

DEPARTMENT OF ZOOLOGY
Credit matrix for M.Sc. Zoology programme w.e.f. 2015-16

Semester	Core paper (C)	Soft core Elective (E)	Foundation (F)	Open elective (OE)	Dissertation/Project Work(D)/Seminar(S)	Total
I	30	-	-	-	01	31
II	24	6	2	2	-	34
III	24	6	-	-	01	31
IV	08	-	-	-	20	28
TOTAL	86	12	2	2	22	124

REQUIRED CREDITS FOR M.SC ZOOLOGY (TWO YEAR COURSE):

CORE PAPER	=86
SOFT CORE	=12
OPEN ELECTIVE	=2
FOUDATION COURSE	=2
DISSERTATION	=20
TOTAL	=124

INSTRUCTION FOR THE STUDENTS

Course Types:

- **Hard Core (C):-** There are Core Courses in every semester. These courses are to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.
- **Soft Core Elective (E):-** Soft core is a course which can be chosen from a pool of papers. It will be supportive to the discipline of study & mandatory as per course curriculum.
- **Foundation Course (F):-** The Foundation Course is based upon the content that leads to Knowledge enhancement. It is mandatory as per course curriculum.
- **Interdisciplinary Course/Open Elective (OE):-**Open elective course may be from an unrelated discipline. It is Interdisciplinary/Open Elective & mandatory as per course curriculum.

DEPARTMENT OF ZOOLOGY
Choice Based Credit System (CBCS)
Scheme of Examination (M.Sc. - Zoology) w.e.f. session 2015-16

SEMESTER I						
Course No.	Nomenclature of Paper	Credit	Hours	MM (Max Marks)	IA (Internal Assessment)	TM (Total marks)
Core Papers						
Zoo-101C	Animal Biochemistry and metabolism	4	4	80	20	100
Zoo-102C	Techniques in Animal Science	4	4	80	20	100
Zoo-103C	Animal Cell Biology	4	4	80	20	100
Zoo-104C	Immunology	4	4	80	20	100
Zoo-105C	Advanced Physiology	4	4	80	20	100
Zoo-106 S	Seminar	1	1	50	-	50
Zoo-107 LC	Lab Course (Zoo-101-105C)	10	20	150	-	150
	Total	31		600	100	700
SEMESTER II						
Course No.	Nomenclature of Paper	Credit	Hours	MM	IA	TM
Core Papers						
Zoo-201C	Developmental Biology	4	4	80	20	100
Zoo-202C	Evolutionary Biology	4	4	80	20	100
Zoo-203C	Molecular Biology	4	4	80	20	100
Zoo-204C	Biology of Invertebrates	4	4	80	20	100
Soft Core Elective Papers						
Zoo-205E	Parasitology	4	4	80	20	100
Zoo-206E	Entomology	4	4	80	20	100
Zoo-207E	Biostatistics and Computer	4	4	80	20	100
Zoo-208E	Wildlife and Conservation	4	4	80	20	100
Interdisciplinary Open elective paper						
Zoo-209 OE	Applied Zoology	2	2	80	20	100
Foundation course						
Zoo-210F	Communication Skills	2	2	80	20	100
Zoo-211LC	Lab Course (Zoo 201-204C & 205/6/7/8E)	10	20	150	-	150
	Total	34		710	140	850
SEMESTER III						
Course No	Nomenclature of Paper	Credit	Hours	MM	IA	TM
Core Papers						
Zoo-301C	Biology of Vertebrates	4	4	80	20	100
Zoo-302C	Molecular Endocrinology	4	4	80	20	100
Zoo-303C	Molecular Cytogenetics	4	4	80	20	100
Zoo-304C	Environmental Biology	4	4	80	20	100
Soft Core Elective Papers						
Zoo-305E	Animal Behavior And Taxonomy	4	4	80	20	100
Zoo-306E	Aquaculture	4	4	80	20	100
Zoo-307E	Biology of Population	4	4	80	20	100
Zoo-308S	Seminar	1	1	50	-	50
Zoo-309LC	Lab Course (Zoo-301-304C & 305/6/7E)	10	20	150	-	150
	Total	31		600	100	700
SEMESTER IV						
Course No	Nomenclature of Paper	Credit	Hours	MM	IA	TM
Core Papers						
Zoo-401C	Biosafety & Ethics in Science	4	4	80	20	100
Zoo-402C	Fundamental of Vermiculture	4	4	80	20	100
Zoo-403D	Dissertation/Project report	20	40	300	-	300
	Total	28		460	40	500
GRAND TOTAL		130		2370	380	2750

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M.Sc. ZOOLOGY w.e.f. session 2015-16

