

CURRICULUM
OF
DOCTOR OF VETERINARY MEDICINE
(DVM)

(Revised 2014)



HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

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PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic programme are required to undergo. It includes objectives & learning outcomes, course contents, scheme of studies, teaching methodologies and methods of assessment of learning. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

University Grants Commission (UGC) was designated as the competent authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled “Supervision of Curricula and Textbooks and Maintenance of Standard of Education”. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

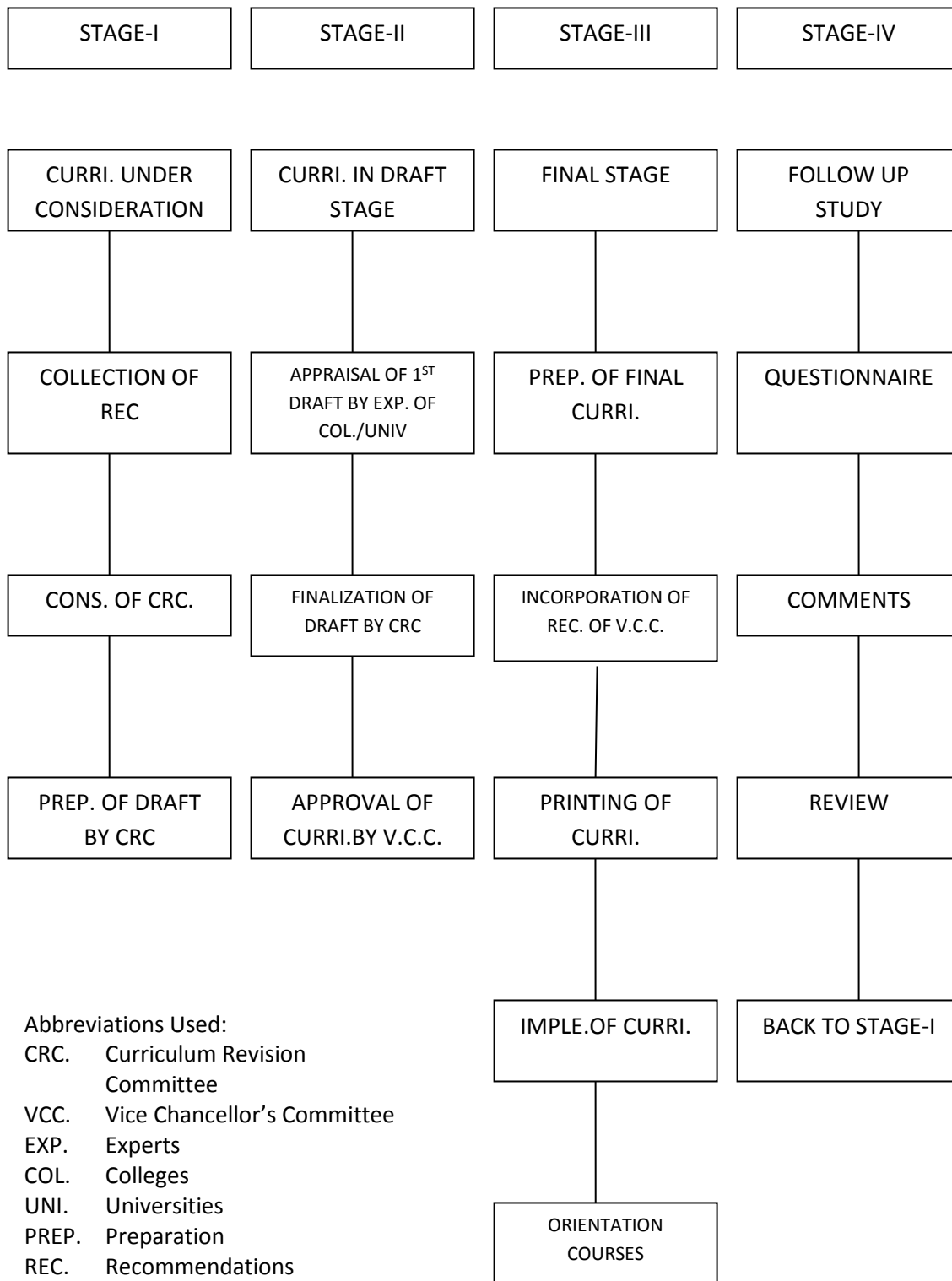
In compliance with the above provisions, the Curriculum Division of HEC undertakes the revision of curricula after every three years through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society by seeking nominations from their organizations.

In order to impart quality education which is at par with international standards, HEC NCRCs have developed unified templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering in 2007 and 2009.

It is hoped that this curriculum document, prepared by the respective NCRC’s, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC (www.hec.gov.pk).

(Fida Hussain)
Director General (Academics)

CURRICULUM DEVELOPMENT PROCESS



INTRODUCTION:

The first meeting of the NCRC in Doctor of Veterinary Medicine was held at Regional Centre Lahore on 27-29, January, 2014, the objective of the meeting was to revise the existing curriculum of DVM. Following members attended the meeting.

1. Prof. Dr. Laeeq Akbar Lodhi
Dean,
Faculty of Veterinary Science,
University of Agriculture, Faisalabad
Convener
2. Dr. Muhammad Arshad
President,
Pakistan Veterinary Medical Council,
16-Cooper Road, Lahore.
Member
3. Prof. Dr. Subhan Qureshi
Dean,
Faculty of Veterinary Science,
University of Agriculture, Peshawar.
Member
4. Dr. Abdul Jabbar Tanweer,
Associate Professor,
Principal
Gomal College of Veterinary Sciences,
D. I. Khan.
Member
5. Prof. Dr. Muhammad Sarwar Khan
Dean,
Faculty of Veterinary Science,
University of Veterinary & Animal Sciences,
Lahore
Member
6. Prof. Dr. Masood Rabbani,
Professor of Microbiology/Director,
University Diagnostic Laboratory,
University of Veterinary & Animal Sciences,
Lahore
Member
7. Prof. Dr. Khalid Javed,
Department of Animal Breeding & Genetics,
Faculty of Animal Production & Technology,
University of Veterinary & Animal Sciences,
Lahore
Member
8. Prof. Dr. Muhammad Ashraf,
Ex-Dean,
Faculty of Bio Sciences,
University of Veterinary & Animal Sciences,
Lahore.
Member

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| 9. | Prof. Dr. Zafar Iqbal Randhawa,
Chairman,
Department of Parasitology,
UAF, Faisalabad | Member |
| 10. | Prof. Dr. Iftikhar Hussain,
Director,
Institute of Microbiology,
University of Agriculture,
Faisalabad | Member |
| 11. | Col (Retd.) Muhammad Asghar Raza,
Registrar,
Pakistan Veterinary Medical Council. ,
House No. 850, St. 26, G-9/1,
Islamabad | Member |
| 12. | Prof. Dr. Ahmed Din Anjum,
Professor,
Riphah College of Veterinary Sciences,
Raiwind Road,
Lahore | Member |
| 13. | Prof. Dr. Safdar Anjum,
Dean,
Faculty of Veterinary Science,
PMAS Arid Agriculture University,
Rawalpindi | Member |
| 14. | Dr. Muhammad Ramzan,
Deputy Director,
Livestock & Dairy Development,
Government of Punjab,Lahore | Member |
| 15. | Prof. Dr. Masood Akhtar,
Dean,
Faculty of Veterinary Science,
Bahauddin Zakariya University,
Multan | Member |
| 16. | Prof. Dr. Muhammad Iqbal,
Faculty of Veterinary Medicine,
Baqai Medical University,
Gadap Road,
Karachi | Member |
| 17. | Prof. Dr. M. Razak Karar,
Dean,
Faculty of Veterinary & Animal Sciences,
Lasbela University of Agriculture, Water &
Marine Science, Uthal, Balochistan | Member |

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| 18. | Prof. Dr. Muhammad Younas,
Principal,
College of Veterinary & Animal Sciences,
Jhang | Member |
| 19. | Prof. Dr. Kamran Ashraf,
Chairman,
Department of Parasitology,
University of Veterinary & Animal Sciences,
Lahore | Member |
| 20. | Prof. Dr. Habib-ur-Rehman,
Chairman,
Faculty of Bio-Sciences,
Department of Physiology,
University of Veterinary & Animal Sciences,
Lahore | Member |
| 21. | Dr. Hafsa Zaneb,
Department of Anatomy,
University of Veterinary & Animal Sciences,
Lahore | Secretary |

MINUTES:

Pakistan Veterinary Medical Council was represented by Dr Muhammad Arshad (President PVMC). After the introductory session, HEC representation was ensured by Mr. Rizwan Shoukat (Deputy Director Curriculum).

Day 1

Session 1:

Proceedings started with recitation from the Holy Quran. The session was chaired by Mr. Fida Hussain (Director General Academics Division, HEC). He welcomed the participants and shared the scope of the meeting with them. Dr Muhammad Arshad (President PVMC) offered PVMC's perspective on the exercise of curriculum revision. It was followed by brief introduction of the participants. Keeping with the tradition, Mr. Fida Hussain offered the house to nominate the Convener and Secretary of the committee. Prof Dr Laeeq Akbar Lodhi (Dean FVS, UAF) and Dr. Hafsa Zaneb (Assistant Prof, UVAS) were nominated as Convener and Secretary of National Curriculum Revision Committee (DVM) respectively.

Mr. Fida Hussain stressed on the need of developing Learning Outcomes (LOs) for Veterinary Curriculum. He was briefed about the previously carried out trainings/workshops by Center for Educational Policy and Administration (CEPA, UVAS) for the said purpose. The house was informed that for majority of DVM courses, LOs have been developed by the faculty as a result of these trainings. Mr. Fida Hussain and Dr Muhammad Arshad appreciated the initiative and offered to sponsor a comprehensive training module for the same purpose to train the faculty of veterinary institutions across Pakistan. The

training module will be designed by Dr. Hafsa Zaneb in coordination with PVMC and HEC.

Sessions 2:

The session was chaired by Dr. Muhammad Arshad. Following points were considered before initiations of curriculum revision:

- i. As per HEC recommendations, one practical credit hour needs to consist of 3 contact hours as opposed to the current practice of 2 contact hours.
- ii. HEC puts a limit of 15-18 credit hours/semester
- iii. OIE day-1 competencies may be considered as guidelines for curriculum revision. The house then discussed the existing scheme of studies and after deliberations agreed upon a scheme of studies which will form basis of further discussions and exercise.

Session 3:

In absence of Prof Dr Laeeq A Lodhi (Convener, NCRC/Dean FVS UAF), Dr Muhammad Arshad invited Prof Dr Muhammad Sarwar (Dean FVS, UVAS) to chair the second session. The course contents of the first 4 semesters were briefly discussed and it was agreed upon that the contents and sequence of the courses will be finalized following the guidelines of OIE while considering the local needs. Prof Dr Subhan Qureshi (Dean Faculty of Animal Husbandry and VS, UAP) and Prof Dr Abdul Raziq Kakar (Dean FV&AS Lasbela University) made some recommendations regarding internship program and offered to develop a proposal and present it next morning.

2ND DAY:

Session 1:

The session began with a welcome note by Prof Dr Laeeq A Lodhi (Convener) whereby he appreciated the inputs provided by the committee members in the previous sessions. Prof Dr Subhan Qureshi and Prof Dr Abdul Raziq Kakar presented their internship proposal following which the house was opened for discussion. Following points were noted by committee members regarding the structure and modalities of DVM internship program:

- i. Regarding enlisting of institutions and organizations for internship, a degree of flexibility is required as different universities have unique circumstances.
- ii. Government livestock farms will be enlisted for the purpose.
- iii. For private farms, the decision lies with the universities to see if the farms are good enough to offer useful experience to their students. It was suggested that farms with more than 500 animals may be enlisted.
- iv. Respective department / institute will be solely responsible for the decisions regarding student placement with intimation to PVMC for information.
- v. Individuals / organizations need to have a limit for number of students accepted / year.
- vi. Durations of internship will be one (01) semester. Students can spend this time at one or more places depending upon the available facilities and circumstances.

- vii. Courses will be retained in the last (10th) semester to comply with the HEC policy. Alternatively 10 credit hours can be assigned to internship to fulfill this requirement.
- viii. Universities will allow exchange of internship students from other accredited institutions.
- ix. Logistical expenses related to internship will need to be borne by the student or employer. The committee can request HEC for its funding but in principal it should be left with Universities.
- x. Each faculty / college will constitute monitoring teams and intimate PVMC and HEC about the process.

Session 2 & 3:

The session began with discussion pertaining to layout of contents in the to-be-proposed courses. It was suggested that detailed contents may be included in annexure while saving only 5-6 lines for the main document. It was also suggested that while it is mandatory to retain compulsory courses as per HEC policy, their content may be re-vamped to make them more relevant to the program.

Prof Dr Talat Naseer Pasha (VC, UVAS) joined the committee briefly. He shared his views on the future direction of the Veterinary Profession and urged the committee to consider recent developments in international trade and food safety practices while revising the curriculum. Prof Dr Laeeq A Lodhi thanked Prof Dr Talat Naseer Pasha for sparing his time and for his observations.

Rationalization of credit hours allocated to courses of different disciplines was carried out according to the consensus achieved on the last day. Practical credit hours were adjusted to 3 contact hour scheme. Resulting document is attached as Annexure II. (This document is likely to be modified following the meetings with stakeholders and working of different subject committees).

Day 3:

Outcome of Day-3 proceedings was as follows:

1. Courses were organized department-wise and contribution of various departments towards scheme of study of DVM was reviewed. Existing credit hour allocation of each department (based on 1 practical credit hour = 2 contact hours) was converted into a projected credit hour allocation (based on HEC recommendations of 1 practical hour = 3 contact hours). During the process, partial rationalization of courses was done. The document is attached as Annexure II.
2. The Departments will develop new courses AND/OR edit the contents of the existing ones to adjust within the contact hours.
3. Subject Committees were constituted by the principal committee (NCRC) to assist in re-structuring/ re-naming the courses. Their details are as follows:

Anatomy & Histology:

- i. Dr Hafsa Zaneb (Assistant Professor Department of Anatomy & Histology UVAS) Convener
- ii. Prof Dr Ans Sarwar Qureshi (Chairman Department of Anatomy & Histology UAF)
- iii. Dr Saima Masood (Assistant Professor Department of Anatomy & Histology UVAS)

Physiology & Biochemistry:

- i. Prof Dr Habib ur Rehman (Chairman, Department of Physiology UVAS) - Convener
- ii. Dr Tanvir Khaliq (Associate Professor, Department of Physiology & Pharmacology UAF)
- iii. Dr Maqsood Sindhu

Pharmacology:

- i. Prof Dr Muhammad Ashraf (Chairman Department of Pharmacology and Toxicology UVAS) - Convener
- ii. Dr Muhammad Ovais Omer (Associate Professor, Department of Pharmacology and Toxicology UVAS)
- iii. Dr Muhammad Junaid (Assistant Professor, Department of Physiology & Pharmacology UAF)

Pathology:

- i. Prof. Dr. Ahrar Khan (Chairman, Department of Pathology UAF) - Convener
- ii. Prof. Dr. M. Zargham Khan (Department of Pathology UAF)
- iii. Dr Asim Aslam (Chairman Department of Pathology UVAS)

Parasitology:

- i. Prof Dr Zafar Iqbal Randhawa (Chairman Department of Parasitology UAF) – Convener
- ii. Dr. Masood Akhter (Dean Faculty of Veterinary Science BZU)
- iii. Prof Dr AG Arijo (Department of Veterinary Parasitology, SAU)
- iv. Dr Imran Rashid (Assistant Professor Department of Parasitology UVAS)

Microbiology:

- i. Prof Dr Iftikhar Hussain (Director, Institute of Microbiology UAF) - Convener
- ii. Prof Dr Khushi Muhammad (Chairman Department of Microbiology, UVAS)
- iii. Prof Dr Masood Rabbani (Department of Microbiology UVAS/Director UDL)
- iv. Dr Jawad Nazir (Assistant Professor Department of Microbiology UVAS)

Epidemiology:

- i. Prof Dr Mansur ud Din (Chairman Department of Epidemiology and

- Public Health UVAS) – Convener
- ii. Prof. Dr. Ghulam Muhammad (Chairman Department of CMS UAF)
- iii. Dr Hassan Mushtaq (Assist Prof Department of Epidemiology and Public Health UVAS)
- iv. Dr. M. Shahid Mehmood (Associate Professor, Institute of Microbiology UAF)

Medicine:

- i. Prof Dr Ghulam Muhammad (Chairman Department of CMS UAF) – Convener
- ii. Dr Aneela Zameer Durrani (Chairperson Department of CMS UVAS)
- iii. Dr Abdul Latif Bhutto (Assist Prof Department of Veterinary Medicine SAU)
- iv. Dr Muhammad Avais (Assistant Prof Department of CMS UVAS)

Surgery:

- i. Prof Dr Muhammad Arif Khan (Department of CMS UVAS) – Convener
- ii. Dr Abdul Asim Farooq (Assist Prof Department of Clinical Sciences BZU)
- iii. Dr Nadeem Asi (Lecturer Department of CMS UAF)
- iv. Dr Arfan Yousaf (Associate Professor Department of Clinical Sciences PMAS AAU)

Theriogenology:

- i. Prof Dr Nasim Ahmad (Department of Theriogenology UVAS) – Convener
- ii. Prof Dr Subhan Qureshi (Dean Faculty of Animal Husbandry and Veterinary Science UAP)
- iii. Dr Amjad Riaz (Assistant Prof Department of Theriogenology UVAS)

Livestock Production / ABG:

- i. Prof Dr Khalid Javed (Chairman Department of Livestock Production UVAS) – Convener
- ii. Prof Dr Abdul Raziq Kakar (Dean Faculty of Veterinary and Animal Science LUAWMS)
- iii. Dr Qamar Shahid (Assistant Prof Department of Livestock Production UVAS)

Poultry Production:

- i. Dr A.D. Anjum (Riphah College of Veterinary Sciences) - Convener
- ii. Prof Dr Safdar Anjum (Dean Faculty of Veterinary and Animal Science PMAS AAU)
- iii. Prof Dr Muhammad Akram (Chairman Department of Poultry Production UVAS)
- iv. Dr Abdul Jabbar (Assistant Professor, Gomal College of Veterinary Sciences GU)

Animal Nutrition:

- i. Prof (Retd) Dr Makhdoom Abdul Jabbar (Member, PARB) – Convener
- ii. Prof Dr Mirza Aslam (Director, Institute of Animal Nutrition and Feed Technology UAF)

- iii. Dr Tanvir Ahmad (Associate Prof Department of Livestock Production and Management PMAS AAU)
- iv. Dr Muhammad Afzal (Assistant Prof Department of Animal Nutrition UVAS)

Allied Courses:

- i. Prof Dr Masood Rabbani (Director UDL UVAS) - Convener
- ii. Prof Dr Zafar Iqbal Randhawa (Chairman Dep of Parasitology UAF)
- iii. Dr Muhammad Arshad (Asstt Prof Dept of Wildlife and Ecology UVAS)
- iv. Dr Noor Khan (Assist Prof Dept of Fisheries and Aquaculture UVAS)
- v. Dr Hafiz Hussain Azhar (Assistant Prof Dept of Social Sciences UVAS)
- vi. Mr Muhammad Iqbal (Assistant Prof ICE&E UVAS)

The Conveners of the committees can opt more members if they feel the need to do so.

1. The subject committees will be sent a copy of OIE recommendations to be considered while finalizing courses at subject committee level.
2. Every course will be preceded by its objectives and intended learning outcomes (ILOs). Courses thereby will be structured accordingly. The committee would like to have the split schedule of each lecture/practical indicating the contents to be covered.
3. The subject committee will look into the matter of duplication of course contents.
4. Number of courses offered by one department will be limited to a maximum of 3-4 (except for the clinical departments) courses so that the students are not over-burdened with a large number of courses/semester. Also, courses with 01 credit hours will be discouraged and departments will be expected to merge the contents of such a course into another relevant course.
5. Relevant subject committees will develop elective courses of up to 8 credits each in the following areas to give a specialized status to graduates. These courses will be evaluated on Pass/Fail or Satisfactory/Non Satisfactory basis, will be in addition to core courses and will be offered during summer.
 - i. Bovine Herd Health, Preventive Medicine and Equine Medicine.
Companion Animal Medicine & Surgery.
 - ii. Poultry Production and Diagnostics.
 - iii. Artificial Insemination & Reproductive Herd Health.
 - iv. Dairy Animal Management/Husbandry.

In every semester, 01 credit course specific to Animal Contact / Behavior will be taught. Meeting with the stakeholders will be held before finalizing the first draft. Their recommendations will be incorporated in existing courses or in new courses to be designed specifically for this purpose. Conveners of all the Subject Committees will be invited in these meetings for ensuring

effectiveness of the exercise (In case of unavailability, the Convener may request any other members of the committee for representation). Meetings can be organized at different locations to ensure maximum participation of major stakeholders.

Following stakeholders were identified initially:

- i) Poultry Sector: Prof. (Retd) Dr. A.D. Anjum and Prof. Dr. M. Akram (Chairman, Department of Poultry Production, UVAS) will be requested to arrange input from industry individually or as a team and present joint recommendations.
- ii) Meat Sector: Prof. Dr. Khalid Javed (Chairman, Department of Livestock Production UVAS) and Dr. Hayat Jaspal (Assistant Professor, Department of Meat and Fiber Technology UVAS) will be requested to arrange input from industry.
- iii) Dairy Sector: Prof. Dr. Khalid Javed (Chairman, Department of Livestock Production UVAS) will be requested to arrange input from industry.
- iv) Government Sector: Prof. Dr. Zafar Iqbal Randhawa (Chairman, Department of Parasitology UAF) will be requested to arrange input from the Government Sector.

Additionally, various veterinary institutes are encouraged to identify more stake holders, hold meetings with them separately if they are remotely located and submit the recommendations to the relevant focal persons by 20th February, 2014.

11. Subject committees can make 15-20% reduction in credit hours themselves. Alternatively, the NCRC allowed the Convener and Secretary to make suitable reduction / addition when and where required.
12. In addition to review of DVM scheme of studies, subject committees will also carry out the review process of postgraduate courses in their respective disciplines and submit report together with DVM scheme.
13. Exercise of curriculum revision will be completed in coordination with HEC.
14. The committee will communicate with HEC to achieve an understanding regarding number of contact hours allocated to One (01) Practical Credit Hour. In existing DVM courses, One (01) Practical Credit Hour is equal to Two (02) Contact Hours, whereas HEC recommends One (01) Practical Hour to be equal to Three (03) Contact Hours.
15. Committee also argued that requirement of successful completion of pre-requisite courses will be imposed at suitable intervals e.g. unless students successfully complete courses of 2nd semester they will not get admission in 3rd semester.

The meeting concluded with a vote of thanks by Prof Dr Laeeq A Lodhi (Convener NCRC).

MINUTES OF THE FINAL MEETING:

The final NCRC meeting was held on 15-17 September, 2014 in HEC Regional Centre, Lahore. It was convened by Prof. Dr. M. Sarwar Khan, who was Dean FVS, UVAS at that time. In addition to the members who attended the first meeting, a few members from Sindh (Dr. M. M. Aziz, Dr. Nazir Kolhoro, Dr. Toufiq A. Qureshi) also attended the meeting.

- | | | |
|----|---|----------|
| 1. | Prof. Dr. Muhammad Sarwar Khan
Dean,
Faculty of Veterinary Science,
University of Veterinary & Animal Sciences,
Lahore | Convener |
| 2. | Dr. Muhammad Arshad
President,
Pakistan Veterinary Medical Council,
16-Cooper Road, Lahore. | Member |
| 3. | Prof. Dr. Maqbool A. Memon
Dean,
Faculty of Veterinary & Animal Sciences,
Sindh Agriculture University,
Tandojam | Member |
| 4. | Prof. Dr. Noor Muhammad Soomro
Department of Pathology,
Sindh Agriculture University,
Tandojam | Member |
| 5. | Dr. Akbar Ali Soomro
Director General,
Livestock & Dairy Development,
Hyderabad | Member |
| 6. | Prof. Dr. Ghulam Hussain Jaffar,
Director,
Livestock & Dairy Development
Brewery Road, Government of Balochistan,
Quetta | Member |
| 7. | Dr. Abdul Jabbar Tanweer,
Associate Professor,
Principal
Gomal College of Veterinary Sciences,
D. I. Khan | Member |
| 8. | Prof. Dr. Masood Rabbani,
Professor of Microbiology/Director UDL
University of Veterinary & Animal Sciences,
Lahore | Member |
| 9. | Prof. Dr. Khalid Javed,
Department of Animal Breeding & Genetics,
Faculty of Animal Production & Technology,
University of Veterinary & Animal Sciences, | Member |

- Lahore.
10. Prof. Dr. Muhammad Ashraf, Member
Ex-Dean,
Faculty of Bio Sciences,
University of Veterinary & Animal Sciences,
Lahore.
 11. Prof. Dr. Zafar Iqbal Randhawa, Member
Chairman,
Department of Parasitology,
UAF, Faisalabad.
 12. Prof. Dr. Iftikhar Hussain, Member
Director,
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Lahore.
 15. Prof. Dr. Safdar Anjum, Member
Dean,
Faculty of Veterinary Sciences,
PMAS Arid Agriculture University,
Rawalpindi.
 16. Prof. Dr. Makhdoom Abdul Jabbar (Retd), Member
University of Veterinary & Animal Sciences,
Lahore.
 17. Dr. Muhammad Ramzan, Member
Deputy Director,
Livestock & Dairy Development,
Government of Punjab,Lahore.
 18. Prof. Dr. Masood Akhtar, Member
Dean,
Faculty of Veterinary Sciences,
Bahauddin Zakariya University,Multan.
 19. Prof. Dr. Muhammad Iqbal, Member
Professor,
Faculty of Veterinary Medicine,

- Baqai Medical University,
Gadap Road,
Karachi.
20. Dr. M. Razak Karar, Member
Dean / Professor,
Faculty of Veterinary & Animal Science,
Lasbela University of Agriculture, Water &
Marine Science, Uthal, Balochistan.
 21. Prof. Dr. Muhammad Younas, Member
Principal,
College of Veterinary & Animal Sciences,
Jhang.
 22. Prof. Dr. Kamran Ashraf, Member
Chairman,
Department of Parasitology,
University of Veterinary & Animal Sciences,
Lahore.
 23. Dr. Nazir Hussain Kalhoro, Member
Executive Director SPVC
Livestock and Fisheries Department.
Govt. of Sindh, Karachi
 24. Dr. Musadiq Asif, Member
Director,
National Group of Companies,
Shadman-2, Lahore.
 25. Prof. Dr. Tofique Ahmed Qureshi, Member
Chairman,
Department of Veterinary Pharmacology,
Sindh Agriculture University,
Tandojam.
 26. Dr. Hafsa Zaneb, Secretary
Department of Anatomy,
University of Veterinary & Animal Sciences,
Lahore.

