UNIVERSITY OF POONCH RAWALAKOT

PROPOSED CURRICULUM

FOR

PhD PROGRAM

IN

ZOOLOGY

DEPARTMENT OF ZOOLOGY
UNIVERSITY OF POONCH RAWALAKOT
AZAD KASHMIR
Website: www.upr.edu.pk

UNIVERSITY OF POONCH RAWALAKOT, AJK
SCHEME OF STUDIES FOR Ph. D. ZOOLOGY DEGREE PROGRAMME

Criteria for PhD

Duration	6-16 Semesters
Courses	19 Credits
Comprehensive Examination (Written and Oral)	Qualified/Not Qualified
Thesis	24 Credits
Total Credits	**43 Credits**

Ph.D. 1st SEMESTER **(Credit hours: 10)**

Course Code	Course Title	Credit Hrs.
ZOO-735	Project Designing, Writing and Execution	3(2+1)
ZOO-795	Seminar	1(1+0)
	Elective Courses	6
Total		**10**

Ph.D. 2nd SEMESTER **(Credit hours: Minimum 9)**

Course Code	Course Title	Credit Hrs.
ZOO-737	Data Analysis and Report Writing	3(2+1)
	Elective Courses	6
Total		**9**

Ph.D. 3rd to 10th SEMESTER

Course Code	Course Title	Credit Hrs.
	Comprehensive Examination (Written and Oral)	Qualified/ Not Qualified
ZOO-799	Thesis	24 (0+24)

LIST OF OPTIONAL COURSES FOR Ph.D. ZOOLOGY SEMESTER 1st and 2nd

Course code	Course Title	Credit Hrs.
ZOO-703	Clinical Bacteriology	3(3+0)
ZOO-704	Environmental Issues in Pakistan	3(3+0)
ZOO-705	Fish Physiology and Breeding	3(3+0)
ZOO-706	Basic Pharmacology and Animal Trials	3(3+0)
ZOO-707	Wildlife of Pakistan and Azad Jammu and Kashmir	3(3+0)
ZOO-708	Biological Molecules	3(3+0)
ZOO-709	Molecular Physiology	3(3+0)
ZOO-710	Cancer Genetics	3(3+0)
ZOO-711	Systemic Toxicology	3(3+0)
ZOO-712	Advances in Medical Parasitology	3(3+0)
ZOO-713	Advances in Developmental Biology	3(3+0)
ZOO-714	Genomics	3(3+0)
ZOO-715	Advances in Molecular Biology and Biotechnology	3(3+0)
ZOO-716	Medical Entomology	3(3+0)
ZOO-717	Medical Virology	3(3+0)
ZOO-718	Immunology: Introduction and Applications	3(3+0)
ZOO-719	Advances in Aquaculture	3(3+0)
ZOO-720	Molecular Biology Technique	3(0+3)
ZOO-721	Advanced Molecular Genetics	3(3+0)
ZOO-722	Bacterial Genetics	3(3+0)
ZOO-723	Biology of Birds and Mammals in Pakistan and AJK	3(3+0)
ZOO-724	Microbial Genomics	3(3+0)
ZOO-725	Cancer Biology	3(3+0)
ZOO-726	Applied Reproductive Physiology	3(3+0)
ZOO-727	Helminthology and Protozoology	3(3+0)
ZOO-728	Behaviorial Zoology	3(3+0)
ZOO-731	Techniques in Wilde Life Research	3(0+3)
ZOO-732	Ethics in Human and Animal Research	1 (1-0)

ZOO-733	Laboratory and Field Safety	1 (1-0)
ZOO-734	Molecular Parasitology	3(3+0)

ZOO-735	Project Designing, Writing and Execution	3(2+1)

Theory

Introduction of Project, Characteristics of a good project, Conceptualization, Problem, Development of Problem, Hypothesis, Hypothesis Testing, Research Design, Key Points of a Project, Timeline of Project, how to make and justify the budget of project, Execution of project, writing of project, writing of a synopsis, main chapters of a synopsis and their characteristics

Practical

Designing of a suitable and feasible research project on either a given topic or a topic chosen by students, writing of that specific project, cross evaluation by students and teachers, defending the project and its budget in front of a committee comprised of course instructor and students or teachers.

Books Recommended

1. Michael P. Marder, 2011. Research Methods for Science. Cambridge University Press.
2. Cothari, C.R. 2004. Research Methodology, Methods and Techniques, New Age Publishers, India
3. Thomas E. Ogden, Israel A. Goldberg, 2002. Academic Press USA
4. Recent Relevant Journals and research papers.

ZOO-737	Data Analysis and Report Writing	3(2+1)

Theory

Part 1: Data and its types, Probability and Normality of Data, Sampling methods, Parametric and nonparametric tests, Introduction to statistical tests and their use, Introduction to T test (Paired T test, one sample t test, Independent sample T test), Introduction to Chi Square test, Introduction to F test and One way analysis of variance, Introduction to two way analysis of variance with LSD and DMRT tests, Introduction to Correlation analysis, Introduction to simple linear regression analysis, Logistic regression analysis, and Odds Ratio etc.

Part 2: Introduction to reports, types of reports, project report, thesis, research paper, review paper, main chapters/parts of a report. Important terms about research Publication etc, Publication ethics, submitting and publishing online.

Practicals

Analysis of given data by T test, Chi square test, Correlation, regression and one way ANOVA applying any of the available statistical software preferably SPSS or Statistix, Interpretation of the analysis results and writing of reports on the base of analysis. Writing a review article and submitting it in some journal for publication.

Books Recommended

1. Montgomery D. C. 2014. Design and Analysis of Experiments 8th Edition, Wiley Publishers, New Dehli.
2. Mariappan P. 2013. Biostatistics: An Introduction (LPE). Pearson, New York, New Dehli.
3. Forthofer R. N. 2011. Biostatistics: A guide to design, analysis and discovery. Elsevier Publishers.
4. Blair R. C. and Taylor R. A. 2009. Biostatistics for Health Sciences. Pearson Education Publishers.
5. Muhammad F. 2005. Statistical methods and Data analysis. Kitab Markaz, Faisalabad.
6. Michael P. Marder, 2011. Research Methods for Science. Cambridge University Press.
7. Cothari, C.R. 2004. Research Methodology, Methods and Techniques, New Age Publishers, India

ZOO-703	CLINICAL BACTERIOLOGY	3(3+0)

Course Objectives

The objectives of the course are: -

- To provide knowledge to students in the fundamental aspects of clinical bacteriology
- To impart the practical know-how about the morphology and microbial activities
- To acquaint the students with basic techniques of sterilization, culturing and isolation of bacteria

Course contents

Theory

Structure of a Bacteria (Gram Positive and Gram Negative Bacteria), Sources of Bacteria, Transmission of Bacteria, Bacterial course of infection, Koch Postulates and Molecular Koch Postulates, Antibiotics, classification of antibiotics and their mode of action, antibiotic resistance.

