal experimentation, demands deeper scientific knowledge of veterinary sciences. Temporal aspirations of knowledge seekers ought to be addressed through building knowledge and skill portfolio suiting the job market and thus enhancing the marketability of the veterinary post graduates

In this perspective, it is important that the veterinary profession respond to the futuristic societal needs to remain relevant and purposeful. Recent advances in veterinary medical sciences have led to wide spread use of animal disease surveillance and prediction system, 3-D holographic animal models, robotic tele-surgery, globe-wide virtual class rooms and demonstration centers, sensor diagnostic facilities etc. The dominant forces shaping the Veterinary-Business and Veterinary-education are global and virtual with a large number of specialists offering tele-veterinary services from off-shore locations like India. The ever changing and demanding public service sector has necessitated re-look into the veterinary higher education.

At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in-depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance. Detailed study of the course curricula and syllabi, being implemented by veterinary colleges in India, revealed that there was enormous heterogeneity in the course structure, nomenclature and contents. Informal discussions amongst veterinary academicians, over

the years, referred to the need to train good teachers and researchers with comprehensive subject knowledge rather than narrow sub-specialization of a discipline at Master's level. In view of the above, the task of formulating need based contemporary post graduate courses and syllabi for implementation of post graduate education uniformly at national level was initiated.

Three BSMA committees, constituted by ICAR for restructuring of masters and doctorate course curricula and syllabi, worked in unison to formulate common basic format. The BSMA committees consisted of [1]Basic Veterinary Sciences (Anatomy and Histology; Veterinary & Animal Husbandry Extension; Biochemistry and Physiology); [2]Veterinary Para-clinical Sciences (Microbiology, Parasitology, Pathology, Pharmacology & Toxicology, Public Health) and [3]Veterinary Clinical Sciences (Animal Reproduction, Gynaecology & Obstetrics; Clinical Medicine, Ethics & Jurisprudence; Veterinary Epidemiology & Preventive Medicine and Surgery & Radiology).

The Master's programme in basic veterinary subjects aims at providing cutting edge concepts as well as practical applications of these exciting fields. The new and restructured Post-Graduate curricula and syllabi in respect of basic, paraclinical and clinical veterinary sciences documents contain several innovative and practically applicable courses and extensively revamped course contents viz. inclusion of imaging techniques, ultra-structural studies and clinical applications in the curricula of veterinary anatomy; emphasis on cell membrane dynamics, receptor biology and proteomics in relation to various animal diseases in veterinary biochemistry; focus on rumen microbiology and metabolism, immuno-physiology and physiology of stress in veterinary physiology; framing of courses on social psychology, group dynamics, gender and livestock development, planning and monitoring, organizational management and information and communication technology in the veterinary and animal husbandry extension.

Para-clinical veterinary subjects, which provide essential support by employing disease diagnostics technologies for prevention and control of animal diseases, directing efforts for Green Earth, maintenance of biodiversity etc., have been redesigned in the light of general recommendations of the BSMA committees on veterinary sciences. Courses have been re-designed in such a manner that an MVSc student in Microbiology studies all aspects of bacteriology, virology, mycology and immunology. The contents of 17 courses of microbiology and 14 courses of immunology have been reshaped and encapsulated into 9 mandatory courses of 600 series and 18 optional courses of 700 series have been carved

in veterinary microbiology. In veterinary parasitology, new courses on malacology, remote sensing and GIS have been introduced. In veterinary pathology, courses on veterolegal pathology and toxico-pathology have been introduced. A new course on ethno-pharmacology has been introduced in veterinary pharmacology while courses on fish, fish products and seafood hygiene; disaster management and bioterrorism; emerging and reemerging zoonoses; occupational health hazards; disposal and recycling of waste; biohazards and bio-security have been introduced in veterinary public health.

The new approach encompassed the latest knowledge for development of advanced diagnostics, clinical management, clinical epidemiology, bio-security, prevention and control of diseases of livestock and poultry including zoonoses like Bird Flu, Rabies, Tuberculosis, Brucellosis etc. New courses on 'Herd Health management', 'Ecology', 'Forensic Medicine', 'Emergency Medicine', 'Diagnostic Imaging Techniques,' 'Survey and Surveillance', 'Diseases of Zoo, Wild and Laboratory Animals' etc. have been framed and contents of other courses were heavily revised to include the latest developments. To encourage clinical practice in the veterinary clinics, courses of Clinical Practice each at MVSc and PhD level have been made mandatory. To focus on learning of research methodology, scientific thinking, planning and experimentation, a course for special problems has been introduced in all the subjects.

Teaching Veterinary Clinical Service Complex, along with clinical departments and diagnostic laboratories, provides yeoman's service to stake holders in the field of animal health. The up-gradation of the clinical services will go a long way in meeting the expectations and demands for advanced diagnosis, therapeutics and prophylaxis. The state of infra-structure, manpower (both technical and support staff) and contingencies attached to clinical service units in veterinary colleges in India, requires immediate attention of policy planners to support and supplement in terms of liberal financial grants.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stake holders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

S. K. Jand, Convener BSMAC (Veterinary Para- Clinical Sciences)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in veterinary science disciplines have been prepared in the light of PG programmes in vogue at different veterinary colleges in India and contemporary developments in veterinary sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each MVSc student should register for all the courses offered by the major department, e.g. an MVSc student in microbiology should study all basic courses of bacteriology, virology and immunology instead of opting for courses of 1 or 2 sub-disciplines only. However, flexibility has been retained at Ph.D. level.

II. Credit Requirements

- Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the veterinary students as given below.
- The total course work of 40 credit hours has been proposed at M.V.Sc. level instead of minimum requirement 35 credit hours (Table 2), keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in table-1) and supporting subjects together (as per requirement) -11 credits.
- At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subjects (specified in table-1) and supporting subjects together -11 credits.
- Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credits should be taken from minor subject and courses with minimum of 3 credit hours from supporting subject should be taken. Thus, students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- It is proposed that clinical practice of 0+3 credit hours should be made compulsory in the two semesters for all MVSc students in departments of Clinical Medicine, Ethics & Jurisprudence, Surgery & Radiology, and Animal Reproduction, Gynaecology & Obstetrics.
- Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.
- The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary

Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for MVSc and 700 for Ph. D. programme.

III. Major additions and alterations in the existing PG courses

Veterinary Microbiology

- Specialization at Masters level in Veterinary Microbiology and Veterinary Immunology has been abolished and there will be one unified masters programme i.e. M.V.Sc (Veterinary Microbiology)
- Contents of existing 31 courses (17 of Microbiology and 14 of Immunology) have been encapsulated in to 9 courses which are all mandatory.
- To keep upfront with the latest developments at doctoral level, 16 out of 18 proposed courses have been framed afresh.

Veterinary Parasitology

- VPA 605 [Parasitological techniques] course contents upgraded to include the latest techniques e.g. Application of remote sensing and geographical information system in Parasitology.
- VPA 611 [Malacology] designed to emphasize the study of intermediate hosts.
- Courses namely VPA 701 [Applications of remote sensing and geographic information system in Parasitology]; VPA 702 [Molecular diagnostics and vaccine development in Parasitology]; VPA 703 [Host parasite interactions]; VPA 708 [*In vitro* cultivation of parasites]; VPA 709 [Emerging and re-emerging parasitic diseases]; VPA 710 [Bionomics of parasites] and VPA 711 [Environmental Parasitology] added to cope up with the unprecedented growth of information in the field

Veterinary Pathology

- VPP 605 and VPP 606 [Necropsy procedures and interpretations –I & II] are new practical oriented courses designed to enhance the interpretation skills.
- VPP 609 [Toxicopathology] previously a doctorate level course has been tailored for Masters.
- VPP 610 [Avian pathology] and VPP 707 [Advances in avian pathology] redesigned to include other avian species besides poultry.
- VPP 612 [Veterolegal pathology] designed in view of increasing veterolegal cases requiring specialized knowledge.
- VPP 704 [Ultrastructural pathology] designed to expose students to ultrastructural pathology.
- VPP 706 [Pathology of important and emerging diseases of pets and livestock] designed to teach emerging diseases of pets and livestock.
- VPP 709 [Molecular pathology of cell injury] and VPP 710 [Experimental pathology] designed in view of latest developments.

Veterinary Pharmacology and Toxicology

- VPT 610 [Pharmacological techniques] redesigned course to include latest techniques.
- VPT 612 [Ethnopharmacology] redesigned to include alternative system of medicine for animals.

Veterinary Public Health

- VPH 608 [Environmental pollution and safety] introduced at Masters level, earlier it was scheduled for doctoral students.
- VPH 609 (Fish, fish products and seafood hygiene) and VPH 610 (Disaster management and bioterrorism)- New course added to meet the present day requirements
- Doctorate level new courses designed to bring in novelty and advances in the field e.g. VPH 702 [Emerging and reemerging zoonoses]; VPH 703 [Quality control of animal food products]; VPH 704 [Occupational health hazards]; VPH 705 [Disposal and recycling of waste]; VPH 706 [Biohazards, bio-security and disaster management] and VPH 707 [Food plant sanitation].

ORGANIZATION OF COURSE CONTENTS
&
CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	**60**	**75**
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given in Table 1.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Table 1. Suggested list of specified minor subjects (departments)

Major Subject	Minor Subjects
Veterinary Microbiology	Animal Biotechnology, Veterinary Epidemiology & Preventive Medicine, Veterinary Pathology, Veterinary Public Health, Veterinary Biochemistry
Veterinary Parasitology	Veterinary Epidemiology & Preventive Medicine, Veterinary Microbiology, Veterinary Pharmacology & Toxicology, Animal Biotechnology, Veterinary Pathology, Veterinary Biochemistry
Veterinary Pathology	Veterinary Microbiology, Veterinary Anatomy and Histology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Parasitology, Veterinary Pharmacology & Toxicology, Animal Nutrition
Veterinary Pharmacology and Toxicology	Veterinary Physiology, Veterinary Biochemistry, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Pathology, Animal Biotechnology
Veterinary Public Health	Veterinary Epidemiology and Preventive Medicine, Veterinary Microbiology, Veterinary Pathology, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Veterinary Parasitology, Livestock Product Technology

* The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean post graduate studies

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 701	ADVANCES IN BACTERIOLOGY	2+1
VMC 702	ADVANCES IN MYCOLOGY	2+1
VMC 703	BACTERIAL GENETICS	2+1
VMC 704	MICROBIAL TOXINS	2+1
VMC 705	MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS	2+1
VMC 706	ADVANCES IN VIROLOGY	2+1
VMC 707	MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS	2+1
VMC 708	STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES	3+0
VMC 709	ONCOGENIC VIRUSES	2+0
VMC 710	SLOW VIRAL INFECTIONS AND PRIONS	2+0
VMC 711	MOLECULAR IMMUNOLOGY	2+1
VMC 712	ADVANCES IN CELLULAR IMMUNOLOGY	2+1
VMC 713	CYTOKINES AND IMMUNOMODULATORS	2+0
VMC 714	ADVANCES IN VACCINOLOGY	2+0
VMC 715	ADVANCES IN IMMUNODIAGNOSTICS	1+1
VMC 716	MODERN IMMUNOTECHNOLOGY	1+2
VMC 717	CURRENT TOPICS IN INFECTION AND IMMUNITY	3+0
VMC 718	VETERINARY MICROBIAL BIOTECHNOLOGY	2+1
VMC 790	SPECIAL PROBLEM	0+2
VMC 791	DOCTORAL SEMINAR I	1+0
VMC 792	DOCTORAL SEMINAR II	1+0
VMC 799	DOCTORAL RESEARCH	45

VETERINARY MICROBIOLOGY

Course Contents

VMC 601 BACTERIOLOGY - I 3+1

Objective

To impart knowledge on general microbiology and important aerobic bacteria.

Theory

UNIT I

Introduction to historical development of cellular organization, genetic & chemical characteristics of eukaryotic and prokaryotic cells. Classification, nomenclature and identification; genetic characterization and numerical taxonomy. Bacterial cell structure, physiology and antigenic structure.

UNIT II

Determinants of pathogenicity and its molecular basis. Bacteriophages: temperate and virulent phages; lysogeny and lysogenic conversion. Bacterial genetics: bacterial variation, genetic transfer mechanisms (transformation, transduction and conjugation); plasmids, transposons and drug resistance; recombinant DNA technology.

UNIT III

Systemic study of following bacteria: Gram negative- aerobic rods and cocci, family *Pseudomonadaceae*, *Legionellaceae*, *Neisseriaceae*, and genus *Brucella*. Facultative anaerobic Gram negative rods, family- *Vibrionaceae*, *Pasteurellaceae*, *Enterobacteriaceae* and other genera.

Practical

Morphological characterization, cell fractionation, enrichment & isolation technology, various methods used in growth measurement and bacterial preservation, gene transfer experiment. Detailed characterization (biochemical, serological, pathogenicity) of bacteria.

Suggested Readings

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial & 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 602 BACTERIOLOGY - II 3+1

Objective

To learn about spore forming bacteria and some important aerobes and anaerobes.

Theory

UNIT I

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, *Dermatophillaceae*, *Streptomycetaceae*.

UNIT II

Mycobacteria and *Nocardia*, family *Actinomycetaceae*. Atypical prokaryotes such as *Chlamydia*, *Rickettsiae*, *Mycoplasma*, *Acholeplasma*, *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 *Bacteriodaceae* 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.

VMC 604 GENERAL VIROLOGY 2+1

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*. 1st 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 605 SYSTEMATIC ANIMAL VIROLOGY 3+1

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 lyrangeotracheitis virus, Marek's disease virus, pseudorabies virus, malignant cattarrh fever virus; infectious canine hepatitis virus, egg drop syndrome virus, inclusion body hepatitis-hydropericardium virus, papiollomatosis, canine parvoviruses, feline panleucopenia virus.

UNIT II

New castle 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, BVDV-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, electropherotyping 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*. 1st 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-genicity, 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 inactivation 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 Laboratory Immunology*. 7th 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 micro-organisms 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 Laboratory Immunology*. 7th 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 701 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 702 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 703 BACTERIAL GENETICS 2+1

Objective

To learn the basic aspects of bacterial genetics.

Theory

UNIT I

Procaryotic and Eucaryotic genome. Replication of eucaryotic and procaryotic 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 704 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 705 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, invasions, impedins, agressins, 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 706 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 707 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 708 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 709 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 710 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 711 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 712 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

Hematopioetic 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 713 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 imunomodulators. Colony stimulating factors and other cytokines in stem cell research.

Suggested Readings

Selected articles from journals.

VMC 714 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 715 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. Disciminant 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 716 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 hydridoma 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 717 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 718 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. Vectored 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 790 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 MICROBIOLOGY

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 (Virology Journal)
* www.elsevier.com/locate/vetmic (Veterinary Microbiology)
* www.jb.asm.org (Journal of Bacteriology)
* www.jac.oxford.journals.org (Clinical Bacteriology)
* www.benthem.org/open/tomycj (The Open Mycology Journal)
* www.nature.com/nrmicro (Nature Review of Microbiology)
* www.trends.com/tim (Trends in Microbiology)
* www.arjournals.annualreviews.org/loi/micro (Annual Reviews of Microbiology)
* www.jcm.asm.org (Journal of Clinical Microbiology)
* www.trends.com/it (Trends in Immunology)
* www.arjournals.annualreviews.org/loi/immunol (Annual Reviews of Immunology)
* www.elsevier.com/locate/vaccine (Vaccine)
* www.nature.com/immunol (Nature Review of Immunology)
* www.iac.asm.org (Infection and Immunity)
* www.jaconline.com (Journal of Allergy and Clinical Immunology)
* www.elsevier.com/locate/molimm (Molecular Immunology)
* www.blackwellpublishing.com/journals/pim (Parasite Immunology)
* www.jleukbio.org (Journal of Leucocyte Biology)
* www.ocw.mit.edu (MIT Open Course Ware/Health Sciences and Technology)

Professional Course Ware Web Sites:

* www.jbpub.com
* www.bact.wisc.edu
* www.textbookbacteriology.net
* www.mhhe.com/Prescott5
* www.Highwirepress.stanford.edu
* www.vibno/Epid/supercurseforvirology

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 signatured bacteria for developing vaccine candidate 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 ZOONOSES	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 701	APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY	1+2
VPA 702	MOLECULAR DIAGNOSTICS AND VACCINE DEVELOPMENT IN PARASITOLOGY	2+1
VPA 703	HOST PARASITE INTERACTIONS	2+0
VPA 704	ADVANCES IN PROTOZOOLOGY	2+1
VPA 705	ADVANCES IN HELMINTHOLOGY-I	2+1
VPA 706	ADVANCES IN HELMINTHOLOGY-II	2+1
VPA 707	ADVANCES IN ENTOMOLOGY AND ACAROLOGY	2+1
VPA 708	*IN VITRO* CULTIVATION OF PARASITES	1+2
VPA 709	EMERGING AND RE-EMERGING PARASITIC DISEASES	2+0
VPA 710	BIONOMICS OF PARASITES	3+0
VPA 711	ENVIRONMENTAL PARASITOLOGY	1+1
VPA 790	SPECIAL PROBLEM	0+2
VPA 791	DOCTORAL SEMINAR I	1+0
VPA 792	DOCTORAL SEMINAR II	1+0
VPA 799	DOCTORAL RESEARCH	45

VETERINARY PARASITOLOGY
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 Diphyllobothriidae.

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 Toda I. 1994. *Helminthology*. Spinger 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. *Monning'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 EJL. 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; 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. *Monning's Veterinary Helminthology and Entomology*. Greenworld Publ.

Lee DL. 2002. *The Biology of Nematodes*. Taylor and Francis.

Soulsby EJL. 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, pathogenesis, 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 PROTOZOOLOGY 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 *Haemobartonell.a*

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.

Kreier 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.

Maudlin I. 2004. *The Trypanosomiases*. Oxford Univ. Press.

Sterling CR. and Adam RD. 2004. *The Pathogenic Enteric Protozoa*. Kluwer Academic Press.

Thompson A. 2003. *Cryptosporidium*. Elsevier

VPA 605 PARASITOLOGICAL TECHNIQUES 0+2

Objective

To impart practical knowledge on various techniques used in veterinary parasitology.

Practical

Microscopy, micrometry, camera lucida drawings, micro- and digital photography.

Collection, processing and examination of faecal and blood samples; lymph node biopsies, skin scrapings and nasal washings from animals for parasitological findings. Quantitative faecal examination.

Evaluation of the efficacy and resistance of drugs against parasites.

Maintenance of tick and fly colonies in laboratory for experimental purposes and testing of drugs; tick dissection for vector potential.

Collection of aquatic snails from field and their examination for the presence of different parasitic stages.

Collection, fixation, staining, whole mounts and identification of parasites.

Cryopreservation of parasites, culturing techniques for important parasites and pasture larval count, worm count and assessment of worm burden.

Remote sensing (RS) and geographic information system (GIS) as tools for mapping parasitic diseases.

Suggested Readings

Chaudhri SS & Gupta SK. 2003. *Manual of General Veterinary Parasitology*. International Book Distr. Co.

Durr P & Gatrell A. 2004. *GIS and Spatial Analysis in Veterinary Science*. CABI.

Ministry of Aghriculture, Fisheries and Food (MAFF). 1986. *Manual of Veterinary Parasitological Laboratory Techniques*. 3rd Ed. Tech. Bull. 18, HMSO.

Rathore VS & Sengar YS. 2005. *Diagnostic Parasitology*. Pointer Publ.

VPA 606 CLINICAL PARASITOLOGY 1+1

Objective

Collection and examination of clinical material for parasitological investigations and study of clinical cases.

Theory

UNIT I

History, clinical signs, gross and microscopic examination of secretions and excretions of clinical cases.

UNIT II

Collection and dispatch of material to laboratory for diagnosis.

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 EJL. 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 parasiticidal 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, immumomodulations 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. Wileyliss Publication, New York.

Waklin D. 1996. *Immunity to Parasites*. Cambridge University Press.

VPA 609 PARASITIC ZOONOSES 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 EJL & 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 & Franson 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

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 701 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 702 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 703 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 704 ADVANCES IN PROTOZOOLOGY 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 on various protozoan parasites.

Suggested Readings

Selected articles from journals.

VPA 705 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 706 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 707 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 haemato-phagous arthropods.

Suggested Readings

Selected articles from journals.

VPA 708 *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 709 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 710 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 711 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 Process-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 790 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 PARASITOLOGY

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 701	PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES	2+1
VPP 702	ADVANCES IN TOXICOPATHOLOGY	2+1
VPP 703	ADVANCES IN DIAGNOSTIC PATHOLOGY	1+2
VPP 704	ULTRASTRUCTURAL PATHOLOGY	1+1
VPP 705	IMMUNOPATHOLOGY	2+1
VPP 706	PATHOLOGY OF IMPORTANT AND EMERGING DISEASES OF PETS AND LIVESTOCK	1+1
VPP 707	ADVANCES IN AVIAN PATHOLOGY	2+1
VPP 708	PATHOLOGY OF FUNGAL DISEASES	2+1
VPP 709	MOLECULAR PATHOLOGY OF CELL INJURY	2+1
VPP 710	EXPERIMENTAL PATHOLOGY	1+1
VPP 790	SPECIAL PROBLEM	0+2
VPP 791	DOCTORAL SEMINAR I	1+0
VPP 792	DOCTORAL SEMINAR II	1+0
VPP 799	DOCTORAL RESEARCH	45

VETERINARY PATHOLOGY
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. Hypersentivity 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

Collection of tissues for histopathological, histochemical, toxic, bacterial and viral examination. Use of different fixatives for preservation of museum specimens. Application of different techniques- histopathological, cryosectioning, micrometry, routine and special staining. Demonstration of different inclusions, bacteria and fungi in tissues. Histochemical techniques to demonstrate different tissue constituents.

Suggested Readings

Culling CFA. 1969. *Handbook of Histological Techniques*. Butter Worths.

Lillie RD. 1965. *Histopathologic Techniques and Practical Histo-chemistry*. 3rd Ed. McGraw-Hill.

VPP 603 ANIMAL ONCOLOGY 1+1

Objective

To acquaint students with different types of neoplasms of domestic animals, their nature, cause, pathology and diagnosis.

Theory

UNIT I

Study of different neoplasms of animals including their identification, and epidemiology.

UNIT II

Etiology, histogenesis and experimental production.

UNIT III

Tumour immunology, cell cultures, transplantation and biological behaviour.

Practical

To study the gross and microscopic changes in different types of neoplasms.

Suggested Readings

Meuten DJ. 2002. *Tumors in Domestic Animals*. 4th Ed. Blackwell.

VPP 604 CLINICAL PATHOLOGY 1+2

Objective

To acquaint students with clinical alterations in blood, urine, CSF and other body fluids due to different diseases.

Theory

UNIT I

Study of changes in blood, urine, faeces, cerebrospinal fluid and biopsy specimens and their interpretation.

UNIT II

Exfoliative cytology, organ function tests and their interpretation.

UNIT III

Biochemical profile of blood/plasma/serum and its correlation with disease conditions in domestic animals.

Practical

Evaluation of laboratory investigations on blood, urine, faeces and biopsy specimens from natural and experimentally produced disease conditions.

Suggested Readings

Benzamin MM. 1978. *Outline of Veterinary Clinical Pathology*. 3rd Ed. Iowa State Univ. Press.

Coles EH. 1967. *Veterinary Clinical Pathology*. WB Saunders.

VPP 605 NECROPSY PROCEDURES AND INTERPRETATIONS-1 0+1

Objective

To acquaint students with different Post-mortem procedures in large animals and study of PM lesions in different diseases.

Practical

Detailed necropsy examination of various species of farm animals, laboratory animals and wildlife. Necropsy case presentation and report writing/protocol preparation. Collection of specimens for diagnosis of viral, bacterial, protozoan, parasitic diseases, toxic/ poisoning and for histochemistry/histopathology. Systemic examination of brain, lungs, heart, endocrine glands, lymph nodes, liver, Gastro Intestinal tract, urinary and genital systems for gross pathological and histopathological studies and correlation of the observations to diagnose the disease conditions.

Suggested Readings

Jones TC & Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott.

VPP 606 NECROPSY PROCEDURES AND INTERPRETATIONS-II 0+1

Objective

To acquaint students with different Post-mortem procedures in small animals and poultry and study of PM lesions in different diseases.