Draft curriculum was presented as agenda of the meeting. This draft was prepared during an exercise organized by Pakistan Veterinary Medical Council and held at UVAS on 4-5th September, 2014.

During the two day exercise, courses were discussed discipline-wise for timeliness, relevance with program objectives, coherence, structure and technical soundness in various sessions. Once the courses and their contents were agreed upon, their arrangement in different semesters was confirmed.

The committee also discussed the merits of offering specialized tracks to DVM students as suggested in the first NCRC meeting. It was suggested to take up this agenda as well as that of module-based curriculum, problem-based and case-based learning in the next curriculum exercise.

There were reservations of members regarding adoption of 3-contact hours for 01 practical credit hour. By the end of the meeting it was agreed that HEC will be approached by PVMC and NCRC once again to resolve this issue.

Dr Muhammad Arshad joined the concluding session and congratulated the members of NCRC for drafting the curriculum and assured of his support for future activities related to curriculum development and related matters.

SCHEME OF STUDIES

Sr No	COURSE NO	COURSE TITLE	CREDIT HOURS	
SEMESTER ONE				
1	ANAT	Veterinary Anatomy –I	3 (1-2)	
2	ANAT	General Veterinary Histology	2 (1-1)	
3	PHYS	Veterinary Physiology-I	3(2-1)	
4	BIOC	Biochemistry	4(3-1)	
5	MATH	Mathematics	2 (2-0)	
6	ENGL	English- I (Functional English)	2 (2-0)	
		TOTAL	16(11-5)	
			26	
SEMESTER TWO				
1	ANAT	Veterinary Anatomy– II	3 (1-2)	
2	ANAT	Systemic Veterinary Histology and Embryology	3 (2-1)	
3	PHYS	Veterinary Physiology-II	4(3-1)	
4	ENGL	English- II (Communication Skills)	2(2-0)	
5	MICR	General Veterinary Microbiology	3(2-1)	
6	PPRO	Introduction to Poultry Production	1(1-0)	
7	LPRO	Fundamentals of Livestock Production	2(1-1)	
8	SOSC	Pakistan Studies	1(1-0)	
		TOTAL	19(13-6)	
			31	
SEMESTER THREE				
1	NUTR	Principles of Animal Nutrition	3(2-1)	
2	PHRM	General and Systemic Pharmacology	4(3-1)	
3	PATH	General Veterinary Pathology	3(2-1)	
4	PARA	General Veterinary Parasitology and Protozoology	3(2–1)	
5	MICR	Veterinary Immunology	2(1-1)	
6	SOSC	Anthropology	1 (1-0)	
7	BIOL	Molecular Biology	2(1-1)	
8	ZOOL	Lab and Zoo Animal Management	1 (0-1)	
		TOTAL	19(12-7)	
			33	

SEMESTER FOUR				
1	NUTR	Livestock Feed Resources and Forage Conservation	3(2-1)	
2	PHRM	Veterinary Chemotherapy and Toxicology	4(3-1)	
3	MICR	Veterinary Bacteriology and Mycology	3(2-1)	
4	PATH	Systemic Veterinary Pathology	3(2-1)	
5	PARA	Veterinary Helminthology	4(3-1)	
6	EXT	Livestock Extension Education	2 (2-0)	
7	LPRO	Animal Breeding and Genetics – I	2(1-1)	
		TOTAL	21(15-6) 33	
SEMESTER FIVE				
1	NUTR	Poultry Nutrition and Feed Technology	2(1-1)	
2	LPRO	Animal Breeding and Genetics – II	3(2-1)	
3	PATH	Veterinary Clinical Pathology	1(0-1)	
4	PARA	Veterinary Entomology and Acarology	3(2-1)	
5	MICR	Veterinary Virology	3(2-1)	
6	THER	Veterinary Reproductive Physiology	3 (2-1)	
7	MEDI	General and Systemic Veterinary Medicine	3(2-1)	
8	SOSC	Islamic Studies/ Ethics	1(1-0)	
		TOTAL	19(12-7) 33	
SEMESTER SIX				
1	EPID	Zoonoses and Food Safety	3 (2-1)	
2	LPRO	Principles of Dairy Production	3(2-1)	
3	THER	Reproductive Biotechnology	2 (2-0)	
4	MEDI	Veterinary Preventive Medicine-I	3(3-0)	
5	PATH/A PTC	Meat Inspection and Necropsy Practice	3(2-1)	
6	SURG	Diagnostic Imaging	2(1-1)	
7	MEDI	Medicine Clinic-I	1(0-1)	
8	SURG	Surgery Clinic – I	1(0-1)	
9	THER	Theriogenology Clinic – I	1 (0-1)	
		TOTAL	19(12-7) 33	

SEMESTER SEVEN				
1	LPRO	Beef and Mutton Production	2(1-1)	
2	MEDI	Veterinary Preventive Medicine-II	3(3-0)	
3	SURG	Anaesthesiology and Intensive Care	1(0-1)	
4	THER	Obstetrics and Genital Diseases	3 (2-1)	
5	PPRO	Commercial Poultry Production	2(1-1)	
6	STAT	Bio-statistics	3(2-1)	
7	MEDI	Medicine Clinic-II	1(0-1)	
8	SURG	Surgery Clinic – II	1(0-1)	
9	THER	Theriogenology Clinic – II	1 (0-1)	
		TOTAL	17(9-8)	
			33	
SEMESTER EIGHT				
1	PPRO	Breeder and Hatchery Management	3(2-1)	
2	EPID	Veterinary Epidemiology and Public Health	3(2-1)	
3	SURG	Small Animal Surgery	4(3-1)	
	AQUA	Fisheries and Aquaculture	1 (0-1)	
4	MEDI	Medicine Clinic III	2(0-2)	
5	SURG	Surgery Clinic III	2(0-2)	
6	THER	Theriogenology Clinic III	2 (0-2)	
		TOTAL	17(7-10)	
			37	
SEMESTER NINE				
1	LPRO	Animal Welfare and Ethics	2 (2-0)	
2	DTECH	Dairy Technology	2 (1-1)	
3	PATH	Poultry Pathology	3(2-1)	
4	SURG	Large Animal Surgery and Shoeing	3(2-1)	
5	MEDI	Medicine Clinic-IV	2(0-2)	
6	SURG	Surgery Clinic – IV	2(0-2)	
7	THER	Theriogenology Clinic – IV	2 (0-2)	
		TOTAL	16(7-9)	
			34	

SEMESTER TEN				
1	ENGL	English- III (Technical Report Writing and Presentation)	2 (2-0)	
2	LEBM	Livestock Economics and Business Management	2(2-0)	
		INTERNSHIP		
		TOTAL	4 (4-0)	
		GRAND TOTAL	167(102-65) 297	

Note: Institutions can add upto 15 credit hour courses to match their circumstances and strengths.

DETAIL OF COURSES SEMESTER I

VETERINARY ANATOMY- I 3(1-2)

Learning Outcomes:

At the end of the course, students will be able to:

1. Define and describe directional terms and bone surface modifications
2. Describe structure and relationship of bones, joints, muscles, nerves and blood vessels of forelimb and hindlimb (Practical only).
3. Describe structure of components of common integument, lymphatic and nervous system.
4. Indicate topographical location of skeletal and associated soft structures on live animals (Practical only).

Theory:

Introduction to anatomy; definitions and branches, body points; general body points of horse, ox and dog, anatomical terminology;directional terms, planes, bone surface modifications, Osteology; structure of bone, classes of bones and comparative aspects, myology; types, structure, naming conventions of muscles and associated structures, and comparative aspects, arthrology; structural and functional classification of joints, structure of synovial joints, gait mechanics; statics and dynamics, types of natural gaits and comparative aspects, integumentary system; Skin and its modifications, mammary apparatus, hoof, claw, digital pads, horn & hair,lymphatic system; lymph centers, lymph nodes and lymphatic channels, CNS; brain and spinal cord, PNS; ganglia, nerves, autonomic nervous system, special senses; ear and eye.

Practical:

Introduction to anatomy, branches of anatomy, terminology, anatomical planes and directional terms, comparative anatomy of forelimb region (equine, ruminant, canine): osteology of forelimb, arthrology of forelimb, myology of

shoulder, brachium, antebrachium and digital regions; blood vessels of the forelimb, their scheme and identification; nerves of the forelimb, their scheme and identification, comparative anatomy of hind limb region (equine, ruminant, canine): osteology of hind limb, arthrology of forelimb, myology: myology of croup, thigh and leg regions; blood vessels of the hind limb, their scheme and identification; nerves of the hind limb, their scheme and identification, anatomy of equine distal limb, comparative anatomy of skull (equine, ruminant, canine), brain and spinal cord, udder, hoof & horn, topography/surface anatomy of forelimb and hind limb regions.

Textbook:

1. Koenig, H. E. and H.G. Liebich, 2009. Veterinary Anatomy of Domestic Animals, Textbook and Colour Atlas, Schattauer, Germany.

RecommendedBooks:

1. Pasquini, C.,T. Spurgeon and S. Pasquini, 2007. Anatomy of Domestic Animals –Systemic and Regional Approach, Soudz, USA.
2. Getty, R.,S.Sisson and J.D. Grossman, 1986. The Anatomy of the Domestic Animals.W.B.Saunders Co., Philadelphia, U.S.A.
3. Miller, M.E., 2000. Guide to the Dissection of the Dog. Edwards Brothers, Ithaca, New York, U.S.A.
4. Philips, G.D., 1988. Guide to Ruminant Anatomy Based on the Dissection of the Goat. Iowa State University Press, Ames, U.S.A.
5. Haward, E. and D. Alexander, 2000. Guide to the Dissection of the Dog. W.B.Saunders Co., U.S.A.

GENERAL VETERINARY HISTOLOGY

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe the light and ultra-structure of cell.
2. Describe and identify the microscopic features of four basic tissues; epithelia, connective and supportive tissues, muscular tissue, nervous tissue.

Theory:

Ultrastructure of cell, epithelial tissue: morphology and classification of types of surface epithelia and glandular epithelia, connective and supportive tissue: cells and fibers of connective tissue, microscopic study of different types of supportive connective tissue, light microscopic study of avian and mammalian blood, muscular tissue: light and fine microscopic structure of skeletal, cardiac, smooth muscle fibers, nervous tissue: light and fine microscopic structure of nervous tissue cells, neuron, ganglion and nerve.

Practical:

Microscopy: different parts of microscope and practical use of microscope, slide preparation: practical demonstration of tissue processing techniques and staining procedures. identification of different cell organelles in electron micrographs, epithelium: identification of different types of surface and glandular epithelium, connective tissue: identification of different types of cells, fibers of connective tissue and different types of proper and supportive connective tissue, blood: identification of different types of blood cells, muscular tissue: identification of different tissue sections of skeletal, cardiac and smooth muscle fibers under light microscope, nervous system: identification of neuron, neuroglia, central and peripheral nervous system: brain, spinal cord and peripheral nerves.

Textbook:

1. Eurell, J. A. and B. L. Frappier, 2007. Dellmann's Textbook of Veterinary Histology, Blackwell Publishing, UK.

Recommended Books:

1. Samuelson, D.A., 2007. Textbook of Veterinary Histology, Saunders Elseviers, USA.
2. Bacha, W.J. and L.M. Bacha, 2012. Color Atlas of Veterinary Histology, 3rd Ed., Wiley Blackwell, USA.
3. Qureshi, A. S. and M.N. Chaudhry, 2007. Illustrated Vet. Histology, MAS Publishers, Faisalabad.
4. McGaedy, T.A., P.J. Quinn, E.S. Fitzpatrick, and M.T. Ryan, 2006. Veterinary Embryology, Blackwell Publishing, UK.
5. Kuehnel, W., 2003. Color Atlas of Cytology, Histology and Microscopic Anatomy, 4th Ed., Thieme Stuttgart, New York.
6. Eroschenko, V.P., 2012. diFiore's Atlas of Histology: with Functional Correlations, 12th Ed., Lippincott Williams & Wilkins, USA.

VETERINARY PHYSIOLOGY-I

3(2-1)

Learning outcomes:

At the end of the course, students will be able to:

1. Describe the basic physiological principles and techniques related to processes of adaptation, homeostasis and feedback control systems.
2. Describe the relationship of structure to function focusing cardiovascular, circulatory and respiratory systems and their regulation with reference to nervous system.
3. Describe the pathophysiology of selected disorders of cardiovascular, circulatory and respiratory systems.

Theory:

Homeostasis and Feed Back Control: Cell and cell membrane transport system, Neuron, Action potential, Synapse and synaptic transmission, Neurotransmitters, Neurophysiology of skeletal and smooth muscles, Excitation-contraction coupling mechanism, Nervous system: Central and

peripheral nervous systems, Upper and lower motor neurons, Physiology of Reflex Arc, Autonomic nervous system; Parasympathetic and sympathetic divisions, Types of receptors and their properties, Anatomical divisions of brain and functions of each part. **Cardiovascular System:** Blood composition, blood cells genesis and differentiation, Structure and synthesis of hemoglobin, its types and iron metabolism, Functions of Neutrophils, Basophils, Eosinophils, Monocyte- Macrophage system and their role against infection, Reticulo-endothelial system, Resistance of body to infection, Lymphocytes and immunity (Humoral and cell mediated immunity), Blood groups, Blood transfusion and its complications, Mechanism of blood coagulation, Fibrinolytic system, Clinical correlations (Anemia, polycythemia, allergy and hypersensitivity, jaundice, hemophilia). **Circulatory Physiology:** Circulation and its characteristics, Biophysics of hemodynamics, Circulation: General; systemic and regional circulation; Coronary, skeletal muscle, splenic, Fetal and Pulmonary Circulation, Microcirculation and fluid exchange. Blood Pressure, neural and hormonal control of blood pressure and blood volume, Local control of blood pressure and flow. Physiology of Lymphatic system channel of body, formation of lymph; Role of lymphatic system in controlling interstitial fluid protein, volume and pressure. Cardiac cell properties and energy requirements, physiological basis of cardiac cycle; Relationship to heart sounds to heart pumping, Regulation of cardiac activity. Rhythmical excitation of heart; electrophysiology of heart; Characteristics of normal electrocardiogram. Clinical correlations (edema formation, circulatory shock, electrocardiographic interpretation of cardiac muscle and coronary blood flow abnormalities). **Respiratory system:** Functional anatomy of respiratory system, Mechanism of Pulmonary ventilation, Pulmonary volume and capacities, Physical principles of gas exchange, Respiratory membrane and diffusion of different gases through it, Fetal gas exchange, Factors affecting rate of gas diffusion, Role of surfactants, Pleural cavity, Regulation of transport of Oxygen and Carbon Dioxide in blood, lungs and tissues, Neural and hormonal control of respiration. Clinical correlations (pulmonary edema, emphysema and hypertension, CO poisoning, hypoxia)

Practical:

Methods of handling and restraining of different animals for blood collection, body temperature, pulse. Sites of Blood collection in different animal species, precautions while blood collection. Blood Collection. Different type of anticoagulants used routinely and their mechanism of actions. Practical demonstration of measurement of body temperature, pulse, respiration rate in different domestic animals. Determination of Total Red Blood Cell count (animal or human source). Determination of Total White Blood Cell count (animal source). Determination of Packed Cell Volume, Haemoglobin concentration, Coagulation and bleeding time, Erythrocyte Sedimentation Rate, Differential Leukocyte Count, Blood Groups. Determination of lung capacities and volumes. Identification of reflexes in frog, Pithing and stunning of frog, Nerve muscle preparation.

Textbook:

1. Cunningham, J.G. and B. G. Klein, 2007. Textbook of Veterinary Physiology. 4th Edition. WB Saunders Company, USA.

Recommended Books:

1. Dukes, H.H., M.J. Swenson and W.O. Reece, 2004. Duke's Physiology of Domestic Animals. 12th Edition, Comstock Publishing, USA.
2. Costanzo, L., 2008. Physiology. 4th Edition, Elsevier Publishing, USA.
3. Guyton, A.C. and J.E. Hall., 2006. Textbook of Medical Physiology. 11th Edition. WB Saunders Company, USA.
4. Barrelet, K.E., S.M. Barman, S. Boitano and H.L. Brooks, 2006. Ganong's Review of Medical Physiology. 23rd Edition. Appleton & Lange, USA.

BIOCHEMISTRY

4(3-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe structure and function of essential biological molecules (e.g., proteins, lipids, carbohydrates) and metabolic & regulatory pathways.
2. Prepare solutions and buffers
3. Detect bio-molecules in various samples.

Theory:

Introduction to Biochemistry, pH & its importance, Buffer, Henderson-Hasselbalch equation, **Carbohydrates**: Introduction to carbohydrates, Classification of carbohydrates, Glycosidic linkages & Glycosides, Isomers, Optical activity & rotations, Chemical properties of monosaccharides, structure and functions of important monosaccharide, Homopolysaccharide, Heteropolysaccharides, **Proteins**: Introduction to Proteins, Classification of proteins, Structure and Classification of amino acids, Amphoteric properties of amino acids, concept of Isoelectric pH Peptide Linkage, Primary, Secondary, Tertiary and Quaternary structure of proteins, **Enzymes**; General Characteristics and classification of enzyme, Enzyme Kinetics **Lipids**: Introduction to Lipids, structure & classification of fatty acids, nomenclature of fatty acids, Physical properties of fatty acids and triglycerides, Chemical Properties of fatty acids and triglycerides, Sterols and cholesterol, Prostaglandin and their physical role, **Carbohydrate metabolism**: Glycolysis, regulation, energy production, Krebs's Cycle, regulation, energy production, Electron Transport Chain, Pentose phosphate shunt, Gluconeogenesis, **Protein metabolism**: Degradation of Proteins and amino acids, Urea cycle and its importance, urea toxicity, Regulation of urea cycle, Bioenergetics of protein metabolism, **Lipid metabolism**: Beta oxidation of even and odd chain fatty acids, Biosynthesis of fatty acids, Biosynthesis of triglycerides, Biosynthesis of Cholesterol, Biosynthesis of Ketone bodies, **DNA metabolism**: Biosynthesis and Degradation of nucleic acids, Comparative features among animal species of particular relevance, metabolism of mono-

gastric and poly-gastric animals, and comparison of metabolism of mono and poly-gastric animals.

Practical:

Preparation of solutions: Preparation of Percentage, Molar and Normal solutions, Preparation of Buffer, Carbohydrate Analysis: Group Identification Test, Identification of mono, di and polysaccharides, Identification of reducing sugars, Identification of ketose sugar and their confirmation by phenylhydrazine test, Identification scheme for carbohydrates, Estimation of glucose in blood sample by glucose oxidase method, Estimation of amino acids by spectrophotometry, Biuret Test and Ninhydrin Test, Precipitation tests of proteins: Precipitation of casein at isoelectric point, salt saturation tests, Serum protein fractionation by electrophoresis, Separation of the colour pigments of Berseem/ alfalfa by paper chromatography, Identification of lipids, Salkowski's test

Textbook:

1. Nelson, D.L. and M.M. Cox. 2013. Principles of Biochemistry, 3rd Edition, Worth Publishers. USA.

Recommended Books:

1. Boyer, R.F., 2014. Modern Experimental Biochemistry. 3rd Edition. The Benjamin / Cummings Publishing Co., USA
2. Stryer, L., 2012. Biochemistry, 7th Edition, W. H. Freeman and Co, USA.
3. Nigam, A. and A. Ayyagari, 2007. Lab Manual in Biochemistry, Immunology and Biotechnology, Tata McGraw-Hill Publ. Co. Ltd., New Delhi.
4. Murray, R., Bender, D., Botham, K.M., Kennelly, P.J., Rodwell, V., P.A. Weil, 2012. Harper's Illustrated Biochemistry, 29th edition. The McGraw-Hill Co. Inc., USA.
5. Voet, D. and J.G. Voet, 2004. Biochemistry, 3rd Edition, John Wiley & Sons, USA.

COMPULSORY MATHEMATICS
(FOR STUDENTS NOT MAJORING IN MATHEMATICS)

1. MATHEMATICS I (ALGEBRA) 3(3-0)

Learning outcome:

At the end of the course, students will be able to apply the algebraic concepts and techniques in their respective disciplines.

Theory:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. *Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression. *Binomial Theorem:* Introduction to mathematical induction, binomial theorem with rational and irrational indices. *Trigonometry:* Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

1. Dolciani, M.P., W. Wooton, E.F. Beckenback, S. Sharron, 1985. *Algebra 2 and Trigonometry*, Houghton & Mifflin, USA.
2. Kaufmann J.E., 1987. *College Algebra and Trigonometry*, PWS-Kent Company, Boston, USA.
3. Swokowski, E.W., 1986. *Fundamentals of Algebra and Trigonometry* (6th edition), PWS-Kent Company, Boston, USA.

2. MATHEMATICS II (CALCULUS) 3(3-0)

Prerequisite(s): Mathematics I (Algebra)

Learning Outcome:

At the end of the course, students will be able to apply the newly learnt concepts and the techniques in their respective disciplines.

Theory:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. *Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives. *Integration and Definite Integrals:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books:

1. Anton, H., I. Bevens, S. Davis, 2005. *Calculus: A New Horizon* (8th Edition), John Wiley, New York, USA.

2. Stewart, J., 1995. *Calculus* (3rd Edition), Brooks/Cole, CA, USA.
3. Swokowski, E.W., 1983. *Calculus and Analytic Geometry*, PWS-Kent Company, Boston, USA.
4. Thomas, G.B., A.R. Finney, 2005. *Calculus* (11th Edition), Addison-Wesley, Reading, MA, USA.

3. MATHEMATICS III (GEOMETRY) 3(3-0)

Prerequisite(s): Mathematics II (Calculus)

Learning Outcome:

At the end of the course, students will be able to apply the newly learnt concepts and the techniques in their respective disciplines.

Theory:

Geometry in Two Dimensions: Cartesian-coordinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line. *Circle:* Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions. *Conic Sections:* Parabola, ellipse, hyperbola, the general-second-degree equation

Recommended Books:

1. Abraham, S., 1969. *Analytic Geometry*, Scott, Freshman and Company, USA.
2. Kaufmann, J.E., 1987. *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston, USA.
3. Swokowski, E.W., 1986. *Fundamentals of Algebra and Trigonometry* (6th Edition), PWS-Kent Company, Boston, USA.

ENGLISH-I (FUNCTIONAL ENGLISH) 2 (2-0)

Objectives: Enhance language skills and develop critical thinking.

Course Contents:

- Basics of Grammar
- Parts of speech and use of articles
- Sentence structure, active and passive voice
- Practice in unified sentence
- Analysis of phrase, clause and sentence structure
- Transitive and intransitive verbs
- Punctuation and spelling

Comprehension

Answers to questions on a given text

Discussion

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening

To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended Books:

1. Functional English

a) Grammar

1. Thomson, A.J. and A.V. Martinet 1997. Practical English Grammar by Exercises 1 and 2. Third edition. Oxford University Press, UK.

b) Writing

1. Boutin, M.C., S. Brinand and F. Grellet, 1993. Writing. Intermediate by Oxford Suppl. Skills. Fourth Impression, UK. pp 20-27 & 35-41.

c) Reading/Comprehension

1. Tomlinson, B. and R. Ellis. 1992. Reading. Upper Intermediate. Oxford Supplementary Skills. Third Impression, UK.

d) Speaking

SEMESTER II

VETERINARY ANATOMY-II

3(1-2)

Learning Outcomes:

At the end of the course, students will be able to:

1. Identify and describe anatomical features of skeletal, muscular, articular, vascular and nervous components of head and neck region (Practical only).
2. Identify and describe anatomical features of Respiratory, Digestive, Urinary, Genital and Endocrine Systems (organs of thoracic, abdominal and pelvic cavities).

3. Identify and describe anatomical features of skeleton and viscera of domestic chicken.
4. Indicate topographical location of organs on live animals (Practical only).

Theory:

Comparative Respiratory System(Equine, Ruminant, Canine); nostrils, nasal cavity, nasopharynx, hyoid apparatus, larynx, trachea, lungs, Comparative Cardiovascular System(Equine, Ruminant, Canine); heart, vessels, Comparative Digestive System(Equine, Ruminant, Canine); oral cavity, pharynx, esophagus, stomach, small intestine, large intestine, peritoneum, omentum, liver, pancreas, spleen, Dentition; Teeth eruption and dental markings on equine teeth with age, Urinary System (Equine, Ruminant, Canine); kidneys, ureters, bladder, urethra, Male Genital System(Equine, Ruminant, Canine); descent of testis, scrotum, spermatic cord, testis, penis, prepuce, Female Genital System(Equine, Ruminant, Canine); peritoneal attachments and anatomy of female internal and external genitalia, Endocrine system, Avian anatomy, Topographic anatomy.

Practical:

Comparative Anatomy of Head & Neck Region (Equine, Ruminant, Canine): Osteology: Skull review, Mandible, Vertebrae. Axial Arthrology. Myology of Face, Neck and Trunk. Sagittal section of head and neck: Nasal and Oral cavities, Larynx (cartilages), Trachea, Esophagus, thyroid glands, contents of carotid sheath. Comparative Anatomy of Thorax, Abdomen and Pelvis (Equine, Ruminant, Canine): Osteology: Ribs and sternum. Boundaries and contents of thoracic cavity, Pleura, Mediastinum, Lungs and Bronchial tree, Heart and Blood Vessels cranial to the heart. Introduction to abdominal cavity, Peritoneum, Omentum, Stomach (Simple and Compound), Small and Large Intestine, Biliary System, Liver and Spleen, Abdominal Aorta. Urinary System, Kidneys, Ureters, Urinary bladder and Urethra. Male Genital System; descent of testis, Scrotum, Testes, Duct system, Penis, Prepuce, Accessory glands. Female Genital System; peritoneal attachments and modifications, Internal and External Genitalia, Endocrine Glands, Avian Anatomy (skeleton and organs), Topography of body organs.

