

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, 432 pp.
5. Kleiman, D.G., K.V. Thompson and C.K. Baer, 2010. Wild Mammals in Captivity: Principles and Techniques for Zoo Management, 2nd Edition, University of Chicago Press.
6. Miller, E. and E. Murray, 2011. Fowler's Zoo and Wild Animal Medicine Current Therapy, Elsevier Health Sciences.

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. 5th Ed. 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. Vol 2, 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.

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.

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.
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 quarter), 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), *Campylobacter 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, 1994. Clinical Veterinary Microbiology. Wolf, London.

Recommended Books:

1. Cottral, G. E., 1978. Manual of Standardized Methods for Veterinary Microbiology, Comstock Publishing Associates: A Division of Cornell University Press, Ithaca and London, UK.
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, 4th edition, WH Freeman and Co. New York, USA
6. Talaro, K. and A. Talaro, 1996. Foundation in Microbiology. 2nd Ed., Win C. Brown Publ., owa.
7. Virella, G., 1997. Microbiology and Infectious Disease. 3rd Ed., 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 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.

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 allelomorphism; 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 lethals 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.

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.

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.