UNIVERSITY OF SARGODHA
OFFICE OF THE REGISTRAR
(ACAD BRANCH)

# NOTIFICATION

On the recommendations of Academic Council made in its 24th (1/2025) meeting held on 26.08.2025, the Syndicate in its 72nd (4/2025) meeting held on 12.09.2025 has approved the addition of three courses in the curriculum of MPhil Zoology for implementation w.e.f. **Fall 2025**. Copy of revised curriculum is attached as annexure-**'A'**.

**(WAQAR AHMAD)**
Additional Registrar (General)

No. SU/Acad/26/ 411

Dated: 11.05.2026

Distribution:

- Chairman, Department of Zoology
- Controller of Examinations
- Director Academics

C.C:

- Dean Faculty of Sciences
- Director, QEC
- Additional Registrar (A & R)
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

# SCHEME OF STUDY FOR MPHIL ZOOLOGY

**(Applicable from 2025)**

**DEPARTMENT OF ZOOLOGY**
**UNIVERSITY OF SARGODHA**
**SARGODHA - PAKISTAN**

**Department of Zoology**
**University of Sargodha**

**To be implemented from 2025**

# MPhil Zoology

Eligibility: MSc/BS 4-Year or equivalent (16 years of Education) in the relevant field or equivalent degree from HEC recognized institution with at least second Division or CGPA 2.00 out of 4.00.

Minimum 2nd division or 45% marks in the terminal degree under Annual system.

Departmental test with atleast 50% marks

Duration: 1.5 to 4 years Year Program (3-8 semesters)
Degree Requirements: 32 Credit Hours

**Program learning objectives:**

The MPhil Zoology program aims to prepare students to meet industrial needs by ensuring they are well-versed in fundamental zoological and biological sciences. The program emphasizes regularly updating the zoology syllabus in line with current proposals, professional requirements, and emerging trends in the field. It seeks to develop postgraduates who are skillful, competitive, and knowledgeable both practically and theoretically. In addition, the program promotes active engagement in academics and research, encouraging a strong balance between theoretical learning and practical application. Ultimately, the objective is to produce graduates capable of addressing the challenges of the 21st century, particularly those aligned with Sustainable Development Goals (SDGs), and contributing effectively to scientific and societal advancement.

**Program learning outcomes:**

Upon completion of the MPhil Zoology program, graduates will be able to demonstrate advanced knowledge of zoological and biological sciences and apply this understanding to address scientific and industrial challenges. They will design and conduct independent research using appropriate methodologies, analyze and interpret data critically, and communicate scientific findings effectively in written and oral forms. Graduates will exhibit practical laboratory and field skills, utilize modern tools and techniques relevant to zoological studies, and integrate theoretical knowledge with real-world applications. They will also demonstrate professional competence, ethical responsibility, and teamwork while contributing to academia, industry, and research organizations. Furthermore, graduates will be capable of addressing contemporary biological issues and contributing toward sustainable development.

**Program structure:**

**Semester-1**

| | | |
|---|---|---|
| ZOOL-7101 | Advanced Techniques in Zoological Sciences* | 3(2-1) |
| ZOOL-XXXX | Elective- I** | 3(3-0) |
| ZOOL-XXXX | Elective- II** | 3(3-0) |
| ZOOL-XXXX | Elective-III** | 3(3-0) |
| URCG-5129/URCG-5131 | Understanding of Holy Quran / Fehm-e-Quran-I or Ethics-I | 1(0-1) |

(Pg 45-53)

**Semester-2**

| | | |
|---|---|---|
| ZOOL-7102 | Research Design and Biostatistics* | 3(2-1) |
| ZOOL-XXXX | Elective-IV** | 3(3-0) |
| ZOOL-XXXX | Elective-V** | 3(3-0) |
| ZOOL-XXXX | Elective-VI** | 3(3-0) |
| URCG-5130/URCG-5132 | Understanding of Holy Quran / Fehm-e-Quran-II or Ethics-II | 1(0-1) |

(Pg 50-54)

**Semester 3-4**

| | | |
|---|---|---|
| | Research work and Thesis write up | 6(0-6) |

*To be offered from Annexure I (list of compulsory courses) based on the availability of faculty

**To be offered from Annexure II (list of optional courses) based on the availability of faculty and on the recommendation of the research supervisor

**ANNEXURE I LIST OF COMPULSORY COURSES**

| | | |
|---|---|---|
| ZOOL-7101 | Advanced Techniques in Zoological Sciences | 3(2-1) |
| ZOOL-7102 | Research Design and Biostatistics | 3(2-1) |

**ANNEXURE II LIST OF OPTIONAL COURSES**

| | | |
|---|---|---|
| ZOOL-7103 | Advances in Immunology | 3(3-0) |
| ZOOL-7104 | Advances in Reproductive Technology | 3(3-0) |
| ZOOL-7105 | Analysis of Development | 3(3-0) |
| ZOOL-7106 | Applied Microbiology | 3(3-0) |
| ZOOL-7107 | Aquaculture and Fisheries | 3(3-0) |
| ZOOL-7108 | Behaviour of Spiders | 3(3-0) |
| ZOOL-7109 | Behavioural Ecology | 3(3-0) |
| ZOOL-7110 | Biological Insect Pest Control | 3(3-0) |
| ZOOL-7111 | Biology of Birds and Mammals in Pakistan | 3(3-0) |
| ZOOL-7112 | Cellular and Molecular Physiology | 3(3-0) |
| ZOOL-7113 | Clinical Teratology | 3(3-0) |
| ZOOL-7114 | Concepts of Toxicology | 3(3-0) |
| ZOOL-7115 | Fish Nutrition | 3(3-0) |
| ZOOL-7116 | Medical Biotechnology | 3(3-0) |
| ZOOL-7117 | Medical Parasitology | 3(3-0) |
| ZOOL-7118 | Physiology of Homoeostasis | 3(3-0) |
| ZOOL-7119 | Protozoans Parasitology | 3(3-0) |
| ZOOL-7120 | Reproductive Endocrinology | 3(3-0) |
| ZOOL-7121 | Statistical Ecology | 3(3-0) |
| ZOOL-7122 | Vascular Biology | 3(3-0) |
| ZOOL-7123 | Vector Biology | 3(3-0) |
| ZOOL-7124 | Wildlife of Pakistan | 3(3-0) |
| ZOOL-7125 | Advanced Animal Diversity | 3(3-0) |
| ZOOL-7126 | Advances in Molecular Biology | 3(3-0) |
| ZOOL-7127 | Animal Biotechnology | 3(3-0) |
| ZOOL-7128 | Classification of Insects and Pest Management | 3(3-0) |
| ZOOL-7129 | Comparative Vertebrate Anatomy | 3(3-0) |
| ZOOL-7130 | Conservation Biology of Wildlife | 3(3-0) |
| ZOOL-7131 | Economic Zoology | 3(3-0) |
| ZOOL-7132 | Environmental Sciences | 3(3-0) |
| ZOOL-7133 | Recombinant DNA Technology | 3(3-0) |
| ZOOL-7134 | Fish Requirements | 3(3-0) |
| ZOOL-7135 | Fisheries Extension and Education | 3(3-0) |
| ZOOL-7136 | Fish Breeding and Hatchery Management | 3(3-0) |
| ZOOL-7137 | Fish Nutrition and Health | 3(3-0) |
| ZOOL-7138 | Wildlife Hunting and Trade | 3(3-0) |
| ZOOL-7139 | Captive Breeding of Wildlife | 3(3-0) |

**ZOOL-7101 Advanced Techniques in Zoological Sciences 3(2-1)**

A variety of instruments and techniques are used in biological studies, some of them are quite complex in nature. Scientific progress is directly related to the advancement in techniques and modern instruments. An understanding of these techniques and their application is essential for reading the zoological research literature, developing skills as a researcher and appreciating the goals, current limitations and future potential of modern zoological research. This course is designed to teach to do zoological research. Course will acquaint students with techniques employed in zoological research at the molecular, cell, tissue, whole organism and population levels. There is one main basic facet to this task. The laboratory exercises and instructions aim to teach students some of the most important, cutting edge, most often used generally applicable in short important zoological research methods and techniques. Such equipment, methodology and/or analysis will serve students wherever they go to do research in the future. This course is designed to set a foundation for student's future research/laboratory experiences.

*Contents*

1. Different staining techniques
2. Animal preservation techniques
3. Sampling techniques
4. Mass Spectrometry
5. Working with and fractionating mammalian cells
6. Separation / partitioning techniques: Gas and liquid chromatography
7. Antibody and fluorescence-based techniques
8. PCR
9. Microtome
10. Gene sequencing
11. DNA / Protein Extraction, electrophoresis and initial characterization of proteins and nucleic acids.

*Practicals*

1. Introduction and hands-on practice of various staining methods (simple, differential, and special stains) used to visualize cells, tissues, and microorganisms under the microscope.
2. Demonstration of traditional and modern techniques for preserving animal specimens, including wet preservation, plastination, and fixation methods.
3. Training in proper sampling methods for field and laboratory studies, covering sample collection, handling, storage, and documentation to ensure data reliability.
4. Overview of mass spectrometry principles, followed by sample preparation and analysis using MS to identify and quantify biological molecules.
5. Procedures for culturing, isolating, and fractionating mammalian cells using centrifugation, filtration, and density gradient techniques.
6. Hands-on exercises in gas chromatography (GC) and liquid chromatography (HPLC), focusing on separation of biomolecules and interpretation of chromatograms.
7. Practical experience in immunoassays and fluorescence microscopy, including ELISA, immunohistochemistry, and use of fluorescent dyes for cell labeling.
8. Step-by-step training on performing polymerase chain reaction (PCR), including primer design, thermocycling, and gel electrophoresis for product verification.
9. Instruction on embedding tissues, operating a microtome, and preparing thin tissue sections for microscopic examination and staining.

10. Exploration of DNA sequencing methods (e.g., Sanger or next-gen), including sample prep, sequencing reaction, and analysis of sequencing results.
11. Lab-based extraction of DNA and proteins from biological samples, followed by gel electrophoresis and basic characterization (e.g., concentration, purity).

*Recommended Texts*


1. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). *Lehninger principles of biochemistry*. New York: Macmillan.
2. Spangler, B. D. (2002). *Methods in molecular biology and protein chemistry*. New Jersey: John Wiley and Sons.


*Suggested Readings*


1. Pratt, C. W., & Cornely, K. (2023). *Essential Biochemistry: International Adaptation*. John Wiley & Sons.
2. Nelson, D. L, Lehninger, A. L., & Cox, M. M. (2008). *Lehninger principles of biochemistry*. New York: Macmillan.

**ZOOL-7102** **Research Design and Biostatistics** **3(2-1)**

Research Design and Biostatistics provides the means to identify and verify patterns in this data and to interpret the findings in a public health context. Topics include the collection, classification, and presentation of descriptive data; the rationale of estimation and hypothesis testing; analysis of variance; analysis of contingency tables; correlation and the statistical control of confounding; sample size and power considerations; survival analysis. This course will also focus on the multiple regression modeling and multivariate analysis to cover multi-way analysis of variance, multiple linear regression, classification and regression trees, automated model search, model fit and diagnostic, experimental design and multivariate analysis (Principal component analysis and cluster analysis) with particular emphasis on applications in medicine and public health. Special attention is directed to the ability to recognize and interpret statistical procedures in articles from the current literature. The course will cover the theory and use of the most common meta-analytic methods Students will use the SPSS statistical package to analyze public health related data.

*Contents*

1. Understanding the purpose, type and scope of research
2. Defining research questions, objectives and hypothesis
3. Literature review
4. Overview of qualitative, quantitative and mixed methods
5. Sampling techniques and data collection methods
6. Research ethics
7. Descriptive statistics, types of data
8. Parametric and non-parametric tests, Z-test, T-test, assumptions of Z and T tests
9. Retrospective case-control studies, exact inference for the odds ratio
10. Assumptions of ANOVA, ANOVA models, Tukey's test, Duncan's tests, nested ANOVA
11. Factorial experiments & Repeated Measures
12. Correlation, Logistic regression, additional topics for logistic regression
13. Survival analysis, cox proportional hazards model, cox proportional hazards regression: assessment of assumptions
14. MANCOVA, estimation of space richness, diversity, evenness
15. Principal component analysis, correspondence analysis
16. Discrete data analysis
17. Meta-analysis

*Practicals*

1. Design a mini research proposal including research questions, hypothesis, methodology, and ethical considerations.
2. Conduct a structured literature review and summarize key findings in an annotated bibliography.
3. Perform descriptive statistics and conduct Z-test and T-test on a sample dataset.
4. Analyze variance using one-way and two-way ANOVA with post-hoc tests on experimental data.
5. Apply logistic regression, PCA, and Cox regression on provided datasets and interpret the outcomes.

*Recommended Texts*

1. McGarigal, K., Cushman, S. A., & Stafford, S. (2013). *Multivariate statistics for wildlife and*

*ecology research*. USA: Springer Science & Business Media.
2. Ludwig, J.A., & Reynolds, J. F. (1988). *Statistical ecology: a primer on methods and computing*. New York: John Wiley and Sons.

*Suggested Readings*

1. Manly, B. F., & Alberto, J. A. N. (2016). *Multivariate statistical methods: a primer*. Florida: CRC press.
2. Koricheva, J., Gurevitch, J., & Mengersen, K. (Eds.). (2013). *Handbook of meta-analysis in ecology and evolution*. New Jersey: Princeton University Press.
3. Rossi, R. J. (2009). *Applied biostatistics for the health sciences*. New Jersey: John Wiley & Sons.

**ZOOL-7103** **Advances in Immunology** **3(3-0)**

The focus of course is on the immune system in disease situations where faulty B and T cell interactions are involved. Central topics are allergy, autoimmunity and cancer immunology. Furthermore, attempts to manipulate the immune response will be described. The course will integrate general immunology and cell biology, with a focus on antigen presentation. Students will be acquainted with understanding of lymph node microanatomy and know how B and T cells encounter antigen and develops in different locations, will know antigen presentation and autophagy on a detailed molecular level. This course will clear understanding of students about the cellular and molecular basis for autoimmune disease and allergies, basic knowledge of tumor immunology and the development of novel recombinant antibodies for treatment of cancer and autoimmune disease. The topics that will be covered include: innate and acquired immune responses; cellular and molecular mechanisms of immunity; antigen processing and presentation; tissue-specific immune responses; immune-mediated pathologies; and vaccination.

*Contents*

1. Molecular mechanism of innate & acquired immunity, TLRs and their role in Immunity.
2. Role of phagocytes in immunity, phagocytosis and role of antimicrobial and cytotoxicity mechanisms.
3. Mechanism of activation of B lymphocytes, role of accessory molecules in activation of B cells.
4. Mechanism of activation of T lymphocytes, General description of activation of T cells
5. Role of accessory molecules in activation of T cells.
6. Role of dendritic cells and regulatory T cells (T regs) in health and disease,
7. Signaling through immune system receptors, signaling pathways in B cells activation, signaling pathways in T cell activation, TLRs signaling pathways.
8. Organization and expression of immunoglobulin genes,
9. mechanism of variable regions DNA rearrangement
10. Generation of antibody diversity.
11. B cells receptor complex, components of BCR complex,
12. Signaling cascades through ligation of BCR complex.
13. T cell receptor complex, components of TCR/CD3 complex, signaling cascades through ligation of TCR complex. Cytokines, their types and their role in modulation of immune responses,
14. Monoclonal antibodies (mAbs) and their therapeutic role, AIDS and other immunodeficiency syndromes, cancer and the immune system, present status of cancer immunology.