Textbook:

1. Koenig, H. E. and H.G. Liebich, 2009. Veterinary Anatomy of Domestic Animals, Textbook and Colour Atlas, Schattauer, Germany.

RecommendedBooks:

1. Pasquini, C., T. Spurgeon, and S. Pasquini, 2007. Anatomy of Domestic Animals – Systemic and Regional Approach. Soudz, U.S.A.
2. Getty, R.,S.Sisson and J.D. Grossman, 1986. The Anatomy of the Domestic Animals.W.B.Saunders Co., Philadelphia, U.S.A.
3. Miller, M.E., 2000. Guide to the Dissection of the Dog. Edwards Brothers, Ithaca, New York, U.S.A.
4. Philips, G.D., 1988. Guide to Ruminant Anatomy Based on the Dissection of the Goat. Iowa State University Press, Ames, U.S.A.

5. Haward, E. and D. Alexander, 2000. Guide to the Dissection of the Dog. W.B.Saunders Co. U.S.A.

SYSTEMIC VETERINARY HISTOLOGY & EMBRYOLOGY

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to

1. Describe developmental stages of embryo and embryonic origin of each organ.
2. Describe and identify the microscopic features of different systems of body and their comparative histological features in domestic animals.

Theory:

Embryology: study of different developmental stages of embryo, Placentation in domestic animals and embryonic origin of each body organ. Integumentary System: Histology of thick and thin skin and epidermal appendages. Cardiovascular System: Histology of Heart and all major types blood vessels. Lymphatic System: Introduction to Lymphoid tissue and histology of Lymph Node, Spleen, Thymus and Tonsils. Digestive System: Histology of all parts of digestive system of Simple and Compound Stomach animals along with accessory glands of Digestive System. Respiratory System: Histology of extra-pulmonary and intra-pulmonary tissues of respiratory system. Urinary System: Histology of Kidney and excretory passage of urinary system. Male Reproductive System: Spermatogenesis. Histology of Testis, its associated ducts, copulatory organ and male accessory glands. Female Reproductive System: Oogenesis. Histology of Ovary, Fallopian Tubes, Uterus, Cervix and Vagina. Endocrine System: Histology of Pituitary Gland, Pineal Gland, Thyroid and Parathyroid Glands, Adrenal Gland.

Practical:

Embryology: Different stages of Embryo. Integumentary System: Tissue Sections of Skin and epidermal appendages. Cardiovascular System: Sections of Heart, and arteries and veins. Lymphatic System: Tissue Sections of Lymph node, Spleen, Thymus and Tonsils. Digestive system: Tissue Sections of Oral Cavity, Esophagus, Simple stomach in horse, dog, cat and Compound Stomach in Ruminants and small and large intestine, Accessory glands of Digestive System. Respiratory system: Tissue Sections of Nasal Cavity, Nasal Sinus, Naso-pharynx and Oropharynx, Larynx and Trachea, Lungs, Bronchi, Bronchioles, Respiratory Bronchioles, Alveoli, Alveolar duct and alveolar sacs. Urinary system: Tissue Sections of Kidney: Nephron, Juxtaglomerular Apparatus, Collecting tubules and collecting ducts and excretory passages. Male Reproductive System: Tissue Sections of the Testes and their associated ducts, Penis and male accessory glands. Female Reproductive System: Tissue Sections of the Ovary, Uterine tube and Uterus, Cervix and Vagina. Endocrine System: Tissue Sections of Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland and Pineal body.

Textbook:

1. Eurell, J. A., and B. L. Frappier, 2007. Dellmann's Textbook of Veterinary Histology, 6th Ed., Blackwell Publishing, UK.

Recommended Books:

1. Samuelson, D.A., 2007. Textbook of Veterinary Histology, Saunders Elseviers, USA.
2. Bacha, W.J. and L.M. Bacha, 2012. Color Atlas of Veterinary Histology, 3rd Ed., Wiley Blackwell, USA.
3. Qureshi, A. S. and M.N. Chaudhry, 2007. Illustrated Veterinary Histology, MAS Publ., Faisalabad, Pakistan.
4. McGaedy, T.A., P.J. Quinn, E.S. Fitzpatrick, and M.T. Ryan, 2006. Veterinary Embryology, Blackwell Publishing, UK.
5. Kuehnel, W., 2003. Color Atlas of Cytology, Histology and Microscopic Anatomy, 4th Ed., Thieme Stuttgart, New York, USA.
6. Eroschenko, V.P., 2012. diFiore's Atlas of Histology: with Functional Correlations, 12th Ed., Lippincott Williams & Wilkins, USA.

VETERINARY PHYSIOLOGY-II**4(3-1)****Learning Outcomes:**

At the end of the course, students will be able to:

1. Describe basic terminologies related to endocrinology, digestive physiology, lactation and renal physiology.
2. Describe relationship of structure to function addressing digestive, renal, lactation and endocrine systems.
3. Describe pathophysiology of selected disorders of digestive, renal, lactation and endocrine systems.

Theory:

Endocrine Physiology: An overview of endocrine system, integration of endocrine and nervous system, Classification and transport of hormones, Hormone-cell interaction and feedback mechanisms, Pituitary Gland, its structure, secretions and function, Thyroid gland, its physiological anatomy, synthesis, release, functions of thyroxin and tri-iodo-thyronin, Endocrine pancreas; role of insulin and glucagon in regulation of glucose metabolism, Parathyroid gland: Physiological anatomy; synthesis, release, functions and abnormalities of parathormone and calcitonin. **Digestive Physiology:** Introduction to gastrointestinal physiology, Feeding behavior, prehension and mastication, enteric nervous system, Physiological mechanism of deglutition, Saliva secretion, composition and regulation, Eructation mechanism, emesis and its control, Ruminant stomach, anatomy and physiology, concept of functional ruminal epithelium, Esophageal groove and concepts of nutrient-by-pass, Microbial ecosystem of digestion in ruminants, Fermentation of carbohydrates, proteins and fats in rumen, Production and absorption of volatile fatty acids, nitrogen in ruminants, Physiologic anatomy of simple stomach, gastric motility, factors affecting gastric motility, Gastric secretion, composition, regulation, factors influencing the gastric secretion, Digestion and

absorption of carbohydrates, proteins, fats, Absorption of vitamins and electrolytes, Role of Pancreas and liver indigestion. Clinical cases like ulcer, ruminal acidosis, urea toxicity, diarrhea; Protected nutrients and enzymes, selected antibiotics in feed, probiotic and prebiotics. **Lactation Physiology:** Functional anatomy of mammary glands, Physiology of mammogenesis, lactogenesis and galactopoesis, Milk synthesis and secretion, Biological functions of milk, its nutritive value, Lactation performance, physiological factors affecting lactation, Mammary biotechnology. **Renal Physiology:** Anatomy and physiology of Nephron, Urine formation, Glomerular filtration, Physiological control and auto-regulation of Glomerular Filtration Rate, Tubular Reabsorption and processing of Glomerular Filtrate, Mechanism of tubular reabsorption and regulation, Regulation of extra-cellular fluid osmolarity, balance of Sodium and Potassium by Kidney, Renal absorption of bivalent ion. Renal blood flow, renal clearance, filtration fraction, regulation of urine volume and concentration, Act of micturition and its regulation, Introduction to acid–base Physiology, Renal mechanisms for maintaining hydrogen ion concentration in body fluids; Regulation of acid–base balance, Clinical correlations (acidosis, alkalosis). Clinical cases related to Endocrine, Digestive, Lactation and Renal Physiology.

Practical:

Demonstration of location of endocrine glands in rats and rabbits, Isolation of rat uterus and effect of oxytocin, Glucose tolerance test, Farm visits for observations on rumination and deglutition; Salivary secretion in ruminants, Tests for saliva of different animals, Motility of ruminant stomach, Rumen fistula/cannulation, Biochemical experiments on bile, Determination of composition of milk, Determination of pH and specific gravity of milk, Determination of total solid in milk, Urinalysis.

Textbook:

1. Cunningham, J.G. and B.G. Klein, 2007. Textbook of Veterinary Physiology. 4th Edition. WB Saunders Company, USA.

Recommended Books:

1. Dukes, H.H., M.J. Swenson and W.O. Reece (2004). Duke's Physiology of Domestic Animals. 12th Edition, Comstock Publishing, USA.
2. Costanzo, L., 2008. Physiology. 4th Edition, Elsevier Publishing, USA.
3. Guyton, A.C. and J.E. Hall., 2006. Textbook of Medical Physiology. 11th Edition. WB Saunders Company, USA.
4. Barrelet, K.E., S.M. Barman, S. Boitano and H.L. Brooks, 2006. Ganong's Review of Medical Physiology. 23rd Edition. Appleton & Lange, USA.
5. Jafri, S.A., M. Rabbani and H. Rehman, 2002. Manual of Digestive Physiology. *Muktaba-i-Danishwaran*, Lahore, Pakistan.
6. Church D.C., 1993. The Ruminant Animal: Digestive Physiology and Nutrition. Waveland Press, Inc, USA.

Objectives: Enable the students to meet their real life communication needs especially communicating with clients during private veterinary practice.

Course Contents:

Paragraph writing

Practice in writing a good, unified and coherent paragraph

Essay writing

Introduction

CV and job application

Translation skills

Urdu to English

Study skills

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills

Letter/memo writing, minutes of meetings, use of library and internet

Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended Books:

Communication Skills

a) Grammar

1. Thomson, A.J. and A. V. Martinet 1997. Practical English Grammar by Exercises 2. Third edition. Oxford University Press, UK.

b) Writing

1. Boutin, M.C., S. Brinand and F. Grellet, 1993. Writing. Intermediate by Oxford Suppl. Skills. Fourth Impression, UK. pp 45-53 (Note taking).

c) Reading/Comprehension

1. Tomlinson, B. and R. Ellis. 1992. Reading. Upper Intermediate. Oxford Supplementary Skills. Third Impression, UK.

Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

GENERAL VETERINARY MICROBIOLOGY

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe general characteristics of bacteria, fungi and virus
2. Elaborate physico-chemical requirements for microbial growth
3. Describe preliminary identification of micro-organisms.

Theory:

Introduction of Microbiology, Definition and branches of Microbiology, Historical introduction including works of Pasteur, Koch and Lister, etc, Recent developments in microbiology, Prokaryotes v/s Eukaryotes, Growth medium, types of culture media, preparation of the medium in the lab, Bacterial growth and multiplication, Bacterial multiplication and growth curve, continuous culture, Physico-chemical requirements (pH, temperature and oxidation reduction potential), Physico-chemical requirements (gaseous and nutritional requirements), Bacterial genetics: Mutation and mutagenesis, Transposons, Plasmid in mutation and mutagenesis, Conjugation, Transformation, Transduction, Lysogeny, Introduction to genetic engineering, antibacterials, Introduction to fungi: Molds and yeasts, Growth requirements and mode of replication of molds and yeasts, Isolation and identification of molds and yeasts, Classification of molds and yeasts, Clinical diagnosis of different fungal diseases, antifungal drugs, Fundamental characteristics of viruses (Definition and history of virology), General properties of viruses, viroids and prions, Bacteriophages and its typing, Methods of studying viruses; Purification of viruses and determination of virus size, Virus classification, Virus replication: Adsorption-receptor/ligand, entry mechanisms, uncoating, biosynthesis of virus components, Virus transcription, translation, assembly and release, Replication of RNA and DNA viruses and their comparison analysis, Replication of Retroviruses and defective viruses, Properties of animal viruses at cellular levels (infection of cell with multiple viruses), Recombination, Exaltation, dormancy and reactivation, Interference, Mechanisms of interference, Interferon (Properties, types, mode of action, biological significance, antibodies vs interferon), Haemadsorption and elution, Viral vaccines and factor affecting success/ failure of viral vaccines, Physico-chemical characteristics of viruses, antiviral agents, Methods for isolation and identification of viruses, algae.

Practical:

Safety in microbiological laboratory, study of principles and application of laboratory equipment, Microscope and microscopy (bright field; dark field; Phase contrast; fluorescent microscopes, Sterilization (moist heat, dry heat, irradiation, filtration), Disinfectants and their efficacy evaluation (how to calculate phenol coefficient against a bacteria), Preparation and demonstration of various bacteriological media (general and selective,

Differential and Enrichment media. Demonstration of staining techniques (negative, simple and Gram's staining), Zeihl-Neelsen and spore staining techniques. Methods of bacterial cultivation and growth measurement, Identification of bacterial characteristics (colony, morphology, shape and arrangement), Biochemical tests, Sugar fermentation tests, Micrometry and motility, Antibiotic susceptibility testing, Isolation and identification of common fungi and molds, Purification of viruses (ultracentrifugation; precipitation and ultra-filtration), Cultivation of viruses (animal inoculation, egg inoculation), isolation and enumeration of bacteriophages from sewerage water and calculation of antiviral activity of disinfectants against a virus, Cell culture preparation, Demonstration of cytopathic effects (CPE), Virus identification methods (electron microscopy through simulation and images, serology, precipitation test, virus neutralization test etc.). Virus titration (determination of EID₅₀, LD₅₀ and TCID₅₀), cultivation and identification of algae.

Textbook:

1. Tortora, G.J.,B.R. Funke and C.L. Case, 2012. Microbiology: An Introduction. 11thEdition.Benjamin Cummings Publisher.

Recommended Books:

1. Quinn, P.J., M.E. Carter, B.K. Markie and G.R. Carter, 2013. Clinical Veterinary Microbiology. St. Louis, USA. (As practical manual)
2. Anonymous, 1999. A Laboratory Manual for the Isolation and Identification of Avian Pathogens. 6thEd. American Association of Avian Pathologists, Iowa State Univ. Press, Ames, Iowa.
3. Burleson, F.G., T.M. Chanbes and D.I. Wiedranks, 1992. Virology-A Laboratory Manual Academic Press, London
4. Castro, A.E. and W.F. Henschele, 1992. Veterinary Diagnostic Virology. Mosby yearbook, Inc., Baltimore.
5. Fenner, F.J., E.P. Gibbs, F.A. Murphy, M.J. Studdert and D.O. White, 1993. Veterinary Virology 2ndEd., Academic Press, London.
6. Merchant, I.A. and R.A. Packer, 1984. Veterinary Bacteriology and Virology. 7thEd., Iowa State University Press, Ames, Iowa.
7. OIE, 2014. Manual of Standards for Diagnostic Tests and Vaccines. Off. Intl. des. Epiz., Paris, France.
8. Rabbani, M. and M.A. Muneer, 2001. Techniques in Virology. 1stEd., UVAS Press, Lahore
9. Talaro, K. and A. Talaro, 1996. Foundation in Microbiology. 2ndEd., Win C. Brown Publ., Iowa, USA.
10. Virella, G., 1997. Microbiology and Infectious Disease. 3rdEd., Williams and Wilkins, Baltimore, USA.

INTRODUCTION TO POULTRY PRODUCTION

1(1-0)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe various production systems and housing-types in poultry production.

2. Describe strategies to benefit rural poultry producers, hobby farmers/fanciers.
3. Provide technical guidance about organic farming, non-traditional poultry and companion birds.
4. Describe methods of disease prevention and their importance in poultry production.

Theory:

Overview of Poultry Industry; Production Systems for broiler and laying hens; Introduction to village and backyard poultry production; Alternative systems of poultry production and its effects on health and disease; Organic and free-range poultry production; Technology and programs for sustainable improvement of rural poultry; Production systems for Waterfowl; Game bird breeding, brooding and rearing - Health and Welfare; Furnished cages for laying hens; Performance, welfare, health and hygiene of laying hens in non-cage systems in comparison with cage systems; Turkey production and management; Alternative systems for meat chickens and turkeys: Quail production; Commercial duck farming; Ostrich farming; Production and management of companion and fancy birds. Laws governing poultry production.

Textbook:

1. Sandiland, V. and P. Hocking, 2012. Alternative systems for poultry: health, welfare, and productivity. CAB International, Wallingford, Oxon, U.K.

Recommended Books:

1. Sreenivasaiah, P.V., 2006. Scientific Poultry Production. 3rd edition. International Book Distributing Co., UP India.
2. Austic, R.E. and M.C. Nesheim, 1990. Poultry Production. 13th edition. Lea and Febiger, Philadelphia, PA, USA.

FUNDAMENTALS OF LIVESTOCK PRODUCTION

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Define and describe Taxonomy and domestication of farm animals
2. Identify types and breeds of farm animals.
3. Describe principles of farm animal housing, feeding and behavioral management.
4. Elaborate equitation, welfare, transportation and marketing of animals.

Theory:

Role of livestock in national economy; Domestication and taxonomy of farm animals; Types and breeds of farm animals; Identification and handling of livestock; Principles of farm animal management; Farm structures and equipment; Management of different types and classes of farm animals; Characteristics, body conformation and capacity of draught animals; Camel as a dairy, meat and draught animal; Farm animal vices and their control;

Deworming and vaccination schedule and biosecurity for various farm animals, Principles of equitation; Welfare of farm animals; Transportation and marketing. Laws governing livestock production.

Practical:

Regions and body points of farm animals; Approaching, handling and restraining of animals; Identification and use of management tools; Grooming and cleaning; Animal identification and transportation systems; Body measurements for weight estimation; Maintenance of various farm records; Design and layout plans for livestock building; Demonstration of body conformation and defects; Determining age; Marking camel and horses; Care of foot; Use and care of harness and saddles; Equitation practices.

Textbook:

1. Banerjee, G.C., 2009. A Textbook of Animal Husbandry. 8th Edition. Oxford and IBH Publishing Co. New Delhi, India.

Recommended Books:

1. Verma D.N., 2006. A Textbook of Livestock Production Management in Tropics. Kalyani Publishers Delhi India.
2. Mackintosh, J.B., 1993. Sheep Production in Pakistan. Pakistan Agricultural Research Council, Islamabad, Pakistan.
3. Kacker, R.N. and B.S. Panwar, 1996. Textbook of Equine Husbandry. Vikas Publications Pvt. Ltd., New Delhi.
4. Wilson, R.T. 1998. Camels. McMillan Education, London.
5. Khan, B.B., M. Yaqoob, M. Riaz, M. Younas and A Iqbal, 2004. Livestock Management Manual for Introductory Courses. Dept. of Livestock Management, University of Agriculture, Faisalabad, Pakistan.

PAKISTAN STUDIES

1(1-0)

Introduction/Objectives:

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline:

1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

- a. 1947-58

- b. 1958-71
 - c. 1971-77
 - d. 1977-88
 - e. 1988-99
 - f. 1999 onward
3. **Contemporary Pakistan**
- a. Economic institutions and issues
 - b. Society and social structure
 - c. Ethnicity
 - d. Foreign policy of Pakistan and challenges
 - e. Futuristic outlook of Pakistan

Recommended Books:

1. Burki, S.J. 1980. *State & Society in Pakistan*, The MacMillan Press Ltd, London, UK.
2. Akbar, S. Zaidi, 2000. *Issue in Pakistan's Economy*. Oxford University Press, Karachi, Pakistan.
3. Burke, S.M. and L. Ziring. 1993. *Pakistan's Foreign Policy: An Historical Analysis*. Oxford University Press, Karachi, Pakistan.
4. Mehmood, S. 1994. *Pakistan Political Roots & Development*. Lahore, Pakistan.
5. Wilcox, W.1972. *The Emergence of Bangladesh*, Washington: American Enterprise, Institute of Public Policy Research, USA.
6. Mehmood, S. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, Lahore, Pakistan.
7. Amin, T., *Ethno -National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, L. 1980. *Enigma of Political Development*. Kent England: WmDawson & Sons Ltd, UK.
9. Zahid, A. 1980. *History & Culture of Sindh*. Royal Book Company, Karachi, Pakistan.
10. Afzal, M.R.1998. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research.
11. Sayeed, K.B.1067. *The Political System of Pakistan*. Boston, USA.
12. Aziz, K.K. 1976. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, Islamabad, Pakistan.
13. Waseem, M. 1987. *Pakistan under Martial Law*, Vanguard, Lahore, Pakistan.
14. Haq, N.U. 1993. *Making of Pakistan: The Military Perspective*. National Commission on Historical and Cultural Research, Islamabad, Pakistan.

SEMESTER III

PRINCIPLES OF ANIMAL NUTRITION

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Define and explain terminology used in the animal nutrition
2. Describe major nutrient classes, feed classification, processing, and preservation procedures
3. Elaborate relationship between dietary classification of animals and digestive processes in GIT
4. Perform proximate analysis and describe its applications in animal nutrition.

Theory:

A brief history and scope of animal nutrition. Comparative digestive anatomy and physiology of ruminants and non-ruminants. Pre-gastric and Post-gastric digestion and absorption of major nutrients. Rumen ecology. Regulation of feed intake in non-ruminants and ruminants. Classification and functions of nutrients. Importance of water in the animal bodies its sources, requirements and losses. Carbohydrates nutrition: Structure classification, digestion and metabolism. Volatile fatty acids (VFA): production, absorption and metabolism in ruminants. Lipids: classification, structure, digestion and metabolism. Protein and amino acid: classification, structure digestion and metabolism. Introduction to mineral and vitamins in animal nutrition. Laws governing pure feed and food.

Practical:

Identification of feed stuffs and their nutritional composition. Sampling techniques for feed ingredients and forages. Processing of samples for chemical analyses. Proximate analysis: dry matter (DM), ash, crude protein (CP), ether extract (EE) and crude fiber (CF) determination. Sample preparation for mineral analysis.

Textbook:

1. Pond, W.G., D.C. Church and K.R. Pond, 2006. Basic Animal Nutrition and Feeding. 5thEd. John Willey and Sons, New York, USA.

Recommended Books:

1. McDonald, P., R.A. Edwards, J.F.D. Greenhalgh, C.A. Morgan, L. Sinclair and R. Wilkinson, 2011. Animal Nutrition. 7thed. Benjamin Cummings, USA.
2. Perry, T.W., A.E. Cullison and R.S. Lowery, 2008. Feeds and Feeding. 6thEdition. Prentice Hall, New Jersey, USA.
3. Banerjee, G.C., 2005. Feeds and Principles of Animal Nutrition. Oxford, IBH Publishing Co., Pvt. Ltd. New Delhi, India.
4. Sarwar, M. and Zia-ul-Hasan, 2000. Nutrient Metabolism in Ruminants. University of Agriculture Press, Faisalabad.
5. A.O.A.C., 2000. Official Methods of Analysis of the Association of Official Analytical Chemists. Vol2, 17thEd. Arlington, VA. USA.

GENERAL AND SYSTEMIC PHARMACOLOGY

4(3-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe transport mechanisms, classification, formulation and routes of administration of drugs
2. Describe pharmacokinetics and pharmacodynamics of drugs of veterinary importance.
3. Describe drugs acting on body systems and mucous membranes.
4. Demonstrate preparation of pharmaceutical preparations and effects of various drugs *in vivo* and *in vitro*.

Theory:

General Pharmacology: Introduction to Pharmacology, historical perspectives and definitions, drug sources, classification of drugs, nomenclature of drugs and drugs information sources, drug development and drug regulations, pharmacokinetic principles and application, transport of drugs across cell membranes and absorption of drugs, distribution of drugs, metabolism of drugs, elimination of drugs, pharmacodynamic concepts of drugs and receptors, structure activity relationship and receptor theories, dose-response relationship, graded dose response, quantal dose response, therapeutic index, adverse drug reactions and drug resistance/tolerance, factors modifying the drug effects and drug interactions.

Systemic Pharmacology: Pharmacology of Autonomic Nervous System: Cholinergic and anticholinergic, adrenergic and antiadrenergic, neuromuscular blocking agents and ganglionic blocking agents, pharmacology of central nervous system: Anaesthetics and pre-anaesthetic medication, analgesics. narcotic analgesics, anti-inflammatory drugs, local anaesthetics, sedatives, hypnotics and tranquilizers, central nervous system stimulants, analgesics and anti-inflammatory drugs, autacoids, drugs affecting digestive system (simple stomach and ruminants), drugs affecting respiratory system, drugs affecting cardiovascular system, drugs affecting uro-genital system, electrolytes, endocrine pharmacology, drugs for skin and mucous membranes, comparative pharmacology, drugs acting on immune system, nutraceuticals.

Practical:

Weights and measures, prescription writing and pharmaceutical calculations, formulations; external and internal dosage forms, techniques of drug administration in animals and identification of various drugs, preparation of ointments, preparation of solutions, preparation of tinctures, collection of blood in common laboratory animals, anesthesia and euthanasia, demonstration of techniques of volatile and intravenous anesthetics, general anesthetics and pre-anaesthetic medication, effect of drugs on isolated heart of rabbits or guinea pigs, effect of drugs on isolated intestine of rabbits or guinea pigs, effect of drugs on intestinal motility on isolated tissue bath, effect of autonomic drugs on eyes of rabbits, preparation of stomach powder for ruminants, preparation of saline electuary for ruminants, demonstration of diuretic and antidiuretic drugs action in animals, demonstration of analgesic activity and local anaesthetic effect of drugs in laboratory animals, visit to pharmaceutical industry.

Textbook:

1. Riviere J.E. and M.G. Papich, 2009. Veterinary Pharmacology and Therapeutics, 9th Edition. Wiley-Blackwell, USA.

Recommended Books:

1. Akhtar, M.S., 2004. Introduction to Veterinary Pharmacology & Therapeutics. 3rd Ed. Agri. Livestock Bureau Pakistan, Faisalabad.
2. Sandhu, H.S., 2013. Essentials of Veterinary Pharmacology & Therapeutics. 2nd Ed. Kalyani Publishers, Ludhiana, India.
3. Hardman, J.G. and L.E. Limbird, 2005. Goodman and Gillman Pharmacology Basis of therapeutics, 11th ed., McGraw-Hill, New York, USA.
4. Clark, M.A., 2001. Lippincott's Illustrated Reviews Pharmacology. 5th Edition. Williams & Wilkins, Philadelphia, USA.
5. Katzung, B.G., 2012. Basic and Clinical Pharmacology. 12th Ed., McGraw-Hill, New York, USA.
6. The Merck Veterinary Manual. 2010. 10th edition. Merck & Co., INC. White House Station, N. J., USA
7. Sandhu, H.S., 1999. Laboratory Manual on Veterinary Pharmacology and Toxicology, Kalyani Publishers, Ludhiana, India.

GENERAL VETERINARY PATHOLOGY 3 (2-1)**Learning Outcomes:**

At the end of the course, students will be able to:

1. Define and explain terminology used in Pathology
2. Differentiate between normal, artifacts and pathological structures
3. Define and describe Pathogenesis and Pathophysiological processes.