Semester-I

Course no.: Zoo-101C

MM: 80

Course Title: Animal Biochemistry And Metabolism

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

Biomolecular foundations of biology:

pH, pK, acids, bases, buffers, Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction) , Structure of soluble biomolecular pool of cells – aminoacids and peptides; monosaccharides, oligosaccharides and polysaccharides; nucleotides, vitamins and Lipids

Unit II

Proteins Structure -primary, secondary, tertiary and quaternary. Lysozyme and Carboxypeptidase. Conjugated proteins-structure and functions. Analysis of proteins: Western blotting; Reverse turns and Ramachandran plots, Nucleic acids: - types, structural and conformation of nucleic acids, Physicochemical techniques and macromolecular analysis,

Unit III

Energy metabolism (concept of free energy); Thermodynamic principles in biology, group transfer; dissociation and association constants; Biological energy transducers, Degradation of palmitic acid, phenylalanine, tryptophan and nucleotides. Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Interconversion of hexoses and pentoses. Energy metabolism and high energy compounds: mitochondrial electron transport chain, Oxidative phosphorylation & coupled reactions.

Unit IV

Biosynthesis of triglycerides; Biosynthesis of urea, proline, aspartic acid, Uridylic acid, adenylic acid, . Classification and nomenclature of enzymes; Regulation of enzymatic activity; Coenzymes: Activators and inhibitors, isoenzymes, allosteric enzymes; Ribozyme and abzyme, Enzyme Kinetics (negative and positive cooperativity), Immobilised enzymes and their applications.

List of Recommended Books

1. D.Voet and J.G. Voet. Biochemistry, John Wiley & Sons.
2. D. Freifelder. Physical Biochemistry, W.H. Freeman & Company
3. I.H. Segal. Biochemical Calculations, John Wiley & Sons.
4. T.E. Creighton. Proteins-structure and Molecular Properties, W.H. Freeman & Company.
5. D. Freifelder, Essentials of Molecular Biology.
6. K. Wilson and K.H. Goulding. A Biologist's guide to principles and techniques of practical biochemistry.
7. T.G. Cooper. Tools of Biochemistry.
8. Hawk. Practical Physiological Chemistry.
9. R.H. Garrett and CM. Grisham. Biochemistry, Saunders College Publishers.

**MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY**

M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-I

Course no.: Zoo-102C

MM: 80

Course Title: Techniques in Animal Sciences

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

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanning and transmission electron microscopes. X-ray diffraction, pH meter, Fixation and staining; cryotechnology and flow cytometry, Confocal Microscopy.

Units II

Spectroscopy: Fluorescence, UV, visible, NMR and ESR spectroscopy; X-ray diffraction. Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography, GCMS spectroscopy.

Unit III

Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC). Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).

Unit IV

Molecular biology techniques: Sequencing of proteins and nucleic acids; southern, northern and western blotting techniques, polymerase chain reaction (PCR), ELISA, MALDITOF. Methods for measuring nucleic acid and protein interactions, Real time PCR and reverse transcriptase PCR.

List of Recommended Books

1. Animal Cell Culture - A practical approach, Ed. John R.W. Masters, IRL Press.
2. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Editions.
3. Shukla and Upadhyaya. Experimental Science
4. Randhir Singh. Practicals in Biochemistry
5. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.H. Goulding, ELBS Edn.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-I

Course no.: Zoo -103C

Course Title: Animal Cell Biology

MM: 80

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 pro-and eukaryotic cells; Structure and function of cells and intracellular organelles of both prokaryotes and eukaryotes); Significance of intracellular compartments;
Structure of nucleus; Genetic analysis in Cell Biology: Nucleus; Mitochondria and chloroplasts and their genetic organization; Evolution of aerobic respiration.

Unit II

Biomembranes: Molecular composition and arrangement functional consequences; Model membranes; Liposomes. Transport across cell membrane-Diffusion, active transport and pumps, uniports, symports and antiports; Membrane potential; Co-transport by symporters or antiporters; Transport across epithelia.
Cytoskeleton: Microfilaments and microtubules-structure and dynamics; Microtubules and mitosis; Cell movements-intracellular transport, role and kinesin and dynein; Cilia and Flagella

Unit III

Cell-Cell signaling:
Signal transduction mechanisms;
Cell surface receptors;
Second messenger system;
MAP kinase pathways;
Cell-cell interaction.
Cell-Cell matrix, adhesion and communication
Ca⁺⁺ dependent & independent homophilic cell-cell adhesion; Gap junctions and connexins
Cell matrix adhesion: Integrins, Collagen, Non-collagen components & Cellulose fibril synthesis and orientation

Unit IV

Cell cycle: Mechanism of cell division including (mitosis and meiosis) and cell differentiation Cyclins and cyclin dependent kinases and Regulation of CDK-cyclin activity;
Biology of cancer, Biology of aging and Apoptosis-definition, mechanism and significance