Different disease related to Gram Positive

- *Staphylococcus* and *Micrococcus*;
- *Streptococcus*; Pharyngitis, Pneumonia
- *Enterococcus*, Enterococcus infections
- *Mycobacterium*, *Mycobacterium tuberculosis*

Gram negative bacteria,

- *Klebseilla*, Meningitis
- *Salmonella*, Typhoid
- *Shigella*, Shigellosis.
- *Neisseria*, Neisseria gonorrhea
- *Haemophilus* and *Haemophilus influenzae*
- *Pseudomonas*, *Pseudomonas aeruginosa*

Anaerobic bacteria, *Clostridium*. *Clostridium botulinum* (Botulism)

Recommended Books

1. Prescott's Microbiology 11th Edition (2011), By Joanne Willey and Kathleen Sandman and Dorothy Wood, McGraw-Hill
2. Greenwood, D. (2012). 18th Edition, Medical Microbiology. I.K. International.
3. Murray PR, Pfaller MA, Tenover FC and Yolken RH (2007). Clinical Microbiology. ASM Press.
4. Talaro K. P. and Talaro A. (2021). Talaro's Foundations in Microbiology. McGraw-Hill College Dimensi. 11th Edition
5. Willey J, Sherwood L. and Woolverton C (2007). Prescott/Harley/Klein's Microbiology, McGraw Hill.
6. Nester E.W, Anderson DG and Nester MT (2006). Microbiology. A Human Perspective, McGraw Hill

ZOO-704	ENVIRONMENTAL ISSUES IN PAKISTAN	3(3+0)

Course Objectives:

The objectives of the course are: -

- To familiarize the students about the learning and solutions of burning environmental issues
- To enable the students to understand impact and importance environmental issues for the betterment of the environment
- To check and control all sources that are destroying natural environment in Pakistan

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

- Acquire the basic knowledge of types of environmental degradationissues
- Understand the conceptsof basic issues related environment of Pakistan
- Solve the problems using learned tools for tackling the environmental issues

Course Contents

Theory

Human population:

Human population explosion,

Environmental and social impacts of growing population and affluence,

Addressing population problems.

Food production and its distribution, hunger, malnutrition and famine.

Pest and pest control need and approach to pest control, integrated pest management.

Water Pollution:

Human impact on water resources,

Eutrophication, Combating eutrophication.

Sewage Pollution: Sewage hazards and sewage managements.

Hazardous Chemical pollution: Nature of chemical risks, pollution sources and control.

Major atmospheric Changes; Acid deposition, global warming/ cooling, greenhouse effect, Ozone depletion.

Solid Waste: Landfills, incineration, management and solutions.

Energy resources: Energy sources and uses; issues related to fossil fuel and nuclear power, alternate energy resources.

Environmental Issues in Pakistan:

Ecological issues: Soil erosion, deforestation, issues related to irrigation system, natural hazards.

Issues related to conservation of habitat and biodiversity:

Major threats to biodiversity in Pakistan

Conservation strategies

Industrial pollution: Sources and remediation.

Population issues: Socio-economic issues in Pakistan.

Recommended Books

1. McKinney, M.L., Schoch, R.M. and Yonavjak, L. Environmental Science: systems and solutions. 2007. 4th Ed. Jones and Bartlett Publishers.
2. Wright, R.T. and Nebel, B. J. Environmental Science. 2007. Toward a Sustainable Future. 10th Ed. Pearson Educational.
3. Botkin, D. B. and Keller, E. A. Environmental Science: Earth as a Living Planet. 2007. 6th Ed. John Wiley and Sons.
4. Botkin, D. B. and Keller, E. A. Environmental Science (Earth as a living planet). 2000. 3rd ed. John Wiley and Sons Inc. New York, USA
5. Pakistan-A Descriptive Atlas (A comprehensive geo-politics course). 2000. 1st ed. Ahmad, R. Z. Ferozsons Pvt. Ltd. Lahore Pakistan.
6. A Geography of Pakistan Environment (Environment, people and economy). 1993. 1st Ed. Khan, F. K. Oxford University Press. New York USA.

WEB SITES

1. http://wu)w.panasia.org.sg/tcdc/pakistan
2. http://urww. wwfpak.org/biodiversity
3. http://www.populationconnection.org
4. http://www.epa.org.pk
5. http://www.unep.org

ZOO-705	**FISH PHYSIOLOGY AND BREEDING**	**3(3+0)**

Course Objectives

The objectives of the course are: -

- To provide sufficient knowledge about all physiological phenomena in fishes.
- To provides practical information to obtain better growth by following physiological aspects during extensive or semi-intensive culture
- To emphasize thoroughly in breeding of most cultivable freshwater fishes by manipulating reproductive and endocrinological aspects during natural season as well as off seasons

Course Contents

Fish nutrition: Digestive system; Stomach less fishes; Stomached fishes; Digestion and absorption; Food; Plant origin; Animal origin; Feeding; Fresh food; Dry concentrates; Pelleted food.

Transportation: Blood; Blood cells (Erythrocytes, leukocytes, Platelets and plasma); Circulation; Arterial system; Venous system; Capillaries; Transport of food material.

Respiration: Gills; Lungs; Skin; Swim bladder; Homeostasis.

Excretion: Kidneys; Hypo-osmotic urine; Hyper-osmotic urine; Osmoregulation.

Reproduction: Gonads; Testes and ovaries; Maturation; Reproductive cells (egg and sperm); Artificial fertilization of sex cells. Breeding: Natural (seasonal); Artificial; Hormonal induced breeding; Temperature and photoperiod; control induced breeding.

Growth: Extensive culture (due to the consumption of natural food); Semi-intensive culture (due to natural and artificial food); Intensive culture (due to only dry concentrates).

Fish health: Water quality; Hygiene of fish culture facilities; Hygiene of equipments used in fish culture.

Diseases and their control: Viral; Bacterial; Fungal; Parasitic; Protozoan; Helminths (trematodes, cestodes, nematodes, acanthocephalons); Crustaceans (cladocera); Annelids (leeches); Arthropods (water ticks, water flea, water mites).

Fish migration: To nursery ground; to maturation grounds; Freshwater to marine water; Marine water to freshwater.

Fish behaviour: Learning and memory; Light response for maturation; Courtship behaviour; Aquarium fish behaviour.

Recommended Books

1. Shulka, A. N. Hormones of Fishes. 1st Edition 2009. Discovery Publishing House Private LTD, New Dehli.
2. Peter, B. Moyle, Joseph, J. Cech, J. R. An introduction to Ichthyology. Fifth Edition. 2014. PHI Learning Private Limited. Dehli.
3. Frank, C. Adminster. Fish Pond for the Form. 2010. AGROBIOS.
4. Kestin, S. C. and Warris, P.D. (Editors). Kestin Farmed Fish Quality, 2002, Blackwell Science, Oxford, UK.