Theory:

Introduction to Pathology, Terminology used in pathology, adaptations, atrophy, hypertrophy, hyperplasia, dysplasia, aplasia, reversible and irreversible cell injury, cell death, necrosis, disturbances of mineral metabolism and pigmentation, disturbances of circulation, Inflammation, repair and healing of wounds and fractures, neoplasia; causes, pathogenesis, classification, auto-immunity, molecular pathology.

Practical:

Tissue sampling, preservation, processing and staining techniques: Sudan, Periodic Acid Schiff, MT etc. Demonstration of general, gross and microscopic picture of reversible and irreversible cell injury, atrophy, hypertrophy, hyperplasia, dysplasia. Calcification, melanosis, Disturbances of circulation: congestion, hyperemia, edema, Inflammation: acute and chronic, granulation tissue, Neoplasia: epithelial, connective tissue, bone, skin tumors.

Textbook:

1. Zachary, J.F., and D. McGavin, 2013. Pathological Basis of Veterinary Disease, 5th Ed., Elsevier, USA.

Recommended Books:

1. Macfarlane P.S., R. Reid and R. Callander, 2011. Pathology Illustrated, 7th

Ed., Churchill Livingstone, Edinburgh, UK.

2. Slauson, D.O. and B.J. Cooper, 2002. Mechanisms of Disease: A Textbook of Comparative General Pathology. 3rd Ed. Mosby Inc, A Harcourt Sciences Company, St Louis, MO, USA.

GENERAL VETERINARY PARASITOLOGY AND PROTOZOLOGY **3(2-1)**

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe the nomenclature used in parasitology and classify parasites
2. Describe life cycle, pathogenesis and control of protozoan diseases
3. Collect and process biological samples and parasite specimens for identification / diagnosis.

Theory:

Introduction to parasitology, effects of parasites on their hosts and their economic importance; Basic terminology, Host parasite relationship, Types of parasitism, Organ specificity, Ecology of parasites, types of hosts, modes of infection of parasites, nomenclature and classification of parasites, parasitic zoonosis, immunity against parasites; General concepts on Parasite control strategies. Introduction to protozoology; history and differences from other unicellular organisms; Anatomy and physiology of protozoa; classification, morphology, life cycle, pathogenesis, diagnosis, treatment and control of the important species of the following genera of protozoa: Trypanosoma/Leishmania, Trichomonas and Histomonas, Entamoeba, Giardia, Balantidium, Eimeria, Isospora, Toxoplasma, Sarcocystis, Plasmodium, Haemoproteus, Leucocytozoan, Hepatozoan, Babesia, Theileria, Anaplasma, Cryptosporidium, Ehrlichia, Eperythrozoon and Neospora; Immunity against protozoan parasites.

Practical:

Introduction to laboratory ethics; qualitative and quantitative faecal examinations, Interpretation of faecal oocyst / egg count; methods of blood examination; quality control for blood examination and pseudoparasites; examination of urine, genital discharges, sputum and cerebrospinal fluid for protozoa; mounting of protozoa; culturing of protozoa; morphological examination of intestinal protozoa, Identification of different protozoa (included in theory course) from field isolates and specimen slides.

Textbook:

1. Schmidt, G.D. and L.S. Roberts, 2013. Foundations of Parasitology. 9th Edition, W.C.B. Company, U.K.

Recommended Books:

2. Akhtar, M., M.A. Hafeez and C.S. Hayat, 2003. General Parasitology and Protozoology. The Elite Scientific Publications, Faisalabad, Pakistan.

3. Bowman, D.D. (2013). Georgis' Parasitology for Veterinarians. 10thEd. Saunders Elsevier, USA.
4. Urquhart G.M., J. Armour, J.L. Duncan, A.M. Dunn, F.W. Jennings, 2000. Veterinary Parasitology. Longman Scientific and Technical, U.K.
5. Foreyt, W.J., 2001. Veterinary Parasitology, Reference Manual Iowa State Press, Blackwell Publishing Company.
6. Zajac, A.M. and G.A. Conboy, 2006. Veterinary Clinical Parasitology 7thEdition. Blackwell Publishing AAVP.
7. Iqbal, Z., M.S. Sajid, A. Jabbar, R.Z. Abbas and M.N. Khan, 2006. Techniques in Parasitology. HEC, Islamabad, Pakistan.
8. Hayat, C.S. and M. Akhtar. 1999. Parasitic Diagnosis. University Grants Commission, Islamabad, Pakistan

VETERINARY IMMUNOLOGY

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Define and describe concepts of immunity
2. Describe immunogens, their properties and nature of vaccines
3. Elaborate immunogenesis or fate of vaccine material in the host
4. Describe and differentiate between immunoglobulins
5. Describe control of microbial infections through immunity
6. Describe vaccine reactions
7. Apply immunotherapy in field viral diseases.

Theory:

Definition, immunity and types of immunity, Innate (non specific) immunity, active and passive immunity, natural and artificial immunity, cell mediated and humoral immunity, autoimmunity, hypersensitivity etc. Non-specific resistance and natural barriers of defense such as sweat sebaceous, skin, mucus membranes, saliva, secretions, phagocytic cells, complement, inflammation, fever, Phagocytosis, (mechanism of phagocytosis and microbicidal activity, evasion of phagocytosis and bactericidal activity, survival of bacteria in macrophages, Immune response: Primary response, booster or secondary response, differences between the both, Immune system: primary lymphoid organs such as bursa of Fabricius and thymus, secondary lymphoid organs such as spleen, lymph nodes, MALT or GALT. Cells of the immune system (birds and animals): B and T lymphocytes, Immunocytes, types of lymphocytes, Th lymphocytes or Th cells, B lymphocytes/ B cells, natural killer cells. Vaccines, types of vaccines, antigens/immunogens: Essential features of antigens/ immunogen, antigenic epitopes, adjuvant, HACCP, SOP, protocols, BMR, labels, vaccine, types of vaccines, cold chain, routes of vaccination, Immunogenesis: Antigen processing cells for exogenous and endogenous antigens, Immunogenesis: Fate of foreign antigen/immunogen/vaccine material within the body, presentation of T cell independent antigens and processing of T cell dependent antigens, Immunoglobulins: structure, chemical nature, classification, and antibody specificity, functions, Humoral immunity:

Agglutination, precipitation, CFT), Humoral immunity: ELISA, FAT, VN), Cell mediated immunity (potency/efficacy, MTT assay, thymidine up-take assay, cytokine assay. Immunotherapy and its applications in viral diseases, Hypersensitivity and its types, *Hypersensitivity type I*, *Hypersensitivity type II*, Hypersensitivity type III and Hypersensitivity type IV.

Practical:

Microscopic examination of mammalian blood cells, Demonstration of organs of immune system, Preparation of HA antigen/bacterial antigen/RBC, Raising antiserum against sheep RBC, calculation of sub-agglutinating titer, sensitization of RBCs, Collection of guinea pig or human serum, its complement titration, mixing of blood from different blood groups, Complement fixation test, HA and HI test demonstration, Calculation of GMT of CFT, HI, bacterial agglutination and precipitation tests and demonstration of results, Bacterial agglutination test, AGPT: Gel preparation and punching of wells, charging of samples, AGPT: Demonstration of results, ELISA test against any virus disease, Skin sensitivity tests (tuberculin test or mallein test), Virus neutralization test (NDV) in chicken embryos, Fluorescent microscopy (Rabies detection), Immunotherapy: treatment of NDV, study tour to Research Institutes / Vaccine Production Unit.

Textbook:

1. Tizzard, I. R., 2013. Veterinary Immunology -An Introduction, 6th Ed. W. B. Saunders Co., London.

Recommended Books:

1. Abbas, A. K., H. L. Andrew and S. P. Jordan, 2008. Cellular and Molecular Immunology. W. B. Saunders Co., London.
2. Kuby, J., 1996. Immunology. 2nd Edi. W. H. Freeman and Co., New York.
3. Quinn, P. J., 2012. Veterinary Microbiology and Microbial Disease. 1st Edi. Blackwell Science Ltd., USA.
4. Anonymous, 1999. A laboratory manual for the isolation and identification of avian pathogens. 6th Ed. American Association of Avian pathologists, Iowa State University Press, Ames, Iowa.
5. Hay F. C. and O. M.R. Westwood, 2002. Practical Immunology, Blackwell Science, 4th Edition.

ANTHROPOLOGY

1 (1-0)

Learning Outcomes:

At the end of the course students will be able to:

- 1- Define and identify basic concepts of anthropology
- 2- Explain Pakistani society and culture
- 3- Differentiate between various social setups and subcultures
- 4- Describe the contribution of women and children to rural development.

Theory:

Anthropology and its basic concepts; society; culture and subcultures; norms, values; socio-cultural processes; social groups; human behaviour;

socialisation and personality; social institutions, marriage and family systems; village life and status of farmers in society; social stratification; social change and factors affecting change process; role of women and children in rural development; global social problems. Mindset issues which limit adoption of new technologies. Clinician- client relationship. How to establish long term relationships between employer and employee.

Textbook:

1. Ember, C.R. and M. Ember, 2011. Cultural Anthropology. 13thedition. Pearson, Prentice Hall, USA.

Recommended Books:

- 1- Iqbal, C.M., 2002. Sociology. Aziz Publications. Lahore
- 2- Singh, M., 2007. Rural Sociology. Anmol Publications. New Delhi. India
- 3- Giddens A., 2006. Sociology.5th Edition. Polity Press, Cambridge, UK

MOLECULAR BIOLOGY

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe the structure, function and types of RNA and DNA
2. Describe the process of manipulation in genome, replication and transcription mechanisms
3. Describe the genomic libraries
4. Describe / Perform protein analysis, DNA and RNA extraction, run the PCR, electrophoresis and detection of bands on gel

Theory:

Introduction to Molecular Biology, RNA, DNA, Genes and chromosomes, Structure of DNA, Replication of DNA, Expression of genetic information, Endoribonucleases, Ligases, Principle of polymerase chain reaction, Principles of primer designing for PCR, DNA sequencing: principle and methods, Introducing mutations in DNA, Site directed mutagenesis in a given gene, Vectors and their uses in molecular biology, Modifications of phage vectors and their uses, DNA modification enzymes, adaptors and their uses, Regulation of gene expression, Restriction fragment length polymorphism, Genetically modified organisms/animals. Law of the land governing ethical issues of molecular biology.

Practical:

Good lab practices, Genomic DNA extraction from eukaryotic and prokaryotic cells, Plasmid DNA extraction, RNA extraction, Protein estimation, SDS-PAGE, Staining of gel and its documentation, Estimation of nucleic acids, Western Blotting, Southern Blotting, Northern Blotting and their result interpretation, Reverse Transcriptase of RNA, PCR, Use of computers for DNA and protein sequence data from world wide web (Bioinformatics).

Text book:

1. Gupta, P.K., 2014. Elements of Biotechnology, 2nd edition. Rastogi Publications, India.

Recommended Book:

1. Green, M.R. and J. Samrook, 2012. Molecular Cloning: A Laboratory Manual, 4th Edition (3 vol. set). Cold Spring Harbor Lab Press, USA.

LAB AND ZOO ANIMAL MANAGEMENT

1(0-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Construct/ establish laboratory and zoo animal housing facilities
2. Deal with the day to day management issues
3. Note behavioral aspects, assessing health status and stress issues
4. Determine nutritional requirements of various laboratory and zoo animals
5. Handle various lab and zoo animals
6. Demonstrate techniques of capturing animals in the field

Practical:

Lab Animals: Introduction to lab animals, Lab animals' facilities designs, management issues in lab animals, Record keeping procedures, Daily feeding, husbandry and management practices, Handling of various lab animals, Common infections in laboratory animals, Conduction of minor procedures like anesthesia of laboratory animals, management of pain, distress and lasting harm, Observations on behavioral aspects in lab animals. **Zoo Animals:** Introduction to lab animals, Importance of zoos in conservation, Calculations on economics of zoo animals, Feeding requirements, husbandry practices and management issues, Record keeping procedures and tagging, Enclosure designs, dimensions and housing requirements of various mammalian and avian species in zoos, visit of museums to observe stuffed animals, Netting/ trapping or restraining techniques for multiple species of wild animals in the field.

Textbooks:

1. Cheeran J.V., 2008. Textbook of Wild and Zoo Animals: Care and Management. 2nd Revised Edition Textbook Student Edition.
2. Pool, T.B., 1989. The UFAW Handbook on the Care and Management of Laboratory Animals. Longman Scientific and Technical Publishers, England. UK.

Recommended Books:

1. Clark. J. D., K. A. Baldwin, M.J. Bayne, G.F. Brown, J.C. Gebhart, J.K. Gonder, M.E. Gwathmey, D.F. Keeling, J.W. Kohn, O.A. Robb and W.J. SmithWhite, 1996. Guide for the Care and Management of Laboratory Animals. National Research Council, National Academic Press, Washington, D. C. 6th edition.
2. Mathialagan P., 2007. Textbook of Animal Husbandry and Livestock Extension. 3rd Revised and Enlarged Edition Textbook Library Edition. International Book Distributing Company.

3. Hosey, G.,M. Vicky and S. Pankhurst, 2013. Zoo Animals:Behaviour, Management, and Welfare Oxford University Press, 696 pp.
4. Rees, P.A., 2011. An Introduction to Zoo Biology and Management,John Wiley & Sons, USA. 432 pp.
5. Kleiman, D.G.,K.V. Thompson and C.K. Baer, 2010. Wild Mammals in Captivity:Principles and Techniques for Zoo Management, 2ndEdition, University of Chicago Press, USA.
6. Miller, E. andE. Murray, 2011. Fowler's Zoo and Wild Animal Medicine Current Therapy, Elsevier Health Sciences, USA.

SEMESTER IV

LIVESTOCK FEED RESOURCES AND FORAGE CONSERVATION 3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Enlist feed resources and describe their classification.
2. Explain nutrient profile of feed resources and their role in ruminant ration.
3. Describe different techniques of forage preservation
4. Describe efficient way of roughage utilization
5. Elaborate ruminant digestive physiology and metabolism
6. Calculate nutrient balance and formulate rations for ruminants
7. Describe emerging trends in ruminant nutrition and their practical implications

Theory:

Classification and nutritional composition of feed stuffs for ruminants: fodders, forages, dry roughages and concentrate feed stuffs. Anti-nutritional factors in feed stuffs for ruminants. Improvement of nutritional quality of low quality roughages. Forage production systems in Pakistan and their implications. Lean periods in forage production and methods to overcome shortage in lean period. Strategies and techniques to improve the nutritional quality of low quality roughages. Conservation of forages for commercial livestock production operations; silage and hay making. Ruminant nutrition: calf nutrition, heifer nutrition, dairy nutrition, meat animal nutrition. Feeding systems for commercial dairy, TMR feeding. Feed Additives and performance modifiers for ruminants. Nutritional and metabolic disorders.

Practical:

Identification of fodders and forages used in conventional and commercial ruminant production systems. Hay and silage preparation. Physical and chemical evaluation of hay and silage samples; laboratory analysis of fodders and forages (DM, NPN, NDF, ADF, Cellulose, lignin, acid insoluble ash). Interpretation of laboratory analysis report and its implementation. Calculation of nutrient balance. Feed formulation: Pearson square method, trial and error method, MS Excel based feed formulation. Least cost feed formulation by using computer software. Visit to commercial livestock enterprise.

Textbook:

1. Perry, T.W., A.E. Cullison and R.S. Lowery, 1999. Feeds and Feeding, 5th Edition. Prentice Hall, New Jersey, USA.

Recommended Books:

1. Ensminger, M. E., J.E. Old Field and W. W. Heinemann, 1990. Feeds and Nutrition Digestion. The Ensminger Publishing Co. Clovis, California, USA.
2. Pond, W.G., D.C. Church and K.R. Pond, 2006. Basic Animal Nutrition and Feeding. 5thEd. John Willey and Sons, New York, USA.
3. Preston, T.R. and R.A. Leng, 1987. Matching Ruminants Production Systems with Available Feed Resources in the Tropics and Subtropics. Penambul Books, Armidale, Australia.
4. Renard, C., 1997. Crop Residues in "Sustainable Mixed Crop/ Livestock Farming Systems. CAB International, UK.
5. Dennis, J. M., 1990. Forage in Ruminant Nutrition. Academic Press Inc, Harcourt Brace Jovanovich Publishers, USA.
6. NRC. 2001. Nutrient Requirements of Dairy Cattle. 7th Revised Edition. National Academy Press, Washington, USA.
7. NRC. 1985. Nutrient Requirements of Sheep. 6th Revised Edition. National Academy Press, Washington, USA.
8. Van Soest P.J., 1994. Nutritional ecology of the ruminant. Cornell University Pr, Ithaca, New York.
9. Lander, P.E., 2001. The Feeding of Farm Animals in India. Biotech Books, New Delhi, India
10. A.O.A.C., 2000. Official Methods of Analysis of the Association of Official Analytical Chemists. Vol2, 17th Ed. Arlington, VA.

VETERINARY CHEMOTHERAPY AND TOXICOLOGY 4(3-1)**Learning Outcomes:**

At the end of the course, students will be able to:

1. Define chemotherapy.
2. Describe the classes of antimicrobial agents, their resistance and tissue residual problems.
3. Define toxicology and describe sources of poisoning, toxicokinetics, toxicodynamics, heavy metals, household and environmental toxicants.
4. Describe the handling of cases of toxicity, mycotoxins, poisonous plants, poisonous animals and toxicity of therapeutic agents.
5. Describe the calculations in toxicology, sample collection, laboratory diagnostic procedures, detection of metals, non-metals and antimicrobials in the samples and *in vivo* and *in vitro* experimentation.

Theory:

Chemotherapy: Introduction and general consideration of chemotherapy and definitions, principles of chemotherapy and classification of chemotherapeutic agents, antimicrobial drug resistance and tissue residue problem, antimicrobial agents: cell wall synthesis inhibitors, aminoglycosides, tetracyclines,

amphenicols (chloramphenicol, thiamphenicol, florfenicol), macrolide antibiotics and lincosamides, fluoroquinolones, sulphonamides and dihydropyrimidines, miscellaneous antimicrobial agents, antifungal agents, antiprotozoal drugs, anthelmintics, drugs against ectoparasites, antiseptics and disinfectants, antiviral agents, anticancer drugs. **Toxicology:** General concepts, scope and terminology, sources of toxicity, toxicokinetics, toxicodynamics, factors affecting toxicosis, diagnosis of poisoning, handling of cases of toxicology, heavy metal toxicosis, house hold toxicosis, pesticides (insecticides, fungicides etc.), urea toxicity, cyanide poisoning, nitrate/nitrite poisoning, mycotoxins, poisonous plants, poisonous animals, environmental pollutants, toxicity caused by feed additives, radiation hazards and toxicity, toxicology of therapeutic agents. Law of the land governing drugs and their use like withdrawal periods, etc.

Practical:

Toxicological terms, calculations in toxicology, collection of samples for laboratory analysis, laboratory diagnostic procedures, experiment for identification of chemical poisons, experiment for the detection of heavy metals, experiment for detection of barbiturates from given sample, experiment for detection of chloral hydrate from given sample, experiment to study the toxicity of cyanide in rat, live animal swab test and swab test on premises, the antibiotic culture sensitivity testing, experiment to study the toxicity of organophosphate insecticide in rat, experiment for estimation of sulphonamides in sample, experiment for estimation of oxytetracycline in sample, experiment for determination of LD50 of a given drug. Visit to Pharmaceutical Industry.

Textbook:

1. Riviere J.E. and M.G. Papich, 2009. Veterinary Pharmacology and Therapeutics, 9th Edition. Wiley-Blackwell, USA.

Recommended Books:

1. Akhtar, M.S., 2004. Introduction to Veterinary Pharmacology & Therapeutics. 3rd Ed. Agri. Livestock Bureau Pakistan, Faisalabad.
2. Sandhu, H.S., 2013. Essentials of Veterinary Pharmacology & Therapeutics. 2nd Ed. Kalyani Publishers, Ludhiana, India.
3. Hardman, J.G. and L.E. Limbird, 2005. Goodman and Gillman Pharmacology Basis of therapeutics, 11th Ed., McGraw-Hill, New York, USA.
4. Clark, M.A., 2001. Lippincott's Illustrated Reviews Pharmacology. 5th Edition. Williams & Wilkins, Philadelphia, USA.
5. Katzung, B.G., 2012. Basic and Clinical Pharmacology. 12th Ed., McGraw-Hill, New York, USA.
6. The Merck Veterinary Manual. 2010. 10th edition. Merck & Co., INC. White House Station, N. J., USA
7. Sandhu, H.S., 1999. Laboratory Manual on Veterinary Pharmacology and Toxicology, Kalyani Publishers, Ludhiana, India.
8. Osweiler, G. D., 1996. Toxicology. Williams and Wilkins, Philadelphia, USA.

9. Stine, K.E. and T.M. Brown, 2006. Principles of Toxicology, 2nd edition. Taylor and Francis. USA.
10. Sandhu, H.S. and R. S. Brar, 2000. Textbook of Veterinary Toxicology, 2nd Ed. Kalyani Publishers, Ludhiana, India.

VETERINARY BACTERIOLOGY AND MYCOLOGY

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe normally existing bacterial /fungal species
2. Identify factors responsible for disease production
3. Elaborate source of samples, cultural characters including biochemical reactions, Microscope and microscopy
4. Provide description for animal inoculation, serodiagnosis, treatment and Immunoprophylaxis of common bacterial diseases prevailing in Pakistan

Theory:

General sketch of exclusion studies for diagnosis of bacterial diseases of veterinary importance including *Staphylococcus spp.* (Mastitis), *Streptococcus spp.* (Mastitis, Strangles), *Escherichia spp.* (Colibacillosis), *Salmonella spp.* (Pullorum, Fowl typhoid, Salmonellosis: livestock), *Pasteurella spp.* (Haemorrhagic septicaemia), *Pasteurella spp.* (Shipping fever), *Brucella spp.* (Brucellosis), *Pseudomonas spp.* (Pyogenic infections), *Burkholderia spp.* (Glanders), *Listeria spp.* (Listeriosis), *Bacillus spp.* (Anthrax), Neurotoxic *Clostridium spp.* (Tetanus), Histotoxic *Clostridium spp.* (Black quarters), Enterotoxic *Clostridium spp.* (Enterotoxaemia), *Corynebacterium spp.* (Lymphadenitis, Mastitis), *Mycobacterium spp.* (Bovine tuberculosis), *Actinobacillus spp.* (Wooden tongue), *Actinomyces spp.* (Lumpy jaw), *Nocardia spp.* (Nocardiosis), *Leptospira spp.* (Leptospirosis), *Borellia/Treponema spp.* (Tick fever), *Compylobacter spp.* (Campylobacter infections), *Mycoplasma spp.* (CCPP, CBPP), *Mycoplasma spp.* (Avian mycoplasmosis: CRD), *Aspergillus spp.* (Brooding pneumonia- poultry), Opportunistic fungi (Thrush, Mastitis), *Trichophyton spp.* (Dermatophytosis), *Microsporum spp.* (Dermatophytosis), Dimorphic fungi (Systemic mycoses), Mycotoxins, and Mycotoxicosis.

Practical:

Collection, transportation and processing of samples for bacterial isolation and identification, *Staphylococcus* species (coagulase tests), *Streptococcus* species (CAMP test, catalase), *E. coli*, (IMVIC), *Salmonella spp.* (bacterial agglutination tests SAT), *Bacillus species*, (Ascoli test), *Pasteurella species*, (animal inoculation test), *Mycobacterium species*, (Tuberculin test), *Clostridium spp.*, (Nagler reaction, Stormy fermentation), *Mycoplasma spp.*, (SAT, ELISA), *Burkholderia species* (Mallein tests), Quality control of bacterial vaccines, Monitoring of vaccinated animals, CFT test for Glanders, Serodiagnosis (AGPT, FAT), isolation and identification of fungal contaminants.

Textbook:

1. Quinn, P.J., M.E. Carter, B.K. Markie and G.R. Carter, 2013. Clinical Veterinary Microbiology. Mosby, USA.

Recommended Books:

1. Cottral, G.E., 1978. Manual of Standardized Methods for Veterinary Microbiology, Comstock Publishing Associates: A Division of Cornell University Press, Ithaca, USA.
2. Merchant, I.A. and R.A. Packer, 1984. Veterinary Bacteriology and Virology. 7th Ed., Iowa State University Press, Ames, Iowa. .
3. OIE, 2000. Manual of Standards for Diagnostic Tests and Vaccines. Off. Intl. des. Epiz., Paris, France
4. Buxton and Fraser, 1977. Animal Microbiology, Volume 1, Black Well Scientific, Publications Limited
5. Seeley, Vandemark and Lee, 1991. Microbes in Action: A laboratory manual of Microbiology, 4thedition, WH Freeman and Co. New York, USA
6. Talaro, K. and A. Talaro, 1996. Foundation in Microbiology. 2ndEd., Win C. Brown Publ., owa.
7. Virella, G., 1997. Microbiology and Infectious Disease. 3rdEd., Williams and Wilkins, Baltimore.

SYSTEMIC VETERINARY PATHOLOGY**3 (2-1)****Learning Outcomes:**

At the end of this course the students will be able to:

1. Describe mechanism of disease development in various body systems of the animals.
2. Conduct the postmortem examination of small and large animals and interpret the findings.
3. Recognize and quantify gross and histopathological lesions in different diseases.
4. Co-relate the lesions with disease conditions.

Theory:

Pathology of important diseases of body systems: digestive, urinary, respiratory, circulatory, lymphatic, reproductive, nervous, musculo-skeletal, skin & appendages and sense organs. Pathology of metabolic diseases and nutritional deficiencies.

Practical:

Postmortem examination of small and large animals. Demonstration of histopathological slides of various systems. Visits to abattoirs and examination of different pathological conditions.

Textbook:

1. Zachary, J.F., and D. McGavin, 2013. Pathological basis of Veterinary Disease, 5th Ed., Elsevier, USA.

Recommended Books:

1. Jubb, K.V.F., P.C. Kennedy and N. Palmer, 2007. Pathology of Domestic Animals, 5th Ed., Academic Press Inc. San Diego, California, USA (3 vol. set).
2. Andrews, J.J. (Ed), 1986. Necropsy Techniques. The Veterinary Clinics of North America, 2(1): 1-2002.