Practical

Detailed necropsy examination of various species of small animals, poultry, laboratory animals and wildlife. Necropsy case presentation and report writing/protocol preparation. Collection of specimens for diagnosis of viral, bacterial, protozoan, parasitic diseases, toxic/ poisoning and for histochemistry/histopathology. Systemic examination of brain, lungs, heart, endocrine glands, lymph nodes, liver, Gastro Intestinal tract, urinary and genital systems for gross pathological and histopathological studies and correlation of the observations to diagnose the disease conditions.

Suggested Readings

Jones TC & Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott.

VPP 607 SYSTEMIC PATHOLOGY 2+1

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 non-infectious 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

UNIT1

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 701 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 702 ADVANCES IN 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. Experimental animal models for toxicity studies and evaluation of parameters.

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

Clinico-pathological studies on natural or experimentally induced toxicity /poisoning in domestic animals. To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.

Suggested Readings

Selected articles from journals.

VPP 703 ADVANCES IN DIAGNOSTIC PATHOLOGY 1+2

Objective

To teach current diagnostic techniques for diagnosis of different diseases.

Theory

UNIT I

Study of the principles of biopsy techniques and electron microscopy.

UNIT II

Current techniques for diagnosis of diseases.

Practical

Principles and practice of fluorescent and phase contrast microscopy, chromatography, spectrophotometery and immunodiffusion technique, use of laboratory animals, chick embryos etc. for the diagnosis of animal diseases.

Suggested Readings

Selected articles from journals.

VPP 704 ULTRASTRUCTURAL PATHOLOGY 1+1

Objective

To study the significance of ultra-structural changes in organelles.

Theory

UNIT I

Study of cells- cell morphology, interpretation of normal and abnormal cells.

UNIT II

Study of cell organelles, degenerations, infiltrations, viral inclusions.

Practical

Study of EM photographs, collection and preparation of specimens for EM studies.

Suggested Readings

Selected articles from journals.

VPP 705 IMMUNOPATHOLOGY 2+1

Objective

To teach students immunologically mediated and autoimmune diseases of livestock.

Theory

UNIT I

Principles of immunopathology, hypersensitivity status, pathology of immune complex diseases.

UNIT II

Immunoproliferative disorders, autoimmune diseases and immune deficiencies in man and domestic animals.

Practical

Immune complexes, quantification and determination by various techniques, enumeration of various populations of lymphocytes by different techniques, determination of C3 levels, autoimmune reaction by demonstrating autoantibodies, hypersensitivity reactions (class IV and others).

Suggested Readings

Selected articles from journals.

VPP 706 PATHOLOGY OF IMPORTANT AND EMERGING DISEASES OF PETS AND LIVESTOCK 1+1

Objective

To teach students important and emerging diseases of pets and livestock.

Theory

UNIT I

Introduction to emerging diseases, foot and mouth disease, vesicular stomatitis, vesicular exanthema, rinderpest/Peste des petits ruminants, para influenza -3, infectious bovine rhinotracheitis/infectious pustular vulvovaginitis, bovine spongiform encephalopathy, scrapie, blue tongue, malignant catarrhal fever, mucosal disease/bovine viral diarrhoea, bovine leucosis.

UNIT II

Tuberculosis/Johne's disease, brucellosis, listeriosis, caprine arthritis, campytobacteriosis, encephalitis, parvovirus infection, emerging diseases of pets.

Practical

Study of clinical and gross alterations and histopathology of some important emerging and enzootic diseases.

Suggested Readings

Selected articles from journals.

VPP 707 ADVANCES IN AVIAN PATHOLOGY 2+1

Objective

To teach different diagnostic techniques for diagnosis of different avian diseases.

Theory

UNIT I

Advances in pathogenesis and pathology including molecular basis of important infections (bacterial, viral, fungal and parasitic).

UNIT II

Non-infectious diseases with particular emphasis on emerging diseases of chickens, turkeys, ducks and other birds.

Practical

Necropsy examination of different species of poultry. Study of gross and microscopic lesions in natural and experimentally produced diseases in different species of birds. Diagnosis of different diseases of poultry.

Suggested Readings

Selected articles from journals.

VPP 708 PATHOLOGY OF FUNGAL DISEASES 2+1

Objective

To teach the diseases caused by different fungi and mycotoxins in animals.

Theory

UNIT I

Pathology of diseases associated with pathogenic fungi like aspergillosis, candidiasis, epizootic lymphangitis, histoplasmosis, coccidioidomycosis, cryptococcosis, bovine abortions, dermatophytomycosis etc.

UNIT II

Diseases associated with mycotoxins like aflatoxins, rubratoxin, T_2 toxin, ochratoxin etc. Metabolism of toxins and their effect in man, domestic and laboratory animals, poultry and aquatic species.

Practical

Demonstration of pathogenic mycotoxic fungi, chemistry of toxic compounds, physical and chemical properties, methods of extraction, isolation and identification of mycotoxins.

Suggested Readings

Selected articles from journals.

VPP 709 MOLECULAR PATHOLOGY OF CELL INJURY 2+1

Objective

To acquaint the students about the molecular basis of cell injury and inflammation.

Theory

UNIT I

Causes of cell injury - Ischemic, Hypoxic, Free radicals, virus and chemical cell injury - Chemical Mediators - Cytoskeletal and biochemical changes in cell injury.

UNIT II

Ultrastructural changes and biochemical mechanisms of reversible injury, necrosis, apoptosis. Molecular basis of disease. Cellular adaptation- hyperplasia, hypertrophy, atrophy, metaplasia and dysplasia. Intracellular accumulations.

UNIT III

Inflammation- mechanism and types. Tissue repair and healing.

Practical

Gross and histopathological studies pertaining to above conditions.

Suggested Readings

Selected articles from journals.

VPP 710 EXPERIMENTAL PATHOLOGY 1+1

Objective

To provide expertise in designing the experiments and handling of animals.

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 790 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 PATHOLOGY

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 (Indian Journal of Veterinary Pathology)
* www.vetpathology.org (Veterinary Pathology)
* www.tandf.co.uk (Avian Pathology)
* www.avdi.allenpress.com (Avian Diseases)
* www.elsevier.com/locate/vetimm (Veterinary Immunology and Immuno-pathology)

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

VETERINARY PHARMACOLOGY AND TOXICOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VPT 601	GENERAL PHARMACOLOGY	2+0
VPT 602	AUTONOMIC AND AUTACOID PHARMACOLOGY	2+1
VPT 603	CNS PHARMACOLOGY	2+1
VPT 604	DIGESTIVE AND RESPIRATORY PHARMACOLOGY	2+0
VPT 605	CARDIOVASCULAR AND RENAL PHARMACOLOGY	2+0
VPT 606	ENDOCRINE AND REPRODUCTIVE PHARMACOLOGY	2+0
VPT 607	CHEMOTHERAPY	2+1
VPT 608	TOXICOLOGY OF XENOBIOTICS	2+1
VPT 609	TOXICOLOGY OF PLANTS AND TOXINS	2+0
VPT 610	PHARMACOLOGICAL TECHNIQUES	1+1
VPT 611	TECHNIQUES IN TOXICOLOGY	1+1
VPT 612	ETHNOPHARMACOLOGY	2+0
VPT 691	MASTER'S SEMINAR	1+0
VPT 699	MASTER'S RESEARCH	20
VPT 701	ADVANCES IN NEUROPHARMACOLOGY	2+0
VPT 702	AUTACOID PHARMACOLOGY	1+0
VPT 703	PHARMACOLOGY OF HERBAL DRUGS	2+1
VPT 704	DRUG METABOLISM	2+0
VPT 705	MOLECULAR PHARMACOLOGY	2+0
VPT 706	PHARMACOKINETICS	2+1
VPT 707	PHARMACOGENOMICS	2+0
VPT 708	IMMUNOPHARMACOLOGY	1+0
VPT 709	MOLECULAR TOXICOLOGY	2+0
VPT 710	CLINICAL PHARMACOLOGY	1+1
VPT 711	CLINICAL TOXICOLOGY	2+1
VPT 712	ECOTOXICOLOGY	2+0
VPT 713	REGULATORY TOXICOLOGY	2+1
VPT 790	SPECIAL PROBLEM	0+2
VPT 791	DOCTORAL SEMINAR I	1+0
VPT 792	DOCTORAL SEMINAR II	1+0
VPT 799	DOCTORAL RESEARCH	45

VETERINARY PHARMACOLOGY AND TOXICOLOGY

Course Contents

VPT 601 GENERAL PHARMACOLOGY 2+0

Objective

To study the scope of pharmacology and to understand the basic mechanisms of drug actions and its effects.

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 603 CNS PHARMACOLOGY 2+1

Objective

To study the pharmacodynamics of drugs acting on CNS.

Theory

UNIT I

Anatomical and physiological considerations of central nervous system (CNS); neurohumoral transmission in CNS.

UNIT II

Historical development, theories, principles and stages of general anaesthesia.

UNIT III

Pharmacology of anaesthetics, sedatives, hypnotics, neuroleptics, antiepileptics.

UNIT IV

CNS stimulants, analeptics, opioid agonists and antagonists; non-steroidal anti-inflammatory agents, central and peripheral muscle relaxants, local anaesthetics, therapeutic gases. euthanizing agents. Doping.

Practical

Study of pharmacodynamics of prototype drugs of each group in experimental animals.

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 604 DIGESTIVE AND RESPIRATORY PHARMACOLOGY 2+0

Objective

To study the pharmacological aspects of drugs acting on digestive and respiratory systems.

Theory

UNIT I

Pharmacology of drugs acting on gastrointestinal tract. Appetite stimulants, emetics and anti-emetics.

UNIT II

Anti-ulcer drugs, modulators of gastric and intestinal motility and secretions.

UNIT III

Gastrointestinal protectants and adsorbents, laxatives and cathartics.

UNIT IV

Agents promoting digestive functions; bile acids and pancreatic enzymes, drugs affecting liver; rumen pharmacology.

UNIT V

Pharmacology of drugs acting on respiratory system: pathogenesis of inflammatory respiratory diseases.

UNIT VI

Bronchodilators, antitussives, mucolytics, expectorants, decongestants.

UNIT VII

Drugs used in treatment of asthma.

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 and Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 605 CARDIOVASCULAR AND RENAL PHARMACOLOGY 2+0

Objective

To study the pharmacological aspects of drugs acting on CVS and kidneys.

Theory

UNIT I

Pharmacology of cardiac glycosides.

UNIT II

Antiarrhythmic, antihypertensive and antihyperlipidaemic drugs.

UNIT III

Drugs affecting vasomotor and cardiorespiratory reflex mechanisms and haemopoietic system.

UNIT IV

Coagulants and anticoagulants, thrombolytic agents.

UNIT V

Pharmacology of drugs affecting renal functions and fluid-electrolyte balance.

UNIT VI

Fluid and electrolyte therapy, diuretics, antidiuretics, uricosuric drugs.

Suggested Readingss

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_{50}, dissociation rate constants, potency ratio, pA_x, pDx and pD'_x values.

Specific tests for evaluation of tranquillizing, hypnotic, analgesic, anti-convulsant, 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, mutagencity, 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

Derelanko MJ. 1995. *CRC Hand Book of Toxicology*. Mannfred A. Holinger.

Gad SC & Chengelis CP. 1998. *Acute Toxicology Testing*. 2nd Ed. Academic Press.

Hayes AW. 1994. *Principles and Methods of Toxicology*. 3rd Ed. Raven Press.

VPT 612 ETHNOPHARMACOLOGY 2+0

Objective

To impart the knowledge and importance of traditional Indian medicine.

Theory

UNIT I

Historical aspects: Traditional Indian remedies and regional folklore in disease cure.

UNIT II

Classification, identification and chemical constituents of medicinal plants. Extraction, distillation, evaporation and other processes used in purification and preparation of active constituents from medicinal plants.

UNIT III

Standardization and clinical validation of bioactive molecules from vegetable sources. Therapeutic and adverse effects of potential herbal drugs. Indigenous drugs used as carminatives, antiseptics, antimicrobials, analgesics, and anti-inflammatory agents.

UNIT IV

Alternate systems of medicine in animals.

Suggested Readings

Agrawal VS. (Ed). 1997. *Drug Plants of India*. Kalyani Publishers.

Anjaria J. 2002. *Inventory of Traditional Veterinary Medicinal Practices in India*. GOI Publ., Pathik Enterprises, Ahmedabad.

Bisset NG. (Ed). 1994. *Herbal Drugs and Phytopharmaceuticals*. CRC Press.

Chopra RN, Nayar SL & Chopra IC. (Eds.). 2002. *Glossary of Indian Medicinal Plants*. NISCAIR, CSIR, New Delhi.

Pushpangadan P, Nyman U & George V. (Eds). 1995. *Glimpses of Indian Ethnopharmacology*. TBGRI Publication.

Rastogi RP & Mehrotra BN (Eds). 1993-95. *Compendium of Indian Medicinal Plants*. Vols. I-IV. Publication and Information Directorate, New Delhi.

Tallarida RJ & Murray RB. 1987. *Manual of Pharmacologic Calculations*. 2nd Ed. Springer Verlag.

VPT 701 ADVANCES IN NEUROPHARMACOLOGY 2+0

Objective

To understand the underlying mechanisms of drug receptor interactions and its effects.

Theory

UNIT I

Definition, classification of receptors, molecular structure of receptors.

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_3, diacylglycerol and cyclic nucleotides.

UNIT V

Signal transduction through protein tyrosine kinases. Receptors as pharmaceutical targets.

Suggested Readings

Selected articles from journals.

VPT 702 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 703 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 704 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 705 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 706 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 707 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 708 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 709 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 710 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 pharmacoeconomics.

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 711 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 712 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 713 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 790 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 PHARMACOLOGY AND TOXICOLOGY

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 (Environmental Toxicology and Pharmacology)
* www.blackwellpublishing.com (Journal of Vet. Pharmacology & Therapeutics)
* www.elsevier.com (Comparative Biochem. & Physiol.-Part C: Toxicol. & Pharma.)
* www.clinicalneuropharm.com (Clinical Neuropharmacology)
* www.arjournals.annualreviews.org (Annual Review of Pharma. & Toxicology)
* www.aac.aron.org (Antimicrobial agents and chemotherapy)
* www.nature.com/big/in dex.html (British Journal of Pharmacology)
* www. dmd.aspetijournals.org. (Drug metabolismand 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 (The Pharmacogenomics Journal)
* www. informaworld.org (International Journal of Toxicology)
* 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

VETERINARY PUBLIC HEALTH

Course Structure- at a Glance

CODE	COURSE TITLE	CREDITS
VPH 601	ELEMENTS OF VETERINARY PUBLIC HEALTH	1+1
VPH 602	BACTERIAL AND RICKETTSIAL AGENTS OF PUBLIC HEALTH SIGNIFICANCE	2+1
VPH 603	VIRAL, FUNGAL AND PARASITIC AGENTS OF PUBLIC HEALTH SIGNIFICANCE	2+1
VPH 604	ZOONOSES AND PUBLIC HEALTH	2+1
VPH 605	PRINCIPLES OF FOOD HYGIENE AND SAFETY	2+1
VPH 606	FOOD-BORNE INFECTIONS AND INTOXICATIONS	2+1
VPH 607	MEAT AND MILK HYGIENE	2+1
VPH 608	ENVIRONMENTAL POLLUTION AND SAFETY	3+1
VPH 609	FISH, FISH PRODUCTS AND SEAFOOD HYGIENE	1+1
VPH 610	BIOTERRORISM AND DISASTER MANAGEMENT	1+1
VPH 691	MASTER'S SEMINAR	1+0
VPH 699	MASTER'S RESEARCH	20
VPH 701	CURRENT TOPICS IN VETERINARY PUBLIC HEALTH	2+1
VPH 702	EMERGING AND REEMERGING ZOONOSES	2+1
VPH 703	QUALITY CONTROL OF ANIMAL FOOD PRODUCTS	2+1
VPH 704	OCCUPATIONAL HEALTH HAZARDS	2+1
VPH 705	DISPOSAL AND RECYCLING OF WASTE	2+1
VPH 706	BIOHAZARDS, BIOSECURITY AND DISASTER MANAGEMENT	2+0
VPH 707	FOOD PLANT SANITATION	2+1
VPH 708	ADVANCES IN ENVIRONMENTAL POLLUTION CONTROL	2+1
VPH 790	SPECIAL PROBLEM	0+2
VPH 791	DOCTORAL SEMINAR I	1+0
VPH 792	DOCTORAL SEMINAR II	1+0
VPH 799	DOCTORAL RESEARCH	45

VETERINARY PUBLIC HEALTH
Course Contents

VPH 601 ELEMENTS OF VETERINARY PUBLIC HEALTH 1+1

Objective

To acquaint students with basics of veterinary public health.

Theory

UNIT I

The purposes and scope of veterinary public health; veterinary interests in public health, principal functions and fields of activity of public health veterinarians.

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 PUBLIC HEALTH SIGNIFICANCE 2+1

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, Microsporum, Trichophyton* and *Sporotrichum*.

UNIT III

Description of parasites of public health importance: *Taenia, Echinococcus, Trichinella, Toxoplasma, Diphyllobothrium, 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 ZOONOSES 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 701 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 702 EMERGING AND RE-EMERGING ZOONOSES 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 703 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 704 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 705 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 706 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 707 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 708 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 790 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 (W.H.O. website related to Zoonotic diseases)
* www.fao.org (Website of Food and Agriculture Organization)
* 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

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

***Communication Skills* -** Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

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 503 (e-Course) **INTELLECTUAL PROPERTY AND ITS MANAGEMENT** **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 animal varieties and farmers' rights and bio-diversity 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 506 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 pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

Annexure

BSMA Committee on Veterinary Paraclinical Sciences

(Vety. Micro, Pathology, Pharma. & Toxicology, Parasitology, Immunology, Virology)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR dated January 14, 2008)

Name	Address	Specialization
Dr. S. K. Jand Dean, PGS ***Convener***	GADVASU, Ludhiana	Microbiology
Dr. G. Krishnan Nair Prof. & Head	Dept. of Vety. Microbiology, College of Vety. & Animal Sciences, Mannuthy, Trichur	Microbiology
Dr. D. Kumar Prof. & Head	Dept. of Vety. Parasitology, RGCOVAS, Pondicherry	Parasitology
Dr. R. Somvanshi Principal Sci. & Head	Division of Pathology, IVRI, Izatnagar	Pathology
Dr. M. L. Satyanarayana Prof. & Head	Dept. of Vety. Pathology, Vety. College, Hebbal, Bangalore	Pathology
Dr. A. K. Srivastava Dean	SKUAST, Jammu	Pharmacology
Dr. Satish Garg Prof. & Head	Dept. of Pharmacology, Mathura Vety. College, Mathura	Pharmacology
Dr. P. K. Kapur Professor	I/C, DFSAH, CCS HAU, Hisar	Public Health
Dr. S.K. Gupta Prof. & Head ***Member Secretary***	Dept. of Parasitology, COVS, CCS HAU Hisar	Parasitology

NEW AND RESTRUCTURED POST-GRADUATE CURRICULA & SYLLABI

Veterinary Clinical Subjects

Animal Reproduction, Gynecology & Obstetrics
Veterinary Clinical Medicine, Ethics & Jurisprudence
Veterinary Epidemiology & Preventive Medicine
Veterinary Surgery & Radiology

Education Division
Indian Council of Agricultural Research
New Delhi

January 2009

Contents

PREAMBLE

Veterinary sciences have helped in reducing animal sufferings, minimizing risk of zoonotic diseases threatening human health and ensuring food security. There have been unprecedented advancements in all the branches of veterinary sciences. The futuristic requirements of the society such as integrated casualty management, public health, food security and safety, healthy eco-system, containing bio-terrorism, productivity, profitability and stability of livestock farming systems etc., have posed greater challenges for veterinary academics and scientific community. Veterinarians with higher qualifications are increasingly being involved in devising means and methods of developing diagnostics against prevalent and emerging pathogens, prevention and control of animal diseases and zoonoses, eco-health stewardship, monitoring and surveillance of diseases of livestock and poultry, combating bio-terrorism, genetic engineering to optimize production and develop disease resistant breeds of animals. Bio-medical research, being heavily dependent upon animal experimentation, demands deeper scientific knowledge of veterinary sciences. Temporal aspirations of knowledge seekers ought to be addressed through building knowledge and skill portfolio suiting the job market and thus enhancing the marketability of the veterinary post graduates

In this perspective, it is important that the veterinary profession responds to the futuristic societal needs to remain relevant and purposeful. Recent advances in veterinary medical sciences have led to wide spread use of animal disease surveillance and prediction system, 3-D holographic animal models, robotic tele-surgery, globe-wide virtual class rooms and demonstration centers, sensor diagnostic facilities etc. The dominant forces shaping the Veterinary-Business and Veterinary-education are global and virtual with a large number of specialists offering tele-veterinary services from off-shore locations like India. The ever changing and demanding public service sector has necessitated re-look into the veterinary higher education.

At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in-depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance. Detailed study of the course curricula and syllabi, being implemented by veterinary colleges in India, revealed that there was enormous heterogeneity in the course structure, nomenclature and contents. Informal discussions amongst veterinary academicians, over

the years, referred to the need to train good teachers and researchers with comprehensive subject knowledge rather than narrow sub-specialization of a discipline at Master's level. In view of the above, the task of formulating need based contemporary post graduate courses and syllabi for implementation of post graduate education uniformly at national level was initiated.

Three BSMA committees, constituted by ICAR for restructuring of masters and doctorate course curricula and syllabi, worked in unison to formulate common basic format. The BSMA committees consisted of [1]Basic Veterinary Sciences (Anatomy and Histology; Veterinary & Animal Husbandry Extension; Biochemistry and Physiology); [2]Veterinary Para-clinical Sciences (Microbiology, Parasitology, Pathology, Pharmacology & Toxicology, Public Health) and [3]Veterinary Clinical Sciences (Animal Reproduction, Gynaecology & Obstetrics; Clinical Medicine, Ethics & Jurisprudence; Epidemiology & Preventive Medicine and Surgery & Radiology).

The Master's program in basic veterinary subjects aims at providing cutting edge concepts as well as practical applications of these exciting fields. The new and restructured Post-Graduate curricula and syllabi in respect of basic, paraclinical and clinical veterinary sciences documents contain several innovative and practically applicable courses and extensively revamped course contents viz. inclusion of imaging techniques, ultra-structural studies and clinical applications in the curricula of veterinary anatomy; emphasis on cell membrane dynamics, receptor biology and proteomics in relation to various animal diseases, in veterinary biochemistry; focus on rumen microbiology and metabolism, immuno-physiology and physiology of stress in veterinary physiology; framing of courses on social psychology, group dynamics, gender and livestock development, planning and monitoring, organizational management and information and communication technology in the veterinary and animal husbandry extension.

Para-clinical veterinary subjects, which provide essential support by employing disease diagnostics technologies for prevention and control of animal diseases, directing efforts for Green Earth, maintenance of biodiversity etc., have been redesigned in the light of general recommendations of the BSMA committees on veterinary sciences. Courses have been re-designed in such a manner that an MVSc student in Microbiology studies all aspects of bacteriology, virology, mycology and immunology. The contents of 17 courses of microbiology and 14 courses of immunology have been reshaped and encapsulated into 9 mandatory courses of 600 series and 18 optional courses of 700 series have been carved

in veterinary microbiology. In veterinary parasitology, new courses on malacology, remote sensing and GIS have been introduced. In veterinary pathology, courses on veterolegal pathology and toxico-pathology have been introduced. A new course on ethno-pharmacology has been introduced in veterinary pharmacology while courses on fish, fish products and seafood hygiene; disaster management and bioterrorism; emerging and reemerging zoonoses; occupational health hazards; disposal and recycling of waste; biohazards and bio-security have been introduced in veterinary public health.

The new approach encompassed the latest knowledge for development of advanced diagnostics, clinical management, clinical epidemiology, bio-security, prevention and control of diseases of livestock and poultry including zoonoses like Bird Flu, Rabies, Tuberculosis, Brucellosis etc. New courses on 'Herd Health management', 'Ecology', 'Forensic Medicine', 'Emergency Medicine', 'Diagnostic Imaging Techniques,' 'Survey and Surveillance', 'Diseases of Zoo, Wild and Laboratory Animals' etc. have been framed and contents of other courses were heavily revised to include the latest developments. To encourage clinical practice in the veterinary clinics, courses of Clinical Practice each at MVSc and PhD level have been made mandatory. To focus on learning of research methodology, scientific thinking, planning and experimentation, a course for special problems has been introduced in all the subjects.