ZOO-706	BASIC PHARMACOLOGY AND ANIMAL TRIALS	3(3+0)

Course contents

Introduction to pharmacology? What are drugs? drug development stages, isolation of active ingredients from sources, in vitro testing. animal trials, studying dose determination, LD_{50}, LC_{50}, drug toxicity, side effects, pharmacokinetics, pharmacodynamics, drug delivery, absorption, distribution, bioavailability, half life and elimination using animals. Phase I, II, III and IV clinical trials,

Ethics of animal trials and other animal studies,

Ethics committees.

Patenting of drugs, commercialization and benefit sharing.

Important study animals.

Recommended Books

1. Pharmacology: An Introduction (Paper back) by Henry Hitner Published January 12th 2011 by McGraw-Hill.
2. Advances in Experimental Medicine and Biology, Volume 595: The Molecular Targets and Therapeutic Uses of Cur cumin in Health and Disease (ebook) by Bharat B. Aggarwal, Published January 1st 2007 by Springer.
3. Principles of Pharmacology: The Path physiologic Basis of Drug Therapy (Paperback) by David E. Golan (Editor) published April 27th 2007 by LWW
4. Pharmacology for Anaesthesia and Intensive Care (Paperback) by Tom E. Peck, Published April 1st 2008 by Cambridge University Press
5. Pharmacology: Prep Manual for Undergraduates (Kindle Edition) by Tara Shanbhag, Published January 23rd 2016 by Elsevier India

ZOO-707	WILDLIFE OF PAKISTAN AND AZAD JAMMU AND KASHMIR	3(3+0)

Course Objectives:

The objectives of the course are:-

1. To familiarize the students with the wildlife fauna of Pakistan
2. To create the awareness among the students about the important wildlife species
3. To equip the students with the knowledge of wildlife management and conservation

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Acquire the basic knowledge about the wild species of Pakistan
2. Evaluate the problems faced by each wildlife species in their ecosystem
3. Demonstrate the wildlife values and threats to wildlife fauna due to environmental aspects

Course Outline:

1. Introduction

- Definitions, concepts and importance of wildlife.
- Classification of the amphibians, reptiles, birds and mammals of Pakistan/AJK up to Orders with identifying characteristics and examples.
- Status and distribution of the wildlife of Pakistan/AJK.
- Species status assessment system of IUCN-global and national

2. Protected Areas

- Protected areas of Pakistan/AJK: History, status, categories and management.
- Zoo, safari parks and Breeding Centers
- Wildlife Sanctuaries, National Parks and Game Reserves
- Wetlands and Ecological Zones

3. Issues and challenges

- Extinct/extirpated wildlife of Pakistan/AJK, with their causes of extinction
- Threatened wildlife of Pakistan/AJK and their threats
- Captive breeding and re-introduction of wildlife
- Cage/fencing, habitat preparation and maintenance of wildlife for captive breeding

4. Wildlife Conservation

- Philosophy and significance of wildlife conservation
- Essentials of Wildlife Conservation and National Perspectives
- In-situ conservation and Ex-situ conservation
- conservation and rural development, role of culture and religion in conservation
- National Conservation Strategy of Pakistan/AJK

5. **Wildlife Rules and Regulations and importance**

- Laws and conventions related to wildlife: Pakistan/AJK Wildlife Act
- Convention on Biological Diversity (1992)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)
- Ramsar Convention (1971)
- National and international organizations involved in wildlife conservation

Text and Reference Books:

1. Wildlife of Pakistan, 2002. Published by Punjab Wildlife Department, Lahore.
2. Miller, G.T. 2002. Living in the Environment: Principles, Connections and Solution. 12th Edition. Thomson Learning Inc., Australia.
3. http://www.wildlifeofpakistan.com
4. Jordan, E. L. and Verma, P. S. 2011.Invertebrate Zoology, S. Chand and Company.
5. Grimmett, R. Roberts, T. J and Inskipp, T. 2008. Birds of Pakistan. Helm Field Guide.

6. Mitsch, W. J. and Gosselink, J. G. 2007. Wetlands 4th ed. John Wiley and Sons, Inc.
7. M.S. Khan. 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company, Florida USA.
8. Mirza, Z. B. 1998. Illustrated handbook of Animal Biodiversity of Pakistan. Printopak.
9. Roberts, T.J. (1997). Mammals of Pakistan. Oxford University Press, Karachi Mammals of Pakistan. Oxford University Press, Karachi

ZOO-708	BIOLOGICAL MOLECULES	3(3+0)

Course Contents

Carbohydrates: classification, types, important characteristics

Structure of carbohydrates; monosaccharides; disaccharides, their types structure and function; polysaccharides, storage and structural types; structure and major functions of polysaccharides.

Amino acids, peptides and proteins: standard amino acids, their structure and classification; acid-base properties of amino acids and their titration curves; peptides, their ionic behavior and amino acid composition.

Lipids: fatty acids, their types and major characteristics; storage lipids, acylglycerols; waxes; structural lipids in membranes; major functions of lipids; lipoproteins, their types and major functions.

Enzymes: introduction; important characteristics of enzymes; immobilized enzymes; how enzymes work; example of enzymatic reaction; enzyme kinetics, enzyme rate of reaction and substrate concentration, how pH and temperature effect enzyme activity.

Vitamins and cofactors: occurrence, structure and biochemical function of vitamins of B-complex group. Nucleic Acids; DNA and RNA structures and types.

Recommended Books

1. Denise R. Ferrier. Biochemsitry. 6th edition.2015 Lippincott's.
2. Aroor A. R. Medical Biochemistry. 2011. Jaypee Brothers Medical publishers, UK London.
3. Nelson, D. L. and Cox, M.M. Lehninger Principles of Biochemistry, 3rd Edition, 2000. McMillan Worth Publishers, New York.
4. Murray, R.K., Granner, D.K., Mayer, P.A. and Rodwells, V.W. Harper"s Biochemistry, 25th Edition, 2000. McGraw Hill, New York.

ZOO-709	MOLECULAR PHYSIOLOGY	3(3+0)

Course Contents

Overview of resting membrane, action potential and synaptic transmission; structure and mechanisms in ion channels; Biosynthesis of neurotransmitters; Neurotransmitters action at synaptic receptors. Neurosecretions and neurotransmitters in higher nervous system

actively. Molecular mechanisms in transduction of sensory stimuli into impulse; photochemistry and transduction of photoreceptor; Colour vision. Overview of endocrine glands, their hormones and roles; chemistry and biosynthesis of hormones of adenohypophysis, thyroid, parathyroid, endocrine pancreas, adrenal medulla and steriodogenic tissues; Metabolism of thyroid and steriodogenic tissues; Structure of hormone receptors; Mechanisms of action of a protein/peptide, a steroid and thyroid hormone; Hormonal regulation of metabolism; Molecular basis of muscular contraction; Molecular interaction at neuromuscular level; Molecular structure of cilia and flagella and mechanisms in movements. Automicity and rythmicity of myogenic heart; Regulation of cardiac activity; humeral regulation of circulation: Vasoconstriction and vasodilatation. Exchange of respiratory gases; Chemical regulation of respiration. Nature formation of various nitrogenous waste products; Glomerular filtration, reabsorption, and secretion mechanisms; Concentration of urine. Regulation of digestive secretions; Digestion and absorption of nutrients, Molecular mechanisms in adaptation to temperature extremes

Recommended Books

1. Randall, D., Burggren, W., French, K. and Fernald, R., 2002. Eckert Animal physiology; Mechanisms and Adaptations, 5th ed. W. H. Freeman and Company,
2. Bullock, J., Boole, J. and Wang, M.B., 2001. Physiology, 4th edition. Lippincott, Williams and Wilkins, Philadelphia.
3. Berne, R.M. and Levy, M.N., 2000. Principles of Physiology, 3rd edition. St., Lious, Mosby.
4. Guyton, A.C. and Hall, J.E., 2000. Textbook of Medical Physiology, 10th Edition. W.B. Saunders Company, Philadelphia.
5. Tharp, G. and Woodman, D., 2002 Experiments in Physiology, 8th Edition, Prentice Hall, London.