VETERINARY HELMINTHOLOGY

4(3-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe life cycle, pathogenesis and control of helminth diseases
2. Collect and process helminth samples and parasite specimens for identification / diagnosis

Theory:

Introduction to helminthology; Classification, morphology, life cycle, pathogenesis, diagnosis and control of the species of the following genera of trematodes: *Dicrocoelium*, *Eurytrema*, *Opisthorchis*, *Clonorchis*, *Nanophyetus*, *Fasciola*, *Fasciolopsis*, *Fascioloides*, *Echinostoma*, *Metagonimus*, *Paragonimus*, *Prosthogonimus*, *Paramphistomum*, *Cotylophoran*, *Gastrothylax*, *Gastrodiscus* and *Schistosoma*. Classification, morphology, life cycle, pathogenesis, diagnosis and control of the species of the following genera of cestodes: *Anoplocephala*, *Paranoplocephala*, *Moniezia*, *Avitellina*, *Stilesia*, *Thysanosoma*, *Davainea*, *Raillietina*, *Amoebotaenia*, *Choanotaenia*, *Dipylidium*, *Hymenolepis*, *Taenia*, *Echinococcus*, *Mesocestoides*, *Diphyllobothrium* and *Spirometra*. Classification, morphology, life cycle, pathogenesis, diagnosis and control of the species of the following genera of nematodes: *Ostertagia*, *Cooperia*, *Haemonchus*, *Trichostrongylus*, *Bunostomum*, *Chabertia*, *Oesophagostomum*, *Ascaris*, *Parascaris*, *Toxascaris*, *Toxocara*, *Heterakis*, *Ascaridia*, *Strongylus*, *Dictyocaulus*, *Metastrongylus*, *Protostrongylus*, *Meullerius*, *Rhabditis*, *Stephanurus*, *Thelazia*, *Spirocerca*, *Gongylonema*, *Tetrameres*, *Angiostrongylus*, *Habronema*, *Ancylostoma*, *Necator*, *Uncinaria*, *Oxyuris*, *Enterobius*, *Subulura*, *Strongyloides*, *Gnathostoma*, *Dirofilaria*, *Wuchereria*, *Loa*, *Parafilaria*, *Setaria*, *Dipetalonema*, *Onchocerca*, *Dracunculus*, *Trichinella*, *Trichuris*, *Capillaria*, *Diectophyma*, *Acanthocephala*, *Macrocanthorhynchus*, *Annelida* and *Hirudo*. Zoonoses in helminthes; Concepts on formulating/designing the effective control strategies against helminth parasites with special reference to cestodes and trematodes

Practical:

Methods for collection, transportation, fixation and preservation of helminthes; Methods for collection and examination of faeces, urine and sputum for the presence of eggs/larvae of cestodes, nematodes and trematodes; Methods for examination and staining of blood film for helminthes; Identification of trematodes, cestodes, nematodes, interpretation of result reports; Field visit at livestock and poultry farms for collection and identification of endoparasites including cestodes, nematodes and trematodes.

Textbook:

1. Urquhart G.M., J. Armour, J.L. Duncan, A.M. Dunn, F.W. Jennings, 2000. Veterinary Parasitology. Longman Scientific and Technical, U.K.

Recommended Books:

1. Schmidt G.D. and L.S. Roberts, 2013. Foundations of Parasitology. 9th Edition, W.C.B. Company, U.K.
2. Bowman D.D., 2013. Georgi's Parasitology for Veterinarians. Saunders Elsevier, 10th Ed.
3. Soulsby, E.J.L., 2006. Helminths, Arthropods and Protozoa of Domesticated Animals. The English Language Book Society Bailliere Tindall, London
4. Foreyt, W.J., 2001. Veterinary Parasitology, Reference Manual Iowa State Press, Blackwell Publishing Company.
5. Zajac A.M. and G.A. Conboy, 2006. Veterinary Clinical Parasitology 7th Edition Blackwell Publishing AAVP
6. Iqbal, Z., Z.D. Sandhu and A. Jabbar, 2004. Manual of Veterinary Helminthology. Friends Science Publishers, Faisalabad.

LIVESTOCK EXTENSION EDUCATION**2 (2-0)****Learning Outcomes:**

At the end of the course, students will be able to:

1. Define and explain basic concepts of extension education
2. Review and apply extension methods in the field
3. Use various communication tools and methods for effective dissemination of knowledge to farming community
4. Plan and execute extension programs

Theory:

Extension education, its role in enhancing livestock productivity; communication and its application in extension, communication barriers and measure to overcome these barriers, attitude change and factors affecting farmers attitude; extension methods; use of audio-visual aids in extension work; interviewing, writing reports and extension articles for newspapers; use of print and electronic media for extension work; adoption and diffusion of livestock innovations; demand-driven extension strategy through participatory approach; practice of microteaching; extension program development.

Textbook:

1. Memon, RA and Bashir, E. 1995. Extension Methods, National Book Foundation. Islamabad, Pakistan.

Recommended Books:

1. De, Dipak and J. Prabhubasava, 2010. A Handbook of Extension Education. Agrobios, Judhpur, India.
- 2- Muhammad, S., 2005. Agriculture Extension Strategies and Skills. Unitech Communications, Faisalabad. Pakistan.

- 4- Calvert, P., 1990. The Communicator's Hand Book: Techniques and Technology, Gainesville, USA.

ANIMAL BREEDING AND GENETICS - I

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe basic concepts of genetics
2. Describe gene as unit of inheritance and principles of inheritance
3. Describe genomic techniques and their application.

Theory:

Genetics; historical development and scope; genetic basis of inheritance, gametogenesis; Mendelism: Mendel's laws, monohybrid and polyhybrid crosses; Probability: concept and laws of probability; Chi-square test and its applications; Modified segregation ratios; Multiple allelo-morphism; Polygenic inheritance; Genes and different gene actions: dominance, recessive, epistasis, additive and non-additive gene action; Genetics of sex: sex determining mechanisms, sex linkage and its variation; Pleiotropy; Linkage and crossing over; Gene mutation and chromosomal aberration; Lethal and sub-lethal genes, elimination of lethal genes from livestock populations and other genetic abnormalities; Genetic engineering: basic concepts of recombinant DNA technology, gene cloning and manipulation; Its application and future; Extra-nuclear inheritance. Laws governing breeding and genetics.

Practical:

Microscopic studies on the animal cells undergoing mitosis and meiosis; Exercises on Mendelian and modified segregation ratios; Karyotyping and Banding for detecting chromosomal abnormalities; Genomic DNA isolation, purification and separation on gel electrophoresis; Quantification and storage; Primers, Polymerase chain reaction (PCR); DNA fingerprinting by using restriction fragment length polymorphism (RFLP), random amplified polymorphic DNA (RAPD), and amplified fragment length polymorphism (AFLP); DNA sequencing and genotyping; Basic alignment of sequences.

Textbook:

1. Klug, W. S., 2010. Essentials of Genetics. Pearson Benjamin Cummings, San Francisco, CA, USA.

Recommended Books:

1. Griffiths, A. J. F., 2012. Introduction to Genetic Analysis. W.H. Freeman and Co., New York.
2. Hodge, R., 2009. Genetic Engineering: Manipulating the Mechanisms of Life. Facts on File, New York.
3. Gardener, E. J., M. J. Simmons and D. P. Snustad, 1991. Principles of Genetics. John Wiley and Sons. Inc., New York, U.S.A.
4. Nicholas, F., 2009. Introduction to Veterinary Genetics. Wiley-Blackwell.

SEMESTER V

POULTRY NUTRITION AND FEED TECHNOLOGY

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Identify avian anatomical and physiological factors which influence feeding and nutrient requirements.
2. Describe various feedstuffs used in poultry feeding and their potential limitations.
3. Describe feeding strategies used in raising poultry for meat and egg production.
4. Explain methods of feed presentation in both conventional and modern production units
5. Perform manual and software based feed formulation for different classes of poultry.
6. Identify emerging areas of interest and concern in poultry feeding and nutrition.

Theory:

Avian digestive anatomy and physiology. Classification of poultry feed ingredients and their chemical composition. Anti-nutritional factors in feed stuffs for poultry. Feed additives in poultry nutrition. New concepts in poultry feeding. Nutrition of broiler, layer and breeder birds. Nutritional deficiency diseases in poultry. Feed stuff handling and storage at poultry feed mill. Feed stuff processing: grinding, mixing, pelleting and extrusion. Current and future prospects of poultry nutrition.

Practical:

Identification of poultry feed ingredients. Bulk feed stuff sampling, sample preparation and handling for laboratory analysis. Raw material handling and storage. Feed formulation for different classes of poultry bird: Manual method, MS excel, computer software. Preparation of wholesome feed at farm level. Quality control management in poultry feed production. Feeding practices at poultry farm. Compound animal feed stuff act. Visit to a commercial poultry feed mill.

Textbook:

1. Lesson, S. and J.D. Summers. 2002. Scott's Nutrition of the Chicken. International Book Distributing Co. Guleph, Ontario, Canada.

Recommended Books:

1. Lesson, S. and J.D. Summers, 1991. Commercial Poultry Nutrition University Books, Guleph, Ontario, Canada.
2. Lesson, S. and J. D. Summers, 2001. Broiler Breeder Production. University Book, Guleph, Ontario, Canada.
3. Nutrient Requirements of Poultry. 1994. National Academy Press, Washington, D.C.

Learning Outcomes:

At the end of the course, students will be able to:

1. Define population genetics
2. Describe concepts of genetic parameters
3. Elaborate principles of selection and methods for improvement of farm animals
4. Explain role of animal breeding in genetic improvement
5. Describe various breeding plans and systems and their application

Theory:

Population Genetics: Gene and genotypic frequency; Hardy-Weinberg law, forces affecting gene frequency and genetic structure of a population; Genetic basis of variation; Quantitative characters and their inheritance; Concepts of heritability and repeatability, methods of their estimation; Genetic and phenotypic correlations; Animal breeding: role of animal breeding; breeding systems; random mating, inbreeding, line-breeding, outbreeding, outcrossing, crossbreeding and grading up; Selection: kinds of selection, methods of selection, basis of selection, selection of superior animals, genetic gain and its measurement; traits of economic importance in cattle, buffalo, sheep, goat and poultry; animal genetic resources, their conservation and preservation; emerging breeding technologies; national breeding policy; constraints and future breeding plans; Role of breed registry societies/ associations in developed countries and its application in Pakistan.

Practical:

Calculation of gene and genotypic frequencies; Estimation of heritability, repeatability and genetic correlations; Measurement of coefficient of inbreeding and relationship; evaluation of livestock on the basis of own performance, pedigree and progeny; Construction of selection index; Calculation of breeding values from single and repeated records; Estimation of genetic gain.

Textbook:

1. Bourdon, R. M., 2000. Understanding Animal Breeding. Prentice-Hall, Inc. Upper Saddle River, New Jersey.

Recommended Books:

1. Lasley, J. F., 1987. Genetics of Livestock Improvement. Prentice-Hall International Inc. Englewood Cliffs, New Jersey.
2. Legates, J. E. and E. J. Warwick, 1990. Breeding and Improvement of Farm Animals. McGraw-Hill Publishing Co., New York.
3. MINFAL, 1991. National Agricultural Policy. Ministry of Food, Agriculture and Cooperatives. Government of Pakistan, Islamabad.
4. Oldenbroek, J. K., 1999. Gene banks and the conservation of Farm Animal Genetic Resources. DLO Institute for Animal Science and Health, The Netherlands.
5. Willis, M. B., 2001. Dalton's Introduction to Practical Animal Breeding. Blackwell Science, Oxford.

CLINICAL VETERINARY PATHOLOGY

1(0-1)

Learning Outcomes:

1. Diagnose diseases conditions based on laboratory tests
2. Perform and interpret biochemical tests
3. Interpret results of molecular diagnostic tests

Practical:

Organization of clinical pathology lab; collection, preservation and dispatch of laboratory specimens, haematological examination in diseases of different animals, diagnosis and interpretations of hematological disorders, anaemia and its classifications, diagnosis of various neoplastic conditions of blood, coagulation disorders, bone marrow response in various diseases and its evaluation, urinalysis, liver function tests (LFTs) and renal function tests (RFTs), plasma protein profile, blood electrolytes, exfoliative cytology, demonstration of molecular diagnostic techniques, case studies.

Recommended Books:

1. Latimer, K.S., E.A. Mahaffey and K.W. Prasse, 2003. Duncan & Prasse's Veterinary Laboratory Medicine Clinical Pathology. 4th Ed., Iowa State Press, Ames, Iowa, USA.
2. Kaneko, J.J., J.W. Harvey and M.L. Bruss, 2008. Clinical Biochemistry of Domestic Animals. 6th Ed. Academic Press, USA.

VETERINARY ENTOMOLOGY AND ACAROLOGY

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe life cycle, vector importance/pathogenesis and control of insects and arachnids.
2. Collect and process biological samples and parasite specimens for identification / diagnosis
3. Assess the prevalence, economic / public health significance of parasitic diseases in an environment.

Theory:

General introduction of entomology: arthropods and their economic significance; classification of arthropoda; respiratory, digestive, nervous and reproductive systems of arthropods; different types of mouthparts of insects and arachnids and their significance in disease transmission; classification, morphology, life cycle, pathogenesis, diagnosis and control of the species of the following families of arthropods: Haematopinidae, Linognathidae, Pediculidae, Cimicidae, Reduviidae, Culicidae, Ceratopogonidae, Simuliidae, Psychodidae, Tabanidae, Gastrophilidae, Glossinidae, Muscidae, Calliphoridae, Oesteridae, Hypodermatidae, Cuterebridae, Hippoboscidae, Ixodidae, Argasidae, Demodicidae, Sarcoptidae, Psoroptidae, Dermanyssidae and Cheylotodae, role of insects and arachnids as vector.

Practical:

Methods for collection, fixation and preservation of arthropods; methods for preparation of permanent mounts and pinning of insects and arachnids; examination of skin scrapings for mange; Identification of lice, bugs, fleas, flies, ticks and mites; field visit for practical exposure to ectoparasitic infestations; demonstration of application of insecticides by arranging visits to livestock farms

Textbook:

1. Urquhart G.M., J. Armour, J.L. Duncan, A.M. Dunn, F.W. Jennings, 2000. Veterinary Parasitology. Longman Scientific and Technical, U.K.

Recommended Books:

1. Schmidt G.D. and L.S. Roberts, 2013. Foundations of Parasitology. 9th Edition, W.C.B. Company, U.K.
2. Bowman D.D., 2013. Georgi's Parasitology for Veterinarians. Saunders Elsevier, 10th Ed.
3. Foreyt, W.J., 2001. Veterinary Parasitology, Reference Manual Iowa State Press, Blackwell Publishing Company.
4. Zajac A.M. and G.A. Conboy, 2006. Veterinary Clinical Parasitology 7th Edition Blackwell Publishing AAVP
5. Taylor, M.A., L.L. Coop, and R.L. Wall, 2007. Veterinary Parasitology. 3rd Ed. Blackwell Publishing, UK
6. Iqbal, Z., M.N. Khan and A. Jabbar, 2003. An Illustrated Textbook of Veterinary Entomology. Friends Science Publishers, Faisalabad- Pakistan.

VETERINARY VIROLOGY**3(2-1)****Learning Outcomes:**

At the end of the course, students will be able to:

1. Elaborate strategic planning for short listing the diseases during the process of diagnosis of unknown viral diseases
2. Provide description for methods of sample collection for submission to veterinary diagnostic labs.
3. Describe entry of viruses into the body of animals, their pathogenesis, excretion in the environment and dissemination
4. Elaborate clinical and laboratory based disease diagnosis
5. Describe preventive vaccination, disinfection and other bio-security measures for control of animal viral diseases.

Theory:

Introduction, etiology, pathogenesis, transmission, diagnosis and control of following DNA containing viral diseases of veterinary importance: Herpesviridae: Infectious bovine rhinotracheitis, Marek's disease, Infectious laryngotracheitis (ILT); Papillomaviridae: Warts- livestock; Adenoviridae: Avian adenovirus-HPS, IBH, EDS, canine adenovirus; Poxviridae: Fowl pox, Cow pox, Capri pox, sheep pox; Parvoviridae: Canine parvovirus, Feline panleucopenia, bovine parvovirus; Circoviridae: Chicken anemia virus.

Introduction, etiology, pathogenesis, transmission, diagnosis and control of following RNA containing viral diseases of veterinary importance: Picornaviridae: FMD virus; Paramyxoviridae: Newcastle disease virus, PPRV, RPV, Canine distemper; Orthomyxoviridae: Avian influenza virus; Rhabdoviridae: Rabies, Bovine ephemeral fever; Birnaviridae: Infectious bursal disease; Reoviridae: Blue tongue, Avian tenosynovitis; Coronaviridae: Infectious bronchitis- poultry, Bovine and canine diarrhea; Togaviridae: Eastern, western, venezuelan equine encephalitis; Pestivirus: BVD; Retroviridae: Avian leukosis, Prions-BSE.

Practical:

Sources of sample; sample collection and transportation of samples for virus isolation, Processing of samples for virus isolation, Cultivation of NDV in chicken embryos, Cultivation of AIV in chicken embryos, Establishment of monolayer of BHK-21 cell line, FMD Virus cultivation in BHK-21, PPR Virus cultivation in vero cell line, HPS virus growth in broilers, EM and demonstration of Negri bodies (through simulations & images), Sero-characterization of NDV-HA&HI tests, Virus neutralization test, Sero-characterization of FMD virus by ELISA, Sero-characterization of PPR virus by CFT, Sero-characterization of IBDV by AGPT, Evaluation of attenuated live NDV virus vaccine and Evaluation of killed FMD virus vaccine, study tour of Research Institutes / Biological Production Units.

Textbook:

1. Quinn, P.J., M.E. Carter, B.K. Markie and G.R. Carter, 2013. Clinical Veterinary Microbiology. Mosby, USA.

Recommended Books:

1. Anonymous, 1999. A laboratory manual for the isolation and identification of avian pathogens.6th Ed. American Association of Avian pathologists, Iowa State University Press, Ames, Iowa.
2. Castro, A.E. and W.F. Henschele, 1992. Veterinary Diagnostic Virology.Mosby yearbook, Inc., Baltimore.
3. Fenner, F.J., E.P. Gibbs, F.A. Murphy, M.J. Studdert and D.O. White, 1993. Veterinary Virology 2ndEd., Academic Press London.
4. OIE, 2000. Manual of standards for diagnostic tests and vaccines. Off. Intl. Des. Epiz., Paris.
5. Talaro, K. and A. Talaro, 1996. Foundation in Microbiology. 2ndEd., Win C. Brown Publ., Iowa.
6. Virella, G., 1997. Microbiology and Infectious Disease.3rdEd., Williams and Wilkins, Baltimore.

VETERINARY REPRODUCTIVE PHYSIOLOGY

3 (2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe structures and functions of male and female reproductive systems

2. Describe reproductive processes of male and female animals (equines, small ruminants and companion animals)
3. Describe mechanisms of pregnancy and parturition

Theory:

Anatomy and physiology of male and female reproductive system, Embryogenesis of male and female reproductive systems, Neural and neuroendocrine reflexes, Mechanisms of action of protein and steroid hormones, Classification of reproductive hormones, Roles of reproductive hormones, Factors affecting the onset of puberty, Factors influencing reproductive cyclicity, Folliculogenesis and oogenesis, Oocyte maturation and ovulation, Physiology of estrous cycle: Follicular Phase, Physiology of estrous cycle: Luteal Phase, Luteinisation and luteolysis, Reproductive behaviour, Sequence of spermatogenesis, Factors influencing sperm production, Physiology of copulation and ejaculation, Sperm transport in the female reproductive tract, Capacitation and fertilization, Early embryogenesis, Maternal recognition of pregnancy, Implantation and placentation, Sex differentiation, Endocrinology of gestation, Endocrinology of parturition, Physiology of puerperium, Physiology of equine reproduction, Physiology of caprine reproduction, Physiology of ovine reproduction, Physiology of canine reproduction, Physiology of feline reproduction

Practical:

Table palpation and biometry of female reproductive organs, Live palpation and biometry of female reproductive organs, Demonstration of male reproductive organs, Demonstration of normal semen parameters, Demonstration of artificial insemination instruments, Practice of passing AI rod, Preparation of semen extenders, Evaluation of fresh and frozen thawed semen, Cumulus Oocyte Complexes (COC) aspiration and grading of oocytes, Demonstration of embryo transfer instruments.

Textbook:

1. Senger, P.L., 2003. Pathways to Pregnancy and Parturition. 2ndEd. Current Conceptions Inc., Pullman, USA.

Recommended Books:

1. Hafez, E.S.E. and B. Hafez, 2000. Reproduction in Farm Animals. 7thEd. Lippincott, USA
2. Salisbury, G.W., N.L. Van Demark and J.R. Lodge, 1985. Physiology of Reproduction and AI. 2ndEd, CBS India
3. Penner, P., R. E. Empringham and P.A. Watson, 1993. Bovine AI Technical Manual. 2ndEd, Ontario, Canada

GENERAL AND SYSTEMIC VETERINARY MEDICINE 3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe systemic states induced by various disease processes in animal's body.

2. Explain clinical manifestations and principles of treatment infectious and non-infectious conditions/diseases of different body organs and/or systems.
3. Restrain animals for clinical examination.
4. Perform clinical examination procedures, analyze information, diagnose, and prescribe.
5. Demonstrate different routes of drug administration in different animal species.

Theory:

History and scope of veterinary medicine, Concept of animal diseases, General terminology used in veterinary medicine; **General Systemic states:** Fever, Hyperthermia, Hypothermia, Toxemia/Septicemia, Bacteremia/Viremia, Shock, Hypersensitivity, Allergy/anaphylaxis; Disseminated intravascular coagulo-pathy; **Diseases of alimentary system:** Principles of alimentary dysfunction, Stomatitis/parotitis, Pharyngitis/esophagitis, Pharyngeal obstruction/esophageal obstruction, Colic, Gastritis, Vomiting, Peritonitis, Simple indigestion, vagal indigestion, Ruminal acidosis and alkalosis, Ruminal tympany/bloat, Diseases associated with hardwares/Traumatic reticulo-peritonitis, Enteritis/diarrhoea, Left sided abomasal displacement, Neoplasms of alimentary tract; **Diseases of liver and pancreas:** Principles of hepatic dysfunction, Hepatitis, jaundice, Cholelithiasis, Pancreatitis, Diabetes mellitus; **Diseases of cardiovascular system:** Principles of circulatory failure, Pericarditis/traumatic pericarditis, Myocarditis/endocarditis, Acute heart failure, Congestive heart failure; Peripheral circulatory failure; **Diseases of haemolymphatic and immune system:** Disorders of white blood cells, Anemia, Oedema, Hemorrhage, Lymphadenopathy; **Diseases of respiratory system:** Principles of respiratory insufficiency, Rhinitis, Laryngitis/tracheitis/bronchitis, Pulmonary congestion and edema, Pneumonia/aspiration pneumonia, Pulmonary emphysema, Hydrothorax/haemothorax/pneumothorax, Pleurisy, Epistaxis/haemoptysis; **Diseases of nervous system:** Principles of nervous dysfunction, Meningitis, Encephalitis, Encephalomalacia, Traumatic injury to brain and spinal cord, Focal diseases of brain; **Diseases of renal system:** Principles of renal insufficiency, Nephritis, Nephrosis, Pyelonephritis, Cystitis, Urolithiasis; **Diseases of musculoskeletal system:** Myositis, Myopathy, Arthritis/synovitis, Arthropathy Osteomyelitis, Osteomalacia, Osteodystrophy; **Diseases of integumentary system:** Pityriasis, hyperkeratosis, Parakeratosis, Patchyderma, Urticarial, Seborrhea, Dermatitis, Photosensitization, Tumors and cysts of skin; **Diseases of eye:** Ophthalmic manifestations of systemic diseases, Conjunctivitis and keratoconjunctivitis, Cataract, Glaucoma; **Diseases of ear:** Otitis, Ear hematoma

Practical:

Orientation of Veterinary Clinics, Animal restraint, History taking, Clinical examination of individual animal and herd (General examination, Physical examination), Recording cardinal signs of health (temperature, pulse rate, respiration rate), Rectal examination (Palpation of pelvic/abdominal organs of

cattle, buffalo, horse etc.), Art of prescription writing, Methods of drug administration (oral, parenteral, topical), Passing of stomach tube, probing, urinary catheter, trocar and cannula etc., Special examination, clinical manifestations and principles of treatment of alimentary system, respiratory system, nervous system, cardiovascular system, musculoskeletal system, renal system, integumentary system, eye, ear and bovine udder.

Textbook:

1. Radostits, O.M., C.C. Gay, K.W. Hincheliff and P. D. Constable. 2007. A Text Book of Veterinary Medicine, 10th Ed. Saunders Elsevier, PA, USA.

Recommended Books:

1. Kelly, W. R., 1984. Veterinary Clinical Diagnosis. 3rd Ed. Bailliere Tindall & Corsell, London, UK.
2. Kahn C.M., 2010. The Merck Veterinary Manual. 10th Ed. Merck & Company., INC, Whitehouse Station, N.J., USA.
3. Pinsent, P.J.N. and C.J. Fulle, 1997. Outline of Clinical Diagnosis in Horse. Blackwell Science, Oxford, UK.
4. Howard J.L, 1999. Current Veterinary Therapy, Food Animal Practice. W.B. Saunders, Co., USA.
5. Hungerford. T.G., 1991, Hungerford's Diseases of Livestock 9th Ed. McGraw-Hill Book Company, Sydney, Australia.