Teaching Veterinary Clinical Service Complex, along with clinical departments and diagnostic laboratories, provides yeoman's service to stake holders in the field of animal health. The up-gradation of the clinical services will go a long way in meeting the expectations and demands for advanced diagnosis, therapeutics and prophylaxis. The state of infra-structure, manpower (both technical and support staff) and contingencies attached to clinical service units in veterinary colleges in India, requires immediate attention of policy planners to support and supplement in terms of liberal financial grants.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stakeholders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

Simrat Sagar Singh, Convener, BSMAC (Veterinary Clinical Sciences)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in veterinary science disciplines have been prepared in the light of PG programs in vogue at different veterinary colleges in India and contemporary developments in veterinary sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each MVSc student should register for all the courses offered by the major department, e.g. an MVSc student in microbiology should study all basic courses of bacteriology, virology and immunology instead of opting for courses of 1 or 2 sub-disciplines only. However, flexibility has been retained at Ph.D. level.

II. Credit Requirements

- Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the veterinary students as given below.
- The total course work of 40 credit hours has been proposed at M.V.Sc. level instead of minimum requirement 35 credit hours (Table 2), keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together -11 credits.
- At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together-11 credits.
- Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credits should be taken from minor subject and course (s) with a minimum of 3 credit hours from supporting subject (s) should be taken. Thus students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- It is proposed that clinical practice of 0+3 credit hours should be made compulsory in the two semesters for all MVSc students in departments of Clinical Medicine, Ethics & Jurisprudence, Surgery & Radiology, and Animal Reproduction, Gynaecology & Obstetrics.
- Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.
- The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary

Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for MVSc and 700 for Ph. D. programme.

III. Major additions and alterations in the existing PG courses

Animal Reproduction, Gynaecology and Obstetrics

- VOG 607 and VOG-608 [Clinical practice – I & II] courses made mandatory in all clinical subjects to encourage 'On site work based learning'.
- VOG 606 and VOG 704 [Reproductive biotechnology and Advances in reproductive biotechnology] contents of 'embryo biotechnology course' improved to include other aspects like stem cell biotechnology, immuno-modulation and immuno-neutralization

Veterinary Clinical Medicine, Ethics and Jurisprudence

- To facilitate comprehensive understanding and learning, all the courses of 600 series are designed so that diseases of group of animals (e.g. equines, canines etc.) are discussed together rather than the diseases of body systems.
- VCM 607 [Clinical diseases of animal species of regional importance e.g. Camel in Haryana, Yak in eastern & elephant in south India] has been introduced.
- VCM 610 [Veterinary forensic medicine]; VCM 611 [Clinical diagnostic techniques] and VCM 612 [Veterinary emergency medicine] are designed to meet current day demands.
- Newly framed courses (VCM 701 to 708) deal with advances in gastroenterology, cardiopulmonary medicine, neurological and urological disorders; endocrine and dermatological disorders; production diseases; pediatrics and geriatrics; veterinary diagnostics and veterinary therapeutics

Veterinary Epidemiology and Preventive Medicine

- To facilitate comprehensive understanding and learning the courses of preventive Medicine of 600 and 700 series are newly designed so that diseases of group of animals (e.g. ruminants, equines, canines etc.) are discussed together rather than the diseases of body systems.
- Two courses of epidemiology viz. VEP 604 [Veterinary clinical epidemiology] and VEP 605, [Bio-security practices in disease prevention] are new courses.
- Advanced courses (of 700 series) of preventive Medicine are new and courses enlist diseases of a group of animals.
- Advanced courses of epidemiology viz. VEP 701 [Recent concepts in epidemiology and disease forecasting]; VEP 702 [Herd health management]; VEP 703 [Data collection, management and presentation]; VEP 704 [Survey and surveillance]; VEP 705 [Emerging and re-emerging animal diseases] and VEP 706 [Ecology of diseases] are all newly designed courses keeping in mind the latest developments.

Veterinary Surgery and Radiology

- VSR 606 [Diagnostic imaging techniques] and VSR 707 [Advances in diagnostic imaging techniques] are redesigned courses from courses of radiology, ultrasound and alternate imaging. These also include latest techniques like MRI, CT Scan, nuclear medicine, positron emission tomography.
- VSR 701 [Veterinary dentistry]; VSR 705 [Anesthesia of wild and laboratory animals] and VSR 709 [Experimental surgical techniques in animals] are new courses.

ORGANIZATION OF COURSE CONTENTS
&
CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	**60**	**75**
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given in Table 1.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Table 1. Suggested list of specified minor subjects (departments)

Major Subject	Minor Subjects*
Animal Reproduction Gynecology and Obstetrics	Veterinary Surgery & Radiology, Veterinary Physiology, Veterinary Biochemistry, Veterinary Clinical Medicine, Ethics & Jurisprudence, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Animal Nutrition
Veterinary Clinical Medicine, Ethics & Jurisprudence	Veterinary Surgery and Radiology, Veterinary Epidemiology and Preventive Medicine, Veterinary Pharmacology & Toxicology, Veterinary Physiology, Veterinary Biochemistry, Animal Reproduction Gynaecology and Obstetrics
Veterinary Epidemiology and Preventive Medicine	Veterinary Microbiology, Animal Biotechnology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Public Health, Veterinary Pathology
Veterinary Public Health	Veterinary Epidemiology and Preventive Medicine, Veterinary Microbiology, Veterinary Pathology, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Veterinary Parasitology, Livestock Product Technology
Veterinary Surgery and Radiology	Veterinary Anatomy and Histology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Pharmacology & Toxicology, Veterinary Physiology, Veterinary Pathology, Animal Reproduction Gynaecology and Obstetrics

*The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean post graduate studies.

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 701	ADVANCES IN GYNAECOLOGY	2+1
VOG 702	ADVANCES IN OBSTETRICS	2+1
VOG 703	ADVANCES IN ANDROLOGY	2+1
VOG 704	ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY	1+1
VOG 705	ADVANCES IN SEMEN PRESERVATION	1+1
VOG 706	CLINICAL PRACTICE I	0+3
VOG 707	CLINICAL PRACTICE II	0+3
VOG 790	SPECIAL PROBLEM	0+2
VOG 791	DOCTORAL SEMINAR I	1+0
VOG 792	DOCTORAL SEMINAR II	1+0
VOG 799	DOCTORAL RESEARCH	45

ANIMAL REPRODUCTION, GYNAECOLOGY & OBSTETRICS
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. 1976. *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

Managemental 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. 1979. *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. 1976. *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

Pelvimetory 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 Languge Book Society & Bailliere Tindall.

Roberts SJ. 1976. *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 hormonal. 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. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency

Salisbury GW, VanDemark NL & Lodge JR. 1978. *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

Computer assisted semen analysis (CASA), Collection and evaluation of semen. Preparation of extenders. Preservation of semen: room temperature, refrigeration and cryopreservation. Handling and evaluation of processed semen. Practice of AI techniques.

Suggested Readings

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins.

Perry J. 1970. *Artificial Insemination of Farm Animals*. Oxford & IBH.

Salisbury GW, VanDemark NL & Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman.

VOG 606 REPRODUCTIVE BIOTECHNOLOGY 2+1

Objective

To impart knowledge and training on biotechniques in animal reproduction.

Theory

UNIT I

Embryo transfer technology: selection of donors and recipients.

UNIT II

Synchronization, super-ovulation, surgical and non-surgical collection of embryos and evaluation of embryos.

UNIT III

Cryopreservation of embryos, transfer of embryos to donors.

UNIT IV

In vitro fertilization, *in vitro* maturation, micromanipulation 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

Synchronization of estrus in donors and recipients, superovulation, surgical and non-surgical collection and transfer of embryos. Collection of oocytes from slaughter house genitalia. *In vitro* fertilization, *in vitro* maturation and cryopreservation of embryos. Sexing of embryos.

Suggested Readings

Gordon I. 2004. *Reproductive Technologies in Farm Animals*. CABI.

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins.

VOG 607 CLINICAL PRACTICE - I 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 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 701 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, Laproscopy, 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 702 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 ovairo-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 703 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 genetalia. 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 704 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 705 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 706 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 707 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 790 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.

ANIMAL REPRODUCTION, GYNAECOLOGY & OBSTETRICS

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 (Animal Reproduction Science)
* www.blackwellpublilshing.com (International Journal of Andrology)
* www.bioreprod.org (Biology of reproduction)
* www.domesticanimalendo.com (Domestic Animal Andocrinology)
* www.reproduction-onlline.org (Journal of Andrology)
* www.reproduction-online.org (Reproduction)
* www.interscience.wiley.com (Reproduction in domestic animals)
* www.theriojournal.com (Theriogenology)
* www.buffaloresearch.com (Buffalo Journal)
* www.eje-online.org (European journal of Endocrinology)
* www.sciencedirect.com (The Veterinary Journal)
* www.blackwellpublishing.com (Asian journal of Andrology)
* 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 701	ADVANCES IN GASTROENTROLOGY	2+0
VCM 702	ADVANCES IN CARDIOPULMONARY MEDICINE	2+0
VCM 703	ADVANCES IN NEUROLOGICAL AND UROLOGICAL DISORDERS	2+0
VCM 704	ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS	2+0
VCM 705	ADVANCES IN PRODUCTION DISEASES	2+0
VCM 706	ADVANCES IN PAEDIATRICS AND GERIATRICS	1+0
VCM 707	ADVANCES IN VETERINARY DIAGNOSTICS	1+2
VCM 708	ADVANCES IN VETERINARY THERAPEUTICS	1+2
VCM 709	ADVANCED CLINICAL PRACTICE I	0+2
VCM 710	ADVANCED CLINICAL PRACTICE II	0+2
VCM 711	ADVANCED CLINICAL PRACTICE III	0+2
VCM 790	SPECIAL PROBLEM	0+2
VCM 791	DOCTORAL SEMINAR I	1+0
VCM 792	DOCTORAL SEMINAR II	1+0
VCM 799	DOCTORAL RESEARCH	45

*Domestic animals of regional importance e.g. Camel in Haryana, Yak in Eastern India, Elephant in South India

VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE

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 sytem, 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*. Verlaug 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 607 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. 1978. *Pathology of Laboratory Animals*. Springer, New York.

Fowler ME. 1986. *Zoo and Wild Animal Medicine*. 2nd Ed. W. B. Sauders.

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. 2007. *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 toxaemia).

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 TECHNQUES 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 701 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 702 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 703 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 704 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 705 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 706 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 707 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 708 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 709 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).

VCM 710 ADVANCED CLINICAL PRACTICE - II 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 (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

VCM 711 ADVANCED CLINICAL PRACTICE - III 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 (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

VCM 790 SPECIAL PROBLEM 0+2

Objective

A short-term project work on some aspect of etio-pathogensis, diagnosis and therapy of diseases of domestic animals.

VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE

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 (Bulgarian Journal of Veterinary Medicine)
* www.jarm.com (International Journal of Applied Research in Vety. Medicine)
* www.ispub.com/ostia/index..php?xmlFilePath=journals/ijvm/front.xml (Internet Journal of Veterinary Medicine)
* Isrvma.org/journal.htm. (Israel Journal of Veterinary Medicine)
* www.medwellonline.net/java/fp.html (Journal of Animal & Veterinary Advances)
* www.jstage.jst.go.ijp/browse/jes/-char/en (Journal of Equine Science)
* www.stage.jst.go.jp/browse/jpsa (Journal of Poultry science)
* www.vesci.org (Journal of Veterinary Science)
* www.sasas.co.za (South African Journal of Animal Science)
* journals.tubitak.gov.tr/veterinary/index.php (Turkish Journal of Veterinary and Animal Sciences)
* 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 DISESASE 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 701	RECENT CONCEPTS IN EPIDEMIOLOGY AND DISEASE FORECASTING	2+1
VEP 702	HERD HEALTH MANAGEMENT	2+1
VEP 703	DATA COLLECTION , MANAGEMENT AND PRESENTATION	2+1
VEP 704	SURVEY AND SURVEILLANCE	2+1
VEP 705	EMERGING AND RE-EMERGING ANIMAL DISEASES	2+0
VEP 706	ECOLOGY OF DISEASES	2+0
VEP 707	MOLECULAR APPROACHES IN EPIDEMILOGY	2+1
VEP 708	ADVANCES IN PREVENTION & CONTROL OF INFECTIOUS DISEASES OF RUMINANTS	2+1
VEP 709	ADVANCES IN PREVENTION AND CONTROL OF INFECTIOUS DISEASES OF EQUINES	2+1
VEP 710	ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN PET ANIMALS	2+1
VEP 711	ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN POULTRY	2+1
VEP 712	ADVANCES IN INFECTIOUS DISEASES OF LABORATORY AND ZOO ANIMALS	1+0
VEP 713	ADVANCES IN DIAGNOSIS AND MANAGEMENT OF TOXICOLOGICAL CONDITIONS	1+1
VEP 790	SPECIAL PROBLEM	0+2
VEP 791	DOCTORAL SEMINAR I	1+0
VEP 792	DOCTORAL SEMINAR II	1+0
VEP 799	DOCTORAL RESEARCH	45

VETERINARY EPIDEMIOLOGY AND PREVENTIVE MEDICINE
Course Contents

VEP 601 PRINCIPLES OF EPIDEMIOLOGY 2+0

Objective

To familiarize students with epidemiological concepts.

Theory

UNIT I

Definitions, scope, concepts, types, application and common terms used in epidemiology.

UNIT II

Host-Agent-Environmental factors in causation of diseases and disease patterns.

UNIT III

Epidemiological data: its nature, sources, collection, storage, retrieval and presentation.

UNIT IV

Epidemiological studies: Experimental and observational, international organizations and laws regulating animal diseases.

Suggested Readings

Martin SW, Meek AH & Willeberg P. 1993. *Veterinary Epidemiology: Principles and Methods*. IBH.

Narayan KG. 2004. *Epidemiology, Diagnosis and Management of Zoonoses*. ICAR.

Schwabe CW, Riemann HP & Franti CE. 1984. *Epidemiology in Veterinary Practice*. 3rd Ed. Lea & Fabiger.

Thrusfield M. 2004. *Veterinary Epidemiology*. 8th Ed. Blackwell.

VEP 602 APPLIED EPIDEMIOLOGY 1+1

Objective

To acquaint students with the application of epidemiology in disease diagnosis, prevention and control.

Theory

UNIT I

Surveys, sampling and collection of information, design questionnaires, disease monitoring and surveillance.

UNIT II

Epidemiological investigations of disease outbreak, modeling, disease forecasting, serological and molecular epidemiology.

UNIT III

Economics of diseases and different strategies for prevention and control of diseases and syndromes. Disease free zones and zero disease concept.

UNIT IV

Molecular basis of a disease, application of nucleic acid based assays for genomic characterization of field isolates vis-à-vis vaccine strains.

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

Smith RD. 2005. *Veterinary Clinical Epidemiology - a Problem Oriented Approach*. 3rd Ed. Taylor & Francis, CRC.

VEP 605 BIOSECURITY PRACTICES IN DISEASE PREVENTION 1+1

Objective

To facilitate learning concepts of disinfection, sterilization and vaccination for disease prevention.

Theory

UNIT I

Definition and principles of biosecurity, shedding of pathogens by infected animals, their survival in the environment, routes of entry and transmission of pathogens.

UNIT II

Protection of susceptible animals, interruption of pathways of transmission, role of disinfection to break cycle of infection.

UNIT III

Chemical disinfectants, microbial resistance to disinfectants, physical methods of disinfection and sterilization.

UNIT IV

Biosecurity measures for collection of specimen from wild animals. Vaccines- success stories of disease eradication through vaccination.

Practical

Practical use of disinfectants in destruction of microbes in laboratory and under field conditions. Determination of efficacy/phenol coefficient of commonly used disinfectants. Measurement of vaccine titres.

Suggested Readings

Linton AH, Hugo WB & Russell AD. 1987. *Disinfection in Veterinary and Farm Animals Practice*. Blackwell.

VEP 606 INFECTIOUS DISEASES OF RUMINANTS - I 2+1

Objective

To supplement cognitive learning with regard to recent progress made in the areas of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of bacterial and fungal diseases of bovine, sheep and goats.

Theory

UNIT I

Mastitis, joint ill, ulcerative lymphangitis, anthrax, clostridial infections, black quarter, tetanus, bacillary haemoglobinuria, botulism, colibacillosis.

UNIT II

Pasteurellosis, listeriosis, compylobacteriosis, tuberculosis, Johne's disease, braxy, entero-toxaemia, brucellosis, salmonellosis, leptospirosis.

UNIT III

Actinomycosis, actinobacillosis, ringworm, cutaneous streptothricosis, sporotrichosis, aspergillosis, coccidiodomycosis, rhinosporidiosis, mucormycosis, histoplasmosis, candidiasis, blastomycosis etc.

Practical

Application of latest diagnostic/serological tests and adoption of preventive measures for the control of various bacterial and fungal diseases of bovine, sheep and goats.

Suggested Readings

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 607 INFECTIOUS DISEASES OF RUMINANTS - II 2+1

Objective

To supplement cognitive learning with regard to recent progress made in the areas of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of viral, rickettsial and parasitic diseases of bovine, sheep and goats.

Theory

UNIT I

Foot and mouth disease, vesicular stomatitis, vesicular exanthema, rinderpest, PPR, bovine viral diarrhea, mucosal disease, ephemeral fever, bovine herpes virus-1 induced syndromes, leucosis, viral pneumonia, pox diseases, infectious gastro-enteritis of viral etiology.

UNIT II

Bovine malignant head catarrh, rabies, scrapie, blue tongue, louping ill, papillomatosis.

UNIT III

Bovine tropical theileriosis, babesiosis, anaplasmosis, trypanosomiosis, toxoplasmasis, coccidiosis.

UNIT IV

Sarcocystosis, fascioliosis, amphistomiosis, gastro-intestinal nematodiosis, schistosomiosis, verminous bronchitis, echino-coccosis, coenurosis, tape worm infestations.

Practical

Application of latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by viruses, rickettsiae, helminth parasites and blood protozoa.

Suggested Readings

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 608 INFECTIOUS DISEASES OF EQUINES 1+1

Objective

Learning of important infectious diseases of equines; their diagnosis, prevention and control.

Theory

UNIT I

Anthrax, tetanus, botulism, strangles, glanders, malignant edema, actinomycosis, clostridial infections, *Rhodococcus equi* pneumonia (Zoonotic), tuberculosis.

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, coccidiodomycosis, dermatophytosis.

Practical

Diagnostic tests and serological tests for study of epidemiology of infectious diseases of equines.

Suggested Readings

Robison NE. 1997. *Current Therapy in Equine Medicine*. WB Saunders.

Wintzer HJ. 1986. *Equine Diseases, a Text Book for Students and Practioners.* Verlaug 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 calci virus, feline immuno-deficiency 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.

Tilley LP & Smith FWK Jr. 2004. *The 5-minute Veterinary Consult (Canine and Feline)*. 3rd Ed. Lippincot, Williams & Wilkins.

VEP 610 INFECTIOUS DISEASES OF POULTRY 2+1

Objective

Learning of etio-pathology, diagnosis, prevention and control of important infectious diseases of poultry.

Theory

UNIT I

Impact of diseases on poultry industry, mechanism of disease transmission. Bacterial diseases: *Escherichia coli* and Salmonella infections, coryza, fowl cholera, gangrenous dermatitis, mycoplasmosis, CRD.

UNIT II

Viral diseases: Newcastle disease, infectious bursal disease, Marek's disease, infectious bronchitis, inclusion body hepatitis, hydro-pericardium syndrome, avian pox, infectious laryngo-tracheitis, avian influenza, lymphoid leucosis, avian encephalomyelitis, infectious bronchitis.

UNIT III

Fungal and parasitic diseases: aspergillosis, candidiosis, favus, mycotoxicosis, coccidiosis, roundworm and tape worm infestations, vaccination schedule etc.

Practical

Postmortem examination of poultry birds, collection of material for isolation, antibiotic sensitivity assay, histopathology and demonstration of other routine diagnostic tests. Seromonitoring for important diseases and pullorum testing.

Suggested Readings

Calnek BW, Barnes HA, Beard CW, Reid WM & Yoder HW Jr. 1994. *Diseases of Poultry*. 10th Ed. Iowa State Univ. Press.

Jordan FTW & Pattison M. 1996. *Poultry Diseases*. WB Saunders.

VEP 611 INFECTIOUS DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE (CAMEL AND SWINE) 2+1

Objective

Learning of diseases of animals which are important to the particular region i.e. swine, camel, yak, mithun, elephant etc. e.g., in Haryana, swine and camel diseases will be taught to the students.

Theory

UNIT I

Specific diseases of camel e.g. kapali, malli, jhooling, pica, satyriasis, specific peritonitis, kumree, chronic peritonitis.

UNIT II

General infectious diseases: anthrax, actinomycosis, black quarter, bronchitis, coccidiosis, contagious echthyma, haemorrhagic septicaemia, hydatidosis, mange, mastitis, camel pox, rabies, surra, tuberculosis etc.

UNIT III

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 & Leman AD. (Eds.). 1978. *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. 1978. *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. 2007. *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 701 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 702 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 703 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

Noordhuzen JPTM, Frankena K, Thrusfield MV & Gruat EAM. 2003. *Application of Quantitative Methods in Veterinary Epidemiology*. International Book Distr. Co.

VEP 704 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 705 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 706 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 707 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 viz. polymerase chain reaction (PCR) assays, nucleotide sequencing, restriction endonuclease analysis and RFLP analysis for genomic characterization using the field material directly or after extraction of nucleic acid from small scale cultures, use of radio-actively labeled or non radioactive oligo-nucleotide probes in dot-blot and Southern hybridizations.

Practical

Extraction and isolation of nucleic acid from field isolates of the causative pathogens, digestion with restriction endonucleases and electrophoresis in agarose gel in order to obtain fingerprints and their comparative analysis. SDS-PAGE for protein profiling. Western blotting, ELISA for screening of field samples.

Suggested Readings

Selected articles from journals.

VEP 708 ADVANCES IN PREVENTION AND CONTROL OF INFECTIOUS DISEASES OF RUMINANTS 2+1

Objective

To understand advancements made in the field of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of diseases of ruminants.

Theory

UNIT I

Bacterial diseases of economic importance in bovines, sheep and goats.

UNIT II

Viral diseases of economic importance in bovines, sheep and goats.

UNIT III

Fungal diseases of economic importance in bovines, sheep and goats.

UNIT IV

Blood protozoan and rickettsial diseases of economic importance in bovines, sheep and goats.

UNIT V

Parasitic diseases of economic importance in bovines, ovines and caprines.

Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures for major diseases of veterinary importance caused by bacteria, viruses, fungi, rickettsiae, parasites and protozoa.

Suggested Readings

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 709 ADVANCES IN PREVENTION AND CONTROL OF INFECTIOUS DISEASES OF EQUINES 2+1

Objective

To train students in learning and practicing advancements made in the field of prevention and control of important infectious diseases of equines.

Theory

UNIT I

Bacterial diseases of economic importance in equines.

. UNIT II

Viral diseases of economic importance in equines.

UNIT III

Fungal diseases of economic importance in equines.

UNIT IV

Blood protozoan and rickettsial diseases of economic importance in equines.

UNIT V

Parasitic diseases of economic importance in equines.

Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by viruses, rickettsiae and protozoa.

Suggested Readings

Selected articles from journals.

VEP 710 ADVANCES IN PREVENTION AND CONTROL OF DISEASE IN PET ANIMALS 2+1

Objective

To get students acquainted with advancements made in the field of prevention and control of important infectious diseases of pet animals.

Theory

UNIT I

Bacterial diseases of economic importance in pet animals.

. UNIT II

Viral diseases of economic importance in pet animals.

UNIT III

Fungal diseases of economic importance in pet animals.

UNIT IV

Blood protozoan and rickettsial diseases of economic importance in pet animals.

UNIT V

Parasitic diseases of economic importance in pet animals.

Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of pet animals caused by bacteria, viruses, fungi, rickettsiae, parasites and protozoa.

Suggested Readings

Selected articles from journals.

VEP 711 ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN POULTRY 2+1

Objective

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 790 SPECIAL PROBLEM 0+2

Objective

To provide expertise in handling practical research problems.

Practical

Short research problems involving contemporary issues and research techniques.