List of Recommended Books

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson. Garland Publishing Inc., New York.
3. Cell and molecular biology Phillip Sheeler, Donald E. Bianchi Wiley, 1987

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-I

Course no.: Zoo-104C

Course Title: Immunology

MM: 80

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

Innate and adaptive immune system
Cells and molecules involved in innate and adaptive immunity,
Effector mechanisms in immunity
Antigens, antigenicity and immunogenicity.
B and T cell epitopes,
Structure and function of antibody molecules,
Generation of antibody diversity,

Unit II

Monoclonal antibodies,
Antibody engineering,
Antigen-antibody interactions,
MHC molecules,
Antigen processing and presentation,
Activation and differentiation of B and T cells,

Unit III

B and T cell receptors,
Humoral and cell-mediated immune responses,
Primary and secondary immune modulation,
The complement system,
Toll-like receptors,
Cell-mediated effector functions

Unit IV

Inflammation,
Hypersensitivity
Autoimmunity,
Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, Congenital
Acquired immunodeficiencies,
Vaccines.

List of Recommended Books

1. Kuby. Immunology, W.H. Freeman, USA.
2. W. Paul. Fundamentals of Immunology.
3. Tatora et al. Microbiology
4. Pelczar. A text book of microbiology
5. I.M. Roitt. Essential Immunology, ELBS Edition.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-I

Course no.: Zoo-105C

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.

List of Recommended Books

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 Harloss, UK.
14. Sastry KV and Shukla V. Text Book of Physiology and Biochemistry, Rastogi Publication, Meerut

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester- I

Course no.: Zoo-107 LC

Course Title: Laboratory Course

M.M.: 150

Time: 6 Hrs.

List of Practicals

1. To separate and identify sugar by TLC
2. To prepare casein from milk
3. To plot the calibration curve for protein estimation by Lowry method
4. To plot standard curve for estimation of carbohydrate by anthrone method
5. Estimation of creatinine in blood
6. Colorimetric estimation of DNA and RNA
7. Separation and identification of amino acids by paper chromatography
8. To test the urine for urea, proteins, ketones and sugar
9. To determine the protein concentration in the given albumin by Biuret method
10. Qualitative estimation of salivary amylase
11. To investigate the effect of temperature on enzyme catalysed reaction
12. To investigate the effect of varying pH on the activity of salivary amylase
13. To study the principle, working and applications of Phase Contrast Microscope.
14. To study the principle, working and applications of Fluorescence Microscope
15. To study the principle, working and applications of Transmission Electron Microscope
16. To prepare wax blocks of biological material for light microscopy
17. To prepare permanent slides from wax blocks and their staining
18. To perform spectrophotometric measurement of glucose (Bradford method)
19. To isolate Genomic DNA by cTAB method
20. To perform PCR for a given sample
21. To perform western blotting to analyse the given protein sample
22. Numericals on half life of radioactive isotopes
23. To study the rate of respiration by aquatic animals
24. To determine the concentration of free CO₂ in variety of given samples
25. Determination of dissolved O₂ of given samples by Wrinklers method
26. Isolation of monocytes
27. To study the effect of osmolarity of solution on RBC
28. To study the knee jerk reflex in man
29. To find the blood group of own blood
30. To find the Rh factor of own blood group
31. To estimate the amount of Hb present in human blood
32. To estimate the TLC present in 1mm³ volume
33. To estimate the RBC present in 1mm³ volume
34. Quantitative assay of precipitation
35. Haemagglutination test
36. To perform gel chromatography for analysis of given sample
37. Separation of molecules using ion exchange chromatography
38. Separation and identification of amino acids by radial chromatography
39. To study different stages of mitosis in onion root tips
40. To perform protein estimation test with the help of Bradford method

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo -201C

Course Title: Developmental Biology

MM: 80

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

Developmental patterns in metazoans; Development in unicellular eukaryotes;
Molecular basis of spermatogenesis, Oogenesis and fertilization

Unit II

Cell fate and Cell lineages; Stem cells; Cleavage types and significance;
Blastula; Fate maps; Comparative account of Gastrulation
Neurulation and ectoderm; Mesoderm and endoderm

Unit III

Cytoplasmic determinants, Cell commitment, specification, induction,
competence, determination and differentiation, Cell specification in nematodes
Germ cell determinants, Germ cell migration, Cell-Cell interaction,
Mutants and transgenics in analysis of development

Unit IV

Caenorhabditis: Vulva formation
Genetics of axis specification in *Drosophila*, *amphibia* and *chick*
Eye lens induction, limb development and regeneration in vertebrates,
Differentiation of neurons, HOX genes, Larval formation,
Metamorphosis, Environmental regulation of normal development,
Sex determination