ZOO-710	**CANCER GENETICS**	**3(3+0)**

Course Contents

- Genome structure,
- nuclear and mitochondrial genome,
- Types of DNA,
- Prokaryote and Eukaryote gene,
- molecular definition of a gene,
- Solitary genes and gene families ,
- Simple sequence repeats and finger printing,
- Eukaryotic Gene Clusters and their Transcription,
- Transposable genetic elements,
- DNA methylation and Cancer,
- Repeat instability, repeat instability and genetic diseases,

- Imprinting,
- Differential methylation and cancer,
- Epigenetics and its implications in the genome,
- Replication and Transcription shaping the genome,
- Telomere and Telomerase and their role in cancer and aging, applications,
- RNA interference, RNAi mediated pathways in nucleus,
- therapeutic potential for human diseases,
- Molecular regulation of gene expression.

Recommended Books

1. Harvey Lodish(2016), Cell and Molecular Biology, W. H. Freeman publishers, USA.
2. Jorde, carey, Bamshad. (2012) Medical Genetics. Elsevier, printed in India by Rajkamal Electrical press, kundli, Haryana.
3. Watson, Baker and Bell (2008) Molecular Biology of the Gene (6th edition) Pearson publication incorporation.
4. Waseem Ahmad (Faridi) 2013. Genetics and Genomics. Pearson publication incorporation.
5. Lewin, Benjamin (2003), Genes VIII, Oxford University Press.

ZOO-711	SYSTEMIC TOXICOLOGY	3(3+0)

Course Contents

Brief introduction to the principals of distribution.

Excretion and absorption of toxicants.

Biotransformation of toxicants and chemical carcinogens.

A detailed study of the **Toxic responses of various systems** of the body like Toxic responses of blood,

Immune system, Liver, Kidney, Respiratory system, Central Nervous system and Cardiovascular system.

Role of free radicals in Toxicity.

Modes of Cell death Necrosis and Apoptosis; Cytokines and Signal Transduction.

Recommended Books

1. Hayes, A. Wallace, 2019. Principles and Methods of Toxicology, Sixth Edition, Raven Press, New York.
2. Klaassen, C. D., (2019). Casarell and Doull‟s Toxicology; The Basic science of Poisons; 6th Edition (International). McGraw-Hill, Health Professions Division, New York.
3. Timbrel, J. A., 2021. Introduction to Toxicology, 3rd edition. Taylor and Francis Ltd. London.

ZOO-712	ADVANCES IN MEDICAL PARASITOLOGY	3(3+0)

Aims and Objectives:

To provide an overview of the major parasitic diseases of man and their vectors. Demonstrate understanding of the biology and the life cycles of the major parasites and of their vectors or intermediate hosts

The objectives of the course are: -

- Identify the major parasites, vectors and intermediate hosts
- Demonstrate understanding of the pathogenesis and pathology of the major parasitic diseases and the immune responses to these parasites
- Appreciate the epidemiology of the major parasitic infections
- Appreciate molecular methods available for chemotherapy and control

Course Contents

Introduction to Advances in Medical Parasitology (Terminologies used in Medical Parasitology, Molecular Parasitology and new approaches in Medical Parasitology), Parasite-host cell molecular interaction, Cytokines: their roles in parasitic diseases, Immunological mechanisms of worm expulsion

- Amoebiasis
- Giardiasis
- Trypanosomiasis
- Leishmaniasis
- Ascariasis
- Echinococcosis
- Schistosomiasis
- Fascioliasis

Study of above medically important diseases of Human and their recent advances with following headings

- Introduction about disease (History, parasite and disease name)
- Biology (Life Cycle of Parasite)
- Epidemiology
- Signs and Symptoms
- Diagnosis (Advance techniques)
- Prevention and Control
- Treatment

Recommended Books

1. D. R. Arrora. Medical Parasitology. 2015. 4th edition. Amazon publishers
2. Hunter‟s Tropical Medicine (6th edition) by G. T. Strickland. 2001.
3. Foundations of Parasitology by L.S. Roberts and J. Janovy Jr., 8th Edition, 2009. McGraw Hill, Boston.
4. Animal Agents and Vectors of Human Diseases by P.C. Beaver and R.C. Jung 2007.
5. Topley and Wilson’s Principle of Bacteriology, Virology, Mycology, Parasitology

and Immunity (Vols. I-6). 9th edition. 2007. Edward Arnold Publishers, UK

ZOO-713	ADVANCES IN DEVELOPMENTAL BIOLOGY	3(3+0)

Course Contents

General Principles: Differential Gene Expression, Cell-Cell Communication, Principles of Development - Differentiation, Specification, and Cell Lineage. Reproduction and Early Development: Meiosis – Gametogenesis, Fertilization, Early Development and Axis Formation – Drosophila, Vertebrates. Apoptosis- mechanism and significance, Ageing- mechanism, concepts and models.

Applied Developmental Biology: Assisted Reproduction and Hormonal Regulation, Multiple ovulation and embryo transfer technology (MOET),

Pluripotent Stem Cells: ES Cells and iPS Cells Application of embryonic stem cells, clinical and economic significance, Embryonic sexing, cloning, screening for genetic disorder diagnosis (ICSI, GIFT etc.), Cloning of animals by nuclear transfer.

Mammalian development and medical embryology: Early Development of the Mammalian Central Nervous System, Early Musculoskeletal Development, Limb Patterning and Development, Development and Birth Defects of the Eye and Ear, Development of the Heart, Development of Lungs and Aortic Arches, Development of the GI and Renal Systems, Sex Determination, Gonadal Development, Neural Crest and Craniofacial Development.

Recommended Books

1. Developmental Biology, S. F. Gilbert. 10th Edi. 2013. Sinauer Associates Inc. Publishers.
2. Jonathan, M., W. Slack. Essential developmental biology.2012 3rd edition. Wiley-Blackwell.
3. Klaus, K. 2001. Biological Development. 2nd Edition. McGraw Hill.
4. Principles of developmental: Lewis Wolpert. 2011. 4th edition. OUP. Oxford.