VETERINARY EPIDEMIOLOGY AND PREVENTIVE MEDICINE

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.

VETERINARY SURGERY AND RADIOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VSR 601	PRINCIPLES OF SURGERY	2+0
VSR 602	CLINICAL PRACTICE – I	0+3
VSR 603	CLINICAL PRACTICE – II	0+3
VSR 604	SMALL ANIMAL ANAESTHESIA	2+1
VSR 605	LARGE ANIMAL ANAESTHESIA	2+1
VSR 606	DIAGNOSTIC IMAGING TECHNIQUES	2+1
VSR 607	VETERINARY OPHTHALMOLOGY AND DENTISTRY	1+1
VSR 608	SMALL ANIMAL SOFT TISSUE SURGERY	2+1
VSR 609	LARGE ANIMAL SOFT TISSUE SURGERY	2+1
VSR 610	ORTHOPAEDIC AND LIMB SURGERY	2+1
VSR 691	MASTER'S SEMINAR	1+0
VSR 699	MASTER'S RESEARCH	20
VSR 701	CLINICAL SURGICAL PRACTICE – I	0+2
VSR 702	CLINICAL SURGICAL PRACTICE – II	0+2
VSR 703	CLINICAL SURGICAL PRACTICE – III	0+2
VSR 704	ANAESTHESIA OF WILD AND LABORATORY ANIMALS	1+1
VSR 705	ADVANCES IN ANAESTHESIOLOGY	2+1
VSR 706	ADVANCES IN DIAGNOSTIC IMAGING TECHNIQUES	2+1
VSR 707	NEUROSURGERY	2+1
VSR 708	EXPERIMENTAL SURGICAL TECHNIQUES IN ANIMALS	1+1
VSR 789	SPECIAL PROBLEMS IN ANAESTHESIA	0+2
VSR 790	SPECIAL PROBLEMS IN SURGERY	0+2
VSR 791	DOCTORAL SEMINAR I	1+0
VSR 792	DOCTORAL SEMINAR II	1+0
VSR 799	DOCTORAL RESEARCH	45

VETERINARY SURGERY AND RADIOLOGY
Course Contents

VSR 601 PRINCIPLES OF SURGERY 2+0

Objective

To impart the basic knowledge of principles of surgery.

Theory

UNIT I

Wound healing, current concepts of inflammation and management, wound infections, antimicrobial therapy, principles of surgical asepsis, sterilization and disinfection.

UNIT II

Systemic effects of surgical stress, haemorrhage and haemostasis, metabolism of the surgical patient, fluid therapy in surgical patients, acid-base balance, shock. Hyperalimentation. Blood transfusion. Host defense mechanism.

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.). 1975. *Radiologic Science for Technologists*. CV Mosby.

Gillette EL, Thrall DE & Lebel JL. (Eds.). 1977. *Carlson's Veterinary Radiology*. Lea & Febiger.

Goddard PJ. (Ed.). 1995. *Veterinary Ultrasonography*. CABI.

Kealy JK. (Ed.). 1987. *Diagnostic Radiology and Ultrasonography in Dogs and Cats*. 2nd Ed. Saunders, Philadelphia.

Morgan JP. (Ed.). 1972. *Radiology in Veterinary Orthopaedics*. Lea & Febiger.

Singh AP & Singh J. (Eds.). 1994. *Veterinary Radiology*. CBS.

Thrall DE. (Ed.). 2007. *Textbook of Veterinary Diagnostic Radiology*. 5th Ed. Saunders, Philadelphia.

VSR 607 VETERINARY OPHTHALMOLOGY 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 conjuctiva, 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 paracentasis, 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.). 2007. *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.). 1974. *Textbook of Large Animal Surgery*. Williams & Wilkins.

Slatter DH. (Ed.). 1981. *Fundamentals of Veterinary Ophthalmology*. WB Saunders.

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.

Oehme FW & Prier JE. (Ed.). 1994. *Textbook of Large Animal Surgery*. Williams & Wilkins.

Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 610 ORTHOPAEDICS AND LIMB SURGERY 2+1

Objective

To familiarize with various affections of bones, joints, tendons, ligaments and foot as well as their treatment in animals.

Theory

UNIT I

Fractures and dislocations, fracture healing, ligaments and tendons - repair techniques.

UNIT II

Treatment of fractures of different bones in domestic animals, bone diseases.

UNIT III

Various affections of the joints, their diagnosis and treatment.

UNIT IV

Conformation of the limb, anatomy of hoof.

UNIT V

Lameness and allied surgical conditions of fore limbs/hind limbs, rehabilitation of orthopaedic patient.

Practical

Internal and external fixation of fractures and dislocation, arthrotomy, tenotomy, examination of limbs for lameness, nerve blocks, injections in joints, operations for arthritis, hoof surgery and corrective shoeing, physiotherapy. Instrumentation, neurological examination, imaging the spine; skull and brain, surgical approach to the cervical spine; thoracolumbar spine and brain.

Suggested Readings

Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders.

Fubini SL & Ducharme NG. (Eds.). 2004. *Farm Animal Surgery*. WB Saunders.

Newton CD & Nunamaber DM. (Eds.). 1985. *Textbook of Small Animal Orthopaedics*. JB Lippincott.

Oehme FW & Prier JE. (Eds.). 1974. *Textbook of Large Animal Surgery*. Williams & Wilkins.

Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 701 CLINICAL SURGICAL PRACTICE - I 0+3

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

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 and personnel.

VSR 702 CLINICAL SURGICAL PRACTICE - II 0+3

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

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 and personnel..

VSR 703 CLINICAL SURGICAL PRACTICE - III 0+3

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

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 and personnel..

VSR 704 ANAESTHESIA OF WILD AND LABORATORY ANIMALS 1+1

Objective

To impart the basic and practical knowledge of chemical immobilization, sedation and anaesthesia of laboratory animals, captive and free ranging wild animals.

Theory

UNIT I

General considerations in chemical restraint of captive and free ranging wild animals.

UNIT II

Methods of administration of anaesthesia in captive, free ranging animals and laboratory animals.

UNIT III

Local and general anaesthesia in exotic species, wild animals, zoo animals and laboratory animals.

UNIT IV

Anaesthetic emergencies and complications.

Practical

Familiarization with capture equipments, local anaesthetic techniques, use of various preanaesthetic and anaesthetic agents in laboratory animals, monitoring of patient during general anaesthesia.

Suggested Readings

Selected articles from journals.

VSR 705 ADVANCES IN ANAESTHESIOLOGY 2+1

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 706 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 707 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 708 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 789 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 790 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.

VETERINARY SURGERY AND RADIOLOGY

List of Journals

* American Journal of Veterinary Research
* Canadian Veterinary Journal
* Compenduim 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.blackwellpublilshing.com/journalasp (Veterinary Surgery)
* www.blackwellpublilshing.com/summit.asp (Veterinary anesthesia and Analgesia)
* www.blackwellpublilshing.com/journalasp (Veterinary Radiology and Ultrasound)
* www.blackwellpublilshing.com/journalasp (Veterinary Ophthalmology)
* 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 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

***Communication Skills* -** Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

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 503 (e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT 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 animal varieties and farmers' rights and bio-diversity 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 506 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 pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

Annexure

BSMA Committee on Veterinary Clinical Subjects

(Vety. Epidemiology, Clinical Medicine, Obst. & Gynae, Surgery & Radiology)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR dated January 14, 2008)

Name	Address	Specialization
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NEW AND RESTRUCTURED POST-GRADUATE CURRICULA & SYLLABI

Livestock Production Technology & Products Management

Animal Genetics & Breeding
Animal Nutrition
Livestock Production and Management
Livestock Products Technology
Poultry Science

Education Division
Indian Council of Agricultural Research
New Delhi

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Contents

PREAMBLE

Livestock sector has gained prominence during the past three decades owing to its impressive growth and increasing GDP contribution within the agricultural sector. Livestock rearing practices have dramatically changed in recent years from subsistence to commercial, subsidiary to main-occupational and unorganized to intensively organized systems. These achievements have taken place in spite of the limited priority and monetary allocations to this sector and the poor resources of the majority of the farmers who have contributed to this phenomenal transition. The high quality man power generated through the educational institutions dealing with veterinary and animal sciences has been mainly instrumental in fulfilling the technological backstopping needed at the field level, through scientific research and technology development. The farming community and the industry adopted latest innovations in production, processing, health and management, resulting in production and productivity enhancement and increased per capita availability of livestock products.

Today, India leads the world in milk production with around 100 million tonnes per annum. Over seventy per cent of the milk produced in India is contributed by semi-medium, small, marginal and landless farmers. Another significant feature of milk production is that over 56 per cent of it is derived from the buffalo, which is an animal species of pride to this country. Poultry sector has set the trend for other sub-sectors of livestock rearing by its intensive commercialization, high productivity level and technology adoption of a high order. Concerns of food and nutritional security are being adequately addressed through inclusion of food products of animal origin in the human diet, particularly the vulnerable sections of the society such as growing children, adolescents, pregnant and nursing mothers, senior citizens and convalescing patients.

Livestock sector is not only a sustainable livelihood option, but also an appropriate medium of socio-economic growth through educational empowerment, employment and entrepreneurship development and gender equity for millions of people in the country. Value addition at the farm level brings additional income to the producer and saves food products of animal origin from deterioration and wastage. Environmental protection through proper shelters, drainage, waste disposal and recycling has become all the more important when our country enters into the era of commercial and intensive production. There are several areas of untapped resources with large scope for development. In the meat sector, the sheep, goats and

swine need to be paid more attention. Buffalo meat production is gaining popularity with increased prospects of export. Emerging dimensions relating to phyto-sanitary monitoring and quality assurance are becoming immensely relevant at national and global levels.

It is imperative that, in tune with the change of times and modern needs, the large scale developments in science and technology in the field of livestock production and processing are appropriately incorporated into the proposed revised course curricula in respect of postgraduate and doctoral programmes. This task has been undertaken by the Broad Subject Matter Area (BSMA) Committee. The subject matter area has been identified as "Livestock Production Technology and Products Management". This exercise has been the outcome of the initiative provided by the Education Division of Indian Council of Agricultural Research, which has constituted the 18 BSMA Committees to cover the entire area of agricultural sciences. The BSMA Committee on Livestock Production Technology and Products Management seriously deliberated upon the issues concerning animal sciecne education in general, and livestock production technology and products management in particular. The curricula and syllabi of all the seven disciplines, viz., Animal Breeding, Animal Nutrition, Animal Physiology, Animal Products Technology, Livestock Production and Management, Meat Science and Poultry Science were discussed at length in the meetings and workshop convened by the BSMA Committee.

The key issues, which need to be specially addressed while contemplating on the revision of course curricula at PG and doctoral levels are: supply of high quality germplasm to farming community, compounded feed supply to intensive livestock production units, adoption of concepts such as total mixed rations, complete feeds, strategic bio-available micro-nutrient supplements, land use for intensive green fodder production, shelter designs for in-house livestock rearing amenable to automation and mechanization, clean milk production to be taken up as a national mission, phyto-sanitary measures for traceability and quality assurance of products of animal origin, onward linkages for processing and marketing of meat, particularly from small ruminants, swine and buffalo, cold chain infrastructure for meat, milk and eggs, entrepreneurship building and economic analysis of livestock production including pricing, insurance, credit, technological backstopping and assessment of economic losses associated with inadequate prioritization of the livestock enterprise.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stake holders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

The BSMA Committee wishes to place on record the help rendered by Dr. Lalitha John, Dean, Madras Veterinery College, Faculty and Staff Members of TANUVAS especially Dr. T. Sivakumar and Dr. J. John Kirubaharan for coordinating teh various BSMA committee meetings and for their active participation, unstinted cooperation and assistance. The help rendered by National Core Group under the Chairmanship of Dr. J.C. Katyal, Vice-Chanceller, CCS Haryana Agricultural University, Hisar for providing guidnace and regulations and format his greatfully acknowledged. The committee is also indebted to Dr. S.P. Tiwari, DDG (Education) and Dr. R.K. Mittal, ADG (EQR), ICAR for providing all administrative assistance. The critical inputs provided by Dr. Dharmeshwar Das (Member, NCG), Dr. B.K. Joshi, Dr. Arjava Sharma, Dr. N. Balaraman, Dr. V. Balakrishnan, Dr. B.T. Deshmukh, Dr. R.S. Yadav, Dr. T. Shivkumar, Dr. F .R. Sheriff, Dr. J.J. Robinson Abraham were helpful in designing this document. The basic document (Ist draft) prepared by the faculty of Animal Sciences, CCS Haryana Agricultural University, Hisar, the efforts put in by the HAU faculty is highly appreciated.

Dr. N. Balaraman

Convener, BSMAC (Livestock Production Technology & Products Management)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in animal science disciplines have been prepared in the light of PG programs in vogue at different veterinary colleges in India and contemporary developments in animal sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each M.Sc./MVSc student should register for all the courses offered by the major department, instead of opting for courses of 1 or 2 sub-disciplines only.

II. Credit Requirements

- Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the animal science students as given below.
- The total course work of 40 credit hours has been proposed at M.Sc./M.V.Sc. level instead of minimum requirement 35 credit hours (Table 1), keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together -11 credits.
- At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together-11 credits.
- Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credits should be taken from minor subject and course(s) with a minimum of 3 credit hours from supporting subject(s) should be taken. Thus students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.
- The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for M.Sc./MVSc and 700 for Ph.D. programme.

Based upon the key issues that are assuming priority day by day, the areas which need to be strengthened in various disciplines, are outlined hereunder.

Animal Genetics and Breeding

Molecular techniques in animal breeding, biometrical techniques in animal breeding, conservation of animal genetic resources and bio-informatics in animal genetics and breeding.

Animal Nutrition

New concepts in feed technology, feed analysis and quality control, clinical animal nutrition, nutrition of companion and laboratory animals, nutrition of wild and captive animals, toxic constituents in animal feed stuffs, modern concepts in feeding of ruminants, monogastrics, rumen fermentation, micronutrients and nutrient-drug interaction.

Livestock Products Technology

Abattoir and slaughter technology, fresh and processed meat technology, animal by products processing, poultry other than chickens and broilers such as turkeys, ducks, geese, quails, emu and ostriches.

Livestock Production and Management

Shelter designs and engineering, climatology in relation to animal production, poultry farm and hatchery management, integrated livestock production systems, acts and regulations relating to animal welfare, livestock business management, management of rabbits and intensive rearing of goats, sheep, swine and buffaloes for meat and milk.

Poultry Science

Commercial layer and broiler production, breeder flock and hatchery management, bio-security of flock management, poultry economics, micro-nutrients and amino acids in poultry nutrition, commercial aspects of marketing and integration.

Regarding certain specific suggestions made during the presentation of the draft report of this BSMA Committee, the following response by way of clarification may be worthwhile mentioning:

Animal Physiology is distinct from Veterinary Physiology deals with physiological aspects relating to production, such as body maintenance, growth, lactation and various other productive and reproductive traits. While the governing basic features of Physiology remain

the same in both the streams, in Animal Physiology, the relationship with nutrition, breeding, management, climate and environment are given special emphasis.

Regarding the admission of B.Sc Agriculture and dairy science graduates to PG programmes in LPM, it can be considered by prescribing supplementary/pre-requisite courses, if need be, as per admission relations and concerned Advisory Committee Recommendations.

ORGANIZATION OF COURSE CONTENTS
&
CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	**60**	**75**
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given below.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Suggested list of specified minor subjects (departments)

Major Subjects	Minor Subjects
Animal Genetics and Breeding	Genetics, Animal Biotechnology, Statistics, Livestock Production and Management, Vety. Gynecology & Obstetrics, Animal Reproduction, Vety. Physiology, Vety. Biochemistry, Poultry Science, Animal Nutrition.
Animal Nutrition	Bio-chemistry, Veterinary Physiology, Livestock Production and Management, Animal Biotechnology, Livestock Product Technology, Poultry Science.
Livestock Production and Management	Animal Nutrition, Animal Genetics & Breeding, Livestock Products Technology and Veterinary and Animal Husbandry Extension
Livestock Products and Technology	Food Science and technology, Biochemistry, Microbiology, veterinary public health, Poultry science, Livestock Production and Management
Poultry Science	Animal Genetics & Breeding, Animal Nutrition, Livestock Product Technology, Livestock Production and Management.

Note: The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean post graduate studies.

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 BREEDDING	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 701	RECENT ADVANCES IN ANIMAL GENETICS	2+0
AGB 702	RECENT TRENDS IN ANIMAL BREEDING	2+0
AGB 703	ADVANCES IN BIOMETRICAL GENETICS	2+1
AGB 704	ADVANCES IN SELECTION METHODOLOGY	2+1
AGB 705	BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING	2+0
AGB 706	ADVANCES IN MOLECULAR CYTOGENETICS	2+0
AGB 707	UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS	2+1
AGB 791	DOCTORAL SEMINAR I	1+0
AGB 792	DOCTORAL SEMINAR II	1+0
AGB 799	DOCTORAL RESEARCH	45

ANIMAL GENETICS AND BREEDING
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 verses population. Genetic Structure of population. Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal popultions. Approach to equalibrium under differnet 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 popultion 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 orf inbreeding in regular and irregular systems. Estimation of effective population size. Computation of quantiatative 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 plateux 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.Compuatation of realized heritability and genetic correlation. Selection index: Computation, Accuracy and response in component traits.Estimation of hetrerosis 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 Jl. 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 buffallo and their Characterisation.Inheritance of important economic traits. Recording and handeling 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 mode; and matrenal grand sire model. Open nucleus breeding systems with MOET.

UNIT III

Methods of cross breeding.Breeding of type, milk quality and production efficency. 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 assocaitions 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 701 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

Transprosons, RNA processing Transcuplion regulation of gene expression, selective gene amplification, post transceptional 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 702 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 703 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 704 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 varaiance.

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 LDMAS & LEMAS.

Suggested Readings

Selected articles from journals

AGB 705 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

Overview of bioinformatics, Database concepts, Algorithms, Information resources for protein and genome databases: Gene Bank, EMBL, SWISS-PROT, PROSITE.

UNIT II

Nucleotide and protein sequence analysis, Pair-wise and multiple sequence alignments, Phylogeny, Micro-array processing, Clustering, Analysis software, Secondary database search.

UNIT III

Genetic characterisation, Use of bioinformatics tools for identifying QTL and selection of elite germplasm.

Suggested Readings

Selected articles from journals.

AGB 706 ADVANCES IN MOLECULAR CYTOGENETICS 2+0

Objective

To educate about the advances in cytogenetics and their application in animal genetic and breeding

Theory

UNIT I

Structure of eukaryotic chromosomes – Evolution of karyotype – Various in vitro cell culture techniques – Cell lines and utility – Genotoxicity.

UNIT II

Somatic cell genetics – Stem cell genetics – Molecular cytogenetics and gene mapping – ISH, FISH, Radiation hybrid mapping, Fibre-FISH, PRINS.

UNIT III

Positional cloning – Spectral karyotyping.

UNIT IV

Image analysis – Chromosome walking – Chromosome painting.

Suggested Readings

Selected articles from journals.

AGB 707 UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS 2+1

Objective

To educate about the recent advances in estimation of non-additive genetic variation and possible use in developing synthetic population of livestock and poultry.

Theory

UNIT I

Heterosis – forms and genetic basis; detection and estimation of non-additive genetic variance – average dominance, overdominance.

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.

ANIMAL GENETICS AND BREEDING
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
- Chormosoma
- Chomosome 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 701	MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION	3+0
ANN 702	MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS	2+0
ANN 703	NUTRITION AND RUMEN FERMENTATION	1+1
ANN 704	ADVANCES IN MICRONUTRIENTS	1+0
ANN 705	ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH	1+2
ANN 706	ADVANCES IN FEED TECHNOLOGY	1+1
ANN 707	CLINICAL NUTRITION	1+1
ANN 708	NUTRIENT AND DRUG INTERACTION	2+0
ANN 709	NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING	2+0
ANN 791	DOCTORAL SEMINAR I	1+0
ANN 792	DOCTORAL SEMINAR II	1+0
ANN 799	DOCTORAL RESEARCH	45

ANIMAL NUTRITION
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.

Cramptan 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 FEED ADDITIVES 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 herbages. 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 Elsvier 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 runminant 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.

McEllihnery, 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 FEED CONSERVATION, 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.

McEllihnery 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 swineduring 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 l, 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 Elsvier.

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.

ANN 609 NON CONVENTIONAL FEEDSTUFFS AND TOXIC CONSTITUENTS / ANTIMETABOLITES IN ANIMAL FEEDSTUFF 2+1

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 701 MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILAZIATION 3+0

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 702 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 703 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 704 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 705 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 innoculum 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, nitrates, 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 706 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 707 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 708 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 709 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.

ANIMAL NUTRITION
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://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.nutrisocietyindia.com/
- http://www.fao.org
- 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 though 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
LPM605	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 701	ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	3+0
LPM 702	ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1
LPM 703	ADVANCES IN SWINE PRODUCTION AND MANAGEMENT	2+1
LPM 704	ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+0
LPM 705	ADVANCES IN POULTRY PRODUCTION MANAGEMENT	2+1
LPM 706	ADVANCES IN ENVIRONMENTAL MANAGEMENT	1+1
LPM 707	ADVANCES IN EQUINE MANAGEMENT	2+0
LPM 791	DOCTORAL SEMINAR I	1+0
LPM 792	DOCTORAL SEMINAR II	1+0
LPM 799	DOCTORAL RESEARCH	45

LIVESTOCK PRODUCTION AND MANAGEMENT
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, Tupping

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 LABORATORAY 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 to 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 poutry, 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 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 prodcution

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.

LPM 701 ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT 3+0

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 f 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.

LPM 702 ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT 2+1

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, Adances 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 703 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

Marketing - Study of population trend and structure. Analysis of breeding, feeding, housing, health care, farrowing management, summer management and special management principles practiced.

Suggested Readings

Selected articles from journals.

LPM 704 ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT 1+0

Objective

To educate the students on the latest advances in problems and prospectus, principles of housing, breeding, feeding and health care of rabbits, rats, mice

& guinea pigs, measures to reduce the mortality in young ones at different seasons .

Theory

UNIT I

Importance and limitations of rabbits for meat and fur production, rats, mice & guinea pigs - Common breeds and strains .

UNIT II

Advances in system of housing, Common diseases and their control measure .

UNIT III

Breeding strategies - 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.

UNIT V

Management of specific pathogen free and gnotobiotic animals ,concepts to related to welfare of laboratory animals

Practical

Visit to Rabbit farms - Study of the various chores in government farms and private farms - Critical analysis of breeding, feeding, disease control management and housing - Rabbit slaughter technique.

Suggested readings

Selected articles from journals.

LPM 705 ADVANCES IN POULTRY PRODUCTION MANAGEMENT 2+1

Objective

To educate the students on advances in housing, feeding, breeding and health care in poultry farming.

Theory

UNIT I

Planning, organisation, executive and management of poultry farms and hatcheries of various sizes - alternative in poultry production

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 706 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_2 - 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_2, 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 707 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.

LIVESTOCK PRODUCTION AND MANAGEMENT

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
- www.ilri.org
- www.fao.org
- www.defra.org.uk
- www.aciar.gov.au
- www.asap.asn.au
- www.thepigsite.com
- www.epa.com
- http://animalscience.ucdavis.edu
- www.tanu.edu
- www.sciencedirect.com
- http://trop.edmgr.com
- 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

Small ruminant production

- 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

CODE	COURSE TITLE	CREDITS
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 701	ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION	2+1
LPT 702	ADVANCES IN FRESH AND PROCESSED MEAT PRODUCTS TECHNOLOGY	3+1
LPT 703	ADVANCES IN POULTRY PRODUCTS TECHNOLOGY	2+1
LPT 704	ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY	3+1
LPT 705	ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS	2+0
LPT 706	BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS	1+1
LPT 791	DOCTORAL SEMINAR I	1+0
LPT 792	DOCTORAL SEMINAR II	1+0
LPT 799	DOCTORAL RESEARCH	45

* Non-Credit (Satisfactory/Unsatisfactory)

LIVESTOCK PRODUCTS TECHNOLOGY
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 physico-chemical 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.

LPT 602 MEAT PROCESSING, PACKAGING, QUALITY CONTROL AND MARKETING 2+1

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, subjectice 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 slaughtter 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, utilazation 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, irradication, curing, smoking, barbecuing, cooking and preparation of further processed poultry and fish products.