List of Recommended Books

- 1.S.F. Gilbert. Developmental Biology. 8th Edition Sinauer Associates Inc., Massachusetts.
- 2.L. Wolpert et. al. Principles of Development; Oxford University Press; 2002
- 3.Jonathan M. W. Slack. Essential Developmental Biology, 3rd Edition. 2012, Wiley-Blackwell
- 4.L. W. Browder et. al. Developmental Biology, 3rd Edition; Saunders College Publishing, Philadelphia ISBN 0-03-013514-1
- 5.T. Subramonium. Molecular Developmental Biology, 2nd Edition, 2013. Narosa Publishing House
- 6.Ethan Bier. 'The Coild Spring'. Cold Spring Harbor Laboratory Press, New York.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo-202C

Course Title: Evolutionary Biology

MM: 80

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

Emergence of evolutionary thoughts and mechanisms:

Lamarck; Darwin's concepts of variation,

Adaptation, struggle, fitness and natural selection;

Mendelism; spontaneity of mutations; the evolutionary synthesis.

Unit II

Origin of cells and unicellular evolution:

Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers;

Concept of Oparin and Haldane; experiment of Miller (1953); the first cell;

Evolution of: unicellular eukaryotes; prokaryotic and eukaryotic cells

Unit III

Paleontology and evolutionary history:

The evolutionary time scale; Eras, periods and epoch;

Major events in the evolutionary time scale;

Origins of unicellular and multicellular organisms;

Stages in primate evolution including Homo

Unit IV

Molecular Evolution:

Concepts of neutral evolution,

Molecular divergence and molecular clocks;

Molecular tools in phylogeny, classification and identification;

Protein and nucleotide sequence analysis;

Origin of new genes and proteins;

List of Recommended Books

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, Sunderland.
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.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo -203C

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; 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 ; the signal hypothesis.

Unit IV

Recombination and repair: Holiday junction, excision repair; RecA and other recombinases and DNA repair mechanisms. Biomaterials and their significance.

List of Recommended Books

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

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo-204 C
Course Title: Biology of Invertebrate

MM: 80
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

Salient Features and classification up to classes with reference to diversity in animal form and function of Protozoa, Porifera,

General account: Aquiferous and skeleton system in Porifera;

Unit II

Salient Features and classification up to classes with reference to diversity in animal form and function of Colenterata, Helminthes, Nematodes,

General account: Polymorphism in cnidarians; parasitic adaptations in helminthes; Larval form and their significance.

Unit III

Salient Features and classification up to classes with reference to diversity in animal form and function of Annelid, Arthropoda,

General account: Larval form and their significance in Arthropoda

Unit IV

Salient Features and classification up to classes with reference to diversity in animal form and function of Mollusca, Echinodermata

General account: Larval form and their significance in Echinodermata; Coelom; Torsion and detorsion in Mollusca; Ambulacral system

List of Recommended Books

1. Kettle, D.S: Medical Veterinary Entomology (CAB International).
2. Boolotian and Stiles: College Zoology (Macmillan)
3. Campbell: Biology (Benjamin)
4. Marshall and Williams: Text Book of Zoology
5. Wolfe: Biology the Foundations (Wadsworth)'
6. Parker & Haswell: Text Book of Zoology Vol.II (Macmillan)
7. Prescott: Cell (Jones & Bartlett).
8. M.Kato. The Biology of Biodiversity, Springer.
9. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
E.O. Wilson. Biodiversity, Academic Press, Washington.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo -205 E
Course title: Parasitology

MM: 80
Time: 3 Hrs

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

Introduction to Parasitology; Host parasite associations (Symbiosis, commensalism, phoresis, mutualism etc); parasite hosts and co-evolution of parasites and their hosts, advantages and limitations of parasitic life style. Factors contributing Parasitism.

Unit II

Morphology, lifecycle, mode of infection of *Plasmodium* and *Leishmania*, molecular biology of *Plasmodium* and *Leishmania* – drug targets, mechanism of drug resistance, vaccine strategies. Morphology, biology, life-cycle, mode of infection of *Entamoeba* and *Giardia*.

Unit III

Gastro-intestinal nematodes, morphology, biology, life-cycles, modes of entry of *Schistosoma*, *Wuchereria*, *Brugia*, *Ancylostoma*, *Trichinella* and *Dracanculus*; molecular biology of nematodes.

Unit IV

Immune response and self-defense mechanisms, immune evasion and biochemical adaptations of parasites; Useful parasites: in maintaining healthy immune system and biological control.