ZOO-714	GENOMICS AND PROTEOMICS	3(3+0)

Course Objectives:

The objectives of the course are:-

- To enable the students to understand organization of Human genome.
- To enable the students to analyse and predict protein models and genome database.
- To train the students to run various databases necessary to predict the effect of certain mutations

Course Contents:

Introduction The Human Genome, Contents and organization of genomes, From gene to protein to disease, Genomic features of model organisms

Contents and Organization of Genomes: Chromosomes, organelles and Plasmids, Genes, Dynamic components of genomes, Genome organization in Prokaryotes, Genome organization in Eukaryotes.

Mapping, Sequencing and Annotation: Strategies for the systematic sequencing of complex genomes, DNA sequencing, Fredrick Sanger and development of DNA sequencing, Maxam Gilbert chemical cleavage method, Automated DNA sequencing.

Orthologs, paralogs and evolutionary genomics, Gene duplication and co-option 2R or not 2R: extensive genomic duplications in early chordates, Primate segmental duplications

Comparative genomics and decoding the regulatory genome, "Evodevo" (Evolutionary Developmental Biology) and genomics, Classification of vertebrate gene deserts, Expansion of introns in animal genomes

Proteomics: Protein structure and types, Protein folding patterns, Changes in folding patterns in protein evolution.

Separation and Analysis of protein Poly acrylamide gel electrophoresis (PAGE)**,** SDS PAGE, Mass spectrometry.

Protein Engineering: Multipl**e** Sequence Alignment, Crustal Omega, Ab initio

Recommended Books

1. Human Molecular Genetics by Tom Strachan and Andrew Read, Garland Science/Taylor and Francis Group; 5th edition (December 6, 2018).
2. Arthur Lesk (3rd Edition). Introduction to Genomics by Oxford University Press, USA; 2017
3. The Regulatory Genome: Gene Regulatory Networks in Development and Evolution Eric H. Davidson Academic Press; 1 edition (June 13, 2006
4. Endless Forms Most Beautiful: The New Science of EvoDevo and the Making of the Animal Kingdom Sean B. CarrollW. W. Norton and Company; 1 edition (April 11, 2005).

ZOO-715	**ADVANCES IN MOLECULAR BIOLOGY AND BIOTECHNOLOGY**	**3(3+0)**

Course contents

- Recombinant DNA technology
- PCR techniques, RFLP technique, Gel electrophoresis,
- Cell culture techniques, some important cell lines and their culture techniques,
- Stem cell research and techniques,
- Hematopoietic stem cells and their culture techniques,
- Stem cell therapy,
- Antibody research and techniques of antibody production, antibody engineering, hybridism technique for generation of monoclonal antibodies,
- Cloning techniques,

- Gene therapy.
- Indigenous knowledge and patenting,
- commercialization and benefit sharing.
- National bioethic committees.

Recommended Books

1. Willium J. Thieman (2014) Introduction to Biotechnology 3rd edition. Pearson publication incorporation
2. Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Robert, Keith; Walter, New York and London: Garland Science; 2002, Molecular Biology of the Cell.
3. Cooper, Geoffrey M. The Cell – A Molecular Approach Sunderland (MA): Sinauer Associates, Inc.; 2002
4. Lodish, Harvey; Berk, Arnold; Zipursky, S. Lawrence; Matsudaira, Paul; Baltimore, David; Darnell, James E. New York: W.H. Freeman and Co.; 1999. Molecular Cell Biology.
5. Karp, J. Cell and Molecular Biology, Concepts and Experiments, 2005. Jhon Wiley and Sons, INC.
6. Malacinski. G. M. 2003. Essentials of Molecular Biology. 4th Edition. Jonesand Bartlett Publishers, Massachusetts

ZOO-716	**MEDICAL ENTOMOLOGY**	**3(3+0)**

Course Objectives:

The objectives of the course are: -

- The objective of this course is to understand the impact of arthropods and arthropods born disease in public and animal health

Course contents

Arthropod borne diseases, Biology, disease relationships and control of insects and other arthropods parasitic on or in humans, clinical and preventive medicine.

Direct impacts that parasitic insects have on human health.

Taxonomy of medically important arthropods and molecular biology applications, epidemiology, transmission, disease control, vector control and disease surveillance. **Arthropod** groups involved in the causation and/or transmission of diseases affecting human health with key morphological characteristics, habits and habitat needs of the various life stages of arthropod being emphasized.

Use of molecular biology applications to medical entomology.

Recommended Books

1. Muller, Gray and lance Durden. 2020. Medical and veterinary entomology, academic. Press: New York.
2. Mike service 2019. Medical entomology for students .5th edition, Cambridge press.
3. Mullen, Gary and Lance Durden. 2009. Medical and Veterinary Entomology,

Academic Press: New York.
4. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods 2nd Edition by B.F. Eldridge, J.D. Edman, Kluwer Academic Publisher
5. Mike Service. 2011. Medical Entomology for Students. 5th Edition, Cambridge Press.

ZOO-717	MEDICAL VIROLOGY	3(3+0)

Course contents

Introduction, structure and classification of viruses, Detection and diagnosis of medically important viruses. Mechanism of virus entry in the cell. Acute, Chronic, Persistent and Latent infection, sources, mode of transmission, life cycle, epidemiology, disease course and control of some human viral infections including HIV, Hepatitis A, B, C and D viruses; polyoma viruses, rabies virus, Epstein barr virus, Varicella zoster virus, Prevention and control of Viral Diseases. Vaccine, its types and mode of action. Antiviral Drugs and their mode of action. Safety measures and rules for working in an infectious disease laboratory

Recommended Books

1. NJ. Dimmock, AJ. Easton and KN. Leppard. 2007. Introduction to Modern Virology, 6th Edition. Blackwell Publishing Ltd.
2. EK. Wagner, MJ. Hewlett, DC. Bloom and D Camirini. 2008. Basic Virology, 3rd Edition. Blackwell Publishing Ltd.
3. CA. Mims, A. Nash and J. Stephen. 2000. Mims´ Pathogenesis of Infectious Diseases, 5th Edition. Academic Press, London.
4. RA. Goldsby, TJ. Kindt and B. Osbourne. 2000. Kuby Immunology, 4th Edition. W.H. Freeman, New York.