Practical

Organization, sanitation and maintenance of poultry processing plants. Slauhtering, ante-mortem and postmortem inspection, meat cutting, grading, production of ready to eat, smoked and cured poultry meatComminuted 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 capascitiy. 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 , posteurization 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.

Suziki 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 utilazation.

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 slaughter-house 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, bactofugation and homogenization. Thermal processing- pasteurization, UHT processing, sterilization, bactotherm and packaging, Storage and distribution of processed milk.Fortified, reconstituted and mild floured milks.

UNIT IV

Membrane processing and related techniques; application of ultrafilteration, 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; biodetergents. 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- panneer- channa- ghee- ice cream- cheese-cheddar-Mozzorella and cottage cheese- khoa- dahi- yoghurt- casein- caseinate-coprecipate- 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.

LPT 701 ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION 2+1

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.

LPT 702 ADVANCES IN FRESH MEAT AND PROCESSED MEAT PRODUCTS TECHNOLOGY 3+1

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 produts. 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 preparataion-Ham, bacon,sausages, patties, burger, meat loaves-various noval meat products.

UNIT IV

Fermented meat products-heat processing-restructured meat products-Reformrd 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-Estiamtion of Nitrate-Preparation of some noval meat products and studies on their shelf life-Total viable count and differential counts of meat and meat products-Visist 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 703 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 704 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 jamum 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 Memeberane processing Technology, Advances in Packaging-Retort, Vacuum and Control Atmosphere Pacakaging Technology.

Suggested Readings

Selected articles from journals.

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

LPT 705 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 manufecturing practices, meat hygine 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 706 BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS 1+1

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.

LIVESTOCK PRODUCT TECHNOLOGY
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
- www.amis.org
- www.meatami.com
- www.mla.org.au
- www.FAO.org
- www.agresearch.co.nz/mirinz
- www.usa.gov
- www.fsis.usda.gov
- www.poultryhelp.com
- www.nddb.org
- www.ndri.res.in
- www.amul.com
- 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

POULTRY SCIENCE
Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
PSC 601	POULTRY BREEDING AND GENETICS	2+1
PSC 602	POULTRY NUTRITION AND FEEDING	2+1
PSC 603	COMMERCIAL LAYER PRODUCTION	2+1
PSC 604	COMMERCIAL BROILER PRODUCTION	2+1
PSC 605	BREEDER STOCK, FLOCK HEALTH AND HATCHERY MANAGEMENT	3+1
PSC 606	MANAGEMENT OF POULTRY OTHER THAN CHICKEN	2+1
PSC 607	POULTRY PRODUCTS TECHNOLOGY AND MARKETING	2+1
PSC 608	POULTRY ECONOMICS , PROJECTS AND MARKETING	2+1
PSC 609	PHYSIOLOGY OF POULTRY PRODUCTION	2+1
PSC 691	MASTER'S SEMINAR	1+0
PSC 699	MASTER'S RESEARCH	20
PSC 701	APPLIED POULTRY NUTRITION	2+1
PSC 702	CONCEPTS IN COMMERCIAL POULTRY PRODUCTION	2+1
PSC 703	DEVELOPMENTS IN POULTRY PRODUCTS TECHNOLOGY	2+1
PSC 704	EMERGING DISEASES OF POULTRY AND FLOCK HEALTH	2+1
PSC 705	ADVANCED POULTRY BREEDING METHODS	2+1
PSC 706	POULTRY ECONOMICS, MARKETING AND INTEGRATION	2+1
PSC 791	DOCTORAL SEMINAR I	1+0
PSC 792	DOCTORAL SEMINAR II	1+0
PSC 799	DOCTORAL RESEARCH	45

POULTRY SCIENCE
Course Contents

PSC 601 POULTRY BREEDING AND GENETICS 2+1

Objective

To impart knowledge on different systems of breeding, selection methods, design and implementation of breeding programme in developing egg-type and meat type birds. Modern tools in poultry breeding.

Theory

UNIT I

Genetic classification of Poultry –Origin and breed characteristics of poultry-Development of Poultry Industry in India - Mendel's laws of inheritance related to poultry -Qualitative and Quantitative traits in Poultry breeding -Additive, Non Additive, Epistatic and complementary gene action – Lethal and mutations in poultry – Sex linked, Sex limited and Sex influenced traits – Economic traits - Heritability – Quantitative inheritance — Phenotype, Genotype & environment interactions.

UNIT II

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

Industrual breeding-Artificial insemination in chicken-Autosexing-Random SampleTest. 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 laryngeo 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.

PSC 608 POULTRY ECONOMICS, PROJECTS AND MARKETING 2+1

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.

PSC 609 PHYSIOLOGY OF POULTRY PRODUCTION 2+1

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 characteristics-

Artificial 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 701 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 702 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 - Managemental 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 703 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 704 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 705 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 706 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.

POULTRY SCIENCE
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

- http://www.alabamapoultry.orghttp://www.eggcom.comhttp://www.dpichicken.comhttp://www.georgiaeggs.orghttp://www.ansc.purdue.edu/ISEBhttp://www.ag.ansc.purdue.edu/ISPhttp://www.MidwestPoultry.comhttp://www.MinnesotaTurkey.comhttp://www.nebraskapoultry.orghttp://www.ncegg.org
- http://www.ohiopoultry.org
- http://www.aeb.orghttp://www.fb.org
- http://www.afia.orghttp://www.albcusa.orghttp://www.amerpoultryassn.comhttp://www.avianresearch.co.ukhttp://www.canr.uconn.edu/ansci/
- http://www.ansc.cornell.eduhttp://www.castscience.orghttp://www.enconline.orghttp://www.internationalegg.comhttp://www.eatchicken.comhttp://www.foodsafety.gov/~dms/fs-toc.htmlhttp://www.nmaonline.orghttp://www.eatturkey.comhttp://www.naga.orghttp://www.mtgplace.comhttp://www.poultryscience.orghttp://www.posc.tamu.edu/library/dother.html
- http://www.poultryegg.orghttp://www.usapeec.orghttp://www.wattpoultry.comhttp://www.afns.ualberta.ca/http://www.poultryresearchcentre.chttp://www.poultryscience.uark.edu/poultry.htmlhttp://www.ag.auburn.edu/dept/ph/index.html
- http://www.aes.ucdavis.edu
- http://animalscience.ucdavis.edu/
- http://animalscience.ucdavis.edu/extension/http://www.calstate.edu
- http://www.csupomona.edu
- http://www.animalscience.calpoly.ed
- http://www.clemson.edu/avs/

Suggested Broad Topics for Master's and Doctoral Research

- Breeding programs for different species of poultry to improve the economic traits.
- Utilization of conventional and unconventional feeds in poultry rations.
- Study on exogenous enzymes, probiotics for increasing the feed efficiency in poultry.
- Evolving ways and means for the improving the performance of commercial, broilers and layers for higher economic gains.
- Micro and trace minerals requirements study for broiler and layers.
- Designing and development of eco friendly and environmentally controlled houses for large commercial poultry farms.
- Standardizing the disinfections procedures for sustainable poultry production.
- Standardizing the sanitary and phyto sanitary measures for safe production of eggs and broilers.
- Prevention and control of toxin, pesticides and antibiotic residues in egg and meat.
- Value added egg and poultry meat products program
- Development of fast foods by utilizing poultry egg and meat.
- Development and standardization of designer eggs and low fat high protein poultry meat.
- Preservation, storage, packaging of value added egg and meat products and their standardization.
- Reduction of pollution from poultry farms and processing plants.
- Profitable utilization of Poultry waste and manure.
- Development and standardization of organic poultry farming and standards for phyto sanitary measures
- Standardization of managemental, nutritional methods and schedules for rearing turkeys, guinea fowls, geese, Japanese quails and domesticated ratites.
- Development of suitable varieties of turkeys and guinea fowl suitable for different agro climatic conditions.
- Development of suitable birds for backyard poultry.
- Poultry bio security measures in organized farms.
- Studies on diseases affecting turkeys, guinea fowl, Japanese quail and their preventive measures.
- Disease surveillance, forecasting and development of field level diagnostic kits.

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination,

numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

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 503 (e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT 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 animal varieties and farmers' rights and bio-diversity 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 506 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 pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

Annexure

BSMA Committee on Livestock Production Technology & Production Management

(Animal Sc./Animal Husb./Animal Bre./Animal Nutrition & AFT/LPM/APT/Poultry Sciences)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR dated January 14, 2008)

Name	Address	Specialization
Dr. N. Balaraman Former Vice-Chancellor **Convener**	Tamil Nadu Univ. of Vety. & Animal Science, Chennai	Animal Nutrition
Dr. B. K. Joshi Director	NBAGR, Karnal	Animal Breeding
Dr. S. K. Jindal Principal Scientist	Animal Physiology, CIRG, Makhdoom, Farh, Mathura (UP)	Animal Physiology
Dr. B. T. Deshmukh Prof.& Head	Deptt. of Physiology & Biochemistry, Bombay Vety. College, Parel, Bombay	Animal Physiology
Dr. Arjava Sharma Head	Division of Animal Gentices & Breeding, IVRI, Izatnagar, Barelly	Animal Breeding
Dr. V. K. Tanwar Professor	Veterinary College, GBPUA & T, Pantnagar	LPT
Dr. C. L. Marwah Professor	Dept. of LPM, COVS, CSKHPAU, Palampur	LPM
Dr. R .S. Yadav Professor **Member Secretary**	Dept. of LPM, College of Animal Science, CCS HAU Hisar	LPM

NEW AND RESTRUCTURED

POST-GRADUATE CURRICULA & SYLLABI

Biotechnology & Bioinformatics

Plant Molecular Biology & Biotechnology
Animal Biotechnology
Bioinformatics

Education Division
Indian Council of Agricultural Research
New Delhi

January 2009

Contents

PREAMBLE

Economic growth and development in India continues to be propelled by growth in agriculture and allied sectors. Since majority of our population is dependent on agriculture, it is pertinent to ensure their economic security under changing competitive globalized environment. This can only be done through technological advancements and competent human resource to serve the needs of highly receptive farming community. In past such efforts have led to green, white, yellow and blue revolutions to make the country self sufficient in food needs. However, over the time, changed circumstances, declining total factor productivity, rising unemployment, fast degrading natural resources etc., have led to declining agricultural growth. Agricultural production through most conventional science and technology innovations has reached a plateau. Therefore, there is need to break the plateau. Thus to put the country's agricultural growth on fast track, development of cutting edge technologies and competent human resource is the need of the hour.

Biotechnology and Bioinformatics are relatively newer cutting edge sciences which incorporate principles of biological, physical and chemical sciences. Biotechnology is based on techniques involving genes, genomes, nucleic acids and other related macro and micro bio-molecules. Bioinformatics apply computer based information technology for storage, retrieval and analysis of vast data bases being generated on genes, genomics and nucleic acids. Advances so far made in these disciplines have already found valuable applications in quality and quality of production and productivity, processing and value addition of produce of agriculture and allied sectors.

The tremendous impetus received for biotechnological research and education has been due to its direct impact on human and animal health, agricultural productivity and environment issues. Due to increasing acceptance of genetically modified foods and agricultural produce, big pharmaceutical and agribusiness companies are investing huge funds in the biotechnology R&D sector. At present in India the number of companies involved in R&D or product development or production related to biotechnology and life sciences products has grown close to 350. To sustain these efforts, biotechnology R&D as well as education sector needs high quality human resources for inventing and creating value added products through intervention of biotechnology. It is felt that the second green-blue-white revolution can be achieved only through sustained improvement in the genetic upliftment of native crops and livestock. Because of tremendous global interest in biotechnology in the last two decades, the genetic blue print of a number of organisms has been worked out, which has led to the accumulation of huge genetic data. This has created requirement of highly skilled manpower equipped with biotechnological as well as information technology skills to analyze, annotate and make use of the genetic information for genetic enhancement of breeds or developing new age drugs for personal medicine to name a few application. These two subjects have gained importance in the recent time not only from industrial point of view but also from basic and strategic future research.

Major interest and scope of Biotechnology has emerged from the techniques which permit manipulation of biological systems in a defined and deliberate manner for beneficial purposes. Both human genome and rice genome projects have demonstrated the tremendous power of biotechnology and bioinformatics tools and techniques and their enormous applications as a commercial activity which is anticipated to grow exponentially. In view of the fast expanding scope of Biotechnology and Bioinformatics, the post graduate programme, non- existent a few decades ago is now being offered in hundreds of public and private universities and institutes. Twenty seven agricultural universities offer Biotechnology programmes, some of which offer both Animal Biotechnology and Plant/Agricultural Biotechnology & Molecular Biology Programmes. Bioinformatics programme is offered only by CCS Haryana Agricultural University. Department of Biotechnology of Union Ministry of

Science & Technology supports PG Biotechnology programmes of ten agricultural universities.

The existing Biotechnology Departments of agricultural universities vary greatly in terms of infrastructure, facilities and human resources which at several places are inadequate for full realization of Biotechnology potential. Also in most cases, these Departments have been created by regrouping of willing and trained human resource form old well established disciplines like Biochemistry, Microbiology, Genetics, Plant Physiology, Plant Breeding etc. Biotechnology and Bioinformatics are fast developing disciplines in which scientific and technological advancements are taking place rapidly. There is strong need for continuous faculty competence improvement, for updating skill and knowledge of scientists through national and international human resource development activities and programmes.

The BSMA Committee has worked with the stakeholders of Biotechnology & Bioinformatics on issues concerning PG education. Curricula and Syllabi recommended by the ICAR and by the Department of Biotechnology of the Government of India, and some Agricultural Universities were considered in preparing the first draft of Curricula and Syllabi of Animal Biotechnology, Molecular Biology & Biotechnology and Bioinformatics. This was prepared by the concerned faculties of CCS Haryana Agricultural University, Hisar. The first draft was thoroughly discussed through e-mail exchanges among BSMAC Members and 64 stakeholders representing academia, biotech industries and government organizations. Curricula & Syllabi were further critically examined and thoroughly discussed in two BSMAC Meetings and a Stakeholders Workshop. All the suggestions and opinions received were properly considered in formulating the restructured Curricula & Syllabi.

The contents of most of the courses in all the three programmes have been revised keeping in view the advances in the respective subject area. Title of quite a few courses has been modified to make them contemporary. Following new courses have been included in the revised curricula:

Plant Molecular Biology & Biotechnology: Molecular Breeding; Nano-biotechnology; Biosafety, IPR and Bioethics; Immunology and Molecular Diagnostics; Crop Biotechnology; Plant Tissue Culture and Genetic Transformation, Environmental Biotechnology, Advances in Crop Biotechnology, Advances in Functional Genomics and Proteomics, Advances in Animal Biotechnology, Commercial Plant Tissue Culture.

Animal Biotechnology: Techniques in Molecular Biology & Genetic Engineering; Biodiversity, Biosafety & Bioethics; Molecular Forensics, Industrial Biotechnology; Animal Biotechnology; Functional Genomics & Proteomics; Gene Cloning and Expression; Trends in Vaccinology.

Bioinformatics: Basic Molecular Biology; Mathematics for Bioinformatics; Pharmacogenomics & IPR.

The new curricula and syllabi has increased practical component to provide hands on training and analytical skills to the students. The new courses such as Techniques in Molecular biology I & II, Techniques in Bioinformatics and Techniques in Molecular Biology & Genetic Engineering have been included with only practical format. The practical exercises have been distinctly out lined in the courses as these are to be conducted rather than in descriptive running text. Such courses are aimed at strengthening the practice/practical skills of the students to equip the students with modern research skills and knowledge to meet requirements of R&D organizations, private sector and global competitiveness for their employability.

H. S. Nainawatee

Convener, BSMAC (Biotechnology & Bioinformatics)

EXECUTIVE SUMMARY

Plant Molecular Biology & Biotechnology

- In the last thirty years, a revolution has taken place that has put molecular biology and biotechnology at the heart of all the biological sciences with extensive applications in agriculture, health, industry and environment. Keeping these developments in view, the new course curriculum for PG program in 'Plant Molecular Biology and Biotechnology' has been developed
- The curriculum now includes courses on 'Plant Tissue Culture and Genetic Transformation', 'Molecular Breeding', 'Genomics and Proteomics', 'Bioinformatics', 'Nano-biotechnology', 'Biosafety, IPR and Bioethics', 'Biostatistics and Computers', 'Environmental Biotechnology', 'Immunology and Molecular Diagnostics', which have direct application in improving agriculture and industry.
- The curriculum also includes seven advanced courses (for Ph.D.) on Molecular Biology, 'Genetic Engineering', 'Microbial Biotechnology', 'Crop Biotechnology', 'Functional Genomics and Proteomics", "Commercial Plant Tissue Culture" and "Animal Biotechnology', which are meant to provide the latest developments in the respective fields of Biotechnology.
- The curriculum also includes two practical courses namely 'Techniques in Molecular Biology I and II' that includes exhaustive hands-on training on various techniques of molecular biology and genomics.
- Highly specialized faculty in different areas of Molecular Biology and Biotechnology, well-equipped laboratories and other resources shall be required for teaching of the courses and conducting practicals given in the new course curriculum. While teaching and research skills of the already employed faculty needs to be improved, new young faculty from advanced Institutes/Universities in India or abroad may be appointed. Exchange of faculty among the various Universities could also be a viable option.
- The new course curriculum shall provide ample opportunity to the students to specialize in several different areas of Biotechnology including 'Plant Tissue Culture', 'Genomics', 'Microbial Biotechnology', 'Animal Biotechnology', 'Molecular Breeding' and 'Genetic Transformation'.
- The proposed curriculum is now tuned with fast evolving area of 'Molecular Biology' and likely to generate qualified human resource at par with those from other elite National and International institutions.
- Training of the faculty is required to teach new courses.
- Approximately, Rs. 10 crores are required for building laboratories, equipment, furniture, etc. for effective implementation of both Ph. D. and M. Sc. Programmes.

Animal Biotechnology

- Opportunities in animal husbandry seek to improve product quality, production efficiency, and animal health & well-being, all while reducing the environmental impact of animal production.
- Animal biotechnology has long been source of innovation in production and processing, profoundly impacting the animal husbandry sector.
- Biotechnological research products, such as vaccines, diagnostics, *in vitro* fertilization, transgenic animals, stem cells, and a number of other therapeutic recombinant products are now commercially available.

- In view of the immense potential of biotechnology in the livestock and poultry sectors, the specialization in animal biotechnology has emerged as a distinct discipline.
- The PG programme in 'Animal Biotechnology' is aimed at providing cutting edge concepts, as well as practical applications of the exciting field of Animal Biotechnology.
- The revised course curriculum covers wide ranging topics including molecular genetics, molecular and cell biology, immunotechnology, transgenic animal technology, animal genomics, proteomics, reproductive biotechnology, molecular diagnostics, molecular forensics and vaccinology and bioprocess technology and bioinformatics.
- The course curriculum also explores the economic, social, legal, environmental safety, IPR, ethical issues and controversies associated with modern biology and biotechnology.
- Extensive laboratory exercises pertaining to analytic biochemistry, molecular biology, genetic engineering, immunology, molecular diagnostics, reproductive biotechniques, animal cell culture, animal genomics and proteomics tools have been included in course syllabi.
- Laboratory sessions will allow students to plan, implement and report on their results of laboratory and simulation experiments.
- The first part of animal biotechnology focuses on the basic sciences, allowing the student to gain a good understanding of the core subject areas, before moving on to study more specialist topics.
- The courses have been designed to encourage critical thinking, use of the scientific method, integration of technology, development of student leadership skills, and application of knowledge and skills related to practical questions and problems.
- In addition to a strong scientific knowledge, the students will also gain an understanding of entrepreneurship related Animal Biotechnology.
- Since, several new courses have been introduced; faculty training is required to teach new courses.
- Infrastructure commensurate to recent development also needs to be created. A separate building and 8000 squire foot covered area housing, Cloning and Expression Laboratory, Animal Cell Culture Laboratory, Embryo Biotechnology, Animal Genomics and Proteomics Laboratory, Molecular biology Teaching Laboratory, Molecular Forensics Laboratory, on Seminar room and lecture halls, department office, committee room, department library etc. Equipment, furniture etc are also required.
- Approximately Rs. 10 crores as one time grant and Rs. 50 lacs as recurring grant is required to effectively run Masters and Ph.D. programmes.

Bioinformatics

- Bioinformatics involves the integration of computers, software tools, and databases in an effort to understand biological systems.
- The emergence of new Internet technologies, new and more accurate algorithms and the development of High Performance Computing coupled with DNA sequencing, serial analysis of gene expression, microarrays, and new mass spectrometry has enabled bioinformatics to address the biological problems from several different angles. It is this change in paradigm that has led to the development of Bioinformatics as a separate skill-oriented discipline.

- The future of bioinformatics is integration of a wide variety of data sources such as GIS data, such as maps, weather systems, with crop health and genotype data, will allow us to predict successful outcomes of agriculture experiments.
- One of the biggest hurdles facing bioinformatics today is the small number of trained manpower and researchers in the field. This scenario needs to be addressed in changed perspective so that bioinformatics moves to the forefront of research.
- In order to produce trained manpower in the area of Bioinformatics, this curriculum has been prepared.
- The syllabus addresses modern concepts (of computing and Biology) and practices, and emphasizes the hands-on training.
- The basic subjects *viz.* Statistics, mathematics, Biological Chemistry, Genetics, Mathematics, Immunology, and computer Advanced courses such as Basic Molecular Biology, Pharmacogenomics & IPR.
- Bioinformatics Courses are Biological Databanks and Data Mining, Biomolecular Sequence and Analysis, Structural Genomics and Proteomics, Molecular modelling and drug design.
- The infrastructure (~ 2500 sq. ft. covered area) required to impart teaching according to present curriculum includes the provision of one high-end PC per student, two workstations, one server with 1 TB or more storage and an internet connectivity of 2 MBPS (for 15 students) or more.
- More emphasis should be on Open Source applications and OS.
- The faculty should be trained in advanced concepts of sequence analysis, systems biology, molecular modelling and data/text mining.
- Since it is new subject area, fresh recruitments should be made in this discipline. Approx. budget required is Rs. 5 crores.

ORGANIZATION OF COURSE CONTENTS
&
CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 500-series courses pertain to Master's level, and 600-series to Doctoral level (corresponding Code nos. for Animal Biotechnology are 600- and 700-series).
- A Ph. D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's programme. Credit seminar for Master's level is designated by code no. 591, and the two seminars for Doctoral level are coded as 691 and 692, respectively.
- Similarly, 599 and 699 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end, which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	20	15
Minor	09	08
Supporting	05	05
Seminar	01	02
Research	20	45
Total Credits	**55**	**75**
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject (e.g., if the major subject is Entomology, the appropriate minor subjects should be Plant Pathology or Nematology).

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
MBB 501**	PRINCIPLES OF BIOTECHNOLOGY	2+1
MBB 502**	FUNDAMENTALS OF MOLECULAR BIOLOGY	3+0
MBB 503**	MOLECULAR CELL BIOLOGY	3+0
MBB 504	PLANT TISSUE CULTURE & GENETIC TRANSFORMATION	1+2
MBB 505**	TECHNIQUES IN MOLECULAR BIOLOGY I	0+3
MBB 506	MICROBIAL/ INDUSTRIAL BIOTECHNOLOGY	2+1
MBB 507	MOLECULAR BREEDING	2+0
MBB 508	GENOMICS & PROTEOMICS	2+0
MBB 509	TECHNIQUES IN MOLECULAR BIOLOGY II	0+3
MBB 510*	BIOSAFETY, IPR AND BIOETHICS	2+0
MBB 511*	ANIMAL BIOTECHNOLOGY	3+0
MBB 512*	IMMUNOLOGY AND MOLECULAR DIAGNOSTICS	2+1
MBB 513*	NANO-BIOTECHNOLOGY	3+0
MBB 551*	PRINCIPLES OF GENETICS	3+1
MBB 552*	GENERAL BIOCHEMISTRY	3+0
MBB 553*, **	BIOSTATISTICS AND COMPUTERS	2+1
MBB 554*	PRINCIPLES OF MICROBIOLOGY	3+1
MBB 555	INTRODUCTION TO BIOINFORMATICS	2+1
MBB 556	ENVIRONMENTAL BIOTECHNOLOGY	3+0
MBB 591	MASTER'S SEMINAR	1+0
MBB 599	MASTER'S RESEARCH	20
MBB 601	ADVANCES IN PLANT MOLECULAR BIOLOGY	3+0
MBB 602	ADVANCES IN GENETIC ENGINEERING	3+0
MBB 603	ADVANCES IN MICROBIAL BIOTECHNOLOGY	3+0
MBB 604	ADVANCES IN CROP BIOTECHNOLOGY	3+0
MBB 605	ADVANCES IN FUNCTIONAL GENOMICS AND PROTEOMICS	2+0
MBB 606	COMMERCIAL PLANT TISSUE CULTURE	2+0
MBB 607	ADVANCES IN ANIMAL BIOTECHNOLOGY	2+0
MBB 691	DOCTORAL SEMINAR I	1+0
MBB 692	DOCTORAL SEMINAR II	1+0
MBB 699	DOCTORAL RESEARCH	45

*May be taken as minor/supporting courses; **Compulsory for M.Sc. Programme

PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Course Contents

MBB 501 PRINCIPLES OF BIOTECHNOLOGY 2+1

Objective

To familiarize the students with the fundamental principles of Biotechnology, various developments in Biotechnology and its potential applications.

