

**MAHARSHI DAYANAND UNIVERSITY ROHTAK**  
**DEPARTMENT OF ZOOLOGY**  
**M. Sc. ZOOLOGY w.e.f. session 2012-13**  
**Semester-II**

**Course no.: Zoo -201**

**MM: 80**

**Course Title: Developmental Biology**

**Time: 3hrs**

Note: There shall be nine questions in total. One question is compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

**Unit I**

Animal development:  
Developmental patterns in metazoans  
Development in unicellular eukaryotes  
Molecular basis of spermatogenesis  
Oogenesis

**Unit II**

Molecular basis of multicellularity:  
Fertilization  
Cleavage types and significance  
Comparative account of Gastrulation  
Fate maps

**Unit III**

Early vertebrate development:  
Neurulation and ectoderm  
Mesoderm and endoderm  
Cytoplasmic determinants and autonomous cell specification:  
Cell commitment and differentiation  
Cell specification in nematodes  
Germ cell determinants  
Germ cell migration  
Progressive cell - Cell interaction and cell specification fate

**Unit IV**

Genetics of pattern formation  
*Caenorhabditis*: Vulva formation  
*Drosophila*:  
Maternal genes and formation of body axis  
Segmentation genes  
Homeotic genes function  
Imaginal disc development  
Vertebrates  
Axes formation and HOX genes  
Limb formation in chick  
Proximate tissue interactions  
Genetics of axis specification in *Drosophila*  
Tetrapod limb and eye development

**Suggested Reading Material**

1. S.F. Gilbert. Developmental Biology. Sinauer Associates Inc., Massachusetts.
2. Ethan Bier. 'The Coild Spring'. Cold Spring Harbor Laboratory Press, New York.
3. Sastry KV and Shukla V. Text Book of Development Zoology, Rastogi Publication, Meerut

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**Semester-II**

**Course no.: Zoo-202**

**MM: 80**

**Course Title: Advanced Physiology**

**Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

**Unit I**

Digestive system:  
Feeding mechanisms and regulation  
Physiology of mammalian ingestion, digestion, absorption, assimilation and egestion;  
Dentition in mammals

**Unit II**

Respiratory system:  
Respiratory organs and respiratory pigments;  
Control of respiration;  
Structure of heart and blood vessel;  
Circulation and composition of body fluids and their regulation;  
Blood coagulation.

**Unit III**

Excretion and osmoregulation:  
Patterns of nitrogen excretion among different animal groups;  
Physiology of excretion;  
Osmoregulation in different mammalian groups;

**Unit IV**

Muscle and Receptor physiology:  
Receptor physiology -  
Mechanoreception  
Photoreception  
Chemoreception  
Equilibrium reception  
Muscles: structure and function;  
Neuromuscular transmission and nerve conduction.

**Suggested Reading Material**

1. Eckert, R. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman and Company, New York.
2. Hochachka, P.W. and Somero, G.N. Biochemical Adaptation. Princeton, New Jersey.
3. Hoar, W.S. General and Comparative Animal Physiology, Prentice Hall of India.
4. Schiemdt Nielsen. Animal Physiology: Adaptation and Environment. Cambridge.
5. Strand, F.L. Physiology: A regulatory Systems Approach. Macmillan Publishing Co., New York.
6. Pummer, L. Practical Biochemistry, Tata McGraw-Hill.
7. Prosser, C.L. Environmental and Metabolic Animal Physiology. Wiley-Liss Inc., New York.
8. Willmer, P.G. Stone, and I. Johnston. Environmental Physiology. Blackwell Sci. Oxford, UK, 644pp.
9. Newell, R.C. (ed.) 1976. Adaptation to environment. Essays on the physiology of marine animals. Butterworths, London, UK, 539pp.
10. Townsend, C.R. and P. Calow. Physiological Ecology: An evolutionary approach to resource use. Blackwell Sci. Publ., Oxford, UK.
11. Alexander, R.M.N. Optima for animals. Princeton Univ. Press, Princeton, NJ.
12. Johnston, I.A., & A.F. Bennett (eds.). Animals and Temperature: Phenotypic and evolutionary adaptation. Cambridge Univ. Press, Cambridge, UK.
13. Louw, G.N. Physiological animal ecology. Longman Harlow, UK.
14. Sastry KV and Shukla V. Text Book of Physiology and Biochemistry, Rastogi Publication, Meerut

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**Semester-II**

**Course no.: Zoo -203**

**MM: 80**

**Course Title: Molecular Biology**

**Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

**Unit I**

History and Scope of Molecular Zoology

DNA replication: Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, Enzymes and accessory proteins involved in DNA replication

**Unit II**

Transcription: Prokaryotic and Eukaryotic transcription; RNA polymerases; General and specific transcription factors; Regulatory elements and mechanisms of transcription regulation

Post-transcriptional modifications in RNA: 5'-Cap formation; Transcription termination; 3'-end processing and polyadenylation; Splicing, Editing; Nuclear export of mRNA; mRNA stability and Transcriptional and post-transcriptional gene silencing.