List of Recommended Books

1. Parasitology – an integrated approach. Alan Gunn and Sarah J. Pitt, Wiley-Blackwell
2. Foundations of Parasitology, Roberts L.S. and Janovy J., McGraw-Hill Publishers, New York, USA.
3. Modern Parasitology: A Textbook of Parasitology, FEG Cox., Wiley-Blackwell, U. K.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo- 206E
Course Title: Entomology

MM: 80
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

Classification and diagnostic features of insects.

Insect Predation and parasitism

Insect societies: Subsociality in insect; Eusociality in insect (Colony and Castes in Hymenoptera and Isoptera); Evolution of eusociality.

Insect defense.

Unit-II

Metamorphosis: Types and Hormonal control

Diapause: diagnosis, ecological causes and its role

Mounting of insects

Unit-III

Digestive system: Alimentary canal: Digestion (Including unusual food materials); Absorption; Nutrition.

Circulatory system: Circulatory organs; Haemolymph; circulation of blood; Immune system

Respiratory system: Tracheal system, Spiracles; Gaseous exchange; Respiration in aquatic and endoparasitic insects.

Excretory system: Malpighian tubules; Nitrogenous excretion; Urine production; fat body and other haemocoelic tissues.

Unit-IV

Reproductive system: male and female reproductive organs; Spermatozoa and sperm transfer; ovulation and fertilization; types of reproduction.

Nervous system: Central nervous system (brain in brief); sympathetic nervous system; Controlling behaviour.

Endocrine system: Endocrine glands; Major hormones; Regulation of hormone titer; Mode of action of hormones.

Sensory system and behavior: Mechanical stimuli; Sound reception and sound production; Chemical stimuli;

Semiochemicals-Pheromones, Kairomones allomones and synomones: Insect vision.

List of Recommended Books

1. The Insect-Structure and Function. - by R.F. Chapman.
2. Imm's General Text Book of Entomology –by O.W. Richards and R.G. Davies.
3. The Insect an outline of Entomology- by P.G. Gullan and P.S. Cranston.
4. A Text Book Of Insect Studies by Dr.Shashi Kanta
5. Diapause in Aquatic Invertebrates: Theory and Human Use- Victor R. Alekseev, Bart Thomas De Stasio, John Gilbert - 2007

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo- 207E
Course Title: Biostatistics and Computer

MM: 80
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

Collection, classification and tabulation of data. Frequency distribution, Diagrammatic and Graphical presentation of statistical data, Sampling techniques. Central tendency, Dispersion, coefficient of variation; Standard error; Confidence limits; Skewness and Kurtosis Measures of Relationship: Correlation, Regression, Non-parametric tests

Unit II

Probability: Approaches to measurement of Probability, Random experiments, sample space, events. Mathematical definition of probability of an event. Probability distributions: - Distribution of Binomial, Poisson and Normal Distributions and their properties; (including problems).

UNIT III

Testing of Hypothesis, Chi-square test, 't' and 'F' test. Analysis of variance for one-way classified data, and two-way classified data.

UNIT IV

Computer peripherals and hardware description- computer system design, recognition and structure of different components of a computer system and their respective usage. Input/output and storage devices. Introduction of internet. Office application: MS office 2000 including MS word, MS excel and MS power point Overview of Windows XP. Number system and flow charts in computing language. DOS internal and external commands. Generations of programming languages, system and application software; Introduction of programming in BASIC.

Suggested Reading Material

1. Batschelet, E. Introduction to mathematics for life scientists. Springer-Verlag, Berlin.
2. Snedecor, G.W. and W.G. Cochran. Statistical methods. Affiliated East-West Press, New Delhi (Indian ed.).
3. Green, R.H. Sampling design and statistical methods for environmental biologists. John Wiley & Sons, New York.
4. Computer fundamentals: concepts, systems and application by PK Sinha. BPB publications
5. Computer fundamentals (Paperback) by Ashok Arora, Shefali Bansai and Shefali Bansal. Excel Books
6. Discovering computers: fundamentals (paperback) by Gary B. Shelly. Pub: Course technology
7. Discovering computers: fundamentals, 4th ed. (Shelly Cashman) (paperback) by Grey B Shelly Thomas J Cashman and Misty E Vermaat. Pub: Course technology
8. Computer fundamentals architecture and organization (paper back) by B Ram. Pub: New age publications (academic)

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-IV

Course no.: Zoo- 208E
Course Title: Wildlife and Conservation

MM: 80
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

Wildlife: Definition, significance and wildlife zones of the world and India, Wildlife Map of the world, Wildlife map of India; Protected Area Systems, Present status of National PA-Systems.

Unit-II

Theory and Practice of Biosphere Reserves of the world: Biosphere Reserves of India. Natural Heritage Sites of the world, Natural Heritage sites in India. Important National Park and Wildlife Sanctuaries of India Wildlife and livelihood; Wildlife and illegal trade & control;

Unit-III

Wildlife Damage, its nature and definition, electric fences for wildlife damage control, Basic electric fence design, Trench design, line trapping, Mist netting, Rocket netting Chemical capture: Equipment, Drugs, Plan of operation. Poaching: Its definition and implications, conducting anti-poaching operations, Evidence in poaching cases.