Theory

UNIT I

History, scope and importance; DNA structure, function and metabolism.

UNIT II

DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their applications.

UNIT III

Molecular markers and their applications; DNA sequencing; Applications of gene cloning in basic and applied research; Genetic engineering and transgenics; Genomics, transcriptomics and proteomics.

UNIT IV

General application of biotechnology in Agriculture, Medicine, Animal husbandry, Environmental remediation, Energy production and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

Practical

i. Isolation of genomic and plasmid DNA
ii. Gel electrophoresis techniques
iii. Restriction enzyme digestion, ligation, transformation and screening of transformants
iv. PCR and molecular marker analysis
v. Plant tissue culture: media preparation, cell and explant culture, regeneration and transformation.

Suggested Readings

Becker JM, Coldwell GA & Zachgo EA. 2007. *Biotechnology - a Laboratory Course*. Academic Press.

Brown CM, Campbell I & Priest FG. 2005. *Introduction to Biotechnology*. Panima Pub.

Brown TA. *Gene Cloning and DNA Analysis*. 5th Ed. Blackwell Publishing.

Dale JW & von Schantz M. 2002. *From Genes to Genomes: Concepts and Applications of DNA Technology*. John Wiley & Sons.

Gupta PK. 2004. *Biotechnology and Genomics*. Rastogi Publications.

Sambrook J, Fritsch T & Maniatis T. 2001. *Molecular Cloning - a Laboratory Manual*. 2nd Ed. Cold Spring Harbour Laboratory Press.

Singh BD. 2007. *Biotechnology Expanding Horiozon*. Kalyani Publishers.

MBB 502 FUNDAMENTALS OF MOLECULAR BIOLOGY 3+0

Objective

To familiarize the students with the basic cellular processes at molecular level.

Theory

UNIT I

Historical developments of molecular biology; Nucleic acids as genetic material; Chemistry, structure and properties of DNA and RNA.

UNIT II

Genome organization in prokaryotes and eukaryotes; Chromatin structure and function; DNA replication; DNA polymerases, topoisomerases, DNA ligase, etc; Molecular basis of mutations; DNA repair mechanisms.

UNIT III

Transcription process; RNA processing; Reverse transcriptase; RNA editing; Ribosomes structure and function; Organization of ribosomal proteins and RNA genes; Genetic code; Aminoacyl tRNA synthases.

UNIT IV

Translation and post-translational modifications; Operon concept; Attenuation of *trp* operon; important features of gene regulation in eukaryotes.

Suggested Readings

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panima.

Malacinski GM & Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publishers.

Nelson DL & Cox MM. 2007. *Lehninger's Principles of Biochemistry*. W.H. Freeman & Co.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene*. 6th Ed. Pearson Education International.

MBB 503 MOLECULAR CELL BIOLOGY 3+0

Objective

To familiarize the students with the cell biology at molecular level.

Theory

UNIT I

General structure and constituents of cell; Similarities and distinction between plant and animal cells; Cell wall, cell membrane, structure and composition of biomembranes, cell surface related functions.

UNIT II

Structure and function of major organelles: Nucleus, Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Microbodies, Golgi apparatus, Vacuoles, etc.

UNIT III

Organellar genomes and their manipulation; Ribosomes in relation to cell growth and division; Cyto-skeletal elements.

UNIT IV

Cell division and regulation of cell cycle; Membrane transport; Transport of water, ion and biomolecules; Signal transduction mechanisms; Protein targeting.

Suggested Readings

Gupta PK. 2003. *Cell and Molecular Biology*. 2nd Ed. Rastogi Publ.

Lodish H. 2003. *Molecular Cell Biology*. 5th Ed. W.H. Freeman & Co.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

MBB 504 PLANT TISSUE CULTURE AND GENETIC TRANSFORMATION 1+2

Objective

To familiarize the students and provide hands on training on various techniques of plant tissue culture, genetic engineering and transformation.

Theory

UNIT I

History of plant cell and tissue culture; Culture media; Various types of culture; callus, suspension, nurse, root, meristem, etc.; *In vitro* differentiation: organogenesis and somatic embryogenesis; Plant growth regulators: mode of action, effects on *in vitro* culture and regeneration; Molecular basis of plant organ differentiation.

UNIT II

Micropropagation; Anther and microspore culture; Somaclonal variation; *In vitro* mutagenesis; *In vitro* fertilization; *In vitro* germplasm conservation; Production of secondary metabolites; Synthetic seeds.

UNIT III

Embryo rescue and wide hybridization; Protoplast culture and regeneration; Somatic hybridization: protoplast fusion, cybrids, asymmetric hybrids, etc.

UNIT IV

Methods of plant transformation; Vectors for plant transformation; Genetic and molecular analyses of transgenics; Target traits and transgenic crops; Biosafety issues, testing of transgenics, regulatory procedures for commercial approval.

Practical

i. Laboratory set-up.
ii. Preparation of nutrient media; handling and sterilization of plant material; inoculation, subculturing and plant regeneration.
iii. Anther and pollen culture.
iv. Embryo rescue.
v. Suspension cultures and production of secondary metabolites.
vi. Protoplast isolation, culture and fusion.
vii. Gene cloning and vector construction
viii. Gene transfer using different methods, reporter gene expression, selection of transformed tissues/plants, molecular analysis.

Suggested Readings

Bhojwani SS. 1983. *Plant Tissue Culture: Theory and Practice*. Elsevier.

Christou P & Klee H. 2004. *Handbook of Plant Biotechnology*. John Wiley & Sons.

Dixon RA. 2003. *Plant Cell Culture*. IRL Press.

George EF, Hall MA & De Klerk GJ. 2008. *Plant Propagation by Tissue Culture*. Agritech Publ.

Gupta PK. 2004. *Biotechnology and Genomics*. Rastogi Publ.

Herman EB. 2005-08. *Media and Techniques for Growth, Regeneration and Storage*. Agritech Publ.

Pena L. 2004. *Transgenic Plants: Methods and Protocols*. Humana Press.

Pierik RLM. 1997. *In vitro Culture of Higher Plants*. Kluwer.

Singh BD. 2007. *Biotechnology: Expanding Horiozon.* Kalyani.

MBB 505 TECHNIQUES IN MOLECULAR BIOLOGY-I 0+3

Objective

To provide hands on training on basic molecular biology techniques.

Practical

UNIT I

Good lab practices; Biochemical techniques: Preparation of buffers and reagents, Principle of centrifugation, Chromatographic techniques (TLC, Gel Filtration Chromatography, Ion exchange Chromatography, Affinity Chromatography).

UNIT II

Gel electrophoresis- agarose and PAGE (nucleic acids and proteins); Growth of bacterial culture and preparation of growth curve; Isolation of plasmid DNA from bacteria; Growth of lambda phage and isolation of phage DNA; Restriction digestion of plasmid and phage DNA; Isolation of high molecular weight DNA and analysis.

UNIT III

Gene cloning – Recombinant DNA construction, transformation and selection of transformants; PCR and optimization of factors affecting PCR.

UNIT IV

Dot blot analysis; Southern hybridization; Northern hybridization; Western blotting and ELISA; Radiation safety and non-radio isotopic procedure.

Suggested Readings

Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. John Wiley.

Kun LY. 2006. *Microbial Biotechnology*. World Scientific.

Sambrook J, Russel DW & Maniatis T. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Laboratory Press.

MBB 506 MICROBIAL/ INDUSTRIAL BIOTECHNOLOGY 2+1

Objective

To familiarize about the various microbial processes/systems/activities, which have been used for the development of industrially important products/processes.

Theory

UNIT I

Introduction, scope and historical developments; Isolation, screening and genetic improvement (involving classical approaches) of industrially important organisms.

UNIT II

Primary metabolism products, production of industrial ethanol as a case study; Secondary metabolites, bacterial antibiotics and non ribosomal peptide antibiotics; Recombinant DNA technologies for microbial processes; Strategies for development of industrial microbial strains with scale up production capacities; Metabolic pathway engineering of microbes for production of novel product for industry.

UNIT III

Microbial enzymes, role in various industrial processes, production of fine chemicals for pharmaceutical industries; Bio-transformations, Bio-augmentation with production of vitamin C as a case study; Bioreactors,

their design and types; Immobilized enzymes based bioreactors; Microencapsulation technologies for immobilization of microbial enzymes.

UNIT IV

Industrial biotechnology for pollution control, treatment of industrial and other wastes, biomass production involving single cell protein; Bio-remediation of soil; Production of eco-friendly agricultural chemicals, bio-pesticides, bio-herbicides, bio-fertilizers, bio-fuels, etc.

Practical

i. Isolation of industrially important microorganisms, their maintenance and improvement.
ii. Production of industrial compounds such as alcohol, beer, citric acid, lactic acid and their recovery.
iii. Study of bio-reactors and their operations.
iv. Production of biofertilizers.
v. Experiments on microbial fermentation process, harvesting purification and recovery of end products.
vi. Immobilization of cells and enzymes, studies on its kinetic behavior, growth analysis and biomass estimation.
vii. Determination mass transfer co-efficients.

Suggested Readings

Huffnagle GB & Wernick S. 2007. *The Probiotics Revolution: The Definitive Guide to Safe, Natural Health*. Bantam Books.

Kun LY. 2006. *Microbial Biotechnology*. World Scientific.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

MBB 507 MOLECULAR BREEDING 2+0

Objective

To familiarize the students about the use of molecular biology tools in plant breeding.

Theory

UNIT I

Principles of plant breeding; Breeding methods for self and cross pollinated crops; Heterosis breeding; Limitations of conventional breeding; Aspects of molecular breeding.

UNIT II

Development of sequence based molecular markers - SSRs and SNPs; Advanced methods of genotyping; Mapping genes for qualitative and quantitative traits.

UNIT III

QTL mapping using structured populations; AB-QTL analysis; Association mapping of QTL; Fine mapping of genes/QTL; Map based gene/QTL isolation and development of gene based markers; Allele mining by TILLING and Eco-TILLING; Use of markers in plant breeding.

UNIT IV

Marker assisted selection (MAS) in backcross and heterosis breeding; Transgenic breeding; Foreground and background selection; MAS for gene introgression and pyramiding: MAS for specific traits with examples.

Suggested Readings

Chittaranjan K. 2006-07. *Genome Mapping and Molecular Breeding in Plants.* Vols. I-VII. Springer.

Newbury HJ. 2003. *Plant Molecular Breeding*. Blackwell Publ.
Weising K, Nybom H, Wolff K & Kahl G. 2005. *DNA Fingerprinting in Plants: Principles, Methods and Applications*. Taylor & Francis.

MBB 508 GENOMICS AND PROTEOMICS 2+0

Objective

To familiarize the students with recent tools used for genome analysis and their applications.

Theory

UNIT I

Structural genomics: Classical ways of genome analysis, large fragment genomic libraries; Physical mapping of genomes; Genome sequencing, sequence assembly and annotation; Comparative genomics, etc.

UNIT II

Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics; Metabolomics and ionomics for elucidating metabolic pathways, etc.

UNIT III

Proteomics - Protein structure, function and purification; Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis, etc.

UNIT IV

Applications of genomics and proteomics in agriculture, human health and industry.

Suggested Readings

Azuaje F & Dopazo J. 2005. *Data Analysis and Visualization in Genomics and Proteomics*. John Wiley & Sons.
Brown TA. 2007. *Genome III*. Garland Science Publ.
Campbell AM & Heyer L. 2004. *Discovery Genomics, Proteomics and Bioinformatics*. Pearson Education.
Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.
Jollès P & Jörnvall H. 2000. *Proteomics in Functional Genomics: Protein Structure Analysis*. Birkhäuser.
Kamp RM. 2004. *Methods in Proteome and Protein Analysis*. Springer.
Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.
Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II. Wiley CVH.

MBB 509 TECHNIQUES IN MOLECULAR BIOLOGY-II 0+3

Objective

To provide hands on training on various molecular techniques used in molecular breeding and genomics.

Practical

UNIT I

Construction of gene libraries; Synthesis and cloning of cDNA and RT-PCR analysis; Real time PCR and interpretation of data.

UNIT II

Molecular markers (RAPD, SSR, AFLP etc) and their analysis; Case study of SSR markers (linkage map, QTL analysis etc); SNP identification and analysis; Microarray studies and use of relevant software.

UNIT III

Proteomics (2D gels, mass spectrometry, etc.); RNAi (right from designing of construct to the phenotyping of the plant); Yeast 1 and 2-hybrid interaction.

UNIT IV

Generation and screening of mutants; Transposon mediated mutagenesis.

Suggested Readings

Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. Wiley.

Caldwell G, Williams SN & Caldwell K. 2006. *Integrated Genomics: A Discovery-Based Laboratory Course*. John Wiley.

Sambrook J, Russel DW & Maniatis T. 2001. *Molecular Cloning: a Laboratory Manual.* Cold Spring Harbour Laboratory Press.

MBB 510 BIOSAFETY, IPR AND BIOETHICS 2+0

Objective

To discuss about various aspects of biosafety regulations, IPR and bioethic concerns arising from the commercialization of biotech products.

Theory

UNIT I

Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

UNIT II

General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc; Impact on environment: gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc.

UNIT III

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and non-radio isotopic procedure; Benefits of transgenics to human health, society and the environment.

UNIT IV

The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

Suggested Readings

Singh BD. 2007. *Biotechnology: Expanding Horizon*. Kalyani.

http://patentoffice.nic.in

www.wipo.org

www.dbtindia.nic.in

www.dbtbiosafety.nic.in

MBB 511 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 hormonal 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-spliting, 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.

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.

MBB 512 IMMUNOLOGY AND MOLECULAR DIAGNOSTICS 2+1

Objective

To discuss the application of various immunological and molecular diagnostic tools.

Theory

UNIT I

History and scope of immunology; Components of immune system: organs, tissues and cells, Immunoglobulin chemistry, structure and functions; Molecular organization of immunoglobulins and classes of antibodies.

UNIT II

Antibody diversity; antigens, haptens, antigens- antibody interactions; immuno-regulation and tolerance; Allergies and hypersensitive response; Immunodeficiency; Vaccines; Immunological techniques.

UNIT III

Immunological application in plant science, monoclonal antibodies and their uses, molecular diagnostics. Introduction to the basic principles of molecular technology and techniques used in pathogen detection, Principles of ELISA and its applications in viral detection.

UNIT IV

Basics and procedures of PCR, Real time PCR, PCR based and hybridization based methods of detection, microarrays based detection, multiplexing etc, detection of soil borne and seed born infections, transgene detection in seed, planting material and processed food, molecular detection of varietal impurities and seed admixtures in commercial consignments.

Practical

i. Preparation of buffers and reagents.
ii. Immunoblotting, immunoelectrophoresis and fluorescent antibody test.
iii. Enzyme immunoassays including ELISA western blotting.
iv. Extraction and identification of DNA/RNA of pathogenic organisms.
v. Restriction hybridoma technique and production of monoclonal antibodies.

vi. Immunogenic proteins, expression and immunogenecity studies, purification of immunogenic protein and immunization of laboratory animals.

Suggested Readings

Bloom BR & Lambert P-H. 2002. *The Vaccine Book*. Academic Press.

Elles R & Mountford R. 2004. *Molecular Diagnosis of Genetic Disease*. Humana Press.

Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby's Immunology*. WH Freeman.

Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.

Lowrie DB & Whalen R. 2000. *DNA Vaccines*. Humana Press.

Male D, Brostoff J, Roth DB & Roitt I. 2006. *Immunology.* Elsevier.

Rao JR, Fleming CC & Moore JE. 2006. *Molecular Diagnostics*. Horizon Bioscience.

Robinson A & Cranage MP. 2003. *Vaccine Protocols*. 2nd Ed. Humana Press.

Spinger TA, 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

MBB 513 NANO-BIOTECHNOLOGY 3+0

Objective

Understanding the molecular techniques involved in structure and functions of nano-biomolecules in cells such as DNA, RNA and proteins.

Theory

UNIT I

Introduction to Biomacromolecules: The modern concepts to describe the conformation and dynamics of biological macromolecules: scattering techniques, micromanipulation techniques, drug delivery applications etc.

UNIT II

Cellular engineering: signal transduction in biological systems, feedback control signaling pathways, cell-cell interactions etc. Effects of physical, chemical and electrical stimuli on cell function and gene regulation.

UNIT III

Chemical, physical and biological properties of biomaterials and bioresponse: biomineralization, biosynthesis, and properties of natural materials (proteins, DNA, and polysaccharides), structure-property relationships in polymeric materials (synthetic polymers and structural proteins); Aerosol properties, application and dynamics; Statistical Mechanics in Biological Systems,

UNIT IV

Preparation and characterization of nanoparticles; Nanoparticular carrier systems; Micro- and Nano-fluidics; Drug and gene delivery system; Microfabrication, Biosensors, Chip technologies, Nano- imaging, Metabolic engineering and Gene therapy.

Suggested Readings

Nalwa HS. 2005. *Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology*. American Scientific Publ.

Niemeyer CM & Mirkin CA. 2005. *Nanobiotechnology*. Wiley Interscience.

MBB 551 PRINCIPLES OF GENETICS 2+1

Objective

This course is aimed at understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problem-solving skills from classical to molecular genetics.

Theory

UNIT I

Early concepts of inheritance; Discussion on Mendel's paper; Sex determination, differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage, recombination and genetic mapping in eukaryotes, Somatic cell genetics.

UNIT II

Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes; Mutations and mutagenic agents.

UNIT III

Genetic code and protein biosynthesis; Gene regulation, Genes in development; Extra chromosomal inheritance, Male sterility and incompatibility; Recombination in bacteria, fungi and viruses, tetrad analysis.

UNIT IV

Inheritance of quantitative traits; Concepts in population genetics; Genes and behavior; Genetics and evolution; Recombinant DNA technology; Genetic fine structure analysis, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families; An overview of some recent discoveries in the field of genetics.

Practical

i. Laboratory exercises in probability and chi-square.
ii. Demonstration of genetic principles using laboratory organisms.
iii. Chromosome mapping using three point test cross.
iv. Tetrad analysis.
v. Induction and detection of mutations through genetic tests.
vi. Pedigree analysis in humans.
vii. Numerical problems on Hardy Weinberg Equilibrium, Quantitative inheritance and Molecular genetics.

Suggested Readings

Klug WS & Cummings MR. 2003 *Concepts of Genetics*. Peterson Education.

Lewin B. 2008. *Genes IX*. Jones & Bartlett Publ.

Russell PJ. 1998. *Genetics*. The Benzamin/Cummings Publ. Co.

Strickberger MW.1990. *Genetics*. Collier MacMillan.

Tamarin RH. 1999. *Principles of Genetics*. Wm. C. Brown Publs.

Uppal S, Yadav R, Subhadra & Saharan RP. 2005. *Practical Manual on Basic and Applied Genetics*. Dept. of Genetics, CCS HAU Hisar.

MBB 552 BASIC BIOCHEMISTRY 2+1

Objective

To provide elementary knowledge/overview of structure, functions and metabolism of biomolecules.

Theory

UNIT I

Scope and importance of biochemistry in agriculture; Fundamental principles governing life; structure of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces; General introduction to physical techniques for determination of structure of biopolymers.

UNIT II

Classification, structure and function of carbohydrates, lipids and biomembranes, amino acids, proteins, and nucleic acids.

UNIT III

Structure and biological functions of vitamins, enzymes classification and mechanism of action; regulation, factors affecting enzyme action. Fundamentals of thermodynamic principles applicable to biological processes, Bioenergetics.

UNIT IV

Metabolism of carbohydrates, photosynthesis and respiration, oxidative phosphorylation, lipids, proteins and nucleic acids. DNA replication, transcription and translation; recombinant DNA technology, Nutritional aspects of carbohydrates, lipids, proteins and minerals.

Practical

i. Preparation of standard and buffer solutions.
ii. Extraction and estimation of sugars and amino acids.
iii. Estimation of proteins by Lowry's method.
iv. Estimation of DNA and RNA by Diphenyamine and orcinol methods.
v. Estimation of ascorbic acid.
vi. Separation of biomolecules by TLC and paper chromatography

Suggested Readings

Conn EE & Stumpf PK. 1987. *Outlines of Biochemistry*. John Wiley.

Metzler DE. *Biochemistry.* Vols. I, II. Wiley International.

Nelson DL & Cox MM. 2004. *Lehninger's Principles of Biochemistry*. MacMillan.

Voet D & Voet JG. *Biochemistry*. 3rd Ed. Wiley International.

MBB 553 BIOSTATISTICS AND COMPUTERS 2+1

Objective

This is the special course for M.Sc. students of Biotechnology. They are exposed to various statistical methods to analyze their experimental data.

Theory

UNIT I

Aims, scope and idea of elementary statistics; Measures of central tendency and dispersion, skewness and kurtosis.

UNIT II

Concept of probability and probability laws, mathematical expectation, moments, moments generating function; Standard probability distributions- Binomial, Poisson and Normal distributions.

UNIT III

Tests of significance based on Z, χ^2, t and F statistics; Correlation and regression, curve fitting by least squares methods.

UNIT IV

Basic principles, organization and operational aspects of computers, operating systems. Introduction to MS-Office, MS-Word, MS-Excel. Statistical Data analysis based on above topics through MS-Excel.

Practical

i. Data analysis using probability, test of significance
ii. Correlation and regression analysis
iii. Usage of MS-Windows
iv. Exercises on test processing, spreadsheet and DBMS
v. SPSS

Suggested Readings

Agarwal BL. 2003. *Basic Statistics*. New Age.
Gupta SP. 2004. *Statistical Methods*. S. Chand & Sons.
Dutta NK. 2002. *Fundamentals of Bio-Statistics*. Kanishka Publ.

MBB 554 PRINCIPLES OF MICROBIOLOGY 2+1

Objective

To acquaint the students with history, classification and role of microbiology in agriculture, food and environment.

Theory

UNIT I

Development of Microbiology in the 18th and 19th century. Morphology, structure and function of prokaryotic and eukaryotic cell. Archea. Classification of prokaryotes – Basic principles and techniques used in bacterial classification.

UNIT II

Evolutionary relationship among prokaryotes. Phylogenetic and numerical taxonomy. Use of DNA and r-RNA sequencing in classifications.

UNIT III

Study of major groups of bacteria belonging to Gracilicutes, Firmicutes, Tanericutes and Mendosicutes.

UNIT IV

Viruses – morphology, classification and replication of plant, animal and bacterial viruses. Cultivation methods of viruses. Immune response – specific and non-specific resistance. Normal microflora of human body; some common bacterial and viral diseases of humans and animals.

Practical

i. Methods of isolation, purification and maintenance of microorganisms from different environments (air, water, soil, milk and food).
ii. Enrichment culture technique – isolation of asymbiotic, symbiotic nitrogen fixing bacteria. Isolation of photosynthetic bacteria.
iii. Use of selective media, antibiotic resistance and isolation of antibiotic producing microorganisms.
iv. Morphological, physiological and biochemical characterization of bacteria.

Suggested Readings

Brock TD. 1961. *Milestones in Microbiology*. Infinity Books.
Pelczar ML Jr. 1997. *Microbiology*. Tata McGraw Hill.

Stainier RY, Ingraham JL, Wheelis ML & Painter PR. 2003. *General Microbiology*. MacMillan.
Tauro P, Kapoor KK & Yadav KS. 1996. *Introduction to Microbiology*. Wiley Eastern.

MBB 555 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, genebank, 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. Retrival 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.