**Unit III**

Translation: Prokaryotic and eukaryotic translation; The translational machinery; Mechanisms of initiation, elongation and termination; Regulation of translation; Genetic code and Co- and post-translational modifications of proteins

**Unit IV**

Recombination and repair: Holiday junction, gene FLP/FRT and Cre/lox recombination; RecA and other recombinases and DNA repair mechanisms.

Biomaterials and their significance

**Suggested Reading Material**

1. Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. The Benjamin/Cummings Pub. Co., Inc., California.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA.
3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
4. Gene VI, Benjamin Lewin, Oxford University Press, U.K.
5. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.), VCH Publishers, Inc., New York.
6. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
7. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York.
8. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford

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**Semester-II**

**Course no.: Zoo -204**

**MM: 80**

**Course Title: Cell Function and Metabolic Regulation**

**Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

**Unit I**

Structure of atoms, molecules and chemical bonds;  
Energy metabolism (concept of free energy); Thermodynamic principles in biology; Energy rich bonds;  
Weak interactions; Coupled reactions and oxidative phosphorylations; Group transfer; Kinetics, dissociation and association constants; Biological energy transducers; Bioenergetics and steady-state conditions of living organisms.

Degradation of palmitic acid, phenylalanine, tryptophan and nucleotides in animals.

**Unit II**

Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Interconversion of hexoses and pentoses.

Energy metabolism and high energy compounds:

Redox potentials

Mitochondrial electron transport chain

Oxidative phosphorylation

**Unit III**

Storage and utilization of biological energy

Biosynthesis of triglycerides; Cholesterol; Phospholipids; Prostaglandins; Sterols.

Biosynthesis of urea, proline, aspartic acid, Uridylic acid, adenylic acid, glucose, glutathione.

**Unit IV**

Classification and nomenclature of enzymes; Regulation of enzymatic activity; Active sites; Coenzymes:

Activators and inhibitors, isoenzymes, allosteric enzymes; Ribozyme and abzyme.

Enzyme Kinetics (negative and positive cooperativity);

Metabolic engineering;

Immobilised enzymes and their applications.

**Suggested Reading Material**

1. D. Voet and J.G. Voet. Biochemistry, J. Wiley & Sons.
2. R.L. Foster, Nature of Enzymology.
3. Lodish et al. Molecular Cell Biology.
4. Annual Reviews of Biochemistry.
5. Garrett and Grisham, Biochemistry.

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**Semester-II**

**Course no.: Zoo-205 (i)**

**MM: 80**

**Course Title: Evolutionary Biology (Programme elective)**

**Time:**

**3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

**Unit I**

Genetics of speciation and Molecular Evolution:  
Phylogenetic and biological concept of species  
Patterns and mechanisms of reproductive isolation  
Models of speciation (Allopatric, sympatric, parapatric)  
Gene Evolution  
Evolution of gene families

**Unit II**

Origin of theories of life  
Phylogenetic gradualism and punctuated equilibrium  
Major trends in the origin of higher categories  
Micro-and Macro-evolution

**Unit III**

Molecular phylogenetics:  
How to construct phylogenetic trees?  
Phylogenetic inference- Distance methods, parsimony methods.  
Immunological techniques  
Amino acid sequences and phylogeny  
Nucleic acid phylogeny-DNA-DNA hybridizations, Nucleotide sequence comparisons and homologies  
Molecular clocks

**Unit IV**

Metapopulations  
Monitoring natural populations  
Why small populations become extinct?  
Loss of genetic variations  
Conservation of genetic resources

**Suggested Reading Material**

1. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
2. Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
3. Futuyama, D.J. Evolutionary Biology, Sinauer Associates, INC Publishers, Dunderland.
4. Haldane, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
5. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
6. King, M. Species Evolution-The role of chromosomal change. The Cambridge University Press, Cambridge.
7. Merrel, D.J. Evolution and Genetics. Holt, Rinehart and Winston, Inc.
8. Smith, J.M. Evolutionary Genetics. Oxford University Press, New York.
9. Strickberger, M.W. Evolution. Jones and Bartlett Publishers, Boston London

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**Semester - II**

**Course no : Zoo -205 (ii)**

**MM: 80**

**Course Title: Animal Biotechnology (Programme elective)**

**Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

**Unit I**

Cell and tissue culture in animals: Media preparation and sterilization; Inoculation and growth monitoring; Biochemical mutants and their use; cell harvesting methods; Primary culture; Cell line; Cell clones; Cell proliferation measurements and Cell viability testing; Micropropagation; Haploidy; Protoplast fusion and somatic hybridization; Cybrides.