Unit-IV

Wildlife conservation techniques, role of WWF, IUCN, UNEP, Red Data Book; Categories of Endangered Wildlife Species. A brief analysis of Avian and Mammalian fauna of the Indian Subcontinent and World. National Projects: Project Tiger, Project elephant, Project Rhinoceros, Project Crocodiles

List of Recommended Books

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services, L.P., 487/42-SOL Wattenslip, Pratum Bangkok, 10400, Thailand
3. Ali, S. Ripley S.D. Handbook of Birds of India, Pakistan 10-Vols. Oxford University Press, Bombay.
4. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
5. Wildlife in India by V.B. Saharia Natraj Publishers, Dehradun.
6. E.P. Gee, The Wildlife of India.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo- 209 OE
Course Title: Applied Zoology

MM: 80
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

Common parasites and pathogens of humans, domestic animals and crops

- Viral-Rabies,
- Japanese encephalitis;
- Bacterial- Brucellosis, Plague;
- Rickettsial- Rickettial zoonosis, Q fever, Scrub typhus

Common parasites and pathogens of domestic animals

Common parasites and pathogens of crops

Unit-II

Piggery industry

Dairy industry

Bioresources

Uses of Biodiversity

Wool and fur industry,

Leather industry.

Pharmaceuticals from animals.

List of Recommended Books

1. Dent, D. Insect Pest Management
2. Hill, D.S., Timber Press. Agricultural Entomology
3. David, B. V. & Ananthkrishnan. General and Applied Entomology . T. N., Tata McGraw-Hill Publishing.
4. Asa C. Chandler, Clark P. Read, Introduction to Parasitology, John Wiley and Sons., Inc., New York.
5. Thomas W.M. Cameron, Parasites and Parasitism, Billing and Sons Ltd. London,
6. Elmer R. Noble, Glenn A. Noble; Parasitology: The Biology of Animal Parasites, Lea and Febiger, Washington.
7. R.P. Hall, Protozoology, Prentice-Hall, Inc. Englewood Cliffs. N.J. Charles E. Tuttle Company, Tokyo

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-II

Course no.: Zoo- 210 F

Course Title: Communication skills in Life-science

MM: 80

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

Research process- scientific method, Criteria for good research,
Research design- Meaning and need for research design, features of good design.
Paragraph writing: proper use of verb, Nouns, pronouns, tense, use of MS office, excel,
powerpoints for preparing a scientific report.
Mechanical and stylistic aspects of scientific writing- Precision and clarity of language,
Writing style, presentation of numerical data and scientific figures,
Usage of line, bar-graphs, charts to describe the results.

Unit II

Scientific presentation: Preparation and Order of material, Use of web information,
Different ways to make impressive presentations: General gesture for presentations, Speed, loudness, clarity
during presentations, Use of appropriate vocabulary during presentation, General discussion.
Scientific paper and review writing; correspondence with editors and reviewers,
Appropriate citations, copyright and Ethical issues in drafting, Acknowledgment,
Keywords, usage of different softwares for manuscript preparation,

List of Recommended Books

1. Rastogi, B.C., Bioinformatics, Concept, Skills & Applications, CBS Publications.
2. Richard Ellis, Communication Skills: Stepladders to success for professional, Gutenberg Press, Malta.
3. John W. Davis, Communication skills: a guide for engineering and applied science students, Prantics Hall, 2001.
4. Gupta S., Communication skills and Functional Grammar, University Science Press, New Delhi 110002.
5. Lloyd M., Bor R., Communication skills for medicine, Elsevier press, Churchill Livingstone Elsevier.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester- II

Course no.: Zoo-211 LC

Course Title: Laboratory Course

M.M.: 150

Time: 6 Hrs.