*Recommended Texts*


1. Punt, J., Stranford, S., Jones, P., & Owen, J. A. (2018). *Kuby's immunology* (8th ed.). New York: W. H. Freeman Company.
2. Delves, P.J., Martin, J. S., Burton, D. R., & Roitt, I.M. (2017). *Roitt's essential immunology* (13thed.). USA: Wiley Blackwell.


*Suggested Readings*


1. Abbas, A., Lichtman, A., & Pilla, S. (2017). *Cellular and molecular immunology* (9th ed.). Netherland: Elsevier.
2. Abbas, A. K., Lichtman, A. H., & Pillai, S. (1994). *Cellular and molecular immunology*. Elsevier Health Sciences.

**ZOOL-7104 Advances in Reproductive Technology 3(3-0)**

Advanced reproductive technology includes medical procedures used primarily to address infertility. This subject involves procedures such as in vitro fertilization, intracytoplasmic sperm injection (ICSI), cryopreservation of gametes or embryos, and/or the use of fertility medication. When used to address infertility, advanced reproductive technology may also be referred to as fertility treatment. Advanced reproductive technology mainly belongs to the field of reproductive endocrinology and infertility. This course will clear the understanding of students about urinary human FSH, stimulation strategies for complex IVF patients programming the cycle with oral contraceptives antecedent to the use of antagonists, physiology to clinical success, micro-dose GnRH for the stimulation of low responders. The role of GnRH antagonist in the management of poor responders, alternative approaches to ovarian stimulation and triggering of ovulation, role of LH in stimulation protocols for ART, role of hMG-HP in stimulated cycles for ART, ovulation induction surgical approaches.

*Contents*

1. Advent of medically assisted reproductive technologies (MART), The endocrinology of ART,
2. Classification of infertility
3. Stimulation strategies: ovulation induction, hyper stimulation, urinary human FSH
4. Alternative approaches to ovarian stimulation and triggering of ovulation,
5. Role of LH & hMG-HP in stimulation protocols for ART
6. Art procedures: vaginal oocyte retrieval, (GIFT), (ZIFT), fallopian tube sperm perfusion
7. Fundamentals of sperm processing techniques, human oocyte and embryo cryopreservation.
8. *In Vitro* Maturation: future clinical applications, sperm separation, molecular biology applied to ART
9. Third party reproduction: Gestational surrogacy, oocyte donation, oocyte-sharing
10. Implantation: pathophysiology of implantation failure in IVF
11. Cryopreservation of oocytes and embryos, cryopreservation of human spermatozoa
12. The male factor, male infertility, isolated teratozoospermia,
13. ICSI or IUI, hormone substitution in male infertility

*Recommended Book*


1. Patel, H. N., & Esteves, C. S. (2019). *Advances in assisted reproductive technologies*. India: Jaypee Brothers.
2. Gautam, N. A., Rita B. D., Rubina, M., & Bruno, L. (2003). *The art and science of assisted reproductive techniques (ART)*. London, New York: Taylor and Francis.


*Suggested Readings*


1. David K. G., Ariel, W., Colin, M., & Howles, Z. S. (2001). *Text book of assisted reproductive techniques laboratory and clinical perspectives*. Martin Dunitz: Taylor & Francis.
2. Gautam, N. A., Rita, B., Das, R. M., & Bruno, L. (2003). *The art and science of assisted reproductive techniques (ART)*. London, New York: Taylor and Francis.

**ZOOL-7105** **Analysis of Development** **3 (3-0)**

This course covers the fundamental aspects of development, from the molecular to the organismal levels. Some of the topics covered include: Determination of cell fate: cell-autonomous specification and induction cell-cell interactions and signal transduction, regulation of gene expression and gene regulatory networks, axis specification, patterning of tissues & organs, morphogenesis. Students will be able to understand the theme of development as a phenomenon of differential gene regulation, manipulation of embryos of different vertebrate classes, analysis of fetal organ twinning, conjoined twins, preservation of vital germplasm, cryopreservation of gametes and embryos, bio-banking and bio–repository. Stages of embryogenesis, morphogenesis, pattern formation and differentiation of developing organisms will be examined. They will also become aware of how various changes in developmental pathways can play a role in human and animal health. Developmental mechanisms, especially at a molecular level, will be examined for differences and commonality among development of embryos of different vertebrate classes. Course will also touch on important issues related to stem cell research, regenerative medicines, animal and embryonic cloning.

*Contents*

1. Manipulation of embryos of different vertebrate classes.
2. Microsurgical techniques and fetal manipulations, In utero surgeries.
3. Analysis of fetal organ twinning, conjoined twins.
4. In vitro fertilization and embryo transfer techniques.
5. Preservation of vital germplasm
6. Cryopreservation of gametes and embryos
7. Biobanking and bio–repository.
8. Stem-cells therapy
9. Regenerative medicine.
10. Animal and embryonic cloning.

*Recommended Texts*


1. Carlson, B. M. (2018). *Human embryology and developmental biology e-book.* Elsevier Health Sciences.
2. Moore, K., Persaud, T.V.N., & Torchia, M. (2016). *The developing human: clinically oriented embryology* (10th ed.). Elsevier: Saunders.


*Suggested Readings*


1. Schoenwolf, G. C., Bleyl, S. B., Brauer, P. R., & Francis-West, P. H. (2014). *Larsen's human embryology e-book.* Elsevier Health Sciences.
2. Sadler, T. W. (2012). *Langman's medical embryology* (Vol. 12). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.
3. Shumway, W. (2002). *Introduction to vertebrate embryology.* India: Daya Books.

**ZOOL-7106** **Applied Microbiology** **3(3-0)**

Applied Microbiology is an interesting and dynamic field where basic knowledge of micro-organisms is applied to human health, industry, agriculture and the environment. The course focuses on how micro-organisms interact with the environment, how to detect causal micro-organisms of diseases and spoilage, and how micro-organisms can be employed to produce valuable products for society, such as antibiotics, fermented foods and drinks, and alternative fuels. The course is a job providing in nature after its completion. This course will also provide an overview of the diversity of microorganisms and their metabolic activities such as the microbial products of major social, economic and environmental importance. Students will learn about: host-microbe interactions, Resistance and immunity, Air, food and water-borne human infections, Human contact diseases, Infectious diseases of animals, Microbiology of food, milk and milk products. Microbial activity measurements, assess the use of microbes as tools in biotechnology and can describe microbial biochemical pathways and relate them to important industrial processes.

*Contents*

1. Control of microorganisms: fundamentals of control by physical and chemical agents
2. Antibiotics and other chemotherapeutic agents.
3. Environmental microbiology: microbiology of air.
4. Aquatic microbiology. Soil microbiology. microbiology of domestic water and sewage.
5. Industrial microbiology: scope of industrial microbiology in food production, control of insects, human therapy, petroleum, mining and bioremediation.
6. Biotechnology and its role in modern human comforts.
7. Microbial ecology: microorganisms in aquatic habitats, deep-sea & terrestrial environments
8. Hydrothermal vents, rumen microbial ecosystem, microbial leaching,
9. Biogeochemical cycles; trace metals and mercury,
10. Biodegradation of xenobiotic.

*Recommended Texts*


1. Jacquelyn, G. B., & Laura, J.B. (2015). *Microbiology principles and explorations* (9th ed.). New Jersey: John Wiley & Sons Inc.,
2. Eugene, W. N., Denise, G., Anderson, M. T., Nester, C., Roberts, E., & Nancy, N. (2008). *Microbiology: a human perspective* (6th ed.). New York: McGraw Hill Higher Education.


*Suggested Readings*


1. Alfred, B., & Heidi, S. (2015). *Benson's microbiological applications laboratory manual in general microbiology* (13th ed.). London: McGraw Hill.
2. Pelczar Jr., Chan, E.C.S., & Krieg, M.R. (2001). *Microbiology* (5th ed.). New York: McGraw Hill.

**ZOOL-7107** **Aquaculture and Fisheries** **3 (3-0)**

Fisheries and aquaculture are the theory and practice of cultivating marine and freshwater algae and animals for food. The industry also provides opportunity in the development of chemical and pharmaceutical products, scientific research, species population restoration, food safety and sustainability, and the production of ornamental plants and animals. Currently, culture of aquatic biota for direct consumption, stock enhancement, or other purposes is the fastest growing and most diverse sector of livestock production. The purpose of this course is to develop an understanding of commonly used culture systems, to become familiar with the fundamentals of fish and shellfish husbandry, and to gain an appreciation of aquaculture's roles in natural resource management, the human food supply, and the global economy. Students will gain an understanding of the key aspects of producing food in aquatic environments and develop scientific skills in experimental design and technical aspects applied in aquaculture.

*Contents*

1. Introduction to fisheries and aquaculture, national and international trends.
2. Fish morphology and diversity in size and shape.
3. Distribution of fishes in Pakistan, commercial fishes, marine and freshwater.
4. Types of ponds, planning construction and pond preparation.
5. Pond fertilization, application
6. Food and feeding habits of fishes, feeding types, artificial and natural fish food, artificial fish feed.
7. Fish habitat, ecology and extant of distribution, water quality parameters and their effects on fish health and production.
8. Biotic parameters of ponds, lakes, rivers, and impacts on fish growth. Induced breeding.
9. Fish diseases and their control.
10. Fishing gears, fishing techniques, fishing communities.
11. Fish preservation, processing transportation and marketing.

*Recommended Texts*


1. Lovrich, G., & Thiel, M. (2020). *Fisheries and aquaculture*. Oxford: Oxford University Press, Incorporated.
2. Gibert, G. (2019). *Novel development in aquaculture and fisheries science*. USA: Callisto Reference.


*Suggested Readings*


1. Sharma, O. P. (2009). *Handbook of fisheries and aquaculture*. New Dehli: Agrotech Publishing Academy.
2. Stickney, R. R. (2009). *Aquaculture: an introductory text*. London: CABI Publishing
3. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: principles and practices*. New York: Blackwell Science Limited.

**ZOOL-7108** **Behaviour of Spiders** **3(3-0)**

This course is about biology of spiders, their morphological and physiological characteristics, range of behaviours and activities performed by them. Spiders are commonly thought as appropriate behavioural models due to the concept that they have small brains and show innate and frequently consistent behaviour. This course will introduce students to the interesting domain of spiders, their biology, their intelligent behaviours like deception, and methods of communications to their relatives and various strategies for self-defense. The course highlights how spiders show amazing mental abilities, changing their behaviour to suit their situational needs and provide care to their young ones. This course unravels the considerable intra-specific as well as intra-individual variability and plasticity in different behaviours ranging from foraging and web building skills to communication, silk production, self-defense and courtship. Students will be able to understand the structure, functions, ecological associations, intelligent abilities and behavioural adaptations in spiders at the completion of this course.

*Contents*

1. Introduction: Spider biology
2. Foraging behaviour
3. Web building behavior
4. Anti-predator behavior
5. Communication
6. Deception
7. Mating behaviour and sexual selection
8. Group living in spiders: cooperative breeding and coloniality
9. Plasticity, learning and cognition
10. Kleptoparasitic spiders - a special case of behavioural plasticity
11. Prey of spiders
12. Hunger and starvation.

*Recommended Texts*

1. Herberstein, M. H. (Editor). (2011). *Spider's behaviour- flexibility and versatility*. New York: Cambridge University Press.
2. Wolfgang, N. (2013). *Ecophysiology of spiders.* London: Oxford University Press.

*Suggested Readings*

1. Viera, C., & Gonzaga, M. O. (2017). *Behaviour and ecology of spiders*. Switzerland: Springer International Publishing AG.
2. Foelix, R. (2011). *Biology of spiders* (3rd ed.). USA: Oxford University Press.
3. Barth, F. G. (2002). *A spider's world: senses and behavior*. New York, Berlin, Heidelberg: Springer.

**ZOOL-7109** **Behavioural Ecology** **3(3-0)**

The course comprises of fundamental features of behavioural ecology. Specific emphasis will be put on various behavioural mechanisms adapted by animals in an evolutionary perspective. In this context topics discussed include interaction between individual interests, social behaviours, life history, and also the role of behavioural ecology in conservation biology. Furthermore, this course provides information about various inter and intraspecific interactions, how competition and cooperation within and among species affects evolutionary suitability. The aim of this course is to understand the evolutionary basis of animal behaviour due to ecological pressures. When we discuss adaptations we are referring to changes brought about during evolution by the process of natural selection. Students will study about the ecological factors that induce behavioral adaptations in this course. Students will be able to learn in this study how to critically evaluate theories and models for sexual selection, foraging, and life history strategies, sociality, predation, speciation, personality, communication and to integrate knowledge of ecology, evolution and behavior.

*Contents*

1. Natural selection, ecology and behavior.
2. Testing hypotheses in behavioral ecology.
3. Economic decisions and the individual.
4. Predator verses prey: Evolutionary arms races.
5. Competing for resources.
6. Living in groups. Social behaviours: Altruism to Spite. Cooperation, Altruism and Conflict in the Social Insects.
7. Sexual Selection, Sperm Competition and Sexual Conflict. Mating Systems. Sex Allocation
8. Parental Care and Family Conflicts
9. Communication and Signals

*Recommended Texts*


1. Nicholas, B. D., John, R. K., & Stuart, A. W. (2012). *An introduction to behavioral ecology* (4th ed.). Oxford: Willy-Blackwell, John Willy and Sons Ltd Publications.
2. John R. Krebs and Nicholas B. Davies. (1997). *Behavioral ecology: an evolutionary approach.* Oxford: Blackwell Science Ltd.


*Suggested Readings*


1. Danchin, E.L., Giradeau, A., & Cezilly, F. (2008). *Behavioral ecology: An evolutionary perspective on Behavior.* UK: Oxford University Press.
2. Dugatkin, L. A. (2001). *Model System in behavioral ecology. Integrating conceptual, theoretical, and empirical approaches.* New Jersey: Princeton University Press.
3. Goodenough, J., McGuire, B., Jakob, E. (2009). Perspective on Animal Behavior. New York: John Wiley & Sons.
4. Dugatkin, L. A. (2012). *Principles of animal behavior.* New York: W.W. Nortan and Co.

**ZOOL-7110** **Biological Insect Pest Control** **3(3-0)**

Use of pesticides is globally disliked due to their environmental and health effects and the scientists are focusing on the use of safer pest control strategies including Biological Pest Control. This course will provide introduction, historical background and geographical distribution of various insect species along factors that makes them pest. Available biological pest control, their identification and distribution will be introduced through these learnings. Students will be given knowledge about biological features and varieties of biological mediators to control insect pests. Ecological and behaviourial characteristics of pest as well as biological control will be highlighted. Pest control methods include predation, parasitism, herbivory and additional natural tools, but characteristically depend on dynamic human management. Understanding about recent strategies which are in practice nationally or internationally to manage pests will be given to students. Several techniques which are commercially used for rearing of biological pest control agents including culturing of bacteria and virus will be familiarized.

*Contents*

1. Pest management: history and recent developments, general aspects of biological pest control, national and international significance and scope.
2. Morphological features, Identification, habitats and distribution of biological pest control agents.
3. Parasitoids: Hymenoptera, Diptera, Strepsiptera other insect orders.
4. Predators: Insects (Coleoptera, Neuroptera, Hemiptera, Odonata, Lepidoptera, Thysanoptera), invertebrates and vertebrates.
5. Biology of Biocontrol agents: Trichogramma, Ichneumonids, Braconids, Tachinids and Chalcids.
6. Rearing techniques for following biocontrol agents:
7. Parasitoids: *Trichogramma spp., Chelonusblackburni, Braconbrevicornis, Meteorusdichomeridis, Copidosomakoehleri, Campoletischlorideae.*
8. Predators: Lady bird beetle: *Cryptolaemusmontrouzieri*, Hemipterans, lace wing: *Crysoperlacarnea*, *Menochilus sp.*, dragonflies, toad, shrews and guppy fish.
9. Bacteria: *Bacillus thurienginesis* and Viruses: Nuclear Polyhedrosis Virus (NPV).