ZOO-718	IMMUNOLOGY: INTRODUCTION AND APPLICATIONS	3(3+0)

Course Objectives

- To introduce students with principles of immunological techniques
- To train the students for all types of immunological assays and techniques used in research and diagnosis

Course contents

Introduction to immune system, First, second and third line of immune system, Innate and acquired immunity, cell mediated and humoral immunity, components of immune system, classification and function of immune cells with process of hematopoiesis, Antibodies, monoclonal and polyclonal antibodies, complement system, Interleukins and interferon, Allergy and Anaphylaxis, Inflammation, Applications of immunology in diagnosis and therapeutics, ELISA, RIA etc. Monoclonal antibodies, antibody engineering and production for diagnostic and therapeutic purposes using animals and animal models

Recommended Books

1. Subash Chandra Parija, Text Book of Microbiology and Immunology, Elsevier, 2016
2. Thao Doan, Roger Melvold, Susan Viselli, Carl Waltenbaugh, Immunology, Published by Wolters Kluwer, India, Pvt. Ltd. New Dehli, 2014
3. F. H. Khan, The Elements of Immunology, Pearson Publishers India, 2012
4. Richard A Goldsby, Thomas J. Kindt. Kuby Immunology. 2006.
5. Alfred I. Tauber. Metchnikoff and the origins of immunology. 2010.

ZOO-719	ADVANCES IN AQUACULTURE	3(3+0)

Course Objectives

The objectives of the course are: -

1. To increase the understanding of fin fish and shell fish aquaculture
2. To teach about different aquaculture species, their rearing facilities andmanagement by using basic techniques
3. To impart knowledge about site selection and construction of fish farm.
4. Problems and management of fish farm

Course Contents

Aquaculture: the concept, mariculture; the substrate system, seawater ponds, cages, enclosure, tanks. Aquaculture in fresh and brackish water.

Water quality parameters in fish culture.

Culture systems (open, semi-closed, closed). Polyculture vs. monoculture. Significance of aeration, culture of molluscs, Crustaceans; Fish (Carp, Trout, Cat fish, Tilapia, Salmon).

Aquaculture management (lakes, reservoirs etc.) economics and marketing; feeding for Carp, Salmonids and Cat Fishes. Intensive and semi-intensive culture of major carps. Aquaculture Engineering,

Applied economics of Fisheries and Aquaculture, Pond Management, Advanced site selection and pond management,

Breeding and raring techniques of local and ornamental fishes,

Carb and lobster aquaculture,

Environmental conditions feeding and fertilization factors, biological filtration in aquaculture,

Sterilization and disinfection,

Design of Production system

Recommended Books

1. Bhardwaj, K. D. A-Z of Fisheries and Aquaculture Technology. 1st Edition. 2011. Cyber. Tech Publication, New Dehli
2. Shulka, A. N. Hormones of Fishes. 1st Edition 2009. Discovery Publishing House Private LTD, New Dehli.
3. Peter, B. Moyle, Joseph, J. Cech, J. R. An introduction to Ichthyology. Fifth Edition.

2014. PHI Learning Private Limited. Dehli.
4. DianabandhuSahoo. Sustainable Aquaculture. 2009. A.P.H. Publishing Corportion, New Dehli
5. Frank, C. Adminster. Fish Pond for the Form. 2010. AGROBIOS.

ZOO-720	MOLECULAR BIOLOGY TECHNIQUES	3(0+3)

Course contents (Practical)

- Extraction and purification of DNA and RNA from body fluids, tissues, skin, hair and nails
- Quantitative PCR RT-PCR, gel filtration
- Agarose gel electrophoresis, polyacrylamide gel electrophoresis (PAGE)
- Ultrafiltration Dialysis
- Lyophilisation, Southern, Northern and Western blotting, Western blotting
- ELISA, RIA
- PCR Techniques RAPD, SSR, DAF, AFLP, FISH
- Principles and applications of visible, UV, IR, NMR spectroscopy
- Atomic absorption
- Fluorescence spectroscopy
- Electron microscopy
- Principle and applications of X-ray diffraction
- Principles and applications of gas chromatography and HPLC
- Fast performance Liquid Chromatography (FPLC)
- Biosensors,
- Protein chips

Recommended Books

1. Carson and Susan (2012) Elsevier Inc. ISBN: 978-0-12-385544-2
2. Keith Wilson, John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press
3. Carson and Susan (2012) Elsevier Inc. ISBN: 978-0-12-385544-2
4. Keith Wilson, John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press

ZOO-721	ADVANCED MOLECULAR GENETICS	3(3+0)

Course Contents

- Genome structure
- Nuclear and mitochondrial genome
- Types of DNA
- Prokaryote and Eukaryote gene
- Molecular definition of a gene

- Solitary genes and gene families
- Simple sequence repeats and finger printing
- Eukaryotic Gene Clusters and their Transcription
- Transposable genetic elements
- DNA methylation and Cancer
- Repeat instability, repeat instability and genetic diseases
- Imprinting
- Differential methylation and cancer
- Epigenetics and its implications in the genome
- Replication and Transcription shaping the genome
- Telomere and Telomerase and their role in cancer and aging, applications
- RNA interference, RNAi mediated pathways in nucleus
- Therapeutic potential for human diseases
- Molecular regulation of gene expression

Recommended Books

1. Harvey Lodish (2016), Cell and Molecular Biology, W. H. Freeman publishers, USA.
2. Jorde, carey, Bamshad. (2012) Medical Genetics. Elsevier, printed in India by Rajkamal Electrical press, kundli, Haryana.
3. Watson, Baker and Bell (2008) Molecular Biology of the Gene (6th edition) Pearson publication incorporation.
4. Waseem Ahmad (Faridi) 2013. Genetics and Genomics. Pearson publication incorporation.
5. Lewin, Benjamin (2003), Genes VIII, Oxford University Press.

ZOO-722	BACTERIAL GENETICS	3(3+0)

Course Objectives:

- To learn the continuity of the life from one generation to other generation
- To provide knowledge based on the mechanisms involving nucleus, chromosomes and genes etc.

Course Contents

Nucleic acids: structure and functions.

DNA replication: replicon origins, events that occur at the replication fork, the structure and functions of DNA polymerases, and replication strategies.

Control of DNA replication: dichotomous replication in prokaryotes. Control of gene expression in prokaryote: polycistrons, transcriptional initiation and termination, the operon, catabolite repression and attenuation control.

Protein synthesis - mRNA translation: Genetic code - non universality, codon usage. Events on ribosomes (c.f. prokaryotes), ribosome structure-function relationships, organelle and archaebacterial systems. Plasmids, episomes and transposons.

DNA mutagenesis: mutagenic agents, repair and mutation suppression.

Genetic recombination: generalized recombination, site specific recombination and illegitimate recombination. Gene transfer mechanisms and their role in evolution. Transformation, transduction, conjugation and cross phylogenic transfer. Gene mapping by conjugation and transduction. Circular chromosomal maps of bacteria. Introduction to genetic rearrangements.

Recommended Books

1. Griffiths, A. J. F., Doebley, J., Catherine, P., Wassarman, D. A. 2020. Introduction to Genetic Analysis, 12th edition
2. Pierca, B. A., 2020. Genetics. A conceptual approach, W. H. Freeman and Company. 7th edition
3. Synder, L. and Champness, W. 2020. Molecular Genetics of Bacteria. ASM Press, Washington D.C. 5th edition
4. Ringo, J., 2004. Fundamental Genetics, Cambridge University Press.