List of Practicals

1. To study the various developmental stages of life cycle of *Caenorhabditis elegans* with the help of charts
2. To study the various developmental stages of embryogenesis and life cycle of *Drosophila melanogaster* with the help of charts
3. To study the various developmental stages of life cycle of Frog with the help of charts
4. To study the Mammalian development (Human) with the help of charts
5. To study various developmental stages of chick embryo with the help of the permanent slides.
6. To dissect out *Drosophila* larvae and to take out the imaginal discs
7. Immuno-histochemical staining to study the expression pattern of gap and pair- rule gene proteins.
8. To study and classify representative animal specimen belonging to protozoans to echinodermata with charts and available materials.
9. To study the permanent slides belonging to protozoans to echinodermata
10. To show the dissection of the representative animals like leech, pila and grasshopper for their anatomical studies of various systems with the help of charts and CD.
11. To study the microscopic fauna from various samples
12. To prepare the dichotomous key of the Porifera
13. To prepare the dichotomous key of the Coelenterata
14. To prepare the dichotomous key of the Arthropoda
15. To study the life cycle of parasites: Diagnosis, Identification, Anatomy, Biochemistry, Physiology etc
16. Stages of Evolution of the eukaryotes
17. Stages of Evolution of the prokaryotes
18. Stages of Possible archaean origins of eukaryotic genes.
19. Primate evolutionary tree
20. Human evolutionary tree
21. Study of evolutionary time scale
22. To perform extraction of nucleic acids
23. To perform isolation of DNA
24. To separate DNA sample by agarose gel electrophoresis
25. To perform western blotting to analyse the given protein sample
26. DNA gel extraction
27. Discuss the problems based on central tendency mean, median, mode, geometric mean, range and standard deviation
28. Correlation and regression analysis
29. Graphical representation of data
30. Parametric and non parametric tests
31. Study computer hardware and its parts
32. Application of MS office in interpretation of biological data
33. Programming in BASIC/C
34. Wild life report

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-III

Course no.: Zoo-301C

Course Title: Biology of Vertebrates

MM: 80

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

Introduction to chordates with their general characters:

Origin of chordates

Classifications of vertebrate's upto order

Unit II

Salient Features and classification up to classes with reference to diversity in animal form and function of

Protochordata

Urochordata

Hemichordata

Unit III

Salient Features and classification up to classes with reference to diversity in animal form and function of

Pisces

Amphibia

General account: Dipnoi; Migration of fishes; Parental care in fishes and amphibians;

Unit IV

Salient Features and classification up to classes with reference to diversity in animal form and function, like:

Reptilia

Aves

Mammals

General account: Flight adaptation in birds; Migration of birds. Evolution of Horse and man.

List of Recommended Books

1. Boolotian and Stiles: College Zoology (Macmillan)
2. Campbell: Biology (Benjamin)
3. Marshall and Williams: Text Book of Zoology
4. Wolfe: Biology the Foundations (Wadsworth)
5. Parker & Haswell: Text Book of Zoology Vol.II (Macmillan)
6. Prescott: Cell (Jones & Bartlett).
7. M.Kato. The Biology of Biodiversity, Springer.
8. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
9. E.O. Wilson. Biodiversity, Academic Press, Washington.
10. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company.
11. E. Mayer. Elements of Taxonomy.
12. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
13. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-III

Course no.: Zoo-302C

Course Title: Molecular Endocrinology

MM: 80

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

Definition and scope of endocrinology; Structure of various endocrine glands; Phylogeny of endocrine glands; Hormones: Classification, structure and function; Endocrine control of various physiological mechanisms in nemerteans, annelids, mollusks, arthropods (Insects and crustaceans) and echinodermates. Techniques for quantitation, purification and characterization of hormones.

Unit II

Biosynthesis and secretion of hormones: Biosynthesis of steroid hormones *de novo*; Biosynthesis and amino-acid derived small size hormones (eg:T4, Epinephrine, etc.); Biosynthesis, storage and secretion of protein hormones: Transcriptional and post-transcriptional mechanisms of hormone biosynthesis and secretion; Regulation of biosynthesis and secretion; Inhibitors of hormone biosynthesis and their use.

Unit III

Hormone action and regulation: Hormone receptors - identification, quantitation purification and physico-chemical properties; Membrane receptors - structure and signal transduction mechanisms, G-proteins; Nuclear receptors - structure and function, Orphan receptors; Receptor antagonists and their applications; Metabolic and developmental hormones.

Unit IV

Neuroendocrine regulation: Neuroendocrine regulation of immune system, Stress hormones and immune responses, Regulation of systemic homeostasis by nervous and immune system interactions; Hormones as therapeutic agents: Current developments in design and production of hormonal contraceptives, Recombinant protein hormones-production and application in regulation of fertility in farm animals and humans.

List of Recommended Books

1. Mac E. Hadley, Jon E. Levine. Endocrinology, Pearson Prentice Hall, 2007
2. H. Maurice Goodman. Basic Medical Endocrinology, Fourth Edition, 2008, Academic Press, Elsevier
3. F Bolander. Molecular Endocrinology, 3rd Edition, 2004, Academic Press, Elsevier
4. E.J.W. Barrington. General and Comparative Endocrinology, Oxford, Clarendon Press.
5. P.J. Bentley. Comparative Vertebrate Endocrinology. Cambridge University Press.
6. R.H. Williams. Text Book of Endocrinology, W.B. Saunders
7. C.R. Martin. Endocrine Physiology. Oxford Univ. Press.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-III

Course no.: Zoo-303C
Course Title: Molecular Cytogenetics

MM: 80
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

Biology of Chromosomes:

Molecular anatomy of eukaryotic chromosomes

Metaphase chromosome: Centromere, Kinetochores, Telomere and its maintenance

Heterochromatin and Euchromatin Giant chromosomes: Polytene and lampbrush chromosomes.