BMB 556 ENVIRONMENTAL BIOTECHNOLOGY 3+0

Objective

To apprise the students about the role of biotechnology in environment management for sustainable eco-system and human welfare.

Theory

UNIT I

Basic concepts and environmental issues; types of environmental pollution; problems arising from high-input agriculture; methodology of environmental management; air and water pollution and its control; waste water treatment - physical, chemical and biological processes; need for water and natural resource management.

UNIT II

Microbiology and use of micro-organisms in waste treatment; biodegradation; degradation of Xenobiotic, surfactants; bioremediation of soil & water contaminated with oils, pesticides & toxic chemicals,

detergents etc; aerobic processes (activated sludge, oxidation ditches, trickling filter, rotating drums, etc); anaerobic processes: digestion, filteration, etc.

UNIT III

Renewable and non-Renewable resources of energy; energy from solid waste; conventional fuels and their environmental impact; biogas; microbial hydrogen production; conversion of sugar to alcohol; gasohol; biodegradation of lignin and cellulose; biopesticides; biofertilizers; composting; vermiculture, etc.

UNIT IV

Treatment schemes of domestic waste and industrial effluents; food, feed and energy from solid waste; bioleaching; enrichment of ores by microorganisms; global environmental problems: ozone depletion, UV-B, greenhouse effects, and acid rain; biodiversity and its conservation; biotechnological approaches for the management environmental problems.

Suggested Readings

Evans GM & Furlong JC. 2002. *Environmental Biotechnology: Theory and Application*. Wiley International.

Jordening H-J & Winter J. 2006. *Environmental Biotechnology: Concepts and Applications*. Wiley-VCH Verlag.

MBB 601 ADVANCES IN PLANT MOLECULAR BIOLOGY 3+0

Objective

To discuss the specialized topics and recent advances in the field of plant molecular biology.

Theory

UNIT I

Arabidopsis in molecular biology, Forward and Reverse Genetic Approaches, Transcriptional and post-transcriptional regulation of gene expression, isolation of promoters and other regulatory elements.

UNIT II

RNA interference, Transcriptional gene silencing, Transcript and protein analysis, use of transcript profiling to study biological systems.

UNIT III

Hormone regulatory pathways: Ethylene, Cytokinin, Auxin and ABA, SA and JA; ABC Model of Floral Development, Molecular basis of self incompatibility, Regulation of flowering: photoperiod, vernalization, circadian rhythms.

UNIT IV

Molecular biology of abiotic stress responses: Cold, high temperature, sub-mergence, salinity and drought; Molecular Biology of plant-pathogen interactions, molecular biology of *Agrobacterium* Infection, Molecular biology of *Rhizobium* infection (molecular mechanisms in symbiosis), Programmed cell death in development and defense.

Suggested Readings

Buchanan B, Gruissen W & Jones R. 2000. *Biochemistry and Molecular Biology of Plants*. American Society of Plant Physiologists, USA.

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panima.

Malacinski GM & Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publ.

Nelson DL & Cox MM. 2007. *Lehninger's Principles of Biochemistry*. WH Freeman & Co.
Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene.* 6th Ed. Pearson Education.

MBB 602 ADVANCES IN GENETIC ENGINEERING 3+0

Objective

To discuss the specialized topics and advances in field of genetic engineering and their application in plant improvement.

Theory

UNIT I

General overview of transgenic plants; Case studies: Genetic engineering of herbicide resistance, Transgenic plants resistant to insects/pests, Genetic engineering of abiotic stress tolerance, Engineering food crops for quality, Genetically engineered pollination control, Induction of male sterility in plants.

UNIT II

Molecular farming of plants for applications in veterinary and human medicine systems: Boosting heterologous protein production in transgenics, Rapid production of specific vaccines, High-yield production of therapeutic proteins in chloroplasts.

UNIT III

Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement; Gene stacking; Pathway engineering; Marker-free transgenic development strategies; High throughput phenotyping of transgenic plants.

UNIT IV

Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

Suggested Readings

Christou P & Klee H. 2004. *Handbook of Plant Biotechnology*. John Wiley & Sons.
Specific journals mentioned later.

MBB 603 ADVANCES IN MICROBIAL BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics about industrially important microorganisms.

Theory

UNIT I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms.

UNIT II

Immobilization of enzymes and cells; Batch, plug flow and chemostate cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles; Down stream processing etc.

UNIT III

Current advances in production of antibiotics, vaccines, and biocides; Steroid transformation; Bioreactors; Bioprocess engineering; Production of non-microbial origin products by genetically engineered microorganisms.

UNIT IV

Concept of probiotics and applications of new tools of biotechnology for quality feed/food production; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Single cell protein, Bioinsecticides; Biofertilizers; Recent advances in microbial biotechnology.

Suggested Readings

Specific journals and published references.

MBB 604 ADVANCES IN CROP BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics on the application of molecular tools in breeding of specific crops.

Theory

UNIT I

Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement.

UNIT II

Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses; Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc); edible vaccines, etc.

UNIT III

Molecular breeding: constructing molecular maps; integrating genetic, physical and molecular maps; diversity assessment and phylogenetic analysis; molecular tagging of genes/traits; selected examples on marker-assisted selection of qualitative and quantitative traits.

UNIT IV

Discussion on application of molecular, transformation and genomic tools for the genetic enhancement in some major field crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane etc.

Suggested Readings

Specific journals and published references.

MBB 605 ADVANCES IN FUNCTIONAL GENOMICS AND PROTEOMICS 2+0

Objective

To discuss recent advances and applications of functional genomics and proteomics in agriculture, medicine and industry.

Theory

UNIT I

Genome sequencing and functional genomics; Human, animal, plant, bacterial and yeast genome projects; genome annotation; *ab initio* gene discovery; functional annotation and gene family clusters; etc.

UNIT II

Functional analysis of genes; RNA-mediated interference; gene knockoffs; Gene traps/ T-DNA insertion lines; homologous recombination; microarray profiling; SAGE; SNPs/variation; yeast-two hybrid screening; gene expression and transcript profiling; EST contigs; EcoTILLING; allele/gene mining; synteny and comparative genomics; Genome evolution, speciation and domestication etc.

UNIT II

Proteomics: protein annotation; protein separation and 2D PAGE; mass spectroscopy; protein microarrays; protein interactive maps; structural proteomics: protein structure determination, prediction and threading, software and data analysis/ management, etc.

UNIT IV

Discussion on selected papers on functional genomics, proteomics, integrative genomics etc.

Suggested Readings

Specific journals and published references.

MBB 606 COMMERCIAL PLANT TISSUE CULTURE 2+0

Objective

To discuss the commercial applications of plant tissue culture in agriculture, medicine and industry.

Theory

UNIT I

Micropropagation of commercially important plant species; plant multiplication, hardening, and transplantation; genetic fidelity; scaling up and cost reduction; bioreactors; synthetic seeds; management and marketing.

UNIT II

Production of useful compounds via biotransformation and secondary metabolite production: suspension cultures, immobilization, examples of chemicals being produced for use in pharmacy, medicine and industry.

UNIT III

Value-addition by transformation; development, production and release of transgenic plants; patent, bio-safety, regulatory, environmental and ethic issues; management and commercialization.

UNIT IV

Some case studies on success stories on commercial applications of plant tissue culture. Visits to some tissue culture based commercial units/industries.

Suggested Readings

Specific journals and published references.

MBB 607 ADVANCES IN ANIMAL BIOTECHNOLOGY 2+0

Objective

Intended to provide cutting edge knowledge on advances in different areas of animal biotechnology.

Theory

UNIT I

Advances in animal cell culture technology, suspension culture technology, advances in commercial scale productions of mammalian cells.

UNIT II

Advances in cell cloning and cell hybridization, advances in monoclonal antibody production technology, Advances in diagnostic technology, Computational vaccinology, reverse genetics based vaccines.

UNIT III

Advances in embryo manipulation, knock out and knock in technology, advances in animal cloning technology, stem cell technology, Advances in development of animal models for human diseases using transgenic animal technology.

UNIT IV

Advances in genetic basis for animal disease resistance, Molecular methods for animal forensics, Advances in animal genomics, proteomics,

Suggested Readings

Selected articles from journals.

PLANT MOLECULAR BIOLOGY & BIOTECHNOLOGY

List of Journals

- Advances in Botanical Research
- Advances in Enzyme Regulation
- Advances in Enzymology
- Advances in Genetics
- Agricultural and Biological Research
- Analytical Biochemistry
- Annals of Botany
- Archives of Biochemistry and Biophysics
- Archives of Microbiology
- Biochemical and Biophysical Research Communication
- Biochemical Genetics
- Biochemistry
- Biotechnology and Bioengineering
- Critical Reviews in Plant Sciences
- Crop Science
- EMBO Journal
- Euphytica
- Genetic and Plant Breeding
- Genome
- Indian Journal of Genetics and Plant Breeding
- Journal of Biotechnology
- Journal of Experimental Botany
- Journal of General Microbiology
- Journal of Heredity
- Journal of Plant Biochemistry and Biotechnology
- Journal of Plant Biology
- Molecular and Cellular Biochemistry
- Molecular Breeding
- Molecular Genetics and Genomics
- Nature
- Nature Biotechnology
- Plant Cell
- Plant Molecular Biology
- Plant Physiology
- Plant Physiology and Biochemistry
- Proceedings of The National Academy of Sciences (USA)
- Science
- Trends in Biochemical Sciences
- Trends in Biotechnology
- Trends in Cell Biology
- Trends in Food Science and Technology
- Trends in Genetics
- Trends in Microbiology
- Trends in Plant Sciences

e-Resources

- National Center for Biotechnology Information
  http://www.ncbi.nlm.nih.gov/
- The World Wide Web Virtual Library: Biotechnology.

http://www.cato.com/biotech/

- The Transgenic/Targeted Mutation Database (TBASE)
  http://www.bis.med.jhmi.edu/Dan/tbase/tbase.html
- Primer on Molecular Genetics
  http://www.bis.med.jhmi.edu/Dan/DOE/intro.html.
- Bioportal
  http://bioportal.gc.ca/english/BioPortalHome.asp
- Access Excellence
  http://www.gene.com/ae
- BioTech Biosources Database: Indiana University
  http://biotech.chem.indiana.edu/
- Information Systems for Biotechnology
  http://gophisb.biochem.vt.edu/
- All About The Human Genome Project (HGP)
  http://www.genome.gov/
- *Human Genome Project at the Sanger Institute*
  http://www.sanger.ac.uk/HGP/
- UCSC Genome Browser
  http://genome.ucsc.edu/
- Gramene
  www.gramene.org/
- The Institute for Genomic Research
  www.tigr.org

Suggested Broad Topics for Master's and Doctoral Research

- Micropropagation of important crop plants, cash crops, ornamentals, forest and horticultural trees, medicinal and aromatic plants.
- Development of transgenics in field crops for resistance against biotic and abiotic stresses, and to improve the nutritional quality, etc.
- DNA fingerprinting of important plant species and germplasm.
- Development of molecular markers (SNP, SSR, transposable elements, etc) and their utilization for genetic diversity and phylogenetic analysis.
- Molecular mapping and marker-assisted selection for major-gene traits in crop species.
- Value-addition including biopesticides, biofertilizers, biofuels, biodegradable plastics, secondary metabolites, etc.
- Genome sequencing and functional analysis of genes of important organisms.
- Allele mining, proteomics, genomics and metabolic engineering for crop improvement.
- Immobilization of enzymes/microorganisms.
- Protein engineering.
- To develop crops with improved mineral (Fe, Zn, Vitamin A, etc) bioavailbility.
- Biodiversity and conservation of endangered plant species.
- Bioprocess engineering and down stream processing.

ANIMAL BIOTECHNOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
ABT 601*	BASIC & APPLIED BIOTECHNOLOGY	3+0
ABT 602**	FUNDAMENTALS OF CELL & MOLECULAR BIOLOGY	3+0
ABT 603*	APPLIED MOLECULAR BIOLOGY	2+1
ABT 604**	ANIMAL CELL CULTURE: PRINCIPLES & APPLICATIONS	1+2
ABT 605**	MOLECULAR DIAGNOSTICS	1+2
ABT 606	VACCINE BIOTECHNOLOGY	2+0
ABT 607	IMMUNOLOGY APPLIED TO BIOTECHNOLOGY	1+1
ABT 608	INTRODUCTION TO BIOINFORMATICS	1+1
ABT 609**	ANIMAL GENOMICS	2+1
ABT 610**	REPRODUCTIVE BIOTECHNOLOGY	2+1
ABT 611**	TECHNIQUES IN MOLECULAR BIOLOGY & GENETIC ENGINEERING	0+3
ABT 612	BIODIVERSITY, BIOSAFETY & BIOETHICS	2+0
ABT 613	MOLECULAR FORENSICS	2+1
ABT 614	INDUSTRIAL BIOTECHNOLOGY	2+1
ABT 615*	PROBIOTICS & FEED BIOTECHNOLOGY	3+0
ABT 616	ANIMAL BIOTECHNOLOGY	3+0
ABT 691	MASTER'S SEMINAR	1+0
ABT 699	MASTER'S RESEARCH	20
ABT 701	GENE CLONING AND EXPRESSION	1+1
ABT 702*	FUNCTIONAL GENOMICS & PROTEOMICS	2+1
ABT 703	ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY	2+1
ABT 704	TRENDS IN VACCINOLOGY	3+0
ABT 705	ADVANCES IN ANIMAL CELL CULTURE	2+1
ABT 706	TRANSGENIC ANIMAL TECHNOLOGY	2+0
ABT 791	DOCTORAL SEMINAR I	1+0
ABT 792	DOCTORAL SEMINAR II	1+0
ABT 799	DOCTORAL RESEARCH	45

* Courses may also be taken as Minor/Supporting
** Compulsory for Master's Programme

ANIMAL BIOTECHNOLOGY
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 Hori*ozon. Kalyani.

ABT 602 FUNDAMENTALS OF CELL & MOLECULAR BIOLOGY 3+0

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, secretary proteins, lipoproteins, glycolipids. Lipid synthesis and transport.

UNIT II

Cytoskeleton: Mechanism of muscle contraction, actin filaments and cell cortex, cilliary 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^{++} 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.

ABT 603 APPLIED MOLECULAR BIOLOGY 2+1

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 tumourogenic 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.

vii. 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.

ABT 604 ANIMAL CELL CULTURE: PRINCIPLES AND APPLICATIONS 1+2

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.

ABT 605 MOLECULAR DIAGNOSTICS 1+2

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.

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. Immunogenecity 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.

Lowrie DB & Whalen R. 2000. *DNA Vaccines*. Humana Press.

Robinson A & Cranage MP. 2003. *Vaccine Protocols*. 2nd Ed. Humana Press.

ABT 607 IMMUNOLOGY APPLIED TO BIOTECHNOLOGY 1+1

Objective

Understanding the application of immunological techniques in biotechnology.

Theory

UNIT I

Introduction, principles of immunology, immune system, immune response, major histocompatibility complex, various techniques used in biotechnology.

UNIT II

Application of antibodies in purification, immunoblotting, expression of recombinant proteins and detection in different expression systems, industrial production of cytokines and interferon, expression of immunoglobulin genes in plants and production of antibodies.

UNIT III

Application of antibodies in chemiluminescence and florescence assay used for actions for recombinant genes, antibody based nucleic acid probes and their applications, immunoinformatics.

UNIT IV

Somatic cell hybridization, hybridoma technology, commercial production of antibodies using monoclonal antibodies.

Practical

i. Immunodiffusion.
ii. Immunoelectrophoresis.
iii. Fluorescent antibody test.
iv. Enzyme immunoassays including ELISA.
v. Immunoblotting.
vi. Affinity chromatography,
vii. Bioinformatics tools for immunological research.
viii. Cultivation of normal lymphocytes and myeloma cell line.
ix. Somatic cell hybridization and production of hybridoma.
x. Screening of hybrids for production of monoclonal antibodies.

Suggested Readings

Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.

Male D, Brostoff J, Roth DB & Roitt I. 2006. *Immunology.* Elsevier.

Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

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, genebank, 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. Retrival 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.

iv. 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. Diiferent types of PCR, Real time polymerase chain reaction

UNIT IV

Cloning of bacterial and viral genes in to 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 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-spliting, 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.

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 701 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 bloting.

Suggested Readings

Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. Wiley.

ABT 702 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 micrroarray 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 spectrophotometery, 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 703 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.

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 704 TRENDS IN VACCINOLOGY 3+0

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 705 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.

Suggested Readings

Selected articles from journals.

ABT 706 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.

ANIMAL BIOTECHNOLOGY

List of Journals

- Animal Biotechnology
- Animal Genetics
- Animal Reproduction
- Cellular and Molecular Probe
- Current Science
- Genome Research
- Indian journal of Microbiology
- Journal of Clinical Microbiology
- Journal of Dairy Science
- Journal of Reproduction and Fertility
- Methods in Virus Research
- Nature
- Nature Biotechnology
- Nature Genetics
- Nucleic Acid Research
- PNAS
- Reproduction in Domestic Animals
- Science
- Theriogenology
- Trends in Biotechnology
- Trends in Genetics
- Viral Research

e-Resources

- www.cls.casa.colostate.edu/TransgenicCrops/teacherlinks
- www.hpc.unm.edu/~aroberts/main/top5%25.htm
- www.isaaa.org
- www.ciat.cgiar.org/biotechnology/cbn/gines_mera_fund.htm
- www.scidev.net/en/agriculture-and-environment/agri-biotech/links/publications-and-information-services
- www.biotechinstitute.org/programs/t_leader_program.html
- www.sci-ed-ga.org/modules/dna/analogies.html
- www.accessexcellence.org/AE/AEPC/WWC/1993
- www.atschool.eduweb.co.uk/trinity/bio2.html
- www.pub.ac.za/resources/teach.html
- www.bio-link.org/biomaterial.htm
- www.biotechnology.gov.au/index.cfm?event=object.showContent&objectID=B35A914C-DE3D-1A59-79F89FAA26F54E44
- www.monsanto.com/products/techandsafety/technicalpubs/eduwebsites.asp
- www.ejbiotechnology.info/content/vol5/issue3/teaching/01/index.html
- www.ncbiotech.org/resource_center/for_educators/online_teaching_resources.html
- www.ias.ac.in/currsci/dec252006/1594
- www.cccoe.k12.ca.us/stsvcs/newteacher/rop/curr_rop_links2.html
- www.scielo.cl/scielo.php?pid=S0717-34582003000100004&script=sci_arttext
- www.sunysb.edu/ligase/Forstudents/BiotechTeachingCenter/biotechcenter.html

- www.ca.uky.edu/agc/pubs/brei/brei3tg/brei3tg.htm
- www.aggie-horticulture.tamu.edu/tisscult/biotech/biotechteach.html
- www.ejbiotechnology.info/content/vol6/issue2/issues/2/index.html
- http://science.nhmccd.edu/biol/bio1int.htm#dna
- http://nhscience.lonestar.edu/biol/bio1int.htm
- www.ingentaconnect.com/content/tandf/tsed/2000/00000022/00000009/art00007
- www.buildingbiotechnology.com/free.php
- www.biotechnologist2020.com/2008/04/teaching-jobs-in-bioinformatics.html
- www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ613711
- www.uq.edu.au/teaching-learning/index.html?page=61920
- www.nature.com/nbt/journal/v18/n9/full/nbt0900_913b.html
- www.fotodyne.com/literature/datasheets/E10700
- www.biotethics.org/conferences/maastricht/partecipants.html
- www.brookes.ac.uk/studying/courses/postgraduate/2008/biotech
- www.bioweb.usc.edu/courses/2003-spring/documents/bisc406-notes_011603
- www.agen.ufl.edu/~chyn/age2062/lect/lect_09/lect_09.htm
- www.bioinformaticscourses.com/BIOL358/lectures.html
- www.isis.vt.edu/~nstone/LifeSci/lect5.html
- www.nwo.nl/nwohome.nsf/pages/NWOA_6Y2LGH_Eng
- www.soi.wide.ad.jp/class/20040016
- www.sciencetech.technomuses.ca/english/schoolzone/biotech.cfm
- www.freevideolectures.com/biotech.html
- www.agen.ufl.edu/~chyn/age4660/lect/lect_07/lect_07.htm
- www.web.mit.edu/cheme/news/frontiers_2005.html

Suggested Broad Topics for Master's and Doctoral Research

- Development of Vaccines against emerging pathogens
- Nucleic acid based diagnostics
- Molecular animal forensics
- Whole genome analysis of animal viruses
- Embryo manipulation
- Animal genomics
- Reproductive biotechnology
- Conservation of endangered animal species
- Animal breed characterization
- Genomic Diversity of animal viruses
- Mapping of disease resistance genes in livestock
- Proteomics

BIOINFORMATICS

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
BIF 501*	INTRODUCTION TO BIOINFORMATICS	2+1
BIF 502*	ADVANCED BIOINFORMATICS	2+1
BIF 503*	TECHNIQUES IN BIOINFORMATICS	0+2
BIF 504**†	BIOLOGICAL CHEMISTRY	3+0
BIF 505**†	STATISTICS FOR BIOINFORMATICS	2+1
BIF 506	CONCEPTS IN COMPUTING	2+2
BIF 507**†	PROGRAMMING LANGUAGES FOR BIOINFORMATICS	2+2
BIF 508**†	BASIC MOLECULAR BIOLOGY	3+0
BIF 509**†	MATHEMATICS FOR BIOINFORMATICS	2+0
BIF 510**	GENETICS & IMMUNOLOGY	3+0
BIF 511	INTRODUCTION TO DATABASE SYSTEMS	2+1
BIF 512	COMPUTATIONAL & SYSTEM BIOLOGY	2+2
BIF 513	BIOMOLECULAR SEQUENCE ANALYSIS	1+1
BIF 514**†	DYNAMIC WEB-DESIGN	1+2
BIF 515	BIOLOGICAL DATABANKS & DATA MINING	1+2
BIF 516	MOLECULAR MODELLING & DRUG DESIGN	2+2
BIF 517	COMPARATIVE AND FUNCTIONAL GENOMICS	2+1
BIF 518	PHARMACOGENOMICS & IPR	2+1
BIF 591	MASTER'S SEMINAR	1+0
BIF 599	MASTER'S RESEARCH	20

* To be offered to the students other than those of M.Sc. Bioinformatics

** May be taken as Minor/Supporting course

† To be offered from respective departments. The syllabi are attached for reference only. Actual contents may be seen from the corresponding department(s).

BIOINFORMATICS

Course Contents

BIF 501 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, genebank, 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.

BIF 502 ADVANCED BIOINFORMATICS 2+1

Objective

To understand the usage of advanced techniques in Bioinformatics

Theory

UNIT I

Biological databases, database hierarchies, sequence and structure databases. Pairwise sequence alignment and database similarity searching: global and local alignments, matrices, gap penalties and statistical significance.

UNIT II

Multiple sequence alignment and phylogenetic analysis, Microarray technology: applications, analysis of data, clustering analysis. Pharmacogenomics: introduction, applications, Genome for medicine, current and future perspectives.

UNIT III

System modeling and metabolomics – concepts and principles. Nutrigenomics: system biology in nutrition and health arena.

UNIT IV

Genome annotation, EST clustering, protein modeling and design.

Practical

i. Development of small database
ii. Phylogenetic analysis
iii. Microarray data analysis (sample data from open sources).
iv. Other practical exercises based on above topics.

Suggested Readings

Baxevanis AD & Ouellettee BFF. 2001. *Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins*. Wiley Interscience.

Mount DW Cold. 2001. *Bioinformatics: Sequence and Genome Analysis*. Spring Harbor

Stekel D. 2003. *Microarray Bioinformatics*. Cambridge University Press.

Tomita M & Nishioka T. 2005. *Metabolomics: The Frontier of Systems Biology*. Springer Verlag.

Wong SHY. 2006. *Pharmacogenomics and Proteomics: Enabling the Practice of Personalized Medicine*. American Association for Clinical Chemistry.

BIF 503 TECHNIQUES IN BIOINFORMATICS 0+2

Objective

To explore the usage of various Open source software for Bioinformatics applications

Practical

UNIT I

Gene Information Resources: GenBank, EMBL, Protein Information Resources: Swiss-Prot, BLOCKS, Gene Prediction Tools: GENSCAN, GRAIL

UNIT II

Structural Databases: PDB, CSD, RELIBASE, REBASE, File Format Converter Tools: BABEL, ReadSeq, NCBI Resources

UNIT III

Visualization tools – RasMol, QMol, Swiss PDB, Pymol, Modelling Tools: MODELLER, SwissPDB, Geno3D, Docking Tools: Chimera, Dock, AutoDock, GRAMM, Hex, Argus Lab.