*Recommended Texts*


1. Abrol, D.P. (2013). *Integrated pest management: current concepts and ecological perspective.* California, San Diego: Academic Press.
2. Sathe T.V. (2013). *Recent trends in biological pest control.* India: India: Daya Publishing House.


*Suggested Readings*


1. Patil, V.J., & Sathe, T.V. (2003). *Insect predators and pest management.* India: Daya Publishing House.
2. Sathe, T.V., & Bhoje, P.M. (2000). *Biological pest control.* India: Daya Publishing House.
3. Srivastava, K.P. (2010). *Text book of applied entomology* (3rd ed.). Kalyani Publishers, India.

**ZOOL-7111 Biology of Birds and Mammals in Pakistan 3(3-0)**

Birds and mammals represent a great diversity of species that are widely distributed across the globe and carry out a variety of functions in the earth's ecosystems. The biology of these animals is the underlying factor allowing the success of birds and mammals in dynamic ecosystems. Being winners in the evolution, birds and mammals have shown exceptional rate of success. They have diversified into many types of environments with more species number than any other vertebrate group. A group of many mammals, with the scientific name of Boreoeutheria, has diversified about seven times faster than expected, beginning about 110 million years ago. Modern birds have diversified about nine times faster than expected, starting about 103 million years ago. Avian physiology has multiple unique features. Birds have unique biological systems allowing flight, migration, production of large yolky eggs, and maintenance of high body temperature and high blood concentrations of glucose together with care of young. Mammals, on the other hand, nourish their young ones with the milk; possess hair, muscular diaphragm, enucleated red blood cells and direct attachment of lower jaw with skull via a hinge. Except for the monotremes (an egg-laying order of mammals comprising echidnas and the duck-billed platypus), all mammals are viviparous, they bear live young.

*Contents*

1. Origin, evolution and life history of birds in Pakistan
2. Classification of avifauna of Pakistan
3. Characteristics, structure
4. Reproduction and development in birds
5. Behavior and population regulation in birds
6. Birds: general ecology, geographical distribution
7. Migration and orientation in birds
8. The mammalian fauna of Pakistan, introduction and classification
9. Behavior and population regulation in mammals
10. Ecological distribution, status and relationships of mammals
11. Species accounts of mammalian and avifauna of Pakistan
12. Endangered birds and mammals of Pakistan
13. Scientific and economic importance of mammalian and avifauna in Pakistan

*Recommended Texts*


1. Gill, F.B., Prum, R.O., & Robinson, S. K. (2019). *Ornithology* (4th ed.). New York: W. H. Freeman.
2. Feldhamer, G. A., Merritt, J. F., Krajewski, C. Rashlow, J. L., & Stewart, K. M. (2020). *Mammalogy: adaptation, diversity, ecology* (5th ed.). Baltimore: Johns Hopkins University Press.


*Suggested Readings*


1. Grewal, B., Sen, S., Singh, S., Devasar, N., & Bhatia, G. (2017). *A photographic guide to the birds of India, Pakistan, Nepal, Bhutan, Sri Lanka and Bangladesh.* New Jersey: Princeton University Press.
2. Grimmett, R., Roberts, T. J., Inskipp, T., & Byers, C. (2008). *Birds of Pakistan.* London: A&C Black.
3. Roberts, T. J. (2005). *Field guide to the small mammals of Pakistan.* Oxford University Press.
4. Roberts, T. J. (2006). *Field guide to the large and medium-sized mammals of Pakistan.* Oxford University Press.

**ZOOL-7112** **Cellular and Molecular Physiology** **3(3-0)**

This study is based on the understanding how molecular and cellular processes give rise to complex physiologic functions in a living body. This course provides the study of molecular structure and function, molecular interactions and cell signalling through simple to complex cellular phenotypes. The course provides details how molecular machines can be the cause of physiological processes and how these mechanisms are regulated. The idea behind this kind of approach is that the whole of a living system can be understood by studying its individual parts, identifying the subset of genes and proteins that function in physiological context or malfunction to trigger disease. The course emphases on the diverse modules of molecular machines that facilitate movement, change molecular states, or stimulate membrane transport, in addition to their mechanisms of action. Focus is maintained on molecular structure and physiology of cellular compartments in addition to chromatin, proteomics, pharma informatics and drug designing.

*Contents*

1. Compartmental diversity within the cell and its maintenance.
2. Molecular mechanisms of vesicular transport, maintenance of compartment identity.
3. Bioenergetics: cellular metabolisms. Energy transformations.
4. Molecular motors: P - loop NTPase super family, myosins, kinesin & dynein, A rotary motor (in bacteria).
5. Signal transduction pathways in cell: G-proteins, cyclic AMP, $Ca^{-2}$ as messenger, protein kinases
6. Ionic basis of membrane excitability: Ionic channels, electrical properties of membrane
7. Control of gene expression: organization of gene, role of gene regulatory proteins, role of DNA-binding proteins, chromatin structure & control of gene expression.
8. Garbage disposal unit inside the cell: lysosomes, peroxisomes
9. Cell and defense: cellular basis of immunity, SER and biotransformation. (Biotics & xenobiotics)
10. Cell renewal: By simple duplication, by stem cells, by pluripotent stem cells,
11. Cell death: apoptosis Type I, apoptosis Type II
12. Genomics and evolution: principles of genome annotation
13. Proteomics and drug designing: Conceptual models of protein structure, three dimensional structure classification and protein function, structural alignment, pharma-informatics & drug designing.

*Recommended Texts*


1. Lodish, H., Matsudaira, P., Berk, A., Ploegh, H., Scott, M., Kaiser, C. A., Krieger, M., & Bretscher, A. (2016). *Molecular cell biology* (8thed.). New York: W. H. Freeman Company.
2. Karp, G., Iwasa, J., & Marshall, W. (2019). *Karp's cell and molecular biology*: *concepts and experiments* (9thed.). USA: Wiley.


*Suggested Readings*


1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., &Watson, J.D. (2017). *Molecular biology of the cell*. New York: Garland Publishing Inc.
2. Cooper, G. (2018). *The cell: A molecular approach* (8th ed.). Oxford: Oxford University Press.

**ZOOL-7113** **Clinical Teratology** **3(3-0)**

Exposures that can induce permanent structural or functional anomalies in an exposed embryo or fetus are called teratogenic, while teratology is the detailed study of those factors that exhibit teratogenic potential under certain conditions. This study is focused on the congenital malformations and abnormalities of physiological development due to exposure to teratogens. The students will be provided details of various types of teratogens, their source, structure and mode of induction of teratogenicity. Students will be provided extensive knowledge about genetic and environmental factors that produce congenital malformations in order to be able to understand differences between inherited, acquired, and so-called multifactorial malformations. Early development also has an influence on age related diseases, so age related effects of teratogens will be discussed in this course. Furthermore, familiarity with the knowledge of possibility of investigating, and treating, fetuses by drugs, genetic engineering or intra-uterine surgery will be provided to learners.

*Contents*

1. Teratogenesis: environmental assaults on human development.
2. Teratogenic agents: retinoic acid, hydroflourocarbons
3. The degradation products used as refrigerants
4. Drug abuse as heroin, alcohol, tobacco and cannabis
5. Heavy metals,
6. Pathogens: *Rubella, Toxoplasma gondii, Treponema pallidum* (Syphilis bacterium)
7. Endocrine disruptors: diethylstilbestrol; nonylphenol; bisphenol A
8. Testicular dysgenesis and declining sperm counts.
9. Developmental biology and future of medicine:
10. Germ-line gene therapy,
11. Stem cell therapy and regeneration therapy.

*Recommended Texts*


1. Gilbert, S.F. (2018). *Developmental biology* (11th ed.). Massachusetts: Sinauer Associates.
2. Moore, K., Persaud, T.V.N., & Torchia, M. (2016). *The developing human: clinically oriented embryology* (10th ed.). USA: Elsevier,Saunders.


*Suggested Readings*


1. Carlson, B.M. (2018). H*uman embryology and developmental biology* (6th ed.). USA: Elsevier.
2. Bedard, P.L., & Cardoso, F. (2008). Recent advances in adjuvant systemic therapy or early-stage breast cancer, *Ann Oncol.*19 (5), pp. 122– 127
3. National Academies USA. (2009). *Understanding stem cells*: An overview of the science and issues from National Academies USA.

**ZOOL-7114** **Concepts of Toxicology** **3(3-0)**

Toxicology is a discipline, which in combination with biology, chemistry and pharmacology, deals with the study of the adverse effects of chemical substances on living organisms. Students through this learning became able to study basic concepts of toxicology as they are applicable to the disturbances of environmental agents, e.g. chemicals or metals for human health. It imparts knowledge about the distribution, cellular penetration, metabolic conversion, and elimination of toxic agents, as well as the fundamental laws governing the interaction of foreign chemicals with biological systems. It provides information about molecular, cellular and pathophysiological reactions resulting from exposure to chemical agents related to human health. It elucidates how to identify underlying susceptibility factors which contribute to the ability of chemicals to provoke bioeffects which contribute to human disease. This course defines the chemical properties and the biological processes which control the toxicokinetics of chemical agents of public health importance, explain the significance of biotransformation reactions.

*Contents*

1. Introduction to principles of toxicology: types, nomenclature, applications of toxicology.
2. Classification of toxic agents according to use: pesticides, food additives, therapeutic drugs
3. Sources of toxins: botanical, environmental.
4. Effects of chemicals: general classification, chemical allergies, mutagenic and carcinogenic
5. Biochemical properties, exposure: route: oral, intranasal, inhalation, dermal and parenteral
6. Accumulation: dose-response relationship, criteria for measurement
7. Toxic kinetics: pharmacokinetics: toxicology testing,
8. Absorption: ionic and non-ionic principles, Henderson- Hassel bach equation,
9. Distribution: fluid compartments, plasma protein binding, lipids, liver and kidney, blood-brain barrier,
10. Biotransformation: principles of detoxification, biochemical pathways, enzyme systems,
11. Elimination: urinary excretion, fecal, pulmonary, mammary gland secretion, other secretion
12. Descriptive animal toxicology: correlation with human exposure,
13. Animal welfare and US animal welfare act,
14. Chemicals: selection of chemicals, route of administration, species differentiation: selection of appropriate animal species, methodologies.

*Recommended Books*


1. Carson, B. L. (2018). *Toxicology biological monitoring of metals in humans*. USA: CRC Press.
2. Frank, C. Lu., & Sam Kacew. *Lu's basic toxicology: fundamentals, target organs, and risk assessment.* USA: Informa Healthcare.
3. Karen, E. S., & Thomas, M. B. (2015). *Principles of toxicology*. USA: CRC Press.


*Suggested Books*


1. Schafer, S.G, Dawes, R., Elsenhans, B., Forth, W., Schumann, K. *Metals "in" toxicology* edited by Hans M., Siegfried, G. S., Roger, M., & Frank, W. (1999). San Diego, London, Boston, New York: Acadmic Press.
2. Barile, F. A. (2013). *Principles of toxicology testing*. USA: CRC Press.

**ZOOL-7115** **Fish Nutrition** **3(3-0)**

The course will provide an introduction to the various food components, nutritional impact on growth, development, reproduction, health and quality of farmed fish. Familiarity of nutritional necessities, the formation of diet regimes, and suitable feed managing practice is necessary for the rearing of any animal species that is cultured intensively. The course will deliver an overview to the various food constituents, nutritional impact on growth, development, reproduction, health and quality of farmed fish. This involves learning about the fish's digestive system and the different nutrient's digestion, absorption, metabolism and biochemical function. The course content highlights the physiological features of nutrition and the response of fish to diet in relative to other environmental factors and to the genetic background of the fish. The course illustrates particular techniques used in experimental studies in fish nutrition. The course also covers relevant undesirable substances in feed that can be a challenge for the health and for the seafood product produced.

*Contents*

1. Bioenergetics; introduction, energy utilization and requirements
2. Digestible, urinary, branchial and metabolizable energy
3. Recovered energy and its use in growth and reproduction
4. Vitamins; introduction, water-soluble vitamins and fat soluble vitamins
5. Amino acids and proteins; qualitative and quantitative requirements of amino acids
6. Methods of amino acid requirement determination
7. Protein requirements and methods of determination
8. Lipids; fatty acids and dietary energy, sources of lipids for feed formulations.
9. Minerals; essential minerals and their requirements for finfish.
10. Intermediary metabolism; metabolic circuitry and control mechanisms
11. Carbohydrate, protein and amino acid metabolism.
12. Diet formulation and manufacture; introduction
13. Feed ingredients, diet formulation, manufacturing and storage.

*Recommended Texts*


1. Jain, N. (2018). *Practical manual on fish nutrition and feed technology*. India: Daya Publishing House.
2. Lee, C. S., Linn, C., Gatlin, D. M., & Webster, C. D. (2015). *Dietary nutrients, additives, and fish health*. New Jersey: Wiley Blackwell.


*Suggested Readings*


1. Halver, J. E., Ronald, W. H., & Dniel, M. H. (2004). *Fish Nutrition* (4th ed.). New York: Academic Press.
2. Hepher, B. (2010). *Nutrition of pond fishes*. Cambridge: Cambridge University Press.
3. National Research Council (NRC). (2011). *Nutrient requirements of fish and shrimp*. Washington D.C: National Academic Press.

**ZOOL-7116** **Medical Biotechnology** **3(3-0)**

The course focus on medical applications of biotechnology, tools used to analyze a variety of biological samples, as well as for health care applications in diagnostics and drug development. The student will be provided with in-depth knowledge about scientific methodologies used for comprehensive analyses of biological systems, and their applications for advanced health care or medical investigation. Medical Biotechnology is the use of sensational advances in molecular and cell biology to medicine, agriculture, and the environment. Through modern technologies such as genetic engineering, biotechnology is modeling different aspects of medicine (cancer, vaccines, therapy and diagnosis of genetic diseases), food production (transgenic plants), and industry (bioremediation). The course curriculum is designed to deliver step wise information regarding various technicalities part of genetic engineering, cell culture, DNA cloning and many more. Further, emphasis is maintained on the use of biotechnology in medical field as gene therapy, mapping of genetic diseases and production of molecular pharmaceutical products.

*Contents*

1. Introduction to the medical biotechnology: its role and interdisciplinary pursuit
2. The principles of cloning DNA in medical biotechnology: strategies and tools
3. The enzymology of *in vitro* DNA recombination,
4. Vectors for cloning, synthesis of DNA for cloning, determination of base sequence in DNA
5. Reaching the gene via mRNA and protein, synthesis of complete gene, reporter genes,
6. Recombinant virus genes, (brief account), gene cloning techniques for mammalian cells
7. Methods of transfection: liposomes, direct transformation, microinjection.
8. Gene expression. Expression of mammalian genes in prokaryotic and eukaryotic systems
9. Basic techniques of animal cell culture and their applications, transgenic animals
10. Molecular techniques for rapid diagnosis of diseases: Gene therapy
11. Medical biotechnological approach to study various types of diseases (infectious and genetic)
12. Other mutations, a molecular basis for inherited disease, mapping a genetic disease
13. Applied medical biotechnology: drug targets: vaccines and antibodies, preparation and usage
14. Biosafety regulation & management: genetically engineered microbes and environment

*Recommended Texts*


1. Lanza, R.P., Langer, R., & Vacanti, J. (2013). *Principles of tissue engineering* (4th ed.). California: Academic Press.
2. Primrose, S.B., & Twyman, R. M. (2006). *Principles of gene manipulation and genomics* (7th ed.). New Jersey: Wiley Blackwell.