**Unit II**

Principles and methods of genetic engineering and Gene targeting; Applications in agriculture, health and industry.

Antisense and Ribozyme technology: Molecular mechanisms of antisense molecules; Inhibition of splicing, polyadenylation and translation; Disruption of RNA structure and capping; Biochemistry of ribozyme; hammerhead, hairpin and other ribozymes; Strategies for designing ribozymes; Application of antisense and ribozyme technologies

**Unit III**

Biochemistry and molecular biology of cancer; Genetic and metabolic disorders; Hormonal imbalances. Drug metabolism and detoxification; Genetic load and genetic counseling. Gene transfer methods in animals; Transgenic biology; Allopheny; Hybridoma technology.

**Unit IV**

Industrial processes: Production of organic acids, amino acids, proteins, antibiotics and pharmaceuticals  
Bioreactors: designing and operation  
An introduction to Genomics, Proteomics, Computational Biology, Biosensors, Biofuels & Biopesticides.

**Suggested Reading Material**

1. Brooker, R.J. Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc.
2. Fairbanks, D.J. and W.R. Anderson. Genetics - The Continuity of Life. Brooks/Cole Publishing Company ITP, NY, Toronto.
3. Griffiths, A.J.F., J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart. An introduction to genetic analysis. W.H. Freeman and Company, New York.
4. Lewin, B. Genes. VII. Oxford University Press, Oxford, New York, Tokyo.
5. Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. Molecular Biology of Genes. The Benjamin/Cummings Publishing Company Inc., Tokyo.

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**Semester- II**

**Course no.: Zoo-LC-II**

**150**

**Course Title : Laboratory Course**

**6 Hrs.**

**M.M. :**

**Time :**

**List of the proposed experiments**

- Media preparation and sterilization
- Inoculation and growth monitoring
- Animal tissue culture
- Plasmid isolation
- Restriction digestion
- Ligation
- Genomic DNA extraction
- Analysis of isozymes/ proteins on SDS page
- To dissect out *Drosophila* larvae to prepare the polytene chromosome slide and arm identification
- To prepare the permanent slide of insect larvae and its study
- To dissect out *Drosophila* larvae and to take out the imaginal discs
- To study the effect of temperature on life cycle of *Drosophila melanogaster*
- To study different developmental stages with the help of charts
- To study the effect of varying pH on salivary amylase
- To determine the effects of varying temperatures on the activity of salivary amylase
- To study the rate of respiration by aquatic animals
- To determine the concentration of free CO<sub>2</sub> in variety of given samples
- Determination of dissolved O<sub>2</sub> of given samples by Wrinklers method
- Isolation of monocytes
- To study hematological parameter in blood
- To study the effect of osmolarity of solution on RBC
- To study the knee jerk reflex in man
- To test the urine for urea, proteins, ketones and sugar
- Separation and identification of amino acids by vertical paper chromatography
- Separation and identification of amino acids by radial chromatography
- To separate and identify the sugar by thin layer chromatography
- To perform extraction of nucleic acids
- To perform isolation of DNA
- To separate DNA sample by agarose gel electrophoresis
- To perform western blotting to analyse the given protein sample
- DNA gel extraction
- To determine the protein concentration in the given albumin by Biuret method
- To plot the calibration curve for glucose with the help of spectrophotometer
- Qualitative estimation of salivary amylase
- To investigate the effect of temperature on enzyme catalysed reaction
- To investigate the effect of varying pH on the activity of salivary amylase
- Quantitative estimation of protein, glucose, DNA and RNA
- Purification of carbohydrates/protein /lipids by column chromatography
- To prepare the phylogenetic tree
- To study genetic variability with the help of thumb impression (Dermatography)
- To determine the T<sub>m</sub> of the DNA sample
- To test the genetic variability by PTC test
- To study genetic variability in human population
- To show reproductive isolation in *Drosophila* species

- To perform Immunelectrophoresis
- To perform Countercurrent Immunelectrophoresis
- Wild life/ conservation report