UNIT IV

Proteomics Tools: EXPASY, CDART, 3D-Structure Optimization Tools, Sequence Analysis Tools: BLAST, FASTA, EMBOSS, TCOFFEE, Phylogenetic Analysis Tools: Phylip, NTSYS, CLUSTALW/CLUSTALX, BIOEDIT

Suggested Readings

Software Manuals and Help files

BIF 504 BIOLOGICAL CHEMISTRY 3+0

Objective

This is intended to prepare the non-biology students for basic concepts of biological structures and functions as well as recapitulate the knowledge of biology students.

Theory

UNIT I

The molecular logic of living organisms; Cells and composition of living matter; Carbohydrates: monosaccharides, oligosaccharides, polysaccharides, proteoglycans and glycoproteins; Lipids: fatty acids, acylglycerols, phospholipids, sphingolipids, cholesterol and membranes.

UNIT II

Structure and function of Proteins and nucleic acids; Enzymes: details of enzyme nomenclature and classification; units of enzyme activity; coenzymes and metal cofactors; temperature and pH effects; Michaelis-Menten kinetics; Inhibitors and activators; active site and catalytic mechanisms; covalent and noncovalent regulations; isoenzymes.

UNIT III

Organization of metabolic systems: enzyme chains, multienzyme complexes and multifunctional enzymes; anaplerotic sequences and amphibolic pathways; pacemaker enzymes and feedback control of metabolic pathways; shuttle pathways; energy charge.

UNIT IV

Oxidation of glucose in cells: high energy bond, glycolysis, citric acid cycle and oxidative phosphorylation, metabolism of lipids, proteins and nucleic acids, signal transduction.

Suggested Readings

Geoffrey LZ, Michael Gregory E & Sitz T. 1997. *Biochemistry*. McGraw-Hill.

Nelson DL, Cox MM & Ocorr MOK. 2005. *Lehninger's Biochemistry*. WH Freeman & Co.

Voet D & Voet JG. 1997. *Biochemistry.* John Wiley & Sons.

BIF 505 STATISTICS FOR BIOINFORMATICS 2+1

Objective

To understand the basic principles of statistics and mathematics and their applications in relation to Biological system.

Theory

UNIT I

Introduction to Statistical Bioinformatics, Principles of sampling from a population; Random sampling

UNIT II

Frequency distributions: Graphical representations and Descriptive measures; Standard Probability Distributions; Correlation and regression analysis.

UNIT III

Hypothesis testing; Markov Models, Cluster Analysis: Hierarchical and Non-Hierarchical methods.

UNIT IV

Phylogenetic Analysis Tools: Maximum Likelihood, Parsimony methods.

Practical

i. Computational exercises on Random Sampling
ii. Construction and representation of frequency distributions
iii. Descriptive measures
iv. Probability distribution.

Suggested Readings

Gupta SC & Kapoor VK. 2000. *Fundamentals of Mathematical Statistics: A Modern Approach*. S. Chand & Co.

Warren JE & Gregory RG. 2005. *Statistical Methods in Bioinformatics*. Springer.

BIF 506 CONCEPTS IN COMPUTING 2+2

Objective

The objective of this course is to introduce the basic concepts of computing with introduction to OS, graphics, networking and client-server technologies.

Theory

UNIT I

Fundamentals of Computing; Introduction to Operating Systems: WINDOWS, UNIX/Linux operating systems; Computer Security (hacking, cracking), Computer Viruses.

UNIT II

Computer Graphics**:** Visualization techniques - Software and Hardware, Interactive Graphics; Viewing in three dimension; Raster algorithms; Rendering; Animation; Image Processing with emphasis on biological systems.

UNIT III

Computer Networking, Security of the network, Fire-walls, Network Goals, Applications Network, Network architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols

UNIT IV

Use of INTERNET and WWW, Internet services.

Practical

i. MS-Windows
ii. Linux, UNIX
iii. Network design
iv. Internet search
v. Graphics and animation.

Suggested Readings

David FR. 1997. *Procedural Elements for Computer Graphics*. WCB/McGraw-Hill.

Foley JD & Van Dam A. 1982. *Fundamentals of Interactive Computer Graphics*. Addison-Wesley.

James FK & Keith WR. 2006. *Computer Networking: A Top-Down Approach Featuring the Internet*. Prentice Hall.

Siever E. 2005. *Linux in a Nutshell*. O'Reilly.

BIF 507 PROGRAMMING LANGUAGES FOR BIOINFORMATICS 2+2

Objective

Programming is a very significant area for bioinformatics and this course gives an understanding for logics of programming and command-line and graphical GDIs.

Theory

UNIT I

Programming in C*:* Pointers, pointers to functions, macro programming in C, graphs, data structure - linked list, stack, queue, binary trees, threaded binary trees.

UNIT II

File and exception handling in C, Programming in Visual Basic*:* Introduction to Application Development using Visual Basic; Working with Code and Forms.

UNIT III

Variables, Procedures and Controlling Program Executor; Standard Controls; Data Access Using Data Control; Connecting to Database using VB.

UNIT IV

Introduction to JAVA, variables, constants, control structures, input output, classes. Jar and Java applets.

Practical

i. Programming in C and Visual basic with special reference to database linking.
ii. Small Java applets

Suggested Readings

Brian WK & Ritchie DM. 1988. *C Programming Language*. Prentice Hall.
Kanetkar. 2002. *Let us C*. BPB Publications.
Microsoft Developers Network (MSDN Digital Library).2006. Microsoft.

BIF 508 BASIC MOLECULAR BIOLOGY 3+0

Objective

To understand the basic concepts of molecular biology in order to relate to the structure and functions of biomolecules and to have an insight of chemical aspects of life.

Theory

UNIT I

Nucleic acids as hereditary material, Genome organization in prokaryotes and eukaryotes.

UNIT II

DNA replication, semi-conservative model, mechanism of replication in *E. coli*, differences in pro- and eukaryotic DNA replication.

UNIT II

Reverse transcription, Transcription in pro- and eukaryotes, post-transcriptional changes; Ribozymes, anti-sense RNA, micro-RNAs

UNIT IV

Genetic code and translation; differences in translation process in pro-and eukaryotes; Gene regulation in prokaryotes and eukaryotes.

Suggested Readings

Gupta PK. 2003. *Cell and Molecular Biology*. 2nd Ed. Rastogi Publications.
Lodish H. 2003. *Molecular Cell Biology*. 5th Ed. W.H. Freeman & Co.
Zhang MQ & Jiang T. 2002. *Current Topics in Computational Molecular Biology*. MIT Press.

BIF 509 MATHEMATICS FOR BIOINFORMATICS 2+0

Objective

To understand and apply fundamental concepts of mathematics as applicable in Biology and to acquaint about theoretical concepts of algebra and geometry and numerical methods.

Theory

UNIT I

Coordinate geometry with basic concepts of 2D and 3D geometry, Vector algebra – Addition and subtraction of vectors, Dot and cross product, Scalar triple product.

UNIT II

Matrix algebra: basic definitions, matrix operations, transpose of a matrix, inverse of matrix, eigen values, Boolean algebra. Geometric and Arithmetic Progression.

UNIT III

Solution of equation by bisection method, Iteration method, Newton Raphson method, numerical differentiation.

UNIT IV

Numerical integration- Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Runga Kutta method of nth order. Fast Fourier transformation.

Suggested Readings

Babu CA & Seshan CR. 2006. *New Engineering Mathematics*. Narosa Publishing House.

Datta KB. 2002. *Matrix and Linear Algebra*. Prentice Hall.

Narayan S. 1980. *Matrix Algebra*. S Chand & Co.

Rao S. 2006. *Numerical Methods for Scientists and Engineers*. Prentice Hall.

BIF 510 GENETICS & IMMUNOLOGY 3+0

Objective

To learn the basic concepts of genetics and immunology.

Theory

UNIT I

Genetics- Science of genetics - objectives, terminologies, methods; Mendelian principles of inheritance, sex linked inheritance; Concept of linkage, linkage maps and recombination; Mutations - molecular, gene/point and chromosomal.

UNIT II

Phenotype and genotype relationships, role of environment, from gene to phenotype, gene interactions. Study of quantitative traits. Genetics of populations, genetics and evolution. Genetics and diseases.

UNIT III

Immunology - Overview of immune system, innate and acquired immune system; Structure and function of antibody molecule and TCR; Genetics of antibody diversity; MHC I and II, Polymorphism; Characteristics of B Cell and T Cell antigens; MHC Peptide interaction; Affinity maturation.

UNIT IV

Autoimmunity and molecular mimicry; Ligand - receptor interaction in the light of protein structure in immune system; Use of bioinformatics in immunology and vaccine development.

Suggested Readings

Johnson RL. 2006. *Genetics*. Twenty-First Century Books.
Male D. 2003. *Immunology*. Open University Worldwide.
Stansfield WD. 2002. *Genetics*. McGraw-Hill.

BIF 511 INTRODUCTION TO DATABASE SYSTEMS 2+1

Objective

To familiarize the concept of RDBMS and to apply the database techniques to biological databanks.

Theory

UNIT I

Data Abstraction; Data Models; Instances and Schemes; E-R Model - Entity and entity sets; Relations and relationship sets; E-R diagrams; Reducing E-R Diagrams to tables; Network Data Model: Basic concepts; Hierarchical Data Model: Basic Concepts.

UNIT II

Multimedia Databases - Basic Concepts and Applications; Indexing and Hashing; Basic concepts (ISAM, B+ Tree indexed files, B Tree indexed files, Static Hash functions, Dynamic Hash functions); Text Databases; Introduction to Distributed Database Processing, Data Security.

UNIT III

MySQL/MS-Access - Select Statements; Data Definition Statements; Data Manipulation Statements; Data Control Statements; Other Database Objects (Views, Sequences, Synonyms); Introduction to Application Development using Visual Basic; Working with Code and Forms; Variables.

UNIT IV

Procedures and Controlling Program Executor; Standard Controls; Data Access Using Data Control; Connecting to Oracle Database using Visual Basic.

Practical

i. Practical exercise using MySQL
ii. Design of database in MS-Access and MySQL.
iii. Database linking.

Suggested Readings

Date CJ. 1986. *Introduction to Database Systems*. Addison-Wesley.
Korth H & Silberschatz A. 2002. *Database System Concepts*. McGraw-Hill.
Martin D. 1986. *Advanced Database Techniques*. MIT Press.

BIF 512 COMPUTATIONAL & SYSTEM BIOLOGY 2+2

Objective

To understand the computational aspects of structural biology; to familiarize the usage of software for 3D structures of nucleic acids and proteins and to translate the sequence to protein structure.

Theory

UNIT I

Methods of single crystal X-ray Diffraction of macromolecules, NMR of macromolecules Anatomy of Proteins - Ramachandran plot, Secondary structures, Motifs, Domains, Tertiary and quaternary structures.

UNIT II

Anatomy of DNA: A, B, Z DNA, DNA bending etc.; RNA structure; Structure of Ribosome; Principles of Protein Folding; Structural data banks - Protein Data Bank, Cambridge small molecular crystal structure data bank.

UNIT III

Methods for Prediction of Secondary and Tertiary structures of Proteins, DNA, RNA, Fold recognition, *Ab initio* methods for structure prediction; Homology modeling, Methods for comparison of 3D structures of proteins.

UNIT IV

Molecular interactions of Protein – Protein with special reference to signal transduction and antigen-antibody interaction, Protein - DNA, Protein - carbohydrate, DNA - small molecules. System modeling and metabolomics – concepts and principles.

Practical

i. Usage of softwares for above topics
ii. Molecular Visualization tools: RasMol, QMol, Swiss PDB, Pymol
iii. Biomolecular Interaction Databases: BIND, DIP;
iv. Structure Similarity Search Tools: CN3D, Vast Search

Suggested Readings

Fall CP. 2002. *Computational Cell Biology*. Springer.

Tsai CS. 2003. *Computational Biochemistry*. John Wiley & Sons.

Waterman MS. 1995. *Introduction to Computational Biology: Maps, Sequences and Genomes*. CRC Press.

BIF 513 BIOMOLECULAR SEQUENCE ANALYSIS 1+1

Objective

To understand the local and multiple alignment concepts and to carry out multiple sequence alignment.

Theory

UNIT I

Analysis of protein and nucleic acid sequences, multiple alignment programs,

UNIT II

Development of programs for analysis of nucleic acid sequences, Use of EMBOSS package.

UNIT III

Phylogenetic analysis – Elements of phylogenetic models, tree interpretation, tree data analysis, alignment – building data model.

UNIT IV

Extraction of phylogenetics data sets, Distance and character based methods.

Practical

i. EMBOSS
ii. File Format Converter Tools: BABEL, ReadSeq
iii. Phylogenetic Analysis Tools: Phylip, NTSYS, PAUP
iv. CLUSTALW/CLUSTALX.

Suggested Readings

Baxevanis AD & Ouellettee BFF. 2001. *Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins*. Wiley Interscience.

Mount DW. 2001. *Bioinformatics: Sequence and Genome Analysis*. Spring Harbor, CSHL Press.
Nei M & Kumar S. 2000. *Molecular Evolution and Phylogenetics*. Oxford University Press.
Salemi M & Vandamme AM. 2003. *The Phylogenetic Handbook – A Practical Approach to DNA and Protein Phylogeny*. Oxford University Press.

BIF 514 DYNAMIC WEB-DESIGN 1+2

Objective

This course teaches the basic principles and application of various technologies used in creation of dynamic web content.

Theory

UNIT I

PERL: Strings, Numbers, and Variables. Variable Interpolation, Basic Input and Output, File handles, Making Decisions, Conditional Blocks, Loops, Combining Loops with Input, Standard Input and Output, Finding the Length of a Sequence File

UNIT II

Pattern Matching, Extracting Patterns, Arrays, Arrays and Lists, Split and Join, Hashes, A Real-World Example, BioPERL; Applications.

UNIT III

Creation, hosting and maintenance of web-site using HTML, XML, ASP, JSP.

UNIT IV

Creation, hosting and maintenance of web-site PHP, PERL and CGI.

Practical

i. Creation of Web-based applications, interactive and dynamic web-pages
ii. Connecting databases using CGI scripting
iii. Creation and maintenance of web-sites using HTML, XML, ASP, PHP, PERL and CGI
iv. Retrieval of specific information from web-sites using CGI scripts.

Suggested Readings

Moorhouse M & Barry P. 2004. *Bioinformatics, Biocomputing and Perl: An Introduction to Bioinformatics*. John Wiley & Sons.
Tisdall JD. 2001. *Beginning Perl for Bioinformatics*. O'Reilly.

BIF 515 BIOLOGICAL DATABANKS & DATA MINING 1+2

Objective

To understand the biological databases – types and formats and to learn the retrieval, deposition and analysis of sequences and structures from biological databanks.

Theory

UNIT I

Data warehousing, data capture, data analysis; Introduction to Nucleic Acid and Protein Data Banks; Nucleic acid sequence data banks: Genbank, EMBL nucleotide sequence data bank.

UNIT II

AIDS Virus sequence data bank, rRNA data bank, Protein sequence data banks: NBRF-PIR, SWISSPROT, Signal peptide data bank; Database Similarity Searches.

UNIT III

BLAST, FASTA, PSI-BLAST algorithms; Pair wise sequence alignment - NEEDLEMAN and Wunsch, Smith Waterman algorithms; Multiple sequence alignments - CLUSTAL, Patterns, motifs and Profiles in sequences.

UNIT IV

Derivation and searching; Derived Databases of patterns, motifs and profiles: Prosite, Blocks, Prints-S, Pfam, etc.; Primer Design.

Practical

i. Gene Information Resources
ii. Protein Information Resources
iii. Structural Databases
iv. Sequence Analysis and Database Similarity Search Tools: BLAST, PHI-BLAST, PSI-BLAST, FASTA, EMBOSS, CLUSTAL, TCOFFEE
v. Use of similarity, homology and alignment tools.

Suggested Readings

Letovsky S. (Ed).1999. *Bioinformatics: Databases and Systems*. Kluwer.

LeÛn D & Markel S. 2003. *Sequence Analysis in a Nutshell: A Guide to Common Tools and Databases*. O'Reilly.

NCBI(www.ncbi.nlm.nih.gov).

PUBMED (www.pubmedcentral.nih.gov) and database web-sites.

BIF 516 MOLECULAR MODELLING AND DRUG DESIGN 2+2

Objective

To understand the Modelling of small molecules; to understand the computational chemistry principles and to familiarize the role of computers in drug-discovery process.

Theory

UNIT I

Concepts of Molecular Modelling, Molecular structure and internal energy, Application of molecular graphics,

UNIT II

Energy minimization of small molecules, Use of Force Fields and MM methods, Local and global energy minima. Techniques in MD and Monte Carlo. Simulation for conformational analysis, *Ab initio*, DFT and semi-empirical methods.

UNIT III

Design of ligands, Drug-receptor interactions, Classical SAR/QSAR, Docking of Molecules;

UNIT IV

Role of computers in chemical research; Structure representation, SMILES; Chemical Databases, 2D and 3D structures, reaction databases, search techniques, similarity searches; Chemoinformatics tools for drug discovery.

Practical

i. Modelling Tools: MODELLER, Geno3D
ii. Docking Tools: Chimera, Dock, MOE, AutoDock Tools, GRAMM, Hex, ArgusLab;
iii. 3D-Structure Optimization Tools: CHEMSKETCH, CHEM 3D, ISIS Draw, CHEMDRAW

Suggested Readings

Bunin BA. 2006. *Chemoinformatics: Theory, Practice and Products*. Springer.

Gasteiger J & Engel T. 2003. *Chemoinformatics: A Textbook*. Wiley-VCH.

Hinchliffe A. 2003. *Molecular Modelling for Beginners*. John Wiley & Sons.

Leach AR. 1996. *Molecular Modelling: Principles and Applications*. Longman.

BIF 517 COMPARATIVE AND FUNCTIONAL GENOMICS 2+1

Objective

To understand the genomic and proteomic concepts and to learn the usage of various algorithms and programmes in analysis of genomic and proteomic data.

Theory

UNIT I

A brief account of recombinant DNA technology, PCR and molecular marker techniques. *Genomics* - Whole genome analysis, Comparative and functional genomics,

UNIT II

Pathway analysis, Repeat analysis, Human genetic disorders, Candidate gene identification, Linkage analysis, Genotyping analysis.

UNIT III

Concepts of Pharmacogenomics *Proteomics* - Introduction to basic Proteomics technology, Bio-informatics in Proteomics, Gene to Protein Function: a Roundtrip,

UNIT IV

Analysis of Proteomes, Analysis of 2-D gels, Protein to Disease and *vice versa*, Human Genome and science after Genome era. SAGE.

Practical

i. Gene Prediction Tools: GENSCAN, GRAIL, FGENESH
ii. NCBI Genomic Resources
iii. Proteomics Tools: EXPASY, CDART

Suggested Readings

Azuaje F & Dopazo J. 2005. *Data Analysis and Visualization in Genomics and Proteomics*. John Wiley & Sons.

Jollès P & Jörnvall H. 2000. *Proteomics in Functional Genomics: Protein Structure Analysis*. Birkhäuser.

BIF 518 PHARMACOGENOMICS & IPR 2+1

Objective

To understand the translation of Bioinformatics into commercial gains; to familiarize the concepts of microarray – data acquisition and analysis and

learn the IPR issues in Biological sciences with special emphasis on bioinformatics.

Theory

UNIT I

Bioinformatics companies, Genomes, transcriptomes and proteomes – their applications in medicine and agriculture, disease monitoring, profile for therapeutic molecular targeting.

UNIT II

Diagnostic drug discovery and genomics. Pharmacogenomics and its application. SNPs and their applications. Microarray and genome wide expression analysis: Introduction to basic microarray technology, Bioinformatics in microarrays, Getting started – target selection.

UNIT III

Customised microarray design, Image processing and quantification, Normalization and filtering, Exploratory statistical analysis, Public Microarray data resources.

UNIT IV

Patenting and data generation from patent literature for commercial benefits. IPR, and bioinformatics. Bioinformatics patents.

Practical

i. Microarray Analysis Tools: MAGICTool
ii. Stanford Microarray Database
iii. Gene Expression Omnibus
iv. Creation of an On-line company.

Suggested Readings

Blalock EM. 2003. *A Beginner's Guide to Microarrays*. Springer.

Catania M. 2006. *An A-Z Guide to Pharmacogenomics*. American Association for Clinical Chemistry.

Chakraborty C & Bhattachary A. 2005. *Pharmacogenomics.* Biotech Books.

Stekel D. 2003. *Microarray Bioinformatics*. Cambridge University Press.

BIOINFORMATICS

List of Journals

- Bioinformatics - Oxford University Press
- BMC Bioinformatics - BioMed Central
- Briefings in Bioinformatics - Oxford University Press
- Briefings in Functional Genomics and Proteomics - Oxford University Press
- Computers in Biology and Medicine – Elsevier
- Journal of Bioinformatics and Computational Biology (JBCB) – World Scientific Publishers
- Journal of Biomedical Informatics – Elsevier
- Journal of Computational Biology - Mary Ann Liebert, Inc. publishers
- Journal of Molecular Modelling – Springer
- Nucleic Acids Research – Oxford Press
- Protein Engineering, Design and Selection *(PEDS)* – Oxford Press

e-Resources

- Bioinformatics.Org: The Open-Access Institute - http://bioinformatics.org/
- European Molecular Biology Network - http://www.embnet.org/
- European Bioinformatics Institute -http://www.ebi.ac.uk/
- The European Molecular Biology Laboratory - http://www.embl.org/
- International Society for Computational Biology - http://www.iscb.org/
- National Center for Biotechnology Information - http://www.ncbi.nlm.nih.gov/
- ExPASy Proteomics Server - http://us.expasy.org/
- Mouse Genome Informatics - http://www.informatics.jax.org/
- Center for Molecular Modeling - http://cmm.info.nih.gov/modeling/
- RCSB PDB - http://www.rcsb.org/pdb
- Bioinformatics resources - http://www.biochem.ucl.ac.uk/bsm/BCSB/bioinfo_resources/bioinform_res.htm
- South African National Bioinformatics Institute - http://www.sanbi.ac.za/
- Swiss Institute of Bioinformatics - http://www.isb-sib.ch/
- Protein Structure Prediction Center - http://predictioncenter.llnl.gov/
- Programs for Genomic Applications -http://www.nhlbi.nih.gov/resources/pga/
- Computational Molecular Biology At NIH - http://molbio.info.nih.gov/molbio/
- Gene Ontology Home - http://www.geneontology.org/
- All About The Human Genome Project (HGP) - http://www.genome.gov/
- UCSC Genome Browser - http://genome.ucsc.edu/

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.;

commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills **-** Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

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 503 (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 bio-diversity 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 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

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 505 (e-Course) AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

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 506 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

pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

Annexure

BSMA Committee on Biotechnology & Bioinformatics

(Plant Biotechnology/Animal Biotechnology/Bioinformatics)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR

dated January 14, 2008)

Name	Address	Specialization
Dr. H.S. Nainawatee Ex. ADG (Edu) ICAR **Convener**	Ex. ADG(Edu), ICAR, New Delhi	Plant Biotech
Dr. P. Anand Kumar Project Director	NRC Plant Biotechnology, IARI, New Delhi	Plant Biotech
Dr. H.S. Chawla Professor	Department of Plant Breeding, GBPUAT, Pantnagar	Plant Biotech
Dr. R.G. Saini Retired Professor	Dept. Biotech., Genetics & Plant Breeding, PAU, Ludhiana	Plant Biotech
Dr. D.R. Sharma Director of Research	Dr. Y.S. Parmar University of Horticulture & Forestry, Solan	Plant Biotech
Dr. K. Kumanan Professor & Head	Department of Animal Biotechnology, TANUVASU, Chennai	Animal Biotechnology
Dr. Sudhir Kumar Associate Professor	Bioinformatics Section, CCS HAU, Hisar	Bioinformatics
Dr. Anant Rai Head	Division of Animal Biotech. IVRI, Izatnagar	Animal Biotechnology
Dr. Gaya Prasad Professor **Member Secretary**	Dept. Animal Biotech. CCS HAU, Hisar	Animal Biotechnology