*Suggested Readings*


1. Hartwell, L.H., Hood, L., Goldberg, M.L., Reynolds, A.E., Silver, L.M., &Veres, R.C. (2010). *Genetics: from genes to genomes* (4th ed.). New York: McGraw-Hill Publishing.
2. Griffiths, A. J. F., Wessler, S.R., Lewontin, R.C., & Carroll, S. B. (2015). *Introduction to genetic analysis* (11th ed.). New York: W.H. Freeman and Company.
3. Ratledge, C., & Kristiansen, B. (2006). *Basic biotechnology* (3rd ed.) New York: Cambridge University Press.

**ZOOL-7117** **Medical Parasitology** **3(3-0)**

This curriculum provides core theoretical aspects of medical parasitology, covering the protozoan and metazoan parasites of humans and the vectors which transmit them. Students will gain familiarity with common protozoan and helminth parasites of humans as well as some related parasites of livestock and companion animals related to medical parasitology. The study will highlight various types, ecology and physiology of vectors responsible for transmission of parasitic diseases. This course provides students with an understanding of parasitic infections of humans including the biology of parasites, understanding of parasitism, epidemiology, pathogenesis, treatment, and prevention of various medically important parasitic infections. Students come to know about the problems in parasitology, including clinical, public health and biological issues and the roles of parasites and of infectious diseases on the ecology and evolution of their hosts. Extensive knowledge about diagnosis, treatment and control of parasitic infections in humans and in veterinary animals will be provided.

*Contents*

1. Symbiosis to parasitism: parasite, host, community;
2. Malaria; biological aspects; immunological and patho-physiological aspects in malaria
3. Leishmaniasis: disease spectra and immunopathology of Chagas' disease
4. Opportunistic pathogens: Toxoplasmosis; Intestinal protozoa: amoebiasis and Giardiasis;
5. Schistosomiasis: hepatosplenic, intestinal and urinary schistosomiasis;
6. Fascioliasis; Echinococcosis;
7. Cerebral and generalized cysticercosis
8. Ascariasis and visceral larva migrans
9. Intestinal nematodiasis: immunological mechanisms of worm expulsion
10. Cytokines: their roles in parasitic diseases
11. Lymphatic filariasis: causes, symptoms, diagnosis and treatment
12. Trichinosis; causative agent, clinical manifestation, diagnosis and treatment
13. Significance of eosinophilia in helminthiasis
14. Parasite-host interaction: molecular to cellular level

*Recommended Texts*


1. Roberts, L.S., & Janovy, J. Jr. (2009). *Foundations of parasitology* (8th ed.). Bostan: McGraw Hill, Publishing.
2. Sastry, A. S., & Bhat, S. (2019). *Essentials of medical parasitology* (2nd ed.). New Dehli: Jaypee Brothers Medical Publishers.


*Suggested Readings*


1. Strickland, G. T. (1984). *Hunter's tropical medicine* (6th ed.). Philadelphia: Saunders
2. Janeway, C.A., &Travers, P. (2001). *Immunobiology.* New York: Garland Science.

**ZOOL-7118** **Physiology of Homeostasis** **3(3-0)**

The curriculum in this course provides an integrated knowledge and understanding of the major principles of homeostasis involved in the maintenance of health. Homeostasis is the body's effort to keep a constant internal environment. This adjusting of physiological systems within the body is called homeostatic regulation. Physiological interactions between the nervous system and the endocrine system maintain homeostasis and health. This course describes the main components of the endocrine, digestive, renal and nervous systems and demonstrates knowledge of how they contribute to the maintenance of homeostasis. Themes in this course include the functions of the central and peripheral nervous systems; the roles of endocrine glands and the hormones they secrete; the gastrointestinal tract in providing nutrition to the body; and the renal system in the regulation of fluid and ion levels. Learning of molecular and physiological mechanisms responsible for the stability in internal environment will be ensured through this course.

*Contents*

1. Homeostasis control systems: feed-back, feed forward
2. Non physiological homeostatic mechanisms.
3. Acclimatization, strategies, adaptations
4. Regulatory devices, behavioral responses
5. Thermoregulation: Strategies, adaptations,
6. Importance of temperature to animal physiology
7. Classification of temperature regulation
8. Heat exchange interactions between animals and the environment,
9. Ectotherms & Endotherms: control of body temperature in endotherms,
10. Comparison of ectothermy with endothermy.
11. The body fluids of animals.
12. The principles of osmosis: osmo-confirmers, regulatory strategies,
13. Osmotic responses of animals under changing environmental conditions.

*Recommended Texts*


1. Moyes, C.D., & Schulte, P. (2014). *Principles of animal physiology* (2nd ed.). New Jersey: Pearson publishers.
2. Hill, R.W., Wyse G. A., & Anderson, M. (2012). *Animal physiology* (3rd ed.). Sunderland: Sinauer Associates, Inc.


*Suggested Readings*


1. Guyton, A. C. (2006). *Textbook of medical physiology* (11th ed.). Philadelphia: Elsevier Saunders.
2. Ian Kay. (1998). *Introduction to of animal physiology*. Milton Park: Bios Scientific Publishers.

**ZOOL-7119** **Protozoans Parasitology** **3(3-0)**

Protozoa is an informal term for single-celled eukaryotes, either free-living or parasitic, which feed on organic matter such as other microorganisms or organic tissues and debris. These one-celled animals are found worldwide in most habitats. Most species are free living, but all higher animals are infected with one or more species of protozoa. Infections range from asymptomatic to life threatening, depending on the species and strain of the parasite and the resistance of the host. This course is designed to give a broad overview of general human and animal parasitology, with respect to the types of parasites, nature of parasitism, advantages and disadvantages of parasitism. It will cover the biology, parasitism and pathogenesis of the parasitic protozoans and arthropod vectors that cause significant transmission of human and animal diseases. This subject covers how each parasite establishes infection in their hosts, how it spreads between hosts, and the pathogenesis of disease. Current approaches to control and to treat parasitic disease will be addressed.

*Contents*

1. History and classification of Protista. Host parasites interactions
2. Systematics, biology, pathology and control of parasitic protozoa
3. Protozoa of medical and veterinary importance.
4. Morphology, life cycle, pathogenesis, diagnosis and control of Trypanosoma,
5. Morphology, life cycle, pathogenesis, diagnosis and control of Leishmania
6. Morphology, life cycle, pathogenesis, diagnosis and control of Trichomonas, Histomonas,
7. Morphology, life cycle, pathogenesis, diagnosis and control of Giardia, Entamoeba, Eimeria,
8. Morphology, life cycle, pathogenesis, diagnosis and control of Isospora, Toxoplasma,
9. Morphology, life cycle, pathogenesis, diagnosis and control of Sarcocystis, Plasmodium
10. Morphology, life cycle, pathogenesis, diagnosis and control of Haemoprotaus, Babesia,
11. Morphology, life cycle, pathogenesis, diagnosis and control of Theileria, Balantidium
12. Morphology, life cycle, pathogenesis, diagnosis and control of Anaplasma.

*Recommended Texts*


1. Robert, L. S., & Janory, J. Jr. (2002). *Foundations of parasitology*. London: W. M. C. Brown Publishers.
2. Chang, T.C. (1996). *General parasitology* (2nd ed.). New York, London: Academic Press.


*Suggested Readings*


1. Walochnik, J., & Duchene, M. (2016). *Molecular prarsitology: Protozoan parasites and their molecules.* New Dehli: Springer- Verlag Wien.
2. Heinz, M. (2016). *Human parasites* (1st ed.). Switzerland: Springer International Publishing.

**ZOOL-7120** **Reproductive Endocrinology** **3(3-0)**

Reproductive endocrinology is the study that imparts knowledge about fundamental pathways regulating reproductive health of an individual. Curriculum provides detailed information about the structure and functioning of the hormone-secreting glands that mediate various processes of the body including reproductive growth, development and fertility. Students will be familiarized with the role of endocrine input at various stages of life including sex differentiation at embryonic level, neuroendocrine mediators at pubertal level and maintained regulation of fertility and reproductive health through whole life. Curriculum is designed to have all relevant information required about complications related to reproduction and fertility mediated through endocrine glands disorders in both men and women. In women, these may include diseases of the fallopian tube, endometriosis, repeated pregnancy loss, uterine myomas, uterine abnormalities and other reproductive endocrine disorders. Men also face reproductive and fertility complications, which may result from disorders such as erectile dysfunction or priapism, decreased sperm count etc.

*Contents*

1. Endocrine aspects of sex differentiation in male and female foetus
2. Hypothalamus and pituitary structure and secretions.
3. Role of Hypothalamic-pituitary-gonadal axis and its regulation.
4. Ovarian function: gametogenesis, steroidogenesis and its regulation
5. Testicular function: gametogenesis, steroidogenesis and its regulation
6. Steroid hormones: biosynthesis and physiological actions.
7. Endocrinology of puberty
8. Endocrine regulation of pregnancy.
9. Endocrinology of lactation.
10. Endocrine disorders in males (few examples)
11. Endocrine disorders in females (few examples)

*Recommended Texts*


1. Wilson, J.D., Foster, D.W., & Larson, P.R. (1998). *Williams textbook of endocrinology.* Philadelphia: W.B. Saunders.
2. Strauss, J.F., Barbieri, R. L., & Gargiulo, A.R. (2018). *Yen & Jaffe's reproductive endocrinology: physiology, pathophysiology, and clinical management* (8th ed.). Amsterdam: Elsevier.


*Suggested Readings*


1. Wilson, J.D., Foster, D.W., & Larson, P.R. (1998). *Williams textbook of endocrinology.* Philadelphia: W.B. Saunders.
2. White, B.A, & Porterfield, S.P. (2013). *Endocrine and reproductive physiology* (4th ed.). Amsterdam: Elsevier/Mosby.

**ZOOL-7121** **Statistical Ecology** **3(3-0)**

Statistical ecology is a new scientific discipline that has developed promptly in response to advances in different academic fields globally. Statistical ecology deals with the development of new methodologies for analyzing ecological data. The course focuses on learning the fundamentals of probability distributions as models of animal abundance, models of demographic processes and evolutionary dynamics. Advanced statistical models and techniques are often needed to provide robust analyses of the available data offered in the life sciences by focusing on the mathematical statistics theory underlying the methods used in ecological and evolutionary analyses. The curriculum explains basic and fundamental concepts of probability and statistical inference in ecology, basic probability distributions to model and employ basic elements of statistical inference in ecology by means of mathematical statistics results. Learners will became aware about basic and advance statistical tools and their applications though this course on ecological data by the help of specific software.

*Contents*

1. Introduction to ecological parameters,
2. Experiments and experimental design in ecology
3. Review of ANOVA, assumptions of ANOVA, ANOVA models, mixed model ANOVA, nested ANOVA,
4. Factorial experiments & repeated measures, linear regression and multiple regression,
5. MANOVA, estimation species richness, diversity evenness.
6. Principal component analysis, corresponding analysis, discriminate functional analysis,
7. Cluster analysis, redundancy analysis,
8. Concept of niche overlap and resource partitioning
9. Distribution models, intraspecific association, intraspecific covariant,
10. Association analysis, non-linear ordinations, resemblance function,
11. Quadrate-variance methods and distance methods.

*Recommended Texts*


1. Ludwig, J.A., & Reynold, J.F. (1988). *Statistical ecology: A primer on methods in computing.* New York: John Wiley and Sons.
2. Ewens, W. (2004). *Mathematical population genetics 1- theoretical introduction.* New York: Springer Verlag.


*Suggested Readings*


1. Pielou, E.C. (1984). *The Interpretation of ecological data: a primer on classification and ordination.* New Jersey: Wiley- Inter-science.

**ZOOL-7122** **Vascular Biology** **3(3-0)**

The course provides detailed knowledge about the formation of blood vessels from progenitors or stem cells and about the interaction of the blood vessels at the tissue, cellular and molecular level. The communication of blood vessels with blood and tissues will be discussed with special reference to the pathophysiology of common vascular diseases as cardiovascular, cerebro- vascular disorders and the effect of toxicants on the circulation. The curriculum elucidates various responses of endothelial and smooth muscle cells to injury, growth and proliferation of vascular cells, endothelial dysfunction in hypertension and cardiomyopathy, roles of vasoactive mediators in mammalian cell function, and signal transduction in vascular endothelial cells. Effect of macromolecules like lipids and lipoproteins in circulation and the relevant immune responses will be shared with the students. Importance of blood vessels for normal physiological states including reproduction, wound healing as well as in disease conditions as cancer and venous thrombosis will be highlighted.

*Contents*

1. An introduction and overview of Vascular Biology,
2. Cardiovascular development/morphogenesis,
3. Vascular stem cells and progenitors
4. Structural anatomy of blood vessels
5. Endothelial cells their structure and characters, and dysfunction
6. Endotheilal cell signaling.
7. Interaction between leukocytes and endothelial cells.
8. Vasculogenesis, angiogenesis, Signaling pathways, Forms of vascular expansion,
9. Inhibition of angiogenesis,
10. Lymphatic vessels, lymphangiogenesis.
11. Extracellular matrix interactions,
12. Smooth muscle cell structure, signaling: function and dysfunction
13. Mechanosensing and signal transduction in the vessel wall
14. Epidemiology and genetics of cardio- and cerebrovascular disease, Venous thrombosis
15. Lipids and lipoproteins in vascular biology, Atherosclerosis, immunity, and inflammation
16. Vascular biology in reproduction
17. Wound healing, Angiogenesis related diseases, Vascular Biology in cancer

*Recommended Texts*

1. Hunt, B.J., Poston, L., Schachter, M., & Halliday, A.W. (Eds). (2002). *An introduction to vascular biology. From basic sciences to clinical practice* (2nd ed.). Cambridge: Cambridge University Press.
2. Krams, R., & Back, M. (Eds). (2017). *The ESC textbook of vascular biology* (1st ed.). Oxford: Oxford University Press.

*Suggested Reading*

1. Ribatti, D. (Ed). (2015). *Vascular morphogenesis. Methods and protocols* (1st ed.). New York: Springer.

**ZOOL-7123** **Vector Biology** **3(3-0)**

Vector is an organism that does not cause disease itself but spreads infection by conveying pathogens from one host to another. The curriculum of course covers the principles of transmission of human and animal pathogens by insects, mites and ticks, arthropod biology with special attention to biological properties of vectors and their interactions with pathogens. Topics about environmental, biological and genetic drivers of transmission and how these are impacted by the social, political and economic climate will also part of course. In addition, the course will provide basic components of arbopathogen disease cycles and principles of pathogen transmission dynamics with specific examples. Students came to know about biological and genetic conditions and mechanisms leading to evolution of resistance in arthropods and the pathogens they vector, methods to manage the development of resistance and ecological components of arthropod-borne disease transmission. Furthermore, familiarity about emerging pathogens, vector genetics, traditional and next generation control strategies will be given to the learners.

*Contents*

1. Introduction to vectors: classification of vectors.
2. Biological and mechanical vector,
3. Human vectors and Animal vectors, their adaptations and pest management.
4. Vector borne diseases – Insect transmitted diseases.
5. External morphology of insects: types of mouthparts, antennae, wings and legs.
6. Life cycle of Housefly: types of metamorphosis in insects.
7. Introduction to mosquitoes: mosquito life cycle, mosquito feeding behavior.
8. Anopheles, Aedes and Culex.
9. Sand files, bugs – human bugs, lice & fleas.
10. Malaria: Parasites, causes, symptoms, diagnostics and treatment. Plasmodium life cycle.
11. Dengue & Filariasis - causes, symptoms, diagnostics and treatment.
12. Blue tongue virus, sleeping sickness.
13. Synthetic drugs: treatment of malaria, filariasis & dengue.
14. Biological treatment for Dengue. Nano-drug delivery system.
15. Vector control – Integrated vector control program. Chemical, physical and botanical control.
16. Synthesis of metal nanoparticles for insect vector control.