Sex chromosomes, sex determination and dosage compensation in *C. elegans*, *Drosophila* & Humans

Unit II

Cytogenetic implications and consequences of structural changes and numerical alterations of chromosomes.

Human Cytogenetics:

Techniques in human chromosome analysis - molecular cytogenetic approach.

Human Karyotype - banding - nomenclature

Numerical and structural abnormalities of human chromosomes - syndromes.

Mendelian and chromosome based heritable diseases in humans.

Unit III

Genome mapping: cytoplasmic, fluorescence *in situ* hybridization

Genetic Mapping: single nucleotide polymorphisms, VNTRs and microsatellites

Physical mapping: restriction maps and radiation hybrid map and STS maps.

DNA fingerprinting,

Unit IV

Molecular markers in genome analysis:

Types : RFLP, RAPD, SCARs, AFLP, ASAPs and SSRs (single sequence repeats) and CAPS.

Applications and limitations of molecular markers.

Genome analysis – *Humans and Drosophila*

List of Recommended Books

1. Atherly, A.G., J.R. Girton and J.F. McDonald. The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, NY.
2. Brooker, R.J. Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc.
3. Fairbanks, D.J. and W.R. Anderson. Genetics - The Continuity of Life. Brooks/Cole Publishing Company ITP, NY, Toronto.
4. Gardner, E.J., M.J. Simmons and D.P. Snustad. Principles of Genetics. John Wiley and Sons. Inc., NY.
5. 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.
6. Lewin, B. Genes. VI. Oxford University Press, Oxford, New York, Tokyo.
7. Snustad, D.P. and M.J. Simmons. Principles of Genetics. John Wiley and Sons. Inc., NY.
8. 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.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester - III

Course no: Zoo-304C

MM: 80

Course Title: Environmental 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

Interactions between environment and biota; Concept and types of ecosystem, Stability and complexity of ecosystems; Productivity and biodegradation in different ecosystems; Limiting factor; food chain and energy flow, productivity and biogeochemical cycles (N₂, P, C and S); Ecological pyramids and recycling; Community structure and organisation;

Unit II

Wild life: Speciation and extinctions; Magnitude and distribution of biodiversity, economic value, wildlife biology, conservation strategies, cryopreservation and sustainable development. Animal trafficking and poaching.

Unit III

Environmental pollution. Global environmental change; biodiversity, status, monitoring and documentation; Major drivers of biodiversity change, biodiversity management approach.
Microbiology of water, air, soil and sewage

Unit IV

Characteristic of population: population growth curves
Concept of metapopulations: demes and dispersals and interdemec extinctions
Age structured population
Biogeographical realms of India

List of Recommended Books

1. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
2. Lendren, D. Modelling in behavioral ecology. Chapman & Hal, London, UK.
3. Sokal, R.R. and F.J. Rohlf. Biometry. Freeman, San Francisco.
4. Odum : Ecology (Amerind)
5. Odum : Fundamentals of Ecology (W.B. Saunders)
6. Ricklefy : Ecology, (WH Freeman)
7. Turk and Turk : Environmental Science (W.B. Saunders)
8. JP Yadav A text book of Environmental Education, GVS publisher, New Delhi

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-III

Course no.: Zoo-305E

Course Title: Animal Behaviour and Taxonomy

MM: 80

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

Definition and basic concepts of biosystematics and taxonomy, Species concepts - species category, different species concepts; sub-species and other infra-specific categories. Principles and theories of biological classification, hierarchy of categories. Taxonomic keys-different kinds of taxonomic keys, their merits and demerits.

Unit II

International code of Zoological Nomenclature (ICZN) - its operative principles, interpretation and application of important rules, Zoological nomenclature; formation of scientific names of various taxa. Chemotaxonomy, Cytotaxonomy, Molecular taxonomy Taxonomic procedures-taxonomic collections, preservation, curation process of identification. Taxonomic characters: different kinds and their significance, Systematic publications: - different kinds of publications.

Unit III

Approaches and Methods in Study of Behavior; Proximate And Ultimate Causation; Altruism and Evolution-Group Selection, Kin Selection, Reciprocal Altruism; Concept Of Learning, Memory, Cognition, Sleep And Arousal; Biological Clock.

Unit IV

Development of Behavior, Social Communication, Social Dominance; Territoriality; Mating Systems, Parental Care, Aggressive