ISLAMIC STUDIES

1(1-0)

Objectives:

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

Detail of Courses:

Introduction to Quranic Studies

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul-Quran

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Baqara Related to Faith(Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)

- 5) Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Ihزاب Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I

- 1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
- 2) Life of Holy Prophet (S.A.W) in Makkah
- 3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

- 1) Life of Holy Prophet (S.A.W) in Madina
- 2) Important Events of Life Holy Prophet in Madina
- 3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction to Sunnah

- 1) Basic Concepts of Hadith
- 2) History of Hadith
- 3) Kinds of Hadith
- 4) Uloom –ul-Hadith
- 5) Sunnah & Hadith
- 6) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence

- 1) Basic Concepts of Islamic Law & Jurisprudence
- 2) History & Importance of Islamic Law & Jurisprudence
- 3) Sources of Islamic Law & Jurisprudence
- 4) Nature of Differences in Islamic Law
- 5) Islam and Sectarianism

Islamic Culture & Civilization

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quran & Science

Islamic Economic System

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba

- 4) Islamic Ways of Trade & Commerce

Political System of Islam

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

Islamic History

- 1) Period of Khlaft-E-Rashida
- 2) Period of Ummayyads
- 3) Period of Abbasids

Social System of Islam

- 1) Basic Concepts of Social System of Islam
- 2) Elements of Family
- 3) Ethical Values of Islam

Reference Books:

- 1) Hameed ullah Muhammad, "Emergence of Islam" , IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, "Introduction to Islam"
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
- 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

ETHICS

1(1-0)

Learning Outcomes:

At the end of the course, students will be able to:

1. Define ethics and describe ethical teaching of world religions
2. Describe ethics to be followed in business, biomedical, society, and interactions with animal

Theory:

Definition, scope and nature of ethics, development of ethical theory, ethical teachings of world religions, promotion of moral values through family and institutions, general review of moral standard as duty and happiness with reference to Kant and Mill, general review of business ethics, profits and ethics, ethics of stakeholders, general review of biomedical ethics, ethical implications of euthanasia (ethics of care), ethical implications of abortion,

general review of ethics and ecology, the right to liveable environment and animals.

Recommended Books:

1. William, L.A., 1982. Introduction to Ethics, Mathuen & Co. Ltd., London, UK.
2. Garewal, S. M., 1985. Pakistan Way of Life and Culture. United Ltd., Lahore, Pakistan
3. Joseph, G., 1984 What the Great Religions Believe, New American Library, New York, USA.

SEMESTER VI

ZOONOSES AND FOOD SAFETY

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Define and describe the basics of zoonotic diseases, one health and principles of food safety
2. Describe laws and regulations impacting food animal, processing industries and food consumers
3. Describe approaches to microbiological and physical food borne hazard identification, testing and sampling; and food borne hazard prevention and control.
4. Describe the route(s) of transmission of major zoonotic diseases, individual and population prevention and control methods for major zoonotic diseases.

Theory:

Introduction to zoonosis and its classification, Impact of zoonotic diseases on human health and economy, Global prevalence of zoonotic diseases, Role of veterinarians in preventing zoonotic diseases, one health concept and Zoonosis: Viral, Bacterial, Parasitic and Fungal, Companion animals and zoonosis, Handling of zoonotic diseases (e.g. woolsorter's diseases), Regulations regarding zoonotic diseases. Food safety as global issue, Foodborne disease surveillance and outbreak investigation, Food safety monitoring, Drug Resistance and food safety, Surveillance and reporting of food borne illness, Hygienic handling and processing of milk and meat products. Water, Milk- and Meat-borne diseases, Microbiological standards of water, milk, meat, eggs and their by-products, Intoxications associated with food products of animal origin, Residues in food products of animal origin, WTO standards, Importance and need of Communication with media, Role of national and international agencies in controlling emerging and re-emerging diseases, HACCP certification, ISO 22000 and Global Gap program for food safety.

Practical:

Collection, transportation and bacteriological examination of water, milk, eggs and meat samples, Qualitative standards for food safety certification of milk and meat, Quantitative standards, most probable number (MPN) and plate count (APC), Testing of residues (Antibiotics, heavy metals etc), Isolation and identification of pathogens from milk products and molecular diagnostic methods for food pathogens, Schematic sketch for isolation and characterization of bacteria, Screening and diagnosis of brucellosis, Screening and diagnosis of Tuberculosis, Screening and diagnosis of mastitis, Identification of adulteration in milk samples, Visits to Milk processing plant, Visits to Abattoir, Data collection and analysis of food borne illness.

Textbook:

1. Hartmurt, K., 2009. Zoonoses, 3rd Edition, ASM press, USA.

Recommended Books:

1. Morris, J. G. and M.E. Potter, 2013. Foodborne Infections and Intoxications. 4th ed. Academic Press. USA
2. Rahman, H., L. R. Chatlod and Z.B. Dubal, 2011. Veterinary public health, New trends. Biotech Books, India
3. Pedro, N. A. and S. Boris, 2003. Zoonoses and communicable diseases common to man and animals. 3rd Edition. Pan American Health Organization. USA.

PRINCIPLES OF DAIRY PRODUCTION

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe current status, challenges and potential of dairy production in Pakistan.
2. Describe modern management systems for enhancement of clean milk production.
3. Run a successful dairy enterprise through modern management techniques and practices.

Theory:

Present status of dairy production in Pakistan; Breeds of local, exotic and crossbred dairy animals; Production systems; Principles of profitable dairy farming; Planning for establishing a dairy farm; management of calves, young stock, dry, pregnant, transition and lactating animals; bull management; housing, welfare and behavior of dairy animals; reproductive management of dairy animals; farm mechanization; feeding management of dairy animals; heat stress management; biosecurity, hygiene and farm waste management; common ailments, prophylaxis and keeping dairy animals healthy; hygienic milk production and parlor management; mastitis control; marketing of animals, milk and milk products, record keeping, data analysis, report preparation and economic appraisal of a dairy farm.

Practical:

Identification/demonstration of characteristics of local, exotic and crossbred animals; judging and scoring of dairy animals; farm management practices for calves, young stock, dry and lactating animals; observation of animal behaviour and cow signals; heat detection practices, pregnancy diagnosis; milking practice and milk analysis; preparation of housing plans for small, medium and large dairy farms; observation and assessment of housing environment; feed preparation practices; cleaning, sanitation and biosecurity measures in farm premises; preparation of feasibility reports; fodder production and preservation practices; record keeping and farm management software.

Textbook:

1. Thomas, C.K., N.S.R. Sastry and G. Ravikiran, 2012. Dairy Bovine Production. Kalyani Publishers, New Delhi

Recommended Books:

1. Donald, B., L. Frank, N. Dickinson and H.A. Tucker, 1985. Dairy cattle: Principles, Practices, Problems, Profits. 3rdEd. Lea &Febiger, Philadelphia.
2. Khan, B.B (Ed.), 2008. Health and Husbandry of Dairy Animals. Pak. T.M. Printers, Faisalabad, Pakistan.
3. Riaz, M., S.H. Raza, M. Lateef and M. Yaqoob, 2006. Principles and Practices in Livestock Management (1stEd.), Pak TM Printers, Faisalabad.
4. Ensminger, M.E., 1990. Dairy Cattle Science. The Interstate Printers and Publishers Inc., Danville, Illinois, USA.
5. Khan, M.A., 2009. Buffalo; The Animal of Future. *Idara Matboat-i-Sulaimani*, Urdu Bazar Lahore.

REPRODUCTIVE BIOTECHNOLOGY**2 (2-0)****Learning Outcomes:**

At the end of the course, students will be able to:

1. Explain the importance of reproductive biotechnologies and their status in Pakistan
2. Describe steps involved in semen preservation, semen evaluation and cryopreservation.
3. Elaborate different estrus synchronization programs and their field applications
4. Define and explain Embryo transfer (ET), In vitro embryo production (IVEP), In vitro Fertilization (IVF), Pre-implantation genetic diagnosis (PGD) and Intracytoplasmic sperm injection (ICSI)
5. Exemplify and describe advanced reproductive biotechnologies

Theory:

Introduction to biotechnology, Estrus cycle and estrus detection, Basics of estrus synchronization, Application of estrus synchronization, Basics of cryopreservation, Consequences of freezing-thawing, History and status of artificial insemination, Techniques of artificial insemination, Breeding

soundness examination, Progeny testing program, Basics of reproductive ultrasonography, Application of reproductive ultrasonography, Introduction to embryo transfer technology, Selection of donors and superovulation, Embryo collection and evaluation, Selection of recipients and embryo transfer, Introduction to *in vitro* technologies, Oocytes collection and grading, *In-vitro* maturation of oocytes, *In-vitro* fertilization and ICSI, *In-vitro* culture of embryos, Assisted reproductive technologies, Applications of assisted reproduction, Pre-implantation genetic diagnosis, Introduction to animal cloning, Application of animal cloning, Gender selection via semen sexing, Gender selection via embryo sexing, Introduction to stem cells technology, Application of embryonic stem cells, Introduction to therapeutic cloning, Introduction to transgenesis in domestic animals

Textbook:

1. Gordon, I., 1996. Controlled reproduction in cattle and buffaloes. Published by CAB International Willingford, UK

Recommended Books:

1. Meredith, M.J. (Ed), 1995. Animal breeding and infertility. 1st edition Blackwell publishers, Berlin, Germany
2. Senger, P.L., 2003. Pathways to pregnancy and parturition. 2ndEd. Current Conceptions Inc. Pullman USA

VETERINARY PREVENTIVE MEDICINE-I

3(3-0)

Learning Outcomes:

At the end of the course, students will be able to:

1. Characterize the etiology, epidemiology, and clinical manifestations of infectious diseases of ruminants and equines.
2. Describe the main transmission routes for infectious diseases, including animal-human, human-animal, vector-borne, water-borne, and air-borne cycles.
3. Explain mechanism of development/pathogenesis of diseases caused by different infectious agents in ruminants and equines
4. Principles and tools for proper diagnosis and differential diagnosis of infectious diseases of animals.
5. Demonstration of treatment protocols of diseases associated with different pathogenic organisms in animals.
6. Describe interventions used to control and prevent disease, and improve animal health at the individual and herd level.

Theory:

While etiology and pathogenesis are reviewed, emphasis will be given on clinical signs, diagnosis, differential diagnosis, treatment, control and prevention.

Diseases associated with Streptococcus species:(Strangles, Neonatal Streptococcal infection); Diseases associated with Staphylococcus species:

(Tick pyemia of lambs); *Diseases associated with Corynebacterium species*: (Contagious bovine pyelonephritis, Caseous lymphadenitis of sheep and goats, Ulcerative lymphangitis of horses and cattle, Contagious acne of horses); *Diseases associated with Listeria species*: (Listeriosis); *Diseases associated with Bacillus species*: (Anthrax); *Diseases associated with Clostridium species*: (Tetanus, Botulism, Blackleg, Malignant edema, Infectious necrotic hepatitis, Bacillary hemoglobinuria, Enterotoxemia); *Diseases associated with Escherichia coli* (Acute undifferentiated diarrhea of newborn farm animals, Colibacillosis); *Diseases associated with Salmonella species*: (Salmonellosis); *Diseases associated with Pasteurella species*: (Septicemic pasteurellosis (HS), Bovine respiratory disease, Pneumonic pasteurellosis (Shipping fever)); *Diseases associated with Brucella species*: (Brucellosis); *Diseases associated with Moraxella species*: (Infectious keratitis of cattle); *Diseases associated with Mycobacterium species*: (Tuberculosis, Johne's disease); *Diseases associated with Actinomyces spp. Actinobacillus spp., Dermatophilus spp.* (Actinomycosis, Actinobacillosis, Dermatophilosis); *Diseases associated with Fusobacterium and Bacteroides spp.*: (Necrobacillosis, Bovine digital dermatitis, Infectious foot rot); *Diseases associated with Pseudomonas and Burkholderia spp.*: (Fleece rot in sheep, Glanders); *Diseases associated with Leptospira spp.*: (Leptospirosis); *Diseases associated with Mycoplasma spp.*: (Contagious bovine pleuropneumonia, Contagious agalactia in sheep and goats, Contagious caprine pleuropneumonia, Mycoplasmal arthritis in cattle); *Diseases of mammary glands*: (Mastitis, Udder edema, blood in milk, Viral lesions of udder and teat); *Viral diseases with manifestations attributable to involvement of body as whole*: (Equine infectious anemia, Bovine ephemeral fever, African horse sickness, Rift valley fever); *Viral disease characterized by alimentary tract signs*: (Foot and mouth disease, Vesicular stomatitis, Rinderpest, Peste des petits ruminants, Malignant catarrhal fever, Bovine virus diarrhea/mucosal disease, Viral diarrhea in calves, lambs, kids and foals, Winter dysentery in cattle, Bluetongue); *Viral diseases characterized by respiratory signs*: (Viral infections of the upper respiratory tract of horses, Equine herpes virus infection, Equine viral arteritis, Equine influenza, Enzootic pneumonia of calves, Bovine respiratory syncytial virus pneumonia, Infectious bovine rhinotracheitis); *Viral diseases characterized by nervous signs*: (Viral encephalomyelitis of horses, Rabies, Pseudorabies, Sporadic bovine encephalomyelitis, Ovine encephalomyelitis, Caprine arthritis encephalitis); *Viral diseases characterized by skin lesions*: (Contagious ecthyma, Lumpy skin disease, Cowpox/Sheeppox/goatpox/Horsepox); *Diseases associated with prions*: (Scrapie, Bovine spongiform encephalopathy); *Diseases associated with Rickettsiales*: (Anaplasmosis, Tick-borne fever, Equine granulocytic Anaplasmosis, Potomac horse fever, Q Fever, Lyme disease); *Diseases associated with algae and fungi*: (Aspergillosis, candidiasis, Ringworm); *Diseases associated with protozoa*: (Babesiosis, Theileriosis, Coccidiosis, Neosporosis, Cryptosporidiosis, Toxoplasmosis,); *Disease associated with Trypanosomes*: (Nagana /Surra, Dourine); *Nematode diseases of the alimentary tract*: (Parasitic gastroenteritis in ruminants, Strongylosis in horses, Miscellaneous roundworm infestation (Oxyuris equi,

Strongyloides , Trichuris}); *Nematode diseases of other organs*: (Lungworm); *Nematode induced skin conditions*: (Summer sores in horses, Filarial dermatitis/Parafilariosis); *Nematodes affecting eye*: (Thalazia); *Diseases associated with trematodes and cestodes*: (Fasciolosis, Stomach fluke disease , Adult and larval tapeworm infestation, GID); *Diseases associated with arthropod parasites*: (Stomach bot, Nasal bots, Warble flies, Sheep ked, Tick infestations, Stable flies, Horse flies, Biting midges); *Mite infestation*: (Demodectic mange, Sarcoptic mange, Psoroptic mange, Chorioptic mange):

Textbook:

1. Radostits, O.M., C.C. Gay, K.W. Hincheliff and P. D. Constable, 2007. Veterinary Medicine, 10th Ed. Saunders Elsevier, PA, USA.

Recommended Books:

1. Kahn, C.M., 2010. The Merck Veterinary Manual. 10th Ed. Merck& Company., INC, Whitehouse Station, N.J., USA.
2. Matin, W. B. and I. D. Ait Isen, 2000. Diseases of Sheep, 3rd Ed. Blackwell Science, Oxford, UK.
3. Howard, J.L, 1999. Current Veterinary Therapy, Food Animal Practice. W.B. Saunders, Co., USA.
4. Rebhum, W.C., 1998. Diseases of Dairy Cattle, Williams and Willkins, Baltimore, USA.
5. Smith B.P., 1996. Large Animal Internal Medicine. 2nd Ed. The Mosby Co. Philadelphia U.S.A.
6. Hungerford, T.G., 1991. Hungerford's Diseases of Livestock 9th Ed. McGraw Hill Book Company, Sydney, Australia.
7. Morgan, R.V., 1997. Handbook of Small Animal Practice. 3rd Ed. W.B. Saunders Company, PA, USA.

MEAT INSPECTION AND NECROPSY PRACTICE

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Differentiate between meat of different animals
2. Evaluate meat for wholesomeness
3. Describe the cause of death and pathological lesions.
4. Demonstrate understanding of vetro-legal cases

Theory:

Food animals, slaughter house / abattoir management, Halal meat industry, objectives of meat inspection, antemortem and postmortem examination of animals, non-specific and specific lesions in different organs of body, rigor mortis, conditions rendering meat unwholesome for human consumption, judgment of carcass, disposal of condemned meat, laws regulating meat quality in Pakistan, differentiation of meat of different animals, recognition of contagious and zoonotic diseases associated with abattoirs, differentiation between lesion and postmortem changes, postmortem of large, small, poultry and wild animals, diagnostic features of accidental and infectious causes of death, single and group animal death features, importance of forensic

veterinary pathology, laws and rules governing forensic examination of animals and report writing.

Practical:

Meat inspection and certification procedures, wholesomeness of carcass, techniques for differentiation of meat of different species of animals, laboratory tests for evaluation of wholesome meat, examination of live and dead animals in forensic cases, necropsy techniques, safety measures to be observed while performing necropsy, disposal of carcasses suspected to be suffering from contagious and zoonotic diseases, visits to slaughter house / abattoir for examining, processing (meat by-products) and further processing (value addition) technologies.

Textbooks:

1. Gracey, J.F., 2014. Meat Hygiene. 11th Edition. The English Language Book Society, Bailliere Tindal, London U.K.
2. Cooper, J.E., M.E. Cooper, 2007. Introduction to Veterinary and Comparative Forensic Medicine. Wiley-Blackwell, USA.

Recommended Books:

1. Herenda, D.C. and D.A. Franco. 1991. Food Animal Pathology and Meat Hygiene. Mosby Year Book. London.
2. FAO, 2000. Manual on meat inspection for developing countries, 2nd Ed., Vol. 119, Food and Agriculture Organization of United Nations, Rome, Italy.
3. Grist, A., 2004. Poultry Inspection: Anatomy, Physiology and Disease condition, 2nd Ed., Nottingham University Press.

DIAGNOSTIC IMAGING

2(1-1)

Learning Outcomes:

At the end of the course, the student will be able to:

1. Describe basics of plain and contrast radiographic techniques.
2. Diagnose different medical and surgical ailments through radiographic presentations as seen on radiographs.
3. Demonstrate practical skills in general abdominal sonography.
4. Demonstrate practical skills for performing a survey radiographic exposure and film processing.

Theory:

Scope of diagnostic imaging in veterinary practice; Radiographic terminology and basic principles to study radiographs; Nature and production of X-rays; Radiographic image formation; Radiographic hazards and protection; Radiography of the skeletal system; Plain and Contrast radiography of Urinary System; Plain and Contrast radiography of Gastro-intestinal System; Plain and Contrast radiography of Respiratory System; Principles of Diagnostic Ultrasound including indications and techniques; Ultrasound Artifacts; Sonography of the General Abdomen: Liver, Pancreas, Adrenals and Spleen; Sonographic features of Gastrointestinal Tract; Sonographic features of

Urinary Tract & Reproductive Tract; Sonography of Musculoskeletal System; Sonographic features of Eye and Orbit; Imaging of Heart and Doppler Ultrasound; Magnetic Resonance Imaging (MRI); CT Scan.

Practical:

X-ray machine and its working; Dark room requirements and maintenance; Exposure factors and processing of films; Contrast Radiography techniques; Examination and evaluation of radiographs; Techniques for radiography of appendicular and axial skeleton; Imaging of the general abdomen; Imaging of liver and spleen; Imaging of gastrointestinal tract and pancreas; Imaging of urinary tract; Imaging of reproductive tract; Imaging of musculoskeletal system; Imaging of head; Imaging of cardiovascular system; Use of ultrasonography equipment; Imaging of clinical cases presented to the clinics of the Department.

Textbook:

1. Thrall, D.E., 2002. Textbook of Veterinary Diagnostic Radiology. 4thed. W. B. Saunders Co., Philadelphia, USA.

Recommended Books:

1. Penninck, D., and M-A d'Anju, 2008. Atlas of Small Animal Ultrasonography. Blackwell Publishing Co., Oxford. UK.
2. Mannion, P., 2006. Diagnostic Ultrasound in Small Animal Practice. Blackwell Science Ltd., Oxford, UK.
3. Kealy, J. K., and H. McAllister, 2004. Diagnostic Radiology and Ultrasonography of the Dog and Cat. 4thed. W. B. Saunders Co., Philadelphia, USA
4. Farrow, C. S., 2003. Veterinary Diagnostic Imaging: the Dog and Cat. Mosby Inc., W. B. Saunders Co. Ltd., USA.
5. Cartee, R. E., B. A. Selcer, J. A. Hudson, S. T. Finn-Bodner, M. B. Mahaffey, P. L. Johnson and K. W. Marich, 1995. Practical Veterinary Ultrasound. Williams and Wilkins, Philadelphia, USA.
6. Singh, A. P., and J. Singh. 1995. Veterinary Radiology. CBS Publishers & Distributors, New Delhi, India.

MEDICINE CLINIC-I

1(0-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Perform disease diagnosis and treatment of clinical cases of alimentary, respiratory, cardiovascular, hemopoietic and lymphatic systems in small and large animals.
2. Exhibit social behaviors with colleagues, clients, and patients consistent with those expected of a member of the veterinary community. Demonstrate knowledge and understanding of the societal needs/responsibilities of veterinarians locally, nationally and globally
3. Demonstrate basic knowledge and understanding of first aid and emergency care of animal diseases.

4. Demonstrate knowledge and understanding of the rationale use of therapeutics and their availability in the market.
5. Demonstrate basic knowledge and understanding of disposal of biomedical wastes in veterinary hospitals and associated hazards.
6. Development of core competencies in clinical case recording.

Clinic:

Exercises in diagnosis and treatment of clinical cases of diseases of alimentary system, respiratory system, cardiovascular system, hemopoietic and lymphatic system in livestock and pets, Communication skills (Veterinarian-client interaction), First aid procedures and emergency medicine, Practice of feeding of sick animals, Practical antimicrobial therapy/rationale therapeutics, Generic and trade names of drugs along with their doses, Disposal of biomedical wastes in veterinary hospitals, Hazards of biomedical wastes and their impact on environment, Basic concept of civic engagement, Deworming procedure and doses for different species of animals/pets/birds, Professional development and social responsibilities of veterinarian, Preparation of case records, case follow up etc., Recording of minimum 10 cases at pet center under the supervision of teacher and making a presentation after consulting veterinary information resources like journals, books and internet etc., economic feasibilities for establishment of veterinary private clinical practice/ hospital/ workup disease diagnostic lab, etc. Study tours to livestock farms and Veterinary Hospitals.

Recommended Books:

1. Radostits, O.M., C.C. Gay, K.W. Hincheliff and P. D. Constable., 2007. Veterinary Medicine, 10th Ed. Saunders Elsevier, PA, USA.
2. Kelly, W. R., 1984. Veterinary Clinical Diagnosis. 3rd Ed. Bailliere Tindall & Corsell, London, U. K.
3. Kahn C.M., 2010. The Merck Veterinary Manual. 10th Ed. Merck & Company., INC, Whitehouse Station, N.J., USA.
4. Pinsent, P.J.N. and C.J. Fulle, 1997. Outline of Clinical Diagnosis in Horse. Blackwell Science, Oxford, UK.
5. Howard J.L, 1999. Current Veterinary Therapy, Food Animal Practice. W.B. Saunders, Co., U.S.A.
6. Hungerford. T.G., 1991, Hungerford's Diseases of Livestock 9th Ed. McGraw Hill Book Company, Sydney, Australia.
7. Smith B.P., 1990. Large Animal Internal Medicine. The C.V. Mosby Company, Baltimore.

SURGERY CLINIC-I

1(0-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Perform general examination of the clinical cases of different animals
2. Perform medication of traumatic animals
3. Demonstrate clinical procedures to treat animals.

Clinic:

General Examination, Asepsis & Antiseptics, Wound management, Antiseptics used in clinics, Bandages and bandaging techniques, Routes of Drug administration, Animal Chipping.

Students will be required to record a minimum of 10 clinical cases (history taking, clinical findings, laboratory investigation, diagnosis, differential diagnosis treatment and discussion) in each clinic case under the supervision of a teacher.

Recommended Books:

1. Venugopalan, A. 2000. Essentials of Veterinary Surgery. 8th ed. Oxford and IBH Publishers and Distributors, New Delhi, India.
2. Kumar, A. 1997. Veterinary Surgical Techniques. Vikas Publishing House, New Delhi, India.
3. Harari, J. 1993. Surgical Complications and Wound Healing in the Small Animal Practice, W. B. Saunders Co., Philadelphia, USA.
4. Kelly, W. R. 1984. Veterinary Clinical Diagnosis. 3rd Ed. Bailliere Tindall, London, UK.

THERIOGENOLOGY CLINIC-I**1(0-1)****Learning Outcomes:**

At the end of the course, students will be able to:

1. Explain the importance of history taking for a clinical case.
2. Describe the protocol for approaching clinical cases at reproduction clinic

Clinic:

Steps to identify a clinical case of reproduction, Approach to clinical case and pre-requisites for handling, Palpation & identification of female reproductive system on table, Technique of rectal palpation in domestic animals, Identification of parts of reproductive tract in live animals, Identification of ovarian structures in live animals, Determination of stage of estrus cycle in live animals, Development of models for estrus detection, Selection of a bull for breeding, Functioning of Semen Production Units. Economic feasibilities for establishment of veterinary private clinical practice/ hospital/ workup disease diagnostic lab or a SPU.

Recommended Books:

1. Zemjenis, R., 1970. Diagnostic & Therapeutic Techniques in Animal Reproduction. Williams & Wilkins Company, Baltimore
2. Morrow, D.A., 1986. Current Therapy in Theriogenology, II. W.B. Saunders Company, Philadelphia
3. Ahmad, M. and M.A. Saji, 1997. Manual for Breeding Soundness of Dairy Bulls for use in A.I. Livestock and Dairy development Department, 16-Cooper Road, Lahore

SEMESTER VII

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe current status of meat production in Pakistan.
2. Identify indigenous and exotic breeds,
3. Describe appropriate and cost effective management, feeding and processing system of meat production.
4. Establish a successful meat production unit through application of modern management techniques and practices.

Theory:

Status of meat production in Pakistan, issues and potential of meat industry in Pakistan, meat type breeds of farm animals, meat production systems, factors affecting carcass and meat quality; management of meat animals, feeding management for optimum growth, grazing systems, management and supplementary feeding, growth rate and fattening potential of male calves, feed additives, hormones and probiotics for growth, management during inclement weather. breeding and reproduction of meat animals, modern abattoirs, slaughtering methods and post slaughter changes in carcass, carcass grades and spoilage of meat, meat hygiene, storage and preservation, Establishing commercial beef/mutton farms, record keeping, data handling and feasibility reports, keeping herd/flock healthy. Law of the land governing slaughtering e.g., Humane slaughter act and regulations.

Practical:

Meat Production Systems, practical demonstrations on early feeding, raising orphan and multiple birth lambs/kids, Creep feeding, dehorning, castration and weaning; preparing beef animals for shows, dentition for age determination; practical tips for housing of beef animals, feasibility reports for beef/mutton production; ante-mortem inspection, Carcass evaluation, Carcass grades and cuts, Beef grades, Shearing and handling wool. Vaccination schedule for meat animals; maintenance of farm records; pure food act and rules governing meat processing facilities, documentation requirements for export of animal meat, visit to farms, abattoir and market.