*Recommended Books*


1. Mike, S. (2008). *Medical entomology for students*. Cambridge: Cambridge University Press.
2. Chapman, R.F. (1998). *The insects: structure and function*. Cambridge: Cambridge University Press.


*Suggested Readings*


1. Eldridge, B.F., & Edman, J.D. (2003). Medical entomology: a textbook on public health and veterinary problems caused by arthropods. Netherlands: Springer.
2. Tyagi. B.K. (2008). Vector-borne diseases: epidemiology and control. Switzerland: Scientific Publishers
3. Arun. K., Heidi, M. M., Adam, F., & Eric, R. B. (2013). *Nanomedicine in drug delivery.* Florida: CRC Press.

**ZOOL-7124** **Wildlife of Pakistan** **3(3-0)**

Regional background information about zoogeographic influences upon animal distribution across the main ecological zones of Pakistan is the core area of this subject. The course outlines introduction, current and past status, distribution of animals, theories, practices, and issues of wildlife and its management in Pakistan. The mountainous areas embracing the Himalayan, Karakorum and Hindukush Ranges are rich in fauna and flora, compared to other parts of the country because of inaccessibility. The Himalayan foothills and the Potohar region, including the Salt Range and Kala Chitta Range, are covered with scrub forests, which have been reduced to scanty growth in most places. Vast Indus flood plains have been cleared of natural vegetation to grow crops. Very little wildlife habitat has been left untouched. Little vegetative cover, severity of climatic conditions and the great thrust of grazing animals on the deserts have left wild animals in a precarious position. The main threats to wild animals include, the competition with domestic livestock, increasing human interference, the construction of roads, and hunting. Establishment of protected areas is crucial to conservation of existing biodiversity.

*Contents*

1. Biodiversity and wildlife in context of its services
2. Wildlife prior to establishment of Pakistan and current status of wildlife
3. Vegetative zones and associated wildlife in Pakistan
4. Important biodiversity eco regions in Pakistan
5. Provincial biodiversity of Pakistan
6. Wildlife rules and regulations in Pakistan
7. Protected areas of Pakistan: Marine protected areas, land protected areas
8. National parks
9. Game reserves
10. Wildlife sanctuaries
11. Ramsar sites and wetlands
12. Major threats to wildlife of Pakistan
13. Endangered fauna of Pakistan
14. Role of national organizations in conservation and management of wildlife

*Recommended Texts*


1. Fryxell, J. M., Sinclair, A. R., & Caughley, G. (2014). *Wildlife ecology, conservation, and management* (3rd ed.). West Sussex: Wiley-Blackwell.
2. Bolen, E.G., & Robinson, W. (2002). *Wildlife ecology and management* (5th ed.). London: Pearson.


*Suggested Readings*


1. Roberts, T.J. (1977). *Mammals of Pakistan* (1st ed.). London: Ernest Benon Ltd.
2. Roberts, T. J. (1991). *The birds of Pakistan, regional studies and non-Passeriformes* (1st ed.). Oxford: Oxford University Press.
3. Roberts, T. J. (1992). *The birds of Pakistan, Passeriformes: pittas to buntings* (1st ed.). Oxford: Oxford University Press.
4. Sharif M.K. (2006). *The amphibians and reptiles of Pakistan.* Florida: Krieger Publishing Company.

**ZOOL-7125** **Advanced Animal Diversity** **3 (3-0)**

This course is about animal diversity, origin and evolution of various taxonomic groups. The diversity of animal life will be investigated in the phylogenetic context of both invertebrate and vertebrate animals. The taxonomy and evolution of the main classes of animals will be examined: morphology, biology, ethology (vertebrates) and physiology. This course will highlight structural and functional integration and looks at organizational patterns from an evolutionary point of view. Students will be able to describe the origin of multicellularity and adaptations necessary for increased size including the basic characteristics of each group and the evolutionary relationships among group members. Moreover, this course will provide insight into the fundamental principles of evolution, and how behavioral, anatomical and physiological adaptations of animals have evolved. Specializations and adaptations of animals to their environment will be investigated This course will be helpful in exploring the current theories in animal biology which attempt to explain the origins, functions and ecological significance of animals.

*Contents*

1. Animal diversity: definitions, overview
2. General and systematic characteristics of animals
3. Diagnostic characters of phyla and classes of Protista, protostomes, deuterostomes.
4. Evolutionary trends in animals
5. Origin and evolution: Protista, Metazoa, Bilateria
6. Origin and evolution: Platyhelminthes
7. Origin and evolution: Annelids,
8. Origin and evolution: Arthropods
9. Origin and evolution: Echinodermata
10. Origin and evolution: Cephalochordates and Urochordates
11. Origin and evolution: Chordates (with emphasis on the expression of HOX genes).
12. Evolution of jawed fishes
13. Origin of Amphibians,
14. Origin of Reptiles and Birds
15. Origin and evolution of Mammals
16. Methods of estimation of biodiversity

*Recommended Texts*


1. Hickman, C. P., Roberts, L. S., & Larson, A. (2002). *Animal diversity*. New York: The McGraw Hill.
2. Wilson, D. E., & Burnie, D. (2001). *Animal: the definitive visual guide to the world's wildlife.* London: Dorling Kindersley.


*Suggested Readings*


1. Miller, S. A., & Harley, J. P. (2016). *Zoology*. New York: McGraw-Hill
2. Kershaw, D. R. (Ed.). (2012). *Animal diversity*. New York: Springer Science & Business Media.
3. Hall, B., & Strickberger, M. W. (2008). *Strickberger's evolution*. Burlington: Jones & Bartlett Learning.

**ZOOL-7126** **Advances in Molecular Biology** **3 (3-0)**

This course is the explanation of the structure and function of molecules, including DNA and RNA, which allow genes to be expressed and be maintained from one generation to the next. Recent years have seen explosive advances in the study of DNA and molecular genetics, including gene cloning, sequencing and mapping. Developments in molecular biology have opened new areas of study and provided powerful techniques that are revolutionizing the pharmaceutical, health, and agricultural industries. The aim is to provide the students with a detailed understanding of the regulation systems for the expression of genes, the genetic nature of developmental pathologies, the different forms of human genetic defects contributing to disorders and of the pathways between the genotype and the phenotype. The key ideas and values of recombinant DNA technology and relevant uses and problems related to popular understanding will also be discussed. Students will also learn about genetic engineering, its application, and the ethical issues associated with its use.

*Contents*

1. Structural explanation of DNA
2. Concept of gene
3. Chromatin to chromosome structure and function
4. Molecular mechanisms DNA of replication.
5. Transcription and translation in prokaryotes and eukaryotes
6. Transcriptional and translational regulation of gene expression
7. Regulation of gene expression in prokaryotes (operon model and types with examples)
8. Regulation of gene expression in eukaryotes
9. Types of recombination
10. Mutations and chromosomal aberrations
11. DNA damage, repair and disrepair
12. Gene sequencing &Principles of Recombinant DNA technology
13. Role of Recombinant DNA Technology in economic development
14. Human Genome Project

*Recommended Texts*


1. Karp, G., Iwasa, J., & Marshall, W. (2019). *Karp's cell and molecular biology: concepts and experiments* (9th ed.). USA: Wiley.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., & Watson, J. D. (2002). *Molecular biology of the cell*. New York: Garland.


*Suggested Readings*


1. Klug, W. S., Cummings, M. R., Spencer, C. A., & Palladino, M. A. (2019). *Concepts of genetics* (12th ed.). New York: Pearson Education, Inc.
2. Lodish, H., Matsudaira, P., Berk, A., Ploegh, H., Scott, M., Kaiser, C. A., Krieger, M., & Bretscher, A. (2007). *Molecular cell biology*. New York: W. H. Freeman Company.
3. Klug, W.S., Cummings, M.R., Spencer, C.A., & Palladino, M. A. (2015). *Concepts of genetics* (9th ed.). New York: Pearson Education, Inc.

**ZOOL 7127** **Animal Biotechnology** **3 (3-0)**

Animal biotechnology is a branch of biotechnology in which molecular biology techniques are used to genetically engineer (modify the genome of) animals in order to improve their suitability for pharmaceutical, agricultural or industrial applications. Animal biotechnology has been used to produce genetically modified animals that synthesize therapeutic proteins, have improved growth rates or are resistant to disease. The objective of this course is to introduce students to cutting edge biotechnologies that can be used for animal and human health and research. In this course students will analyze and discuss the primary literature on stem cells, cloning, large animal models for disease and development of therapies and treatments. In addition, the use of biotechnology for animal related issues such as food safety, disease control and biosecurity will be considered. A range of genetic, immunological and reproductive technologies will be introduced. The integration of these technologies to improve animal production, health and welfare will be explored.

*Contents*

1. Nuclear structure, organization, and function, DNA, proteins &chromatin structure
2. Central dogma, gene structure
3. Transcription, translation and regulation of gene expression
4. Transposons, retrotransposons, and retroviruses
5. Cloning Techniques: somatic cell nuclear transfer, embryo splitting
6. Nuclear Transplantation tools in genetic engineering, molecular cloning vectors
7. Genetic engineering guidelines & genetic engineering in aquaculture
8. Transgene delivery, detecting integration & expression of transgene.
9. Ethics: morality and animal biotechnology
10. Application of bio-security methods in various culture production
11. Molecular techniques in disease diagnosis
12. Human genome project
13. Principles of Immunology: antigens & immunoglobulins: immunotoxins
14. Immune system responses, lymphocytes& applications of ELISA.

*Recommended Texts*


1. Ranga, M. M. (2005). *Animal biotechnology*. India: Agrobios.
2. Kettle, D. S. (1984). *Medical and veterinary entomology*. Kent: Croom Helm Ltd.


*Suggested Readings*


1. Banerjee, G. C. (2018). *A textbook of animal husbandry*. Oxford: IBH publishing.
2. Mettenleiter, T. C., & Sobrino, F. (Eds.). (2008). *Animal viruses: molecular biology*. Norfolk: Caister Academic Press.
3. Nagabhushanam, R. (Ed.). (2004). *Biotechnology of aquatic animals*. Florida: CRC Press.

**ZOOL-7128 Classification of Insects and Pest Management (3-0)**

The classification of insects can be complex but it is very important to group and identify insects so that they can be studied reliably. Insects, like all animals, are classified using a hierarchical system of classification. It is the coordinated use of pest and environmental information along with available pest control methods, including cultural, biological, genetic and chemical methods, to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to people, property, and the environment. This course will provide knowledge to students about insect classification with its importance. Various insect orders and their principal features for identification of insects of agriculture and medical importance will be discussed. Ecological aspect of the course is also adequate to providing basic knowledge of insect population dynamics including factors regulating insect abundance, insect population prediction and monitoring systems. The course will also cover important areas such as insect behavior, communication, phylogeny and arthropod relations.

*Contents*

1. A general account including classification of insect orders: Collembola, Orthoptera, Dictyoptera, Isoptera, Hemiptera, Lepidoptera, Diptera, Hymenoptera, Coleoptera.
2. Only diagnostic characters of the remaining insect orders: Thysanura, Diplura, Protura
3. Ephemeroptera, Odonata, Plecoptera, Grylloblattoidea, Phasmida, Dermaptera, Embioptera,
4. Zapatero, Psocoptera, Mallophaga, Siphunculata, Thysanoptera, Neuroptera,
5. Meco- ptera, Tricoptera, Siphonaptera, Strepsiptera,
6. Insects of economic importance.
7. Brief account of biological control, chemical control and integrated pest management
8. Common sampling techniques in insect pest management
9. Concept of economic levels, economic damage and economic boundary
10. Economic injury level and economic threshold.
11. Household pests and their management.
12. Knowledge of pests of cotton, rice, sugarcane.

*Recommended Texts*


1. Pedigo, L. P., & Rice, M. E. (2014). *Entomology and pest management*. Long Grove: Waveland Press.
2. Richards, O. W., & Davies, R. G. (2013). *Imms' general textbook of entomology: classification and biology*. USA: Springer Science & Business Media.


*Suggested Readings*


1. Maredia, K. M., Dakouo, D., & Mota-Sanchez, D. (Eds.). (2003). *Integrated pest management in the global arena*. Oxford shire: CABI.
2. Dent, D. (2000). *Insect pest management*. Oxford shire: CABI.
3. Metcalf, R. L., & Luckmann, W. H. (Eds.). (1994). *Introduction to insect pest management* (Vol. 101). New Jersey: John Wiley & Sons.

**ZOOL-7129 Comparative Vertebrate Anatomy 3 (3-0)**

Comparative Vertebrate Anatomy is a course concerning the evolution of vertebrate's anatomy with changing environmental conditions. This course will explore how vertebrates originated, their characteristic anatomical and physiological features, how they developed, and how those features allow vertebrates to perceive their environment, locomotion, seek prey, avoid predators, maintain homeostasis and basically do everything an organism must do to live. Students will learn to appreciate that the vertebrate body is not simply a collection of static anatomy, but that the form and function of vertebrates is integrated into functional systems. This course will also introduce students to the groups of vertebrates and explores the anatomical evolution of vertebrates within the context of the functional interrelationships of organs and the changing environments to which vertebrates have adapted. An ideal entry point into the ways living creatures interact with their immediate physical world, we examine how the forms and activities of animals reflect the materials available to nature and consider rules for structural design under environmental forces.

*Contents*

1. Introduction and concepts
2. Methods of comparative biology and vertebrate diversity
3. Comparative anatomy of various body systems in vertebrate.
4. The outer organism – integument, acquiring food, dentition
5. Skeletal elements & the vertebrate axis: vertebral column
6. Vertebrate locomotion: girdles and limbs
7. Biomechanics: biological and physical design, walking & running, swimming, powered flight
8. Organismal respiration and circulation
9. Osmoregulation: concepts, organization and the vertebrate kidney
10. Nervous system: organization, functional integration
11. Sensing vibrations: lateral lines, hearing & vision

*Recommended Texts*


1. Hildebrand, M., & Goslow, G. (2001). *Analysis of vertebrate structure* (5th ed.). New York: Wiley.
2. Pough, F. H., Heiser, J. B., & McFarland, W. N. (1999). *Vertebrate life*. Upper Saddle River, NJ: Prentice Hall.


*Suggested Readings*


1. Diogo, R., & Abdala, V. (2010). *Muscles of vertebrates: comparative anatomy, evolution, homologies and development*. Florida: CRC Press.
2. Kardong, K. V. (2006). *Vertebrates: comparative anatomy, function, evolution*. New York: McGraw-Hill.
3. Hyman, L. H., & Wake, M. H. (1992). *Hyman's comparative vertebrate anatomy*. Chicago: University of Chicago Press.

**ZOOL-7130** **Conservation Biology of Wildlife** **3(3-0)**

The wildlife faces a variety of threats that compromise their ability to survive and reproduce. Wildlife is forced to either adapt to life with humans or face extinction in the wake of industrial revolution, population growth and urbanization. The survival of every species of wildlife is critical to preserving earth's rich biodiversity and unique natural history. Managing wildlife populations and their habitats are the core areas of conservation biology. The goal of conservation biology is to analyze the effects of different threats (xenobiotics, chemicals, pesticides, hunting, invasive species, overexploitation, climate change, anthropogenic activities, predation and land use) that endanger the existence of wild animal populations. Reconstruction of local habitats, formation of protected areas, implementation of breeding programs in sanctuaries, monitoring of animal movements with satellite tracking and other remote techniques, survey of animal populations, conducting population assessments keeping in view the harms to wild animals and limiting the effects of environmental degradation, climate change and the loss of biodiversity are the key components of conservation biology.