ZOO-723	**BIOLOGY OF BIRDS AND MAMMALS IN PAKISTAN AND AZAD JAMMU KASHMIR**	**3(3+0)**

Course Objectives:

The objectives of the course are:-

- To familiarize the students with the mammals and birds fauna of Pakistan
    - To create the awareness among the students about the important wildlife species
    - To equip the students with the knowledge of wildlife management and conservation

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

- Acquire the basic knowledge about the birds and mammals of Pakistan
- Evaluate the problems faced by birds and mammal's species in their ecosystem
- Demonstrate the wildlife values and threats to wildlife fauna due to environmental aspects

Course Contents

General Characteristics of birds

- Structure
- origin
- evolution
- reproduction
- life history of birds
- behaviour, population regulation
- general ecology
- Geography migration and orientation in birds

- Classification of avifauna of Pakistan

General Characteristics of mammals

- characteristics
- distribution
- classification
- reproduction and development
- behaviour, population and economic relationship of mammal.
- the mammal fauna of Pakistan and its scientific and economic importance

Recommended Books

1. Jordan, E. L. and Verma, P. S. 2011.Invertebrate Zoology, S. Chand and Company.
2. Grimmett, R. Roberts, T. J and Inskipp, T. 2008. Birds of Pakistan. Helm Field Guide.
3. Gaston, G. and J. Spicer. 2007. Biodiversity. Blackwell Publishing and Co. London, UK.
4. Mitsch, W. J. and Gosselink, J. G. 2007. Wetlands 4th ed. John Wiley and Sons, Inc.
5. Hickman, Roberts, and Larsen, 2003. Animal Diversity (3rd Edition).McGraw Hill, New York.
6. Hickman, Roberts, and Larsen, 2004. Integrated principles of Zoology (12th Edition).McGraw Hill, New York.
7. M.S. Khan. 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company, Florida USA.
8. M. M. Shafique, 2005. Wildlife Acts and Rules of Pakistan. PFI, Peshawar.
9. Mirza, Z. B. 1998. Illustrated handbook of Animal Biodiversity of Pakistan. Printopak.

10 Roberts, T. J. (1997). Mammals of Pakistan. Oxford University Press, Karachi Mammals of Pakistan. Oxford University Press, Karachi

ZOO-724	MICROBIAL GENOMICS	3(3+0)

Course Contents

Genome Mapping: Genome size-complexity, structure and function of prokaryotic and eukaryotic genome. Physical mapping of genome-Sequencing whole genome, Restriction mapping – FISH, STS mapping, Hybridization assays , Physical mapping without cloning Mapping by genetic techniques, DNA markers: RFLPs, SSLPs, SNPs. Sequencing methods and Strategies: Basic DNA sequencing , Modifications of chain terminator sequences, Automated DNA sequencing, DNA sequencing by capillary array electrophoresis, shotgun sequencing Overlapping clone contigs, High throughput sequencing strategies, Alternative DNA sequencing, EST sequencing and sequence skimming. Genome Analysis: Overview of sequence analysis, Gene prediction, Tools for

genome analysis. Detecting open-reading frames-using homology to find genes, software programs for finding genes Identifying the function of a new gene, Analyses not based on homology, Genome annotation, Molecular hylogenetics. Comparative Genomics : Comparative genomics of prokaryotes, organelles, eukaryotes and other aspects. Representational difference Analysis of cDNA and Genome Comparisons, Gene Expression during Host-pathogen interactions, genomics of Mycobacterium tuberculosis, Helicobacter pylori. Approaches to bacterial mRNA extraction and labeling for microarray Analysis. Functional Genomics: DNA micro array, Construction and Design, Application of DNA micro array for comparative and Evolutionary Genomics. Gene silencing, RNAi, SiRNA, SHRNA-Proteome analysis, Protein-protein Interactions. Application of Microbial Genomics, Reverse Vaccinology: from genome to vaccine, Microbial genomics for Antibiotic Target Discovery.

Recommended Books

1. Pina Faramico, Yanhong Liu, Sophia Kathariou (2011). Genomes of food borne and water borne pathogens ASM Press Washington DC
2. Fraser, C. M., T. D. Read and K. E. Nelson (2004). Microbial Genomes, Humana Press, USA
3. Thomas J. Dougherty, Steven J. and Projan (2003). Microbial Genomics and Drug Discovery CRC Press. 4. Brendan Wren, Nick Dorrell (2002). Functional Microbial Genomics, Methods in Microbiology, Academic Press, UK.
4. Sandy B. Primrose Richard M. Twyman (2005). Principles of Genome Analysis and Genomics, Blackwell Publishing, USA.

ZOO-725	**CANCER BIOLOGY**	**3(3+0)**

Course Contents

- Cancer Introduction,
- General features and types of cancer.
- Carcinogenesis; Mechanisms of Carcinogenesis, Factors involved in Carcinogenesis. Role of cell cycle in carcinogenesis.
- Cell Cycle regulation. Metastasis or spread of cancers. Role of Proteinases in the spread of cancer.
- Matrix Metalloproteinases (MMPs), MMP1-13Tissue Inhibitors of Matrix Proteinases (TIMMPs),
- Urokinase type plasminogen activator.
- Angiostatin, Endostatin, FGF, VEGF Kinases, Receptor and their ligands, EGF, TGF. Viral Proteins; FOS, JUN, Myc, Ras. Surrogate cancer Markers; AML, APC, BRCA, Estrogen Receptors Adhesion Molecules and Integrins.
- Cathepsins. Role of Apoptosis in cancer.
- Role of Cytokines in regulating carcinogenesis

Recommended Books

1. Harvey Lodish (2016), Cell and Molecular Biology, W. H. Freeman publishers, USA.
2. Jorde, carey, Bamshad. (2012) Medical Genetics. Elsevier, printed in India by Rajkamal Electrical press, kundli, Haryana.
3. Watson, Baker and Bell (2008) Molecular Biology of the Gene (6th edition) Pearson publication incorporation.
4. Zhang, Wei, (2004). Genomic and molecular neuro-oncology, Jones and Bartlett Publishers, Boston.

ZOO-726	APPLIED REPRODUCTIVE PHYSIOLOGY	3(3+0)

Theory

Introduction, reproductive health. Infertility in male: classification, diagnosis, disorders at various levels. Infertility in female: classification, dianosis, distinct disorders. Contraception, male and female, approaches rationale, modalities, side effects. Menopause: physiology, replacement therapy. Senescence in male reproduction: aging, sexuality, treatment. Field trials of artificial insemination to determine fertility rates. Causes of sterility n domestic animals. Anti-fertility mechanisms in humans. Synthesis of milk and lactation. Gender selection based on human genome project.

Books Recommended

1. Bruce White Susan Porterfield. 2012. Endocrine and Reproductive Physiology. 4th Edition. Mosby Physiology Monograph Series.
2. Nischlag, E. and Behre, H.M. 2010. Andrology. 3rd Eds. Springer. NY. USA.
3. Knobil, E and Neill, J.D. 2013. The Physiology of Reproduction. 3rd Edition. Ravan Press. NY. USA.
4. DeGrool, L.J. 2010. Endocrinology. 6th Edition. Saunders Publishers. NY. USA.