Textbook:

1. Alvi, A. S., 1991. Meat Production and Technology in Pakistan, Pakistan Agricultural Research Council, Islamabad.

Recommended Books:

1. Ensminger, M. E., 1996. Beef Cattle Science. The Interstate Printers and Publisher, Danville, Illinois, USA.
2. Mackintosh, J.B., 1983. Sheep production in Pakistan, PARC, Islamabad.
3. Anwar, A. H., 1996. Meat Hygiene and Inspection. Dept. Veterinary Parasitology, University of Agriculture, Faisalabad.
4. Ensminger, M.E. and R.O. Parker, 1986. Sheep and Goat Science. Interstate Printers and publishers Inc. Danville, Illinois. USA.

5. Steel, M., 1996. Goats. McMillan Education Ltd. London
6. Devendra, C. and George B. McLeroy, 1982. Goat and sheep production in the tropics. Longman Group, the University of Wisconsin – Madison.

VETERINARY PREVENTIVE MEDICINE-II

3 (3-0)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe the etiology, epidemiology, and clinical manifestations of metabolic disorders, deficiency diseases, plant/chemical toxicities and animal poisons in livestock and pets.
2. Elucidate process of development of metabolic disorders and ill effects of nutritional deficiencies, plant/chemical toxins on animal's body.
3. Principles and tools for proper diagnosis and differential diagnosis of non-infectious diseases of animals.
4. Demonstration of treatment protocols for metabolic and deficiency diseases in veterinary practice and use of different specific antidotes against plant and chemical toxicities.
5. Describe interventions used to control and prevent disease, and improve animal at the individual and herd level.
6. Demonstrate knowledge and understanding of the infectious and non-infectious diseases of camels, dogs, cats and poultry.

Theory:

While etiology and pathogenesis are reviewed, emphasis will be given on clinical signs, diagnosis, differential diagnosis, treatment, control and prevention.

Metabolic diseases: (Parturient paresis, Downer cow syndrome, Lactation tetany of mares, Hypomagnesemic tetany, Ketosis, Pregnancy toxemia in sheep, Postparturient hemoglobinuria in cattle, Sporadic acute exertional rhabdomyolysis in horses, Atypical myopathy in grazing horses, Equine cushing's disease); *Diseases associated with nutritional deficiencies:* (Cobalt deficiency, Copper deficiency, Iodine deficiency, Iron deficiency, Zinc deficiency, Manganese deficiency, Selenium and vitamin E deficiency, Dietary deficiency of phosphorus, calcium and vitamin D); *Diseases associated with deficiencies of vitamins:* (Vitamin A deficiency, Vitamin K deficiency, Thiamin deficiency, Riboflavin deficiency, Nicotinic acid deficiency, Pyridoxine deficiency, Pantothenic acid deficiency, Folic acid deficiency, Vitamin B₁₂ deficiency); *Diseases associated with physical agents:* (Radiation injury, Lightning stroke and electrocution, Drowning, Frostbite); *Diseases associated with inorganic and farm chemicals:* (Lead poisoning, Arsenic poisoning, Selenium poisoning, Mercury poisoning, Copper poisoning, Sodium chloride poisoning, Zinc poisoning, Poisoning by anthelmintics, Organophosphates poisoning); *Diseases associated with toxins in plants and animals:* (Cyanogenic glycoside poisoning, Nitrate and nitrite poisoning, Bracken fern poisoning, Snakebite, Bee stings, Tick paralysis); *Poisoning by mycotoxins:*

(Aflatoxicosis, Deg Nala disease); *Diseases associated with allergy*: (Autoimmune hemolytic anemia of the newborn, Pupura hemorrhagica); *Diseases of dogs and cats*: (Leptospirosis, Rabies, Canine distemper, Infectious canine hepatitis, Borreliosis, Canine ehrlichiosis, Lahore canine fever, Parvovirus infection, Feline panleukopenia, Feline calicivirus infection, Ringworms, Ecto and endo parasitism); *Diseases of camel*: (Trypanosomiasis, Filariasis, Mali, Kapauli, Contagious necrosis of skin, Kumree, Vail, Specific peritonitis, Meningitis, Camel pox, Influenza, Hemorrhagic disease, ecto and endo parasitism) *Diseases of poultry*: {(*Viral diseases*: Newcastle disease, Avian influenza, Fowl pox, Marek's disease, Lymphoid leucosis, Infectious bursal disease, Egg drop syndrome, Infectious laryngotracheitis, Infectious bronchitis, Hydropericardium syndrome, Inclusion body hepatitis, Avian infectious anemia, Femur head necrosis)}; {(*Bacterial Diseases*: Salmonellosis, Infectious coryza, Mycoplasmosis, Spirochaetosis, Fowl cholera, Colibacillosis, Staphylococcal, streptococcal and clostridial diseases)}; {(*Fungal Diseases*: Brooder's pneumonia, Thrush, Mycotoxicosis)}; {(*Parasitic Diseases*: Diseases caused by protozoa, nematodes, cestodes and arthropods)}; {(*Nutritional Diseases*: Deficiencies/imbbalances of vitamins, minerals, proteins and other nutrients)}; {(*Miscellaneous Conditions*: Poisoning and intoxications, Heat stress, Cannibalism)}:

Textbook:

1. Radostits, O.M., C.C. Gay, K.W. Hincheliff and P. D. Constable., 2007. Veterinary Medicine, 10thEd. Saunders Elsevier, PA, USA.

Reference Books:

1. Kahn C.M. 2010. The Merck Veterinary Manual. 10th Ed. Merck & Company., INC, Whitehouse Station, N.J., USA.
2. Swayne D.E. (Ed.), 2013. Diseases of Poultry. 13thEdition. Wiley-Blackwell, USA.
3. Matin W.B. and I.D. Ait Isen, 2000. Diseases of Sheep, 3rd Ed. Blackwell Science, Oxford, UK.
4. Iqbal C.Z. and Akbar S.U.J., 2000. The Camel and its Diseases. Al Bayan Printing and Publishing Est. UAE.
5. Howard J.L, 1999. Current Veterinary Therapy, Food Animal Practice. W.B. Saunders, Co., U.S.A.
6. Rebhum, W.C., 1998. Diseases of Dairy Cattle, Williams and Wilkins, Baltimore, USA.
7. Smith B.P., 1996. Large Animal Internal Medicine. 2nd Ed. The Mosby Co. Philadelphia U.S.A.
8. Hungerford. T.G., 1991, Hungerford's Diseases of Livestock 9th Ed. McGraw-Hill Book Company, Sydney, Australia.
9. Larry P. Tilley and Francis W. K. Smith, Jr., 1997. The 5 Minutes Veterinary Consult Canine and Feline. William and Wilkins, M.D. USA.
10. Morgan, R.V., 1997. Handbook of Small Animal Practice. 3rd Ed. W.B. Saunders Company, PA, USA.

Learning Outcomes:

At the end of the course, the student will be able to:

1. Describe different methods of general anaesthesia (injectable and inhalation).
2. Describe different sites and techniques of regional and local anaesthesia.
3. Monitor the surgical patient during intra and post-operative period.
4. Practically demonstrate induction and maintenance of anaesthesia in clinical practice in different animals.

Practical:

Introduction to Veterinary Anaesthesia, including Pre-anaesthetics and Anaesthetic agents and their uses; Pre-anaesthetic considerations; Types of anaesthesia (local, regional and general), and their clinical applications; Epidural and Paravertebral anaesthesia and their practical demonstration; Local nerve blocks (for dental, eye and horn surgeries and their practical demonstration); Local nerve blocks in limbs for lameness diagnosis and their practical demonstration. Stages of General Anaesthesia and patient monitoring during and after anaesthesia; Anaesthesia under field conditions; Practical demonstration of anaesthetic regimens for small and large animals (including dogs, cats, small ruminants, horses, donkeys, large ruminants and camels); Anaesthetic regimens for birds, exotics, and laboratory animals; Anaesthetic emergencies (cardiac arrest, respiratory failure, shock, acid base imbalance) and their management.

Recommended Books:

1. Tranquilli, W. J., J. C. Thurmon and K. A. Grimm. 2007. Lumb and Jones' Veterinary Anesthesia and Analgesia. 4th ed. Blackwell Publishing, USA.
2. Aldridge, P. and L. O'Dwyer. 2013. Practical Emergency and Critical Care Veterinary Nursing. John Wiley & Sons, Ltd., UK.
3. Venugopalan, A. 2000. Essentials of Veterinary Surgery. 8thed. Oxford, New Delhi.
4. Harrari, J. 1996. Small Animal Surgery. Williams and Wilkins, Baltimore, USA.
5. Thrall, D.E. 1994. Textbook of Veterinary Diagnostic Radiology. 2nded. W. B. Saunders Co., Philadelphia, USA.
6. Turner, A. S. and C. W. McIlwraith. 1989. Techniques in Large Animal Surgery. 2nded. Lea & Febiger Philadelphia, USA.
7. Jennings. Jr. P. B. 1984. The Practice of Large Animal Surgery. W.B. Saunders Co., Philadelphia, USA.

OBSTETRICS AND GENITAL DISEASES

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe causes and management of fetal deaths in early and late gestation

2. Describe causes of abortion
3. Evaluate causes and management of pre- and post-partum disorders
4. Describe the causes of infertility in animals

Theory:

Introduction and significance of obstetrics, Effect of climate on fertility, Effect of nutrition on fertility, Early embryonic mortality, Non-infectious causes of abortion, Infectious causes: bacterial, viral and protozoal diseases causing reproductive disorders in farm animals, Fetal mummification & maceration, Dropsy of fetal membranes & teratological defects, Uterine torsion, Genital prolapse, Causes and types of dystocia, Selection of obstetrical procedures, Diseases of puerperal period, Retention of fetal membranes, , Hormonal causes of infertility, Repeat Breeding, Anestrus, Uterine infections, Uterine cultures and treatment, Genetic and nutritional basis of infertility in male, Different types/forms of infertility in male, Principles of hormonal & antibiotic therapy, Small ruminants reproductive disorders, Equine reproductive disorders, Canine reproductive disorders.

Practical:

Overview of obstetrical anatomy, Normal/abnormal presentation, position and posture, Identification and usage of obstetrical instruments, Normal parturition mechanism in different species, Fetal and maternal dystocia: causes and treatment, Performance of mutation and forced extraction, Introduction and performance of fetotomy, Local, epidural and paravertebral anaesthesia, Caesarean section, Approach and handling of obstetrical cases, Induction of parturition and abortion in farm animals, Handling of prolapse and torsion, Prevention and treatment of infertility in male and female, Injuries/diseases of the puerperal period.

Textbook:

1. Roberts, S.J., 1986. Veterinary Obstetrics and Genital Diseases. 2nd Ed., Edwards Brothers, Inc., Ann. Arbor, Michigan, U.S.A

Recommended Books:

1. Morrow, D.A., 1986. Current Therapy in Theriogenology, II. W.B. Saunders Company, Philadelphia
2. Youngquist, R.S. and W. Threlfall, 2007. Current Therapy in Large Animal Theriogenology. W.B. Saunders Company, Philadelphia

COMMERCIAL POULTRY PRODUCTION

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe modern managerial tools in different production systems and housing types.
2. Describe different methods of processing of broiler meat.
3. Demonstrate optimum production and management of layer chicken on the floor and in the cages.

4. Perform disease prevention and control through proper implementation of biosecurity and vaccination procedures.
5. Describe procedures required to maintain health and welfare of the birds.

Theory:

Present status and future scope of commercial poultry farming in Pakistan; characteristics of different breeds/strains involved in the development of broiler and layers; housing requirements for broiler and layer production; selection and procurement of quality chicks; pre-brooding and brooding requirements for broiler and layer chicks; feeding and management practices of broiler production; sex separate raising of broilers and measuring broiler growing efficiency; integrated broiler farming; processing of broilers chicken; factor affecting growth rate and meat quality in broiler production; vices and their remedies in layer production; light and feed manipulation to attain sexual maturity; management of layer flock during laying; layer management in cages; factors affecting egg production; production standards; management of the flock in hot and cold environment; induced molting and its economics; trouble shooting in commercial poultry farming; waste disposal; record keeping.

Practical:

Typical characteristics of poultry birds for meat production; demonstration of various types of brooders; sanitary practices on the farm; selection and culling of birds; pre-brooding and brooding management; selection and grading of live birds; litter management; feeding strategies for broiler; monitoring of growth performance of broilers viz. weekly feed consumption, weekly weight gain, mortality, feed to gain ratio and feed conversion ratio; processing techniques; carcass measurements and evaluating dressing percentage; giblet weights; sensory evaluation of broiler meat quality; biosecurity and its management; vaccination and vaccination schedule for common diseases; calculating economics of broiler production; debeaking, dubbing and toe clipping; identification of layer and non-layer; selection and culling procedures; catching and transportation of birds; cost benefit ratio of layer enterprises; induced molting techniques; managing flock during heat stress; use of computer in record keeping; visit to layer farm; feasibility report of broiler; feasibility report of 10,000 layer flock; record keeping.

Textbook:

1. North, M.O. and D.D. Bell. 2001. Commercial Chicken Production Manual. Van Nostrand Reinhold Co., New York, USA.

Recommended Books:

1. Ensminger, M.E., 1999. Poultry Science. The Interstate Printers and Publishers Inc., Danville, Illinois, U.S.A.
2. Austic, R.E. and M.C. Nesheim, 1990. Poultry Production. Lea and Febiger, Philadelphia, U.S.A.
3. Vegad, J.L., 2004. Poultry Diseases: A Guide for Farmers and Poultry Professionals. International Book Distributors Co. Lucknow, India.

4. Hurd, L.M., 2003. Modern Poultry Farming. Greenworld Publishers 8/217, Indira Nagar Lucknow-226 016 (UP).
5. Charles, T.B. and H.O. Stuart, 2011. Commercial Poultry Farming. 6th edition, Biotech Books, USA.
6. Sreenivasiah, P.V., 2006. Scientific Poultry Production. 3rd edition. International Book Distributing Co., UP India.
7. Haq, A. and M. Akhtar, 2004. Poultry Farming. Higher Education Commission, H-9, Islamabad, Pakistan.
8. Jadhav, N.V. and M.F. Siddiqi, 1999. Handbook of Poultry Production and Management. Jaypee Brothers, Medical Publishers (P) Ltd. New Delhi, India.

BIO-STATISTICS

3 (2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Define bio-statistics and describe its applications
2. Differentiate between continuous and discrete data
3. Define and explain probability, correlation, regression and salient statistical concepts
4. Perform statistical analysis pivotal to bio-statistics

Theory:

Introduction of bio-statistics, types of data (scales of measurements), frequency distribution for continuous and discrete data, visual representation of data, stem and leaf display, box and whisker plots; measures of location and variability, moments, skewness, coefficient of skewness and Kurtosis, definitions and laws of probability, simple correlation and regression analysis, elementary ideas of sampling, distribution of means and proportions, Test of significance of means, proportion, difference between means and difference between proportions with their confidence Intervals. Experimental Design (Completely Randomized Design, Randomized Complete Block Design).

Practical:

The statistical packages Minitab and SPSS will be used for Measure of Location, Measure of Dispersion, Graphical Presentation, Regression and Correlation Analysis, Test of significance of Means, Proportion, Differentiate between Two Means, Proportions, CR Design and RCB Design.

Textbook:

1. Zar, J.H., 2003. Biostatistical Analysis, Fourth Edition, Pearson Education (Singapore) Prentice Hall International (UK) Limited. London, UK.

Recommended Books:

1. Muhammad F., 2000. Statistical Methods and Data Analysis, Kitab Markaz, Bhawana Bazar Faisalabad, Pakistan.
2. Choudhry, M. R., 2001. Modern Statistics (Vol-I & II). Polymer Publications, Urdu Bazaar, Lahore.

3. Steel, R. G. D, J. H. Torrie and D.A. Dickey, 1997. Principles and Procedures of Statistics: A Biometrical Approach. 3rd Edition. WCB McGraw-Hill, New York, USA.

MEDICINE CLINIC-II

1(0-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Perform disease diagnosis and treatment of clinical cases of hepatobiliary, nervous, urinary and integumentary systems of large and small animals.
2. Collect samples of body fluid and tissues.
3. Demonstrate knowledge and skills in the interpretation of common diagnostic procedures and Lab reports.
4. Describe role of vaccination in diseases control and general vaccination schedule for different animal species.
5. Interact with community through small scale project development.
6. Develop of core competencies in clinical case handling and recording.

Clinic:

Clinical skills for multiple species of animals. Exercises in diagnosis and treatment of clinical cases of diseases of hepatobiliary system, nervous system; urinary system, integumentary system in livestock and pets; Practice of sample collection, labeling, packaging and dispatch of biological materials (blood, serum, feces, skin scrapings, milk and other body fluids) for laboratory examination, Hematological evaluation and interpretation, Evaluation of acid-base balance and interpretation, Fecal examination procedures and interpretations, Examination of skin scrapings and interpretation, Urine evaluation procedures and interpretation, Tests and their interpretation for hemoprotozoan diseases, Interpretation of blood chemistry profile in diseases, Paracentesis and interpretation of test results, Milk tests for mastitis and interpretation, Vaccines and vaccination in ruminants, equines and pets, Preparing and implementing projects for community development, Recording of minimum 15 cases under the supervision of teacher and making a presentation after consulting veterinary information resources like journals, books and internet. Professional jurisprudence/ legislations, ethics, national and international certification procedures and laws governing and rules of business in administration of private and public veterinary practice, Study tours to livestock farms and Veterinary Hospitals.

Recommended Books:

1. Radostits, O.M., C.C. Gay, K.W. Hincheliff and P. D. Constable, 2007. Veterinary Medicine, 10th Ed. Saunders Elsevier, PA, USA.
2. Kelly, W. R., 1984. Veterinary Clinical Diagnosis. 3rd Ed. Bailliere Tindall and Corsell, London, UK.
3. Kahn C.M., 2010. The Merck Veterinary Manual. 10th Ed. Merck & Company., INC, Whitehouse Station, N.J., USA.

4. Pinsent, P.J.N. and C.J. Fulle, 1997. Outline of Clinical Diagnosis in Horse. Blackwell Science, Oxford, UK.
5. Howard J.L, 1999. Current Veterinary Therapy, Food Animal Practice. W.B. Saunders, Co., U.S.A.
6. Hungerford. T.G., 1991, Hungerford's Diseases of Livestock 9th Ed. McGraw-Hill Book Company, Sydney, Australia.
7. Smith B.P., 1990. Large Animal Internal Medicine. The C.V. Mosby Company, Baltimore.

SURGERY CLINIC-II

1(0-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Perform different techniques for handling of animals for examination and treatment purposes
2. Protect themselves and the animals from serious injuries.
3. Perform different surgical exercises on clinical cases.
4. Perform management during post-operative period.

Clinic:

Physical and chemical restraint techniques in horses, ruminants, pets, history taking and clinical examination, routes of drug administration and catheterization in male and female animals, Bandages and bandaging techniques, Preparations used for topical dressing of wounds, management of wounds, galls, ulcers and abscesses, Trocarization in small and large animals, Hospitalization and care of sick animals. Students will be required to record a minimum of 10 cases (history taking, clinical findings, laboratory investigation, diagnosis, differential diagnosis treatment and discussion) in each clinical case under the supervision of a teacher.

Recommended Books:

1. Venugopalan, A. 2000. Essentials of Veterinary Surgery. 8th Ed. Oxford and IBH Publishers and Distributors, New Delhi, India.
2. Kumar, A. 1997. Veterinary Surgical Techniques. Vikas Publishing House, New Delhi, India.
3. Harari, J., 1993. Surgical Complications and Wound Healing in the Small Animal Practice, W. B. Saunders Co., Philadelphia, USA.
4. Kelly, W. R. 1984. Veterinary Clinical Diagnosis. 3rdEd. Bailliere Tindall, London, UK.

THERIOGENOLOGY CLINIC - II

1(0-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe the importance of breeding bull, its selection and clinical evaluation.
2. Basics for semen collection, evaluation and processing.

Clinic:

Method and importance of history questions in case handling, Breeding program in a herd, How to diagnose pregnancy in domestic animals, Breeding soundness examination of male, Preparation of Bull and Artificial Vagina for semen collection, Methods of semen collection (Techniques), Evaluation of semen (characters) and processing (storage methods), Preparation of extenders, Rectal palpation and passing of rod for Artificial Insemination.

Recommended Books:

1. Zemjenis, R., 1970. Diagnostic & Therapeutic Techniques in Animal Reproduction. Williams & Wilkins Company, Baltimore
2. Morrow, D.A., 1986. Current Therapy in Theriogenology, II. W.B. Saunders Company, Philadelphia
3. Ahmad, M. and M.A. Saji, 1997. Manual for Breeding Soundness of Dairy Bulls for use in A.I. Livestock and Dairy development Department, 16-Cooper Road, Lahore.

SEMESTER VIII

BREEDER AND HATCHERY MANAGEMENT

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe modern managemental techniques for optimum and cost-effective production of broiler and layer breeder.
2. Describe techniques for optimum production, selection, fumigation of storage of hatching eggs.
3. Ensure disease prevention and control through proper implementation of biosecurity and vaccination procedures.
4. Describe procedures involved in production of good quality chicks
5. Demonstrate maintenance of health and welfare of the breeding birds.
6. Plan, implement, and manage optimum and hygienic hatchery operations.
7. Perform chick sexing, grading, vaccination, packing practices in the hatchery.
8. Handle problems in the breeding poultry and hatchery operations.

Theory:

Status and scope of Poultry Breeding Industry in Pakistan/World; commercial breeding programs; bio-security; breeder house layout and equipment requirements; environment control vs. open sided housing; care and management during brooding period; light and feed management during growing; monitoring body weights and uniformity during growing; grading and selection during growing period; significance of fleshing, feathering, shank and keel length; transportation or shifting of growing flock to breeding house; pre-breeder nutrition; feeding programs for adults; production standards; male management during rear and production; causes of poor fertility and

hatchability; major management health concerns with breeders; summer and winter strategies to enhance production; induced molting in the breeder flocks; incubation methods; types of incubators; role of computer in modern hatchery operations; incubation requirements; embryonic development of chick; factors influencing fertility, hatchability and quality of chicks; setting and candling of eggs; taking off the hatch; hatchery sanitation and waste disposal; hazard management during incubation; incubation records; trouble shooting at different stages in the breeder and hatchery operation.

Practical:

Demonstration of commercial breeding programs; reproductive systems of male and female; vaccination programs and methods; blood and tissue sampling; environment control housing; ventilation and heating systems; toe clipping, dubbing and beak trimming; monitoring body weights during growing and uniformity calculations; basic practices for male management; identification of sexing errors; separate-sex feeding system; male to female ratio; artificial insemination; nest management; egg collection, handling, cleaning; hatching egg fumigation, selection, storage and transportation; summer and winter management; calculating cost of producing hatching eggs and chicks; calculations and conversions; feasibility report of 10,000 broiler and layer breeder flocks; Layout and design of hatcheries; selection, candling and setting of hatching eggs; cleaning of hatching eggs; fumigation; types of incubators and their different parts; operation of incubators; sexing, vaccination, grading; packing and transportation of day-old chicks; hatchery sanitation; disinfection and fumigation of incubators; visits to commercial hatcheries; record keeping; feasibility report of hatchery.

Textbook:

1. North, M.O. and D. D. Bell, 2001. Commercial Chicken Production Manual. Van Nostrand Reinhold Co., New York, USA.

Recommended Books:

1. Taylor, L.W., 2003. Fertility and Hatchability of Chicken and Turkey Egg. International book distributing company, Lucknow, India.
2. Lakhotia, R. L., 2003. Reproduction in Poultry. CAB International, Wallingford, Oxon, U.K.
3. Hocking, P. M., 2009. Biology of breeding poultry. CAB International, Wallingford, Oxon, U.K.
4. Austic and Nesheim, 1990. Poultry Production. 13th edition. Lea and Febiger; Philadelphia, Pennsylvania.
5. Leeson, S. and J.D. Summers, 2000. Broiler Breeder Production. University Book Foundation, University of Guleph, Canada.
6. Leeson, S. and J.D. Summers, 2001. Nutrition of the Chicken. International Book Distributing C., Lucknow, India.
7. Sreenivasiah, P.V., 2006. Scientific Poultry Production. 3rd edition. International Book Distributing Co., UP India.

VETERINARY EPIDEMIOLOGY AND PUBLIC HEALTH³(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe basic principles of epidemiology, including descriptive/analytical epidemiology
2. Elaborate techniques used to conduct disease outbreak investigations and develop disease prevention programs
3. Describe causal models, distribution/patterns and control of disease or other health-related events in populations.
4. Perform epidemiologic data collection, management and analysis, evaluation of analyses and critical evaluation of published information.

Theory:

Introduction to epidemiology & public health, disease occurrence, Mapping, Causality, Determinants of disease, Diagnostic testing, Transmission and maintenance of infection, Descriptive epidemiology, Analytical epidemiology, Case-control studies, Cohort studies, Experimental epidemiology, Animal disease survey, Types of sampling, Surveillance, Prevention, Control and eradication, Outbreak investigation, National and international disease reporting, Trans-boundary disease of veterinary importance, TAD distribution, mapping, regulatory implications, TAD control, International trade framework

Practical:

Nature of veterinary data scale of measurement, Data elements, Representation of data: coding numeric codes, symbols, Presentation of numerical data, Measure of disease occurrence, Vital statistics, Collection, handling and transportation of appropriate samples, Methods of data collection, Survey and sample size calculation, Questionnaire development for field visit, Field visit for detection of weather determinants, global positioning system (GPS) and GIS Arc for mapping of important communicable diseases, entry of data collected during survey and its analysis, Epidemic investigation steps, Questionnaire for epidemic investigation of retrospective, cohort and prospective studies.

Textbook:

1. Thrusfield M., 2007. Veterinary Epidemiology. Blackwell Publisher

Recommended Books:

1. Gordis L., 2008. Epidemiology. 4th Edition. Saunders, Elsevier, USA
2. Bonita, R., R. Beaglehole, T. Kjellstrom, 2006. Basic Epidemiology. 2nd Edition. WHO
3. Merrill, R. M., 2013. Introduction to Epidemiology, 6th Edition. Jones and Barletta Learning, USA.

SMALL ANIMAL SURGERY

4(3-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Correct surgical problems encountered in small animal practice
2. Practice the learned techniques on experimental and clinical cases.