*Contents*

1. Introduction to conservation biology
2. Biodiversity: species diversity, ecosystem diversity, genetic diversity, functional diversity
3. Global patterns and drivers of biodiversity
4. Genetic concepts and tools to support wildlife populations
5. Genetic variation and fitness in wildlife populations
6. Threats to biodiversity: mass extinction and global changes, ecosystem degradation and loss
7. Overexploitation, deforestation, fragmentation and reduction in wildlife habitats, climate change
8. Introduction of exotic species, inbreeding and outbreeding depressions, loss of genetic variability
9. Environmental fluctuations, factors limiting the population size
10. Human factors, economic factors, politics and actions
11. Historical precedent of wildlife conservation in Pakistan
12. Current scenario of wildlife conservation in Pakistan
13. Species level, community and ecosystem conservation, ex-situ conservation
14. Major challenges faced during wildlife conservation, conservation and sustainable development
15. Role of protected areas in wildlife conservation and management in Pakistan
16. Role of national and international agencies in conservation and management of wildlife
17. International conventions and their role in wildlife conservation in Pakistan

*Recommended Texts*

1. Mills, L. S. (2012). *Conservation of wildlife populations: demography, genetics, and management*. New Jersey: John Wiley & Sons.
2. Primack, R. B. (2014). *Essentials of conservation biology* (6th ed.). Sunderland: Sinauer Associates.

*Suggested Readings*

1. Hunter Jr, M. L., & Gibbs, J. P. (2006). *Fundamentals of conservation biology*. New Jersey: John Wiley & Sons.
2. Cardinale, B., Primack, R., & Murdoch, J. (2019). *Conservation biology* (1st ed.). Sunderland: Sinauer Associates.
3. Fryxell, J. M., Sinclair, A. R., & Caughley, G. (2014). *Wildlife ecology, conservation, and management* (3rd ed). West Sussex: Wiley-Blackwell.

**ZOOL-7131** **Economic Zoology** **3 (3-0)**

It is a specialized branch of zoology which deals with animal world that is associated with the economy, health and welfare of humans. It includes culturing animals for mass production for human use and to control or eradicate animals that are injurious to man directly or indirectly. This course deals with the topics in a scientific way, the multidisciplinary nature of Economic Zoology has been given due importance incorporating topics like sericulture, lac culture, apiculture, poultry, fisheries, parasitology and dairy science. In this course the students will learn about Aquaculture, Poultry and Animal husbandry, Parasitism in relation to man, insects in relation to man that will include productive insects, insect pest & vectors of human diseases. This course offers students an understanding of experiential learning on the methodology of fish culture, sericulture and apiculture. It will also provide information about economic aspects of culturing animals.

*Contents*

1. Parasitic protozoans and their role in human welfare, soil protozoans and their role in agriculture.
2. Sponge culture and its importance in industry.
3. Concept of Coral reef and its significance.
4. Helminths as human and animal parasites.
5. Nematodes- parasitic roundworms of animals and plants.
6. Vermiculture industry
7. Household insects, apiculture, lac culture, sericulture, prawn culture, insects of
8. Commercial value and stored grain pests.
9. Economic importance of amphibian, reptiles and birds
10. Poultry, Piggery
11. Dairy industry
12. Wool industry.

*Recommended Texts*


1. Ravindranathan, K.R. (2017). *A text book of economic zoology*. New Dehli: Wisdom Press.
2. Islam, A. (2016). *A textbook of economic zoology*. New Dehli: I. K. International Publishing House Pvt. Ltd.


*Suggested Readings*


1. Ahsan, J., & Sinah, S.P. (2010). *A hand book of economic zoology*. New Dehli: Chand Publishing.
2. Jabde, P. V. (2005). *Text book of applied zoology*. India: Discovery Publishing House.
3. Shukla, G. S., & Upadhyay, V. B. (1998). *A textbook of economic zoology*. India: Rastogi Publication.

**ZOOL-7132** **Environmental Science** **3(3-0)**

Environmental Science is focused on a holistic understanding of earth systems in order to learn from the past, comprehend the present and influence the future. Environmental Science is an unusual academic discipline in that it requires scientific knowledge about the natural world, as well as an understanding about ways in which humans interact with the natural world. Course will examine effects of human actions on the environment, and the means by which policies, regulations, and decisions influence human actions. It will also examine human behavioral, cultural, and sociological interactions that affect the environment. This course is designed around three core themes- understanding of environmental issues, investigations of environmental changes & impacts and prediction and mitigation of environmental issues. This course examines environmental issues through many lenses, including ecology, economics, ethics and policy analysis. This course also explores laws and regulatory policies governing to water and air pollution, land use and hazardous waste at national and international levels.

*Contents*

1. Definition, principles and scope of environmental science.
2. Physico-chemical and biological factors in the environment.
3. Concept of major and trace elements, classification of trace elements, human use, trace elements and health.
4. Air Pollution: natural and anthropogenic sources of pollution.
5. Primary and secondary pollutants, transport and diffusion of pollutants and effects of pollutants
6. Water Pollution: Types, sources and consequences of water pollution. Water quality standard.
7. Soil Pollution: Analysis of soil quality. Soil Pollution Control.
8. Industrial waste effluents and heavy metals, their interactions with soil components.
9. Soil micro-organisms and their functions,
10. Degradation of different insecticides, fungicides and weedicides in soil.
11. Noise Pollution: Sources of noise pollution, measurements of noise and Indices
12. Effect of meteorological parameters on noise propagation.
13. Noise exposure levels and standards. Noise control and abatement measures.
14. Impact of noise on human health.

*Recommended Texts*


1. Smith, T. M., Smith, R. L., & Waters, I. (2012). *Elements of ecology*. San Francisco: Benjamin Cummings.
2. Chiras, D. D. (2011). *Environmental science*. Burlington: Jones & Bartlett Publishers.


*Suggested Readings*


1. Newman, E. I. (2008). *Applied ecology and environmental management*. New Jersey: John Wiley & Sons
2. Molles, M. (2015). *Ecology: concepts and applications*. New York: McGraw-Hill Education.
3. Phalen, R. F., & Phalen, R. N. (2011). *Introduction to air pollution science: a public health perspective*. Burlington: Jones & Bartlett Publishers.

**ZOOL-7133** **Recombinant DNA Technology** **3(3-0)**

It is an interdisciplinary subject that encompasses the sciences of Molecular Biology, Biomedicine as well as the genomic, proteomic, transcriptomic and metagenomics applications. Recombinant DNA technology is a technique which changes the phenotype of an organism (host) when a genetically altered vector is introduced and integrated into the genome of the organism. So, basically, the process involves introducing a foreign piece of DNA into the genome, which contains our gene of interest. This gene, which is introduced, is the recombinant gene and the technique is called the recombinant DNA technology. The course has been designed to acquaint the student with the fundamental techniques of genetic engineering; manipulation of DNA in vitro, transformation techniques, library construction and screening methods, expression systems and host-vector systems. Recent applications of recombinant DNA technology in the analysis of biological processes, diagnosis of human diseases, isolation of human genes, DNA finger printing, gene therapy and the development of commercial products are also covered. The course has 3 major components: techniques used in the generation of recombinant molecules, application of recombinant technology to diagnostics and therapeutics and genetically modified organisms. The discussion of potential ethic concerns of genome manipulations will also be included in the course

*Contents*

1. An outline of DNA cloning experiment; southern and northern blotting
2. Potentials of recombinant DNA technology; PCR; production of proteins
3. Plasmid vectors, bacteriophage, expression vectors, other vectors
4. Construction of genomic and c-DNA libraries,
5. Screening methods for gene libraries
6. Joining of DNA fragments to vectors, cohesive and blunt end ligation, adaptors, and linkers
7. Tissue culture techniques; transgenic organisms and gene therapies
8. Restriction fragment length polymorphisms and disease detection (e.g. cystic fibrosis)
9. Human genome project
10. Stem cells and therapeutic cloning; social considerations.

*Recommended Texts*


1. Khan, F. A. (2020). *Biotechnology fundamentals* (3rd ed.). Florida: CRC Press.
2. Ratledge, C., & Kristiansen, B. (Eds.). (2006). *Basic biotechnology*. Cambridge: Cambridge University Press.


*Suggested Readings*


1. Brown, T. (2010). *Gene cloning and DNA analysis: an introduction*. New Jersey: John Wiley & Sons.
2. Primrose, S. B., & Twyman, R. (2009). *Principles of gene manipulation and genomics*. USA: Wiley. com.
3. Howe, C. J. (2007). *Gene cloning and manipulation*. Cambridge: Cambridge University Press.

**ZOOL-7134** **Fish Requirements** **(3-0)**

Fish Requirements refers to the essential conditions and resources needed for the growth, health, and reproduction of fish. These include optimal water quality (temperature, pH, oxygen levels), appropriate nutrition, sufficient space, protection from predators, and a suitable environment that mimics their natural habitat. The objectives of the course are to teach students about basic concepts of fin fish feed requirements and recent trends in feed formulation and manufacturing. It will provide information about nutrient requirements of different commercially important fish species under variable environmental conditions. The course will enable the students to understand recent trends in fish feed technology for economical fish production. The student will be able to learn about basics of artificial fish feed ingredients and feed requirements of various fin fish species and to formulate and manufacture technology of various types of fish feed (floating and sinking pellets). Students will be able to explain recent advances in finfish feed preparation and manufacturing technology to increase fish yield with minimum cost.

*Contents*

1. Introduction to fish nutrition.
2. Digestion and absorption of nutrients.
3. Feeding types and anatomy.
4. Energy, protein, lipids, carbohydrate, mineral and vitamin requirements of fish.
5. Factors affecting nutrient requirements of fish.
6. Energy losses and partitioning in fish.
7. The role of other dietary components viz. water, fiber, hormones, antibiotics, antioxidants, pigments, pellet binders and feeding stimulants.
8. Anti-nutrients and toxins.
9. Forms and size of feed, feeding rates and feeding practices for different fish species.
10. Special purpose feeding.
11. Feed calculations, feed requirements and feed conversion ratios.
12. Feed ration and frequency, judging feeding response of cultured species, methods of feeding.

*Recommended texts*


1. Fitzsimmons, K., R.S.N. Janjua and M. Ashraf, 2015. *Aquaculture Handbook—Fish Farming and Nutrition in Pakistan.*
2. John Halver. 2013. *Fish Nutrition*, ELSEVIER.
3. Lovell, T., 2012. *Nutrition and Feeding of Fish*. 2nd Ed. Springer Science, USA
4. Hepher, B., 2010. *Nutrition of Pond Fishes*. Cambridge University Press, UK.


*Suggested Readings*


1. Halver, J.E., Ronald, W.H. and Daniel, M.H. 2004. *Fish Nutrition* (4thed.). Academic Press, N. York.
2. Pillay, T.V.R. 1999. *Aquaculture: Principles and Practices*. Fishing News Books, London.
3. N.C.R., 1998. *Nutrient Requirements of Fish.* National Academy Press, Washington D.C.

**ZOOL-7135** **Fisheries Extension and Education** **(3-0)**

Fisheries Extension and Education focuses on disseminating knowledge and skills related to fisheries and aquaculture to stakeholders such as fish farmers, communities, and policymakers. It involves training, outreach programs, and the use of educational tools to promote sustainable practices, improve fish production, and address challenges in the fisheries sector. The objectives of the course are to familiarize students about fisheries & aquaculture sector and various stakeholders. Its purpose is to impart knowledge on participatory approaches in fisheries extension programs. Course insights into different concepts, principles, recent changes and emerging challenges in fisheries extension and to acquire skills required to practice various fisheries extension approaches. Students will be able to earn about participatory approach and onsite training demonstration, discussion with fish farmers and fishermen. It will explore ways to increase the awareness of fisheries and aquaculture through extension services.

*Contents*

1. Overview of fisheries and aquaculture sector in Pakistan and world.
2. Scope and importance of fisheries and aquaculture extension.
3. Special characteristics of fisheries sector and its stakeholders.
4. Introduction to extension education, research, and service.
5. Overview of fisheries research, development and extension systems in Pakistan.
6. Critical review of philosophy, principles, concepts, and practices of fisheries extension systems and approaches.
7. Teaching, learning and co-learning.
8. Fisheries extension – advantages and limitations of present welfare and subsidy-oriented extension systems.
9. Development and extension approach as practiced by public agencies like Department of Fisheries, NGOs, FAO, and by the private sector; participatory fisheries extension approaches.
10. Participatory approaches for aquatic resources management and development: need, importance and guiding principles.
11. Public-Private-Community Partnership.
12. Social change; social control, social problems and conflicts in fisheries; gender issues in fisheries; theories of learning, learning experience, learning situation.
13. Reviewing national and international case studies on participatory approach to aquaculture research and development.

*Recommended Texts*


1. Malhotra SP & Sinha VRP. 2007. *Indian Fisheries and Aquaculture in a Globalizing Economy*. Part II. Narendra Publ. House.
2. Ray, G. L. (2006). *Extension, Communication and Management*. 6 th edition, Kalyani Publication (PD)
3. Brown D, Derek S & Simon FS. 2005. *Mainstreaming Fisheries Co-Management in the Asia-Pacific*. Asia-Pacific Fishery Comm. Rep. Publ. 2005/24, FAO, United Nations Regional Office for Asia and the Pacific, Bangkok.
4. Robert SP. 2005. *Fisheries Co-Management*: A Practical Hand Book. CABI.


*Suggested readings*


1. Chandrasekhar CS. (Ed.). 2004. *Privatization of Agricultural Extension in India*. MANAGE, Hyderabad.
2. Ramchandran C. 2004. *Teaching not To F(in)ish: A Constructivist Perspective on Reinventing a Responsible Marine Fisheries Extension System*. CMFRI, Kochi. 8. Edwards P, Little DC &Demaine H. 2002. Rural Aquaculture. CABI.
3. Rivera WM. 2000. *Agricultural Extension: Worldwide Institutional Evolution and Forces for Change*. Elsevier.
4. Kumar D. 1999. *Trickle Down System (TDS) of Aquaculture Extension for Rural Development*. RAP Publ.

5. Kumar D. 1996. Aquaculture Extension Services Review: India. FAO Fisheries Circular No. 906, Rome.
6. Chambers R, Arnold P &Thrupp LA. 1989. *Farmers First: Farmer Innovation and Agricultural Research. Intermediate Technology* Publ. 13. Chambers R. 1983. Rural Development Putting the Last First. Longman.

**ZOOL-7136** **Fish Breeding and Hatchery Management** **(3-0)**

Fish Breeding and Hatchery Management focuses on techniques for fish reproduction and hatchery operations, including induced breeding, larval rearing, and maintaining water quality. It covers fish reproductive biology, disease control, and hatchery design to enhance fish production for aquaculture, conservation, or research purposes. The objectives of the course are to enable students to produce quality fish seeds (fry, fingerlings and juveniles) and exchange necessary skills with students in site selection, design, construction and management of fish hatchery. The course will help transfer basic knowledge for transportation of fish seeds and control of diseases in fish hatchery. It will provide students with opportunities to develop fish seeds production skills such as brood stock management, fertilization and incubation of eggs, larval and fingerlings rearing. Students will be able to explain the different methods of artificial propagation of fish seeds and its importance and will demonstrate the various types of fish hatcheries and their management.