ZOO-727	HELMINTHOLOGY AND PROTOZOOLOGY	3(3+0)

Course Objectives: The objectives of the course are:-

- To impart knowledge on various trematodes, cestodes, nematodes and protozoans affecting human and animals.
- To understand basic principles of host parasite interaction.
- To familiarize students with morphological criteria to differentiate the most common helminthes and protozoans.
- To improve their diagnostic capability by explaining basic and advanced diagnostic exercises using a compound microscope

Theory

- Systematics, biology, pathology
- Host-parasite relationship and control of parasitic helminths, with special reference to helminths of medical and veterinary importance.
- Systematics, biology, pathology, Host-parasite relationship and control of parasitic protozoa of medical and veterinary importance.

Books Recommended

1. Foundations of Parasitology by L.S. Roberts and J. Janovy Jr., 8th Edition, 2009. McGraw Hill, Boston.
2. D. R. Arrora. Medical Parasitology. 2015. 4th edition. Amazon publishers
3. Hunter‟s Tropical Medicine (6th edition) by G. T. Strickland. 2001.
4. Animal Agents and Vectors of Human Diseases by P.C. Beaver and R.C. Jung 2007.

ZOO-728	BEHAVIORIAL ZOOLOGY	3(3+0)

Course Objectives:

The objectives of the course are:

- To impart knowledge about animal responses to external stimuli
- To emphasize on different behavioural mechanisms (classical and recent concepts)
- To explain development of behavior with suitable examples of animals
- To understand role of genetic and neuro-physiology in behavioural development

Theory

- Instincts and learning, physiology of learning
- Physiological basis behavior
- Ultimate analysis of behavior, role of nature in shaping a behavior Migratory behavior
- Predatory and anti-predatory behavior
- Group defense and mimicry, aggression and flight behavior
- Game theory models, prisoner's dilemma, behavioral strategies, sexual behavior. Natural and sexual selection, Swimming, burrowing and attachment behavior
- Social and community behavior
- Communication behavior and chemical signals

Books Recommended

1. Nithya M Devi. 2011. Elements of Animal Behaviour. Anmol Publishers. India.
1. Lee Alan Dugatkin. 2013. Principles of Animal Behavior. 3rd Edition. Norton, W. W. & Company, Inc.
2. Sherman, PW. And Alcock, J. 2013. Exploring Animal Behavior. 6th edition. Sinauer Associates, NY USA
3. Alcock, J. 2005. Animal Behavior 8th Edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts USA
4. Daugatkin, L. A. 2004. Principles of Animal Behavior. W.W. Norton & Company Inc., 500 avenues, New York, N.Y.

ZOO-731	Techniques in Wilde Life Research	3(0+3)

Course Contents

Introduction to field techniques for habitat analysis and evaluation, Habitat improvement techniques, estimating the numbers of wildlife populations (estimates, total counts, sample counts: the logic, models and arithmetic, indirect estimates of population size indices). Specialized techniques; audio instruments, visual instruments, radio-telemetry, GIS techniques and other activity recording instruments. Radioisotopes and their use in wildlife. Techniques for capturing, trapping, immobilization, marking, weight measurement and estimation ageing, sexing/reproduction, and handling etc. of wild animals. Taxonomical techniques for identification and classification of different groups of wild animals. Instruments/equipments for wildlife studies. Methods of trapping, capturing, marking, ultrasound, sample collection and tissue¬ storage. Identification of mammals, birds, reptiles, amphibians, and fish. Field collection of fecal materials and stomach contents for food habit analysis in¬ herbivore, carnivore and omnivore mammals, birds, reptiles, amphibians and fish. Page 5 of 20 Laboratory analysis of fecal and stomach contents in herbivore, carnivore and¬ omnivore vertebrate species Practical application of radio-telemetry, field surveys of forest, rangelands, wetlands ecosystems for the study of environmental factors and wildlife populations for practical application of different wildlife techniques.

Books recommended

1) Cormack, R. M., G. P. Patil and D. S. Robson. 1979. Sampling biological populations. International Co- operative Publishing House, Fairland, Maryland, USA.

2) Peterson, R.T. and Murie, O.J. 1992. A Field Guide to Animal Tracks. Houghton Miffin Field Guides publishers.

3) Sale, J.B. 1988. Manual of Wildlife Techniques for India. Special Publication of the Wildlife Institute of India.

4) Schemnitz, S.D. 1980. Wildlife Management Techniques Manual. The Wildlife Society Washington, D.C.

5) Tanner, J.T. 1978. Guide to the Study of Animal Populations. The University of Tennessee Press, Knoxville.

ZOO-732	Ethics in Human and Animal Research	1 (1+0)

Contents

Rules and Regulations by international research ethics committees, Ethics of Human sampling, Ethics of Animal sampling, Ethics of Human experimentation, Ethics of Animal Experimentation Informed consent, Publication ethics etc

ZOO-733	Laboratory and Field Safety	1 (1+0)

Contents

General safety rules for laboratory and field research, Safety in Microbiology lab, Safety in Infectious lab, Safety in virus lab, Safety in wildlife field etc.

ZOO-734	Molecular Parasitology	3(3+0)

Theory

Parasite-host cell molecular interaction, Molecular approaches for the identification of different parasites. Antigenic variations in *Giardia lamblia*, Biological functions of nematode surfaces. Molecular mechanism of parasites invasion in host, Molecular action of different parasitic drugs. Drug resistance gene. Transcription and RNA processing in *Trypanosoma brucei*. Paradigm for the use of genetics in the study of protozoan parasites. *Toxoplasma gondii*: Cell Biology update. Regulation of Cell-mediated immunity by parasites. Immune responses in Immunology of Schistosomiosis. Immunobiology of Trypanosomiosis. Molecular Diagnosis of different parasitic infection based on antigen-antibody reactions, PCR for identification of Parasites, diagnosis and drug resistance genes, Gel and DNA electrophoresis for study of isozymes

Books Recommended:

1. John C. Boothroyd and R. Komuniecki, 2002. Molecular Approaches to Parasitology Wiley-Liss New York.

2. Marr, J.J., Nilsen, T.W. and R.W. Komuniecki, 2002. Molecular Medical Parasitology. Academic Press Inc. London

3. Kasper LH, Boothroyd JC. 1992. Toxoplasma gondii: Immunology and molecular biology in K. Warren (ed): Immunology and Molecular Biology of Parasites. Oxford: Blackwell,

4. Pfefferkom ER. 1991: Cell Biology, Molecular Biology of Toxoplasma gondii. In D.J. Wyler, M.E.A. Pereira, D. Wirth (eds) Cell Biology, Molecular Biology and Immunology of Parasites. Freeman Press, New York.

5. Foundations of Parasitology by L.S. Roberts and J. Janovy Jr., 8th Edition, 2007. McGraw Hill, Boston.