Theory:

General surgical considerations, Fluid and electrolyte therapy in small animals, Affections of mouth & teeth, salivary glands, neck, digestive system, Hip and Shoulder Dislocations, Fracture, Affections of respiratory system, skin and its adnexa, ears, urinary system, Male and female genital systems.

Practical:

Laparotomy techniques in small animals, Tooth extraction procedure, salivary gland resection, Splenectomy, Gastrotomy, Intestinal end-to-end anastomosis, Castration in dog and cat, Ovariohysterectomy in bitches and queens, Cystotomy, Nephrotomy and Nephrectomy, Thoracotomy, correction of auricular haematoma, ear cropping, Tail docking and Dewclaw amputation, repair of prolapse of eye ball, Approaches to different long bones and use of external and internal fixation devices for fracture repair, Anal sac resection.

Textbook:

1. Slatter, D. H. (ed.) 1991. Textbook of Small Animal Surgery. 2nded. W. B. Saunders Co., Philadelphia, USA.

Recommended Books:

1. Bojrab, M. J. (ed.) 1998. Current Techniques in Small Animal Surgery. 4th Ed. Lea and Febiger, Philadelphia, USA.
2. Fossum, T. W. (ed.) 1997. Small Animal Surgery. 3rded. Mosby-Year Book, Inc., St. Louis, Missouri, USA.
3. Harvey, C. E., C. D. Newton and A. Schwartz, 1990. Small Animal Surgery. J. B. Lippincott. Philadelphia, USA.
4. Knecht, C. D., A. R. Allen, D. J. Williams and J. H. Johnson, 1987. Fundamental Techniques in Veterinary Surgery. 3rdEd. W. B. Saunders Co., Philadelphia. USA.
5. Piermattei, D. L., 1993. An Atlas of Surgical Approaches to the Bones and Joints of the Dog and Cat. 3rd Ed. W. B. Saunders Co., Philadelphia, USA.
6. Archibald, J. (ed.) 1974. Canine Surgery. 2nd Ed. Santa Barbara, American Veterinary Publications, Inc., California, USA.

FISHERIES AND AQUACULTURE

1(0-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Differentiate between fish, fisheries & aquaculture.
2. Identify fish species on the basis of morphology.
3. Apply principles of aquaculture for appropriate site selection, designing and pond construction; selection of suitable fish species for sustainable aquaculture.
4. Apply best aquaculture operational and management skills.
5. Formulate and prepare aqua feed, induced breeding techniques, diagnosis and control of diseases in commercially important fish species.

Practical:

Introduction to fish, fisheries and aquaculture; fish diversity, source and consumers preference; fish identification, morphometric and meristic counts, dissection, anatomy and dressing percentage; construction and components of fish ponds; determination of water quality parameters (physical, chemical and biological-phytoplankton and zooplankton sampling and identification); diagnosis and control of infectious and metabolic fish diseases; formulation and preparation of aqua feed; types of fish hatchery and management; induced fish breeding techniques; ornamental fishes and aquarium making; fishing gears and netting.

Textbook:

1. Garg, S. K., A. Bhatnagar, A. Kalla and M.S. Johal, 2002. Experimental Ichthyology. CBS Publishers. India.

Recommended Books:

1. Mirza, M. R. and M. Sharif, 1998. Key to the Identification of Fishes of Punjab. Ilmi Publications, Lahore.
2. Ali, S. S., 2001. Fresh Water Fish Biology. Naseem Book Depot, Hyderabad.
3. Shammi, Q. J. and S. Bhatnager, 2002. Applied Fisheries. Agrobios. India.
4. Pillay, T.V.R., 2002. Aquaculture: Principles and Practices. Blackwell Science Ltd.
5. Bhatti, M. N. and M.R. Mirza, 1995. *Jadeed Fish Culture*. Feroze Sons, Lahore.
6. Bhatti, M. N. and M.R. Mirza, 1993. *Pakistan Ki Machhliyan aur Mahiparwari*. Feroze Sons, Lahore.

MEDICINE CLINIC-III

2(0-2)

Learning Outcomes:

At the end of the course, students will be able to:

1. Perform disease diagnosis and treatment of clinical cases of musculoskeletal system, eye and ear of large and small animals.
2. Practice emergency handling and critical care of patient in ICU and demonstrate basic skills of diseases outbreak investigation.
3. Use alternative medicine in veterinary practice.
4. Describe principles of storage of dangerous drugs and development of strategies for parasite control in livestock.
5. Demonstrate basic knowledge of diseases diagnosis, treatment and control of zoo and wild animal diseases.
6. Develop core competencies in clinical case handling and recording.

Clinic:

Exercises in diagnosis and treatment of clinical cases of diseases of musculoskeletal system, eye and ear during normal circumstances and during natural calamities/ disaster management; Practice of emergency handling and critical care (colic, tympany, snakebite, poisonings, drug reactions, hemorrhage, shock, heat stroke, etc.), Managing of an outbreak of infectious/ contagious disease, Application of different diagnostic and treatment tools

(gastric lavage, enema, allergic tests etc.), Screening tests for brucellosis, Health and safety (human, animal, environment), Maintenance and storage of dangerous/ poisonous drugs, Practical demonstration of the control measures of ecto- and endo-parasites on individual animals and herd basis, Introduction to the practice of complementary medicine (alternative medicine), Use of biotechnology in disease diagnosis, treatment, control and prevention, Introduction to important diseases of zoo/wild animal species, Recording of minimum 15 cases under the supervision of teacher and making a presentation after consulting veterinary information resources like journals, books and internet. Study tour to livestock farms, Zoo/Wildlife Parks and Veterinary Hospitals.

Recommended Books:

1. Radostits, O.M., C.C. Gay, K.W. Hincheliff and P. D. Constable, 2007. Veterinary Medicine, 10th Ed. Saunders Elsevier, PA, USA.
2. Kelly, W. R., 1984. Veterinary Clinical Diagnosis. 3rdEd. Bailliere Tindall & Corsell, London, U. K.
3. Kahn C.M., 2010. The Merck Veterinary Manual. 10th Ed. Merck & Company., INC, Whitehouse Station, N.J., USA.
4. Pinsent, P.J.N. and C.J. Fulle, 1997. Outline of Clinical Diagnosis in Horse. Blackwell Science, Oxford, UK.
5. Howard J.L, 1999. Current Veterinary Therapy, Food Animal Practice. W.B. Saunders, Co., U.S.A.
6. Hungerford. T.G., 1991, Hungerford's Diseases of Livestock9th Ed. McGraw-Hill Book Company, Sydney, Australia.
7. Smith B.P., 1990. Large Animal Internal Medicine. The C.V. Mosby Company, Baltimore.

SURGERY CLINIC-III

2(0-2)

Learning Outcomes:

At the end of the course, students will be able to:

1. Control and handle different animals for the purpose of surgical manipulations.
2. Manage treatment of animals brought to the Surgery clinic.
3. Prepare animals for surgical operations.
4. Manage pre-operative and post-operative requirements of individual patients.
5. Manage and feed admitted cases.

Clinic:

Management and treatment of burn wounds, Antibiotics, Analgesics, Anti-inflammatory drugs used in surgery, Lameness in large animals, Nerve block, regional and local anaesthesia in clinical cases, Use of firing and counter irritants in veterinary practices, Induction and maintenance of general anaesthesia in field conditions, Surgical management of horn, hoof and tail affections, Teat surgery (instruments, techniques and complications), Castration of large animals, disaster management of wounded animals and public communication in cases of natural calamities like earthquake, floods, etc. Visits to animal farms and hospitals.

Recommended Books:

1. Crow, S. E. and S. O. Walshaw, 1997. Manual of Clinical Procedures in the Dog, Cat and Rabbit. 2ndEd. J. B. Lippincott, Philadelphia, USA.
2. Kelly, W. R. 1984. Veterinary Clinical Diagnosis. 3rdEd. Bailliere Tindall, London, UK.
3. Kirk, R. W., S. I. Bistner and R. B. Ford, 1985. Kirk and Bisner's Handbook of Veterinary Procedures and Emergency Treatment. 6th Ed. W.B. Saunders Co., Philadelphia, USA.
4. Oehme, F.W. and I. E. Prier, 1998. Text book of Large Animal Surgery. 2nd Ed. Williams and Wilkins, Baltimore, London, UK.

THERIOGENOLOGY CLINIC - III

2(0-2)

Learning Outcomes:

At the end of the course, students will be able to:

1. Explain the procedures of Artificial Insemination and their application.
2. Elaborate the use of ultrasonography in reproductive management.
3. Describe and demonstrate; how to handle reproductive disorders.

Clinic:

Approaches to diagnose and record reproductive disorders in clinical cases, Different methods of artificial insemination (AI) in domestic animals, Semen handling and structure of liquid nitrogen container, Thawing of frozen semen, Preparation of AI gun, Pre-requisites for AI procedure, Determination of time of

insemination, Method of AI rod & AI gun passing in the female reproductive tract on table and in live animals, Clinical application of hormones in different reproductive disorders, Ultrasonography in domestic animals, Synchronization for reproductive management in domestic animals, Causes and management of repeat breeding, Diagnosis causes of anestrus, prolapse and its management, Uterine sample collection for culture sensitivity and endometrial biopsy, Diagnosis and prevention of abortion.

Recommended Books:

1. Zemjenis, R., 1970. Diagnostic & Therapeutic Techniques in Animal Reproduction. Williams & Wilkins Company, Baltimore
2. Morrow, D.A., 1986. Current Therapy in Theriogenology, II. W.B. Saunders Company, Philadelphia
3. Kahn, W., D. Wolkmann, and R.M. Kenney, 1994. Veterinary Reproductive Ultrasonography, Mosby-Wolfe, London

SEMESTER IX

ANIMAL WELFARE AND ETHICS

2(2-0)

Learning Outcomes:

At the end of the course, students will be able to:

1. Enumerate international and national organizations working for animal welfare
2. Describe challenges of captive animals
3. Elaborate regulations, policies and principles governing care and use of laboratory animals
4. Describe various hazards affecting welfare of animals

Theory:

Care and welfare of multiple animal species, National / Provincial Legislation for Animal Welfare, Regulations, policies and principles governing the care and use of animals, Code of practice for domestic poultry, farm, captive, laboratory and companion animals, Hazards (Natural and Man-made) affecting the welfare of animals and their management, Difference between hazard and disaster, Ethics, Animal Welfare Organizations like Society for Prevention of Cruelty to Animals (SPCA), Challenges to Zoo and animal welfare, Setting Standards for Evaluating of captive Facilities.

Textbook:

1. Fraser, D., 2008. Understanding Animal Welfare: The Science in its Cultural Context. ISBN: 978-1-4051-3695-2 Wiley-Blackwell.

Recommended Books:

1. NAP, 1996 Guide for the care and use of Laboratory Animals, National Research Council, National Academy Press, Washington D.C.
2. Anonymous, 2014. Animal Welfare Act, Government of the Punjab. (www.punjab.gov.pk)

3. Clark, J. D, Baldwin, K. A., Bayne, M. J. Brown, G. F., Gebhart, J. C. Gonder, J. K. Gwathmey, M. E. Keeling, D. F. Kohn, J. W. Robb, O. A. Smith, W. J. White, 1996. Guide for the Care and Management of Laboratory Animals. National Research Council, National Academic Press, Washington, D. C. 6thedition.

DAIRY TECHNOLOGY

2(1-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe composition and properties of milk
2. Describe processes involved in production, collection, transportation, processing and marketing of milk and milk products

Theory:

Mammary system, synthesis of milk, milk composition, milk let down and its inhibition, factors affecting milk production and composition, biotechnology and enhanced milk production, hand and machine milking, physical and chemical properties of milk, hygienic milk production, collection and transportation, processing and marketing of milk, cooling, homogenization and standardization, manufacturing of dairy products (yoghurt, butter, ghee, whey, cheese, etc.), planning, layout and management of dairy plant.

Practical:

Demonstration of milk let down, measures for hygienic milk production, manual and machine milking practice, physical and chemical analysis of milk, cleaning and sanitizing of barns, collection, cooling, tenderization, homogenization, pasteurization and UHT practices, economics of milk production and processing, visit to milk processing plants.

Textbook:

1. Walstra, P., 2005. Dairy Technology; Principles of Milk Properties and Processes. Marcel Dekker Inc, New York, USA.

Recommended Books:

1. Bath, D.L, F.N. Dickenson and H.A. Tucker, 1985. Dairy Cattle; Principles, Practices, Problems, Profits. Lea & Fabiger, Philadelphia, U.S.A.
2. Davis, J.G., 1994. Milk testing. Agro-Botanical. Publications, India.
3. Larson, B.L., 1985. Lactation. The Iowa State University Press. Iowa.
4. Schmidt, G.H., L.D. Van Vlk and M.F. Hutjens, 1988. Principles of Dairy Science. 2nd Ed. Prentice Hall Inc. Englewood cliffs, New Jersey, U.S.A.

POULTRY PATHOLOGY

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Diagnose poultry diseases
2. Describe gross and microscopic pathology of different poultry diseases

3. Explain relationship of environment and nutrition with disease

Theory:

Pathology of various viral, bacterial, parasitic, fungal and nutritional diseases; environmental and managerial problems, intoxications.

Practical:

Hands-on practice on postmortem of poultry, common laboratory tests in poultry disease diagnosis, investigation of field outbreaks of disease, visits to poultry farms, hatcheries, research institutes and disease diagnostic laboratories.

Textbook:

1. Saif, Y.M., H. J. Barnes, J.R. Glisson, A.M. Fadly, L.R. McDougold, D.E. Swayne, 2003. Diseases of Poultry. 11th Ed., Iowa State University Press, Ames, Iowa, USA.

Recommended Books:

1. Randall, C. J., 1987. A Colour Atlas of Diseases of the Domestic Fowl and Turkey. ELBS/Wolfe Medical Publications, London.
2. AAAP, 2000. Whiteman and Bickford's Avian Disease Manual 5th Ed., The American Association of Avian Pathologists, University of Georgia, USA.

LARGE ANIMAL SURGERY AND SHOEING

3(2-1)

Learning Outcomes:

At the end of the course, students will be able to:

1. Surgically correct problems encountered in large animal practice
2. Perform foot care and hoof management
3. Describe and perform procedures of corrective shoeing.

Theory:

Scope of large animal surgery, Surgical affections of head, neck, ear, eye, teeth, thorax, claws, horn, tail, teats and udder of large animals. Affections: musculo-skeletal, digestive, urinary, male and female genital systems, integumentary system, Surgical management of colic, history and basic terms in shoeing; the horseshoe and shoe-nails, Hot and cold shoeing, Injuries caused by farrier, shoes, and nails, Affections of the foot, fore and hind limbs and corrective shoeing, blemishes and vices in animals, Dentition of large animals, Soundness.

Practical:

Ectropion, entropion and enucleation of eyeball, Ectropion, Various tenectomies and tendon repair and neurectomy, Temporary and Permanent Tracheotomy, and laryngeal diverticulectomy procedure, Oesophagotomy procedure, Oesophagotomy, practical demonstration, Rumenotomy procedure, Castration of farm animals and equine, Penile amputation, Methods of disbudding and dehorning and tail docking in cattle and buffaloes, Shoeing tools, Types of shoes and nails, Hot Shoe preparation, Application of shoes

(removal of shoe, preparation of foot), Practices in determination of age from teeth, Soundness certificate writing.

Textbook:

1. Jennings. Jr. P. B., 1984. The Practice of Large Animal Surgery. W.B. Saunders Co., Philadelphia, USA.

Recommended Books:

1. Stashak, T. S. 1987. Adams' Lameness in Horses. 4th Ed. Lea and Febiger, Philadelphia, USA.
2. Venugopalan. A., 2000. Essentials of Veterinary Surgery 8th Ed. Oxford and IBH Publishers and Distributors, New Delhi, India.
3. Auer. J.A., 1999. Equine Surgery. 2nd Ed. W.B. Saunders Co., Philadelphia. USA.
4. Colahan, P. T., I. G. Mayhew, A. M. Merritt and J. N. Moore, 1999. Equine Medicine and Surgery. 5th Ed. (Vol. 1 & 2). Mosby, Philadelphia. USA.
5. Turner, A.S. and C. W. McIlwraith, 1989. Techniques in Large Animal Surgery. 2nd Ed. Lea & Febiger Philadelphia, USA.
6. Tyagi, R. P. S. and L. Singh, 1993. Ruminant Surgery. C.B.S. Publishers and Distributors, New Delhi, India.
7. Greenough, P. R., F. J. MacCallum and A. D. Weaver, 1997. Lameness in Cattle. 3rdEd. Wright and Sons. Bristol, UK.
8. Pollitt, C. C., 1995. Colour Atlas of the Horse's Foot. Mosby-Wolfe, London, UK.
9. Emery, L., J. Miller and N. V. Vanhoosen, 1977. Horseshoeing Theory and Hoof Care. Lea and Febiger, Philadelphia, USA.

MEDICINE CLINIC-IV

2(0-2)

Learning Outcomes:

At the end of the course, students will be able to:

1. Demonstrate knowledge and understanding of the clinical manifestations, diagnostic procedures, methods of treatment and typical pathologic abnormalities for common diseases of small and large animals.
2. Demonstrate knowledge of regulatory laws pertaining to the veterinary profession and handling of Vetrolgal cases.
3. Use radiographic and ultrasonography techniques in diseased diagnosis.
4. Demonstrate effective oral and written communication skills with veterinarians, animal health technicians, staff and the general public.
5. Develop and apply diagnostic and therapeutic strategies for common problems identified from the clinical evaluation of the animal.
6. Demonstrate role of Veterinarian in natural calamities and Veterinary disaster preparedness.
7. Exhibit altruism, integrity, honesty, responsibility, and compassion in the delivery of high quality animal healthcare

8. Develop core competencies in clinical case recording through independent case handling.

Clinic:

Practice of differential diagnosis of diseases with similar clinical signs, Cow signals (Body condition scoring, Udder scoring, Hoof scoring, Rumen scoring, Fecal scoring, Gait scoring etc.), Biosecurity of livestock farms, Ultrasonography and Endoscopy, Training in ambulatory veterinary practice, Handling of Veterolegal cases, Role of Veterinarian in natural calamities and Veterinary disaster preparedness (flood, earthquakes, release of gases, radiations, drought and nuclear disaster), Professional films, World Trade Organization (WTO), Veterinarian's responsibility in preventing drugs residues in foods of animal origin, Veterinary profession interactions with health authorities, drug and food regulatory authorities, zoo/animal welfare organizations and civil administration, Social conduct and personality profile in management of clinical practice, how to effectively communicate with animal owner/ clients, documentation requirements/ how to get consent of client on prescribed forms, Animal Health Act and Regulations, law of the land, use and ethical issues of animals in research and training, Euthanasia, Assignment of indoor cases and maintaining their complete records, Independent handling, diagnosis and treatment of clinical cases, Recording of minimum 15 cases under the supervision of teacher and making a presentation after consulting veterinary information resources like journals, books and internet. Study tours to livestock farms, Zoo/Wildlife Parks and Veterinary Hospitals.

Recommended Books:

1. Radostits, O.M., C.C. Gay, K.W. Hincheliff and P. D. Constable, 2007. Veterinary Medicine, 10th Ed. Saunders Elsevier, PA, USA.
2. Kelly, W. R., 1984. Veterinary Clinical Diagnosis. 3rdEd. Bailliere Tindall & Corsell, London, U. K.
3. Kahn C.M., 2010. The Merck Veterinary Manual. 10th Ed. Merck & Company., INC, Whitehouse Station, N.J., USA.
4. Pinsent, P.J.N. and C.J. Fulle, 1997. Outline of Clinical Diagnosis in Horse. Blackwell Science, Oxford, UK.
5. Howard J.L, 1999. Current Veterinary Therapy, Food Animal Practice. W.B. Saunders, Co., U.S.A.
6. Hungerford. T.G., 1991, Hungerford's Diseases of Livestock 9th Ed. McGraw-Hill Book Company, Sydney, Australia.
7. Smith B.P., 1990. Large Animal Internal Medicine. The C.V. Mosby Company, Baltimore.

SURGERY CLINIC-IV

2(0-2)

Learning Outcomes:

At the end of the course, students will be able to:

1. Control and handle different animals for the purpose of surgical manipulations
2. Treat different animals brought for treatment

3. Deal with the clients.
4. Handle indoor and outdoor cases.

Clinic:

Handling surgical emergency cases and how to effectively communicate with animal owner/ clients, documentation requirements/ how to get consent of client on prescribed forms. Fluid replacement therapy and blood transfusion in animals, Practice of passing stomach tube and stomach lavage, Back-racking, rectal palpation, Surgical management of choking, colic and grain overload, Management of urine retention cases, Application of plaster casts, Use of radiography and ultrasound as diagnostic tools, Group discussion on cases received at the clinics and case presentations, Independent handling of surgical cases.

Recommended Books:

1. Speirs, V. C. and R. H. Wrigley, 1997. Clinical Examination of Horses. W. B. Saunders Co., Philadelphia, USA.
2. White II, N. A. and J. N. Moore, 1997. Current Techniques in Equine Surgery and Lameness, 2nd Ed. W. B. Saunders Co., Philadelphia, USA.
3. Stashak, T. S. 1987. Adams' Lameness in Horses. 4th Ed. Lea and Febiger. Philadelphia, USA.
4. Colahan, P. T., I.G. Mayhew, A. M. Merritt and J. N. Moore, 1999. Equine Medicine and Surgery, 5th Ed. (Vol. I & 2) Mosby, Philadelphia, USA.
5. Pollitt, C. C., 1995. Colour Atlas of the Horse's Foot. Mosby-Wolfe, Philadelphia, USA.
6. Kelly, W. R., 1984. Veterinary Clinical Diagnosis. 3rd Ed. Bailliere Tindall, London, UK.

THERIOGENOLOGY CLINIC - IV**2 (0-2)****Learning Outcomes:**

At the end of the course, students will be able to:

1. Explain the basics of reproductive management in dairy herds.
2. Demonstrate the handling of pre and post-partum reproductive disorders.
3. Establish the comprehension of better conception rate by managing infertility issues.

Clinic:

Systematic procedure for conducting clinical examination of female genitalia, evaluation of history (method, relevancy etc.), Breeding Act or Law of the Land, AI/ breeding plans in multilevel dairy enterprises, how to effectively communicate with animal owner/ clients, documentation requirements/ how to get consent of client on prescribed forms, AI procedures, practices etc. to increase pregnancy rate through AI in dairy herds, Synchronization programs in dairy herds, Diagnosis and treatment of uterine infections, Prevention and management of vaginal & uterine prolapse, Causes, prevention and management of retained placenta, Induction of parturition/ abortion in farm

animals, Cystic ovarian degeneration, Use of ultrasonography in reproductive management, Determination of gestation age in domestic animals, Methodologies to decrease calving interval, Reproductive management in canines (breeding time, semen evaluation), Dystocia management and post-partum care, Collection and examination of preputial samples of bulls.

Recommended Books:

1. Zemjenis, R., 1970. Diagnostic & Therapeutic Techniques in Animal Reproduction. Williams & Wilkins Company, Baltimore
2. Morrow, D.A., 1986. Current Therapy in Theriogenology, II. W.B. Saunders Company, Philadelphia
3. Kahn, W., D. Wolkman, and R.M. Kenney, 1994. Veterinary Reproductive Ultrasonography, Mosby-Wolfe, London.

SEMESTER X

ENGLISH-III (TECHNICAL WRITING AND PRESENTATION SKILLS)

2 (2-0)

Learning Outcomes:

At the end of the course, students will be able to:

1. Write well organized academic text e.g. assignments, examination answers
2. Write narrative, descriptive, argumentative essays and reports (assignments)
3. Write research/term papers

Theory:

Presentation skills; essay writing, descriptive, narrative, discursive, argumentative, academic writing, how to write a proposal for research paper/ term paper, how to write a research paper/ term paper (emphasis on style, content, language, form, clarity, consistency), technical report writing, progress report writing.

Recommended Books:

1. White, R. 1992. Writing. Advanced, Oxford Supplementary Skills. Third Impression.
2. Langan, J., 2004. College Writing Skills. McGraw-Hill Higher Education.
3. Kirszner, L.G. and S.R. Mandell. Patterns of College Writing (4th edition), St. Martin's Press.
4. Neulib, J., K.S.Cain, S. Ruffus, and M. Scharton (Ed.). The Mercury Reader. A Custom Publication. Compiled by Norther Illinois University

LIVESTOCK ECONOMICS AND BUSINESS MANAGEMENT

2(2-0)

Learning Outcomes:

At the end of the course, students will be able to:

1. Describe role of livestock in national economy
2. Design feasibility studies for livestock and related businesses
3. Describe salient international trade laws, regulations and alliance

Scope & definition of economics, growth and economic development, national income accounting GDP, GNP, NNP, demand & supply, share of livestock, poultry and dairy industry in Pakistani economy, financial and economic analysis of agro livestock business, economic feasibilities for establishment of veterinary private clinical practice/ hospital/ workup disease diagnostic lab, livestock poultry and related businesses, livestock & poultry products market and functions, dairy marketing systems, poultry feed industry, whole sale and distribution & marketing of eggs and broilers, channels for value addition of livestock and poultry product, business & entrepreneurship, types of businesses, business cycle, new venture planning, management & organization, types of managers, small business role, project cycle and stages, evaluation of development project & management, definition, nature & scope of marketing, product planning, development & marketing patents trade mark, market segmentation, marketing mix and four Ps of marketing, advertising, sales promotion strategy, supply chain management, brands, services marketing, companies, micro & macro environments, trade, law of comparative and absolute advantage- international trade and barrier, trade agreements, alliance, international economic integration and cooperation., WTO liberalization and international trade.

Recommended Books:

1. Nickels G.W., McHugh M.J. and McHugh Susan. Understanding Business. 7thEdition. McGraw-Hill Irwin.

Reference Books:

1. Koontz H., Cannice M.V. and Weihrich H. Management A global and entrepreneurial perspective 12thEdition.
2. Downey, W.D. & S.P. Enieson, 1998. Agricultural Business Management, McGraw-Hill Book Co; Singapore.
3. Terry G.R. and Franklin, 1992. Principles of Management, Interstate Printers and publishers, Illinois, U.S.A.
4. Ahmad, B., M. Ahmad, and M.A. Chaudhry, 1996. Economics of Livestock production and Management, University of Agriculture, Faisalabad, Pakistan.

INTERNSHIP. As specified by PVMC Regulations from time to time.