*Contents*

1. Fish Breeding: Sexuality in fishes, sexual dimorphism, reproductive cycle, courtship and mating, fecundity and spawning, natural and artificial propagation of fishes and gonad anatomy and reproductive mechanisms.
2. Brood Husbandry: brood availability, transport, selection of brood stock for rearing, brood captive rearing and maturation, nutritional and environmental requirement for broodstock.
3. Methods of breeding: criteria for selection of mature brood fish induce spawning, wet and dry method of breeding, factors affecting maturation and spawning in fishes, fish pituitary gland, its structure, collection, preservation and preparation of extract for injection, synthetic hormones used for induced breeding of carps, dosages and methods of injection, collection and hatching of egg.
4. Fish Hatchery Management

*Recommended Texts*


1. Pillay.T V R and M N Kutty, 2005, *Aquaculture- principles and practices*, Blackwell sciences, UK
2. Thomas.P.C et al, 2003. *Breeding and seed production of finfish and shellfish*, Daya publishing house, New delhi
3. Mathew Landau, 1992. *Introduction to Aquaculture*, John Wiley and sons, INC,New York
4. Jhingran. V G, 1991, *Fish and Fisheries of India*, Hindustan Publishers. 5. Rath, P K, 2000, Freshwater Aquaculture, Scientific Publishers, Jodhpur


*Suggested Readings*


1. Jhingran VG and Pullin R S V, 1985, *Hatchery Manual for the Common, Chinese and Indian major carps,* ICLARM
2. Sharma, O. P. 2009. *Handbook of Fisheries and Aquaculture*. Agrotech Publishing Academy, Udaipur, New Delhi, India
3. Hart, P. J. B. and J. D. Reynolds. 2008. *Handbook of Fish Biology and Fisheries*, Volume 2. Blackwell Science Ltd., New York, USA
4. Huet, M. 1998. *Text Book of Fish Culture - Breeding and Cultivation of Fish*. Fishing News, London, UK.

**ZOOL-7137** **Fish Nutrition and Health** **(3-0)**

Fish Nutrition and Health focuses on understanding the dietary needs of fish and maintaining their overall health. It covers nutrient requirements, formulation of balanced diets, feed management, and the role of nutrition in disease prevention. The course also addresses common fish diseases, health monitoring, and strategies for ensuring optimal growth and sustainable aquaculture. The course is designed to familiarize students with physiological aspects of nutrition and response of fish to diet in relation to feed additives and immunity. Also inform students with recent advancement in aquaculture nutrition, nutritional constituents and their energetics, nutritional deficiency and diseases. This course will tell students about fish feed formulation procedures and processing practices and risk associated factors to the aquaculture nutritional balance and management of the feed stocks. Acquire knowledge about fish nutrition and methods of feeding for sustainable fish production. Students will be able to interpret various macro and micro-nutrients, energetics and digestibility of nutrients and demonstrate manufacturing techniques of various types and size of fish feed, feeding regimens in relation to the species cultured and the type of culture facility.

*Contents*

1. Introduction: Introduction to nutrients (macronutrients and micronutrients) and their importance; carbohydrates, lipids, protein, amino acids, vitamins, minerals, carotenoids. Nutritional energetic: digestion process in fish, energy partitioning, bioenergetics model, methods of digestibility determination, factors affecting digestibility, nutrient digestibility.
2. Types of fish feed: natural and artificial; production of live feed; classification of fish feed on the basis of nutrient composition and texture.
3. Feed Additives and anti-nutritional factors: Introduction to feed additives; other dietary components (water, fiber, hormones, antibiotics, pigments, pellet binders, stimulants). Anti-nutritional factors, types of antinutrients and their sources.
4. Introduction to toxic agents and anti-oxidants: Toxic agents, non-nutrient diet components; antioxidants in compounded feeds.
5. Nutritional disorders: Nutritional fish diseases; nutrients and immune response; feed rancidity.
6. Feed Rationing and Frequency: Feeding ratio; feeding frequency; feed conversion ratio; feed digestibility; pre-biotics and pro-biotics.
7. Novel diets for aquaculture: Encapsulated diets, medicinal diets and experimental diets.
8. Aqua feed industry: Introduction, economics of feed production and feeding; quality control in fish feed manufacturing; feed regulations.

*Recommended texts*


1. John Halver. 2013. Fish Nutrition, ELSEVIER.
2. Lovell, T., 2012. *Nutrition and Feeding of Fish*. 2nd Ed. Springer Science, USA
3. Stickney, R. R. 2009. *Aquaculture: An Introductory Text*. CABI Publishing, London, UK.
4. Pandey, B. N., S. Deshpande and P. N. Pandey. 2007. *Aquaculture*. APH Publishing Corporation, New Delhi, India.
5. Ojha, J.S. 2006. *Aquaculture Nutrition and Biochemistry*. Geeta Somani Agrotech Publishing Academy, Udaipur, India.
6. Parker R. O., 2004. *Aquaculture Science (4thedt.)*. Delmar Learning, London.


*Suggested readings*


1. Halver, J.E. and Hardy, R.W. 2002. *Fish Nutrition*. Academic Press. Boston, London
2. Hertrampf, J.W., Pascual, F.P. and Ong, S.L. 2002. *Handbook on Ingredients for Aquaculture Feeds*. Kluwer Academic Publishers
3. Rajagopalsamy, C.B.T. and. Ramadhas. V. 2002. *Nutrient Dynamics in Freshwater Fish culture system*. Daya Publishing house, Delhi.
4. Bhujel, R. C.; Yakupitiyage, A.; Turner, W. A. and Little, D. C. (2001). *Selection of a Commercial Feed for Nile Tilapia (Oreochromisniloticus) Broodfish Breeding in Hapa-in-Pond systems.* Aquaculture 194: 303-314.

**ZOOL-7138** **Wildlife Hunting and Trade** **3(3-0)**

The aim of this course is to provide students with a detailed understanding of the dynamics of wildlife hunting and trade, including its historical background, cultural practices, ecological impacts, and legal frameworks. The course focuses on both legal and illegal aspects of wildlife exploitation, covering subsistence hunting, commercial hunting, trophy hunting, and the domestic and international trade in wildlife and wildlife products. Special attention is given to the impacts of hunting and trade on species survival, ecosystems, and conservation efforts in Pakistan. Students will also explore strategies to regulate and monitor hunting and trade activities, enhance law enforcement, and promote community-based sustainable use of wildlife resources.

*Contents*

1. Introduction to Wildlife Hunting and Trade: Definitions, history, and cultural significance of hunting.
2. Types of Hunting: Subsistence hunting, commercial hunting, trophy hunting, poaching; their motivations and impacts.
3. Wildlife Trade Networks: Local, national, and international wildlife trade routes; live animal trade, body parts (skins, bones, horns), and derived products (medicines, ornaments).
4. Impacts of Hunting and Trade: Species decline, ecosystem imbalance, genetic bottlenecks, extinction risks, and loss of biodiversity.
5. Status of Wildlife Hunting and Trade in Pakistan: Key species under threat due to hunting and trade; traditional hunting communities; illegal markets and smuggling routes.
6. Legal Framework and International Conventions: Pakistan Wildlife Protection Ordinance, CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), national hunting regulations, and penalties.
7. Hunting Permits and Game Management: Game species in Pakistan, Trophy hunting programs, quotas, seasonal regulations, and wildlife utilization models.
8. Wildlife Forensics and Trade Monitoring: Use of DNA analysis, tagging, and databases to track illegal trade and enforce wildlife laws.
9. Socio-Economic Aspects of Wildlife Trade: Community dependence on wildlife, bushmeat trade, livelihoods, and challenges of sustainable use.
10. Control Strategies and Community-Based Approaches: Anti-poaching units, awareness campaigns, sustainable hunting models, and the role of local communities in regulation.

*Recommended Texts*


1. Geist, V. (1990). Wildlife Conservation Policy. Van Nostrand Reinhold.
2. Nijman, V. (2010). An overview of international wildlife trade from Southeast Asia. Biodiversity and Conservation.
3. Oldfield, S. (2003). The Trade in Wildlife: Regulation for Conservation. Earthscan.


*Suggested Readings*

1. WWF-Pakistan Reports on Illegal Wildlife Trade.
2. IUCN Pakistan Publications on Trophy Hunting and Sustainable Use.
3. CITES Appendices and Trade Database
4. UNEP and TRAFFIC Reports on Wildlife Crime and Trade Monitoring.

**ZOOL-7139** **Captive Breeding of Wildlife** **3(3-0)**

The aim of this course is to provide students with a comprehensive understanding of the principles, objectives, and practices of captive breeding as a tool for wildlife conservation and species survival. It seeks to familiarize students with the biological, ecological, genetic, and behavioral requirements of wildlife species in captivity, and to highlight the significance of captive breeding in preventing species extinction, supporting population recovery, and promoting biodiversity conservation. The course emphasizes the study of reproductive technologies, genetic management, animal welfare, health care, and the challenges of reintroducing captive-bred animals into the wild. Additionally, it aims to develop practical skills in species observation, enclosure design, studbook management, health monitoring, and the evaluation of breeding programs, enabling students to contribute effectively to conservation initiatives, zoological institutions, and wildlife rehabilitation centers in Pakistan and beyond.

*Contents*

1. Introduction to Captive Breeding: Definition, history, importance, objectives, principles of captive breeding in wildlife conservation.
2. Reproductive Biology in Captivity: Natural and assisted reproductive strategies, mating systems, breeding cycles, and factors affecting reproduction in captivity.
3. Captive Breeding Techniques: Natural mating, artificial insemination, embryo transfer, hand-rearing, cross-fostering, and cryopreservation.
4. Genetic Management in Captivity: Importance of genetic diversity, inbreeding avoidance, studbook management, pedigree analysis, and genetic records.
5. Nutritional and Health Management: Diet planning, nutritional requirements, preventive health care, disease control, veterinary interventions, and quarantine protocols.
6. Behavioral Management and Animal Welfare: Behavioral needs of captive animals, signs of stress, stereotypic behaviors, and welfare assessment standards.
7. Case Studies of Captive Breeding Programs: Success stories and failures, with examples from national and international projects.
8. Challenges and Ethical Issues: Limitations of captive breeding, ethical dilemmas, animal rights, and debates on the role of zoos and breeding centers.
9. Reintroduction and Release Programs: Principles, protocols, site selection, post-release monitoring, and evaluation of reintroduction outcomes.

*Recommended Texts*


1. Kleiman, D.G., Thompson, K.V., & Baer, C.K. (2010). Wild Mammals in Captivity: Principles and Techniques for Zoo Management. University of Chicago Press.
2. Stanley Price, M.R., Soorae, P.S., & Kleiman, D.G. (1995). Reintroduction Biology. Wiley-Blackwell.
3. Ballou, J.D., Gilpin, M., & Foose, T.J. (2011). Population Management for Survival and Recovery. Columbia University Press.


*Suggested Readings*


1. Sheikh, K.M. & Molur, S. (2005). Status and Red List of Pakistan's Mammals. IUCN Pakistan.
2. Khan, M. S. (2011). Amphibians and Reptiles of Pakistan. Krieger Publishing Company.
3. Roberts, T.J. (1997). The Mammals of Pakistan. Oxford University Press.
4. WWF-Pakistan Reports and Conservation Strategies.
5. IUCN Species Survival Commission (SSC) Guidelines and Reports.
5. Research papers, case studies, and policy documents on captive breeding programs in Pakistan.

# Model Course Outline
# for the Course Understanding of Quran – I

**Course Title:** Understanding of Quran – I
**Course Book:** Muallim ul Quran (Volume 1, 2 & 3) by Dr Ubaid ur Rahman
**Credit Hours:** 1 (0-1)
**Contact Hours:** 3 per week
**Weeks:** 15-16 (45-48 hours)

## Course Learning Outcomes:

*By the end of this course, students will be able to:*

1. Develop the ability to understand basic words of the Quran, phrases and sentences that do not contain verbs (unit 1 to 5 of Muallim ul Quran Book) and then sentences having present tense (first half of unit 6 of Muallim ul Quran Book).
2. Acquire a strong foundation for understanding long verses of the Quran with clarity.
3. Comprehend Quranic vocabulary, particles (operative & non operative particles) , compounds (Adjective & Possessive compound), pronouns (singular & plural) and types of plural through hundreds of Quranic sentences.
4. Recognize and understand different styles of Quranic sentences, including nominal sentence, emphatic sentence, double emphatic sentence, negative sentence, interrogative sentence, oath –based sentences.
5. Strengthen understanding of fundamental Quranic linguistic styles, expressions and idioms.
6. Understand at least 30 to 40 % of each page of the holy Quran.

## Provision of material, content and books:

- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helping material:** Helping material for the teachers like quizzes, question papers and images is available on website.

## Course Outline:

| Weeks | Lectures (1.5 hrs) | Units | Lessons | Assignments/Home Task | Linguistic Rules |
|---|---|---|---|---|---|
| 1. | 1. | 1 | 1-6 | Writing the meaning of Quranic words Lesson 1-8 | Proper Noun Masculine & Feminine |
| | 2. | 1 | 9-14 | Writing the meaning of Quranic words 9-14 | Two kinds of plural Concept of (و) "And" Common Noun |
| 2. | 1. | 1 | 15-17 | Writing the meaning of Quranic words, phrases & translation of Sentences 15-17 | Demonstrative Noun (This & That for Masculine (هذا- هذه) Demonstrative Noun (This & That for Feminine) (ذلك- تلك) |
| | 2. | 1 | 18-19 & Revision (Unit 1) | Writing the meaning of Quranic words , phrases & translation of Sentences 17-19 Quiz | Laam for emphasis (لام التأكيد) Superlative Degree like أكبر Revision of all Quranic Sentences |
| 3. | 1. | Unit 2 | 1-3 | Writing the meaning of Quranic words, phrases & translation of Sentences 1-3 | Emphatic Particle إن Preposition "For" ( اللام) Preposition (في) |
| | 2. | 2 | 4-6 | Writing the meaning of Quranic words, phrases & translation of Sentences 4-6 | Preposition (على- من- إلى) |
| 4. | 1. | 2 | 7- 9 | Writing the meaning of Quranic words & translation of Sentences 7-9 | Preposition (الباء) Absolute Negation Particle Exceptive Particle ( لا النافية للجنس)( ما النافية) (إلا) |
| | 2. | 2 | 10-13 & Revision (Unit 2) | Writing the meaning of Quranic words, phrases & translation of Sentences 10-13 Quiz | Subordinating Conjunction(أن), Was (كان), Vocative Particle(حرف النداء) |

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| 5. | 1. | Unit 3 | 1-2 | Writing the meaning of Quranic phrases<br>1-2 | Quranic Adjective Compounds<br>(صفة وموصوف) |
| | 2. | 3 | 3-5 | Writing the meaning of Quranic phrases & translation of sentences<br>3-5 | Quranic Possessive Construction<br>(مضاف ومضاف إليه) |
| 6. | 1. | 3 | 6 -7 | Writing the meaning of Quranic phrase translation of sentences<br>6-7 | Quranic Possessive Construction<br>(مضاف ومضاف إليه) |
| | 2. | 3 | 8-10 & Revision (Unit 3) | Writing the meaning of Quranic phrase & translation of sentences<br>8-10<br>Quiz | Active Participle (اسم الفاعل), Passive Participle (اسم المفعول), Dual (مثنى) |
| 7. | 1. | Unit 4 | 1-2 | Writing the meaning of Quranic phrase & translation of sentences<br>1-2 | Personal Pronoun He( هو المنفصل)<br>Possessive Pronoun His ـه المتصل) |
| | 2. | 4 | 3-4 | Writing the meaning of Quranic phrase & translation of sentences<br>3 -4 | Possessive Pronoun with prepositions<br>like في بيته<br>Pronoun "His" with prepositions like له، منه، فيه |
| 8. | 1. | 4 | 5-8 | Writing the meaning of Quranic sentences<br>5-8 | Personal Pronoun You( أنت المنفصل)<br>Possessive Pronoun Your ك المتصل)<br>Possessive Pronoun with prepositions<br>like في بيتك<br>Pronoun "your" with prepositions like لك، منك، فيك |
| | 2. | Mid Term | | | |

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| 9. | 1. | 4 | 9-12 | Writing the meaning of Quranic phrases & sentences 9-12 | Personal Pronoun She( هي المنفصل)<br>Possessive Pronoun Her ها المتصل)<br>Possessive Pronoun with prepositions like في بيتها<br>Pronoun "Her" with prepositions like لها، |
| | 2. | 4 | 13-16 | Writing the meaning of Quranic phrases & sentences 13-16 | Personal Pronoun I ( أنا المنفصل)<br>Possessive Pronoun Her ي المتصل)<br>Possessive Pronoun with prepositions like في بيتيPronoun "My" with prepositions like لي |
| 10. | 1 | 4 | 17 & Revision Unit 4 | Revision of all Quranic sentences of Unit 4 Quiz | Adverb (حال) |
| | 2. | Unit 5 | 1-2 | Writing the meaning of Quranic phrases & sentences 1-2 | Masculine Plural<br>جمع المذكر السالم و جمع المذكر السالم المسبوق بحرف الجر |
| 11. | 1. | 5 | 3-4 | Writing the meaning of Quranic phrases & sentences 3-4 | Possessive Construction with Plurals<br>جمع المذكر السالم المسبوق بالإضافة |
| | 2. | 5 | 5-6 | Writing the meaning of Quranic phrases, sentences & verses 5-6 | Personal Pronoun They ( هم المنفصل)<br>Possessive Pronoun Their هم المتصل) |
| 12. | 1. | 5 | 7-8 | Writing the meaning of Quranic phrases, sentences & verses 7-8 | Possessive Pronoun with prepositions like في بيتهمPronoun "Their" with prepositions like لهم |
| | 2. | 5 | 9-11 | Writing the meaning of Quranic phrases, sentences & verses 9-11 | Personal Pronoun You ( أنتم المنفصل)<br>Possessive Pronoun Your كم المتصل)<br>Possessive Pronoun with prepositions |



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| | | | | | في بيتكم like |
| 13. | 1. | 5 | 12-14 | Writing the meaning of Quranic phrases & sentences & verses 12-14 | Pronoun "Your" with prepositions like لكم<br>Personal Pronoun We ( نحن المنفصل)<br>Possessive Pronoun Our نا المتصل) |
| | 2. | 5 | 15-16 | Writing the meaning of Quranic sentences & verses 15-16 | Possessive Pronoun with prepositions like في بيتنا<br>Pronoun "Our" with prepositions like لنا |
| 14. | 1. | 5 | 17-18 | Writing the meaning of Quranic sentences & Verses 17-18 | Demonstrative Pronoun These, Those ( هؤلاء- أولئك) |
| | 2. | 5 | 19-23 | Writing the meaning of Quranic sentences & Verses 19-23 | ما / إلا، إن / إلا، إنما، ليس، ما ، ( أم/أم، أن، بل، كان)<br>( ألا، أليس، اليوم، يومئذ، سبحان، مابينهما، قل، إذن، بئس، نعم، كلا، ما أدراك، حسب، أعلم بـ، مصير، مرجع، دينا(تمييز) |
| 15. | 1. | 5 | Revision Unit 5 | Quiz | |
| | 2. | 5 | 1-3 (till Page 16) | Writing the meaning of Quranic Verbs &Translation of Quranic Sentences & Verses (1-3) | Introduction of Present Tense(فعل مضارع) & Verbal Sentence ( جملة فعلية)<br>Present Tense<br>الفعل المضارع صيغة المفرد يعلم |
| 16. | 1. | 6 | 3 (From Page 17) & 4 -5 | Translation of Quranic Sentences & Verses 3-5 | Present Tense<br>الفعل المضارع صيغة المفرد يعلم |
| | 2. | 6 | 6 | Translation of Quranic Sentences & Verses | Present Tense<br>الفعل المضارع صيغة الجمع يعلمون |

# Model Course Outline
# for the Course Understanding of Quran – II

**Course Title:** Understanding of Quran – II
**Course Book:** Muallim ul Quran (Volume 3, 4 & 5) by Dr Ubaid ur Rahman
**Credit Hours:** 1 (0-1)
**Contact Hours:** 3 per week
**Weeks:** 15-16 (45-48 hours)

## Course Learning Outcomes:

*By the end of this course, students will be able to:*

1. Directly comprehend hundreds of Quranic sentences & verses.
2. Understand at least 80 to 85 % of each page of the holy Quran.
3. Understand common verses across different Quranic topics.
4. Achieve proficiency in the basic and advance linguistic aspects of the Arabic language.
5. Understand the difference between Quranic verbs in various forms, such as present, past and imperative.
6. Develop the ability to understand long verses of the holy Quran independently and then comprehend their interpretation.

## Provision of material, content and books:

- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helping material:** Helping material for the teachers like quizzes, question papers and images is available on website.

## Course Outline:

| Weeks | Lectures | Units | Lessons | Assignments/Home Task | |
|---|---|---|---|---|---|
| 1. | 1. | 6 | 6 | Understanding & Translation of Verses | Present Tense<br>صیغۃ جمع مذکر غائب مثل یعبدون |
| | 2. | 6 | 7-8 | Understanding & Translation of Verses | Present Tense<br>صیغۃ جمع مذکر غائب مثل یعبدون |
| 2. | 1. | 6 | 9-10 | Understanding & Translation of Verses | Present Tense<br>صیغۃ مفرد مذکر مخاطب (تعبد)<br>وجمع مذکر مخاطب ( تعبدون) |
| | 2. | 6 | 11-12 | Understanding & Translation of Verses | Present Tense<br>صیغۃ جمع مذکر مخاطب ( تعبدون) |

| | | | | | صيغة المتكلم (أعبد) |
|---|---|---|---|---|---|
| 3. | 1. | 6 | 13 | Understanding & Translation of Verses | Present Tense<br>صيغة جمع المتكلم (نعبد) |
| | 2. | 6 | 14-15 | Understanding & Translation of Verses | Negative Imperative<br>صيغة المفرد وصيغة الجمع , لا تعبدْ، لا تعبدوا |
| 4. | 1. | 6 | 16-17 | Understanding & Translation of Verses | Conditional Sentences & masdar moawal<br>(مصدر موؤل) |
| | 2. | 6 | 18-19 | Understanding & Translation of Verses | Laam uttaleel<br>(لام التعليل) &<br>Laam ul jhood(لام الجحود) |
| 5. | 1. | 6 | 20-21 | Understanding & Translation of Verses | Present with object pronouns &<br>Passive Voice |
| | 2. | 6 | Revision (Unit 6) | Quiz | |
| 6. | 1. | Unit 7 | 1 (sec 1-3) | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد الغائب |
| | 2. | 6 | 1 (Sec 4-5) | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد للغائب |
| 7. | 1. | 6 | 1 (Sec 5-6) | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد للغائب |
| | 2. | 6 | 1 (Sec 7-9) | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد للغائب |
| 8. | 1. | 7 | Revision | Understanding & Translation of Verses<br>QUIZ | Past Tense<br>صيغة المفرد للغائب |
| | 2. | MID TERM | | | |
| 9. | 1. | 7 | 2 (sec 1-2) | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| | 2. | 7 | 2 (sec 3) | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| 10. | 1. | 7 | 2 (sec 4-5) | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| | 2. | 7 | 2 (sec 6-7) | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| 11. | 1. | 7 | 3 (sec 1-2) | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |

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| | 2. | 7 | 3<br>(sec 2-3) | Understanding &<br>Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |
| 12. | 1. | 7 | 3<br>(sec 3-4) | Understanding &<br>Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |
| | 2. | 7 | 3<br>(sec 4-5) | Understanding &<br>Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |
| 13. | 1. | 7 | 4<br>(sec 1-2-3) | Understanding &<br>Translation of Verses | Past Tense<br>صيغة الجمع للمخاطب عبدتم |
| | 2. | 7 | 4<br>(sec 4-5) | Understanding &<br>Translation of Verses | Past Tense<br>صيغة الجمع للمخاطب عبدتم |
| 14. | 1. | 7 | 5-6 | Understanding &<br>Translation of Verses<br>Quiz | Past Tense<br>صيغة المتكلم والمخاطب عبدتُ ،<br>عبدتُ |
| | 2. | 7 | 7 | Understanding &<br>Translation of Verses | Past Tense<br>صيغة المؤنث للغائب عبدتْ |
| 15. | 1. | 7 | 8 | Understanding &<br>Translation of Verses | Passive Voice (Past Tense)<br>فعل مجهول للمفرد |
| | 2. | 7 | 9 | Understanding &<br>Translation of Verses | Passive Voice (Past Tense)<br>فعل مجهول الجمع |
| 16. | 1. | 8 | 1-4 | Understanding &<br>Translation of Verses | Imperative Verb for singular<br>فعل الأمر للمفرد |
| | 2. | 7 | 5-8 | Understanding &<br>Translation of Verses | Imperative Verb for plural<br>فعل الأمر للجمع |

**URCG-5131** **Ethics-I** **1(0-1)**

**1-Course Description**

The Ethics-I course is designed to provide students with a comprehensive understanding of ethical principles, practices, and theories in various societal contexts. Throughout this degree program, students will explore the complexities of ethical theories of semitic and non-semitic religions along with decision-making and develop critical thinking skills to navigate moral dilemmas. This course will also enable the students to interact with others religious identities with humanistic, inclusive and holistic approach

**2- Learning Objectives**

This course aims to:

1. Introduce students to the fundamental concepts, scope, and importance of ethics.
2. Explore the relationship between law, morality, and social values.
3. Develop a clear understanding of virtuous and immoral ethics and their impact on individual and collective life.
4. Study the role of major religious figures in the moral development of human society and enable students to apply ethical principles for personal development, conflict resolution, and social harmony.

**3- Learning Outcomes**

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

1. Students will be able to identify and analyze major ethical theories, values, and their scope in social and individual life.
2. Differentiate between law and ethics, and analyze their interrelationship.
3. Identify types of virtuous and immoral ethics and assess their social impacts.
4. Examine the ethical teachings of major religions and their relevance in contemporary society.
5. Apply ethical principles to address modern challenges in personal and professional life.

**4-Course Structure**

1. Interactive lectures, Group discussions and debates
2. Reflection papers and presentations
3. Assignments and Quiz

**Course Contents**

**Unit 1: Introduction and Fundamentals of Ethics**

1. Literal and terminological definition of ethics
2. Literal and terminological definition of values
3. Relationship between law and ethics
4. Need, importance, and scope of ethics

**Unit 2: Types of Ethics and Their Impact on Society**

- Virtuous ethics: concept, types, benefits, and outcomes
- Immoral ethics: concept, types, and harms
- Role of ethics in social refinement and establishment of peace

**Unit 3: Virtuous Ethics (Akhlaq-e-Hasanah)**

- Concept, need, and importance of virtuous ethics
- Scope of virtuous ethics in the light of religions
- Major virtues in revealed and non-revealed religions
- Impact of virtuous ethics on individual and collective life

**Unit 4: Immoral Ethics (Akhlaq-e-Razilah)**

- Concept of immoral ethics
- Social problems caused by immoral ethics
- Practical consequences of immoral ethics
- Major vices in revealed and non-revealed religions

**Unit 5: Role of World Religious Figures in Moral Development**

- Prophet Moses (AS): introduction, miracles, and role in moral refinement
- Prophet Jesus (AS): introduction, miracles, and role in moral refinement
- Prophet Muhammad (ﷺ): introduction, miracles, and role in moral refinement

**Textbook**

1. Izutsu, T. (2002). *Ethico-Religious Concepts in the Qur'an*. McGill-Queen's University Press.

**Suggested Readings**

1. Gert, B. (2005). *Morality: Its Nature and Justification*. Oxford University Press.
2. MacIntyre, A. (2007). *After Virtue: A Study in Moral Theory*. University of Notre Dame Press.
3. Al-Ghazali, Abu Hamid (2001). *The Alchemy of Happiness*. Islamic Texts Society.
4. Nasr, S. H. (1994). *The Heart of Islam: Enduring Values for Humanity*. Harper One.
5. Beauchamp, T. L., & Childress, J. F. (2019). *Principles of Biomedical Ethics*. Oxford University Press.
6. Hasan, Z. (2010). *Ethics in Islam: Key Concepts and Contemporary Challenges*. Islamic Research Institute.

**URCG-5132** **Ethics-II** **1(0-1)**

1 (0-1)

**1-Course Description**

The course *Ethics-II* is designed to provide students with a deeper understanding of ethical principles and practices from both Semitic and non-Semitic religions, as well as their application in professional and social contexts. Students will engage with Jewish, Christian, Islamic, Hindu, Buddhist, Sikh, Confucian, and Jain ethical traditions. The course emphasizes moral reasoning, decision-making, tolerance, and peacebuilding. It aims to cultivate an inclusive, humanistic, and holistic approach towards ethical living and interfaith engagement.

**2- Learning Objectives**

The course objectives are to:

1. Understand the fundamental principles and theories of ethics.
2. Introduce the ethical and moral teachings of Judaism, Christianity, Islam, and Hinduism.
3. Explore the ethical teachings of non-Semitic religions such as Buddhism, Sikhism, Confucianism, and Jainism.
4. Develop critical thinking skills to evaluate ethical arguments and theories.
5. Promote ethical leadership and interfaith harmony.

**3- Learning Outcomes**

By the end of this course, students will be able to:

1. Identify and analyze major ethical theories and teachings from world religions.
2. Understand the role of religions in improving moral values and social behavior.
3. Demonstrate ethical decision-making in various personal and professional contexts.
4. Recognize the impact of ethical decisions on individuals, communities, and society.
5. Apply skills of ethical leadership, including communication, conflict resolution, and inclusive engagement.

**4-Course Structure**

1. Interactive lectures, Group discussions and debates
2. Reflection papers and presentations
3. Assignments and Quiz

~~Course Title: Ethics-II (For Non-Muslim Students) Course Code: URGC-5130~~ X

## Course Contents

**Unit 1: Ethical Teachings of Semitic Religions**

- Judaism and its ethical teachings
- Christianity and its ethical teachings
- Islam and its ethical teachings

**Unit 2: Ethical Teachings of Non-Semitic Religions**

- Hinduism and its ethical teachings
- Sikhism and Buddhism: ethical values and practices
- Confucian and Jain ethical traditions

**Unit 3: Professional Ethics**

- Ethics for students and teachers
- Ethics in doctor–patient relationships
- Ethics in trader–customer interactions

**Unit 4: Concept and Significance of Tolerance**

- Definition, need, and importance of tolerance
- Teachings of Semitic religions on tolerance and their contemporary relevance
- Teachings of non-Semitic religions on tolerance and their contemporary relevance

**Unit 5: Foundational Values and Ethics for Peacebuilding in Society**

- Respect for sacred scriptures, personalities, places of worship, and religious symbols
- Promotion of tolerance and broadmindedness
- Encouragement of dialogue and harmony
- Benevolence towards humanity
- Establishment of justice and fairness
- Patience, forbearance, and forgiveness

**Textbook**

- Kidder, R. M. (2009). *How Good People Make Tough Choices: Resolving the Dilemmas of Ethical Living*. Harper.

**Suggested Readings**


1. Barash, D. P., & Webel, C. P. (2014). *Peace and Conflict Studies*. Sage.
2. Smart, N. (1998). *The World's Religions*. Cambridge University Press.
3. Nasr, S. H. (2003). *The Heart of Islam: Enduring Values for Humanity*. HarperOne.
4. Sharma, A. (2006). *Hindu Ethics: Purity, Abortion, and Euthanasia*. SUNY Press.
5. Harvey, P. (2000). *An Introduction to Buddhist Ethics: Foundations, Values and Issues*. Cambridge University Press.
6. Coward, H., & Perkinson, J. (2013). *A Cross-Cultural Dialogue on Ethical Leadership*. Wilfrid Laurier University Press.
7. Confucius. (1998). *The Analects*. Oxford University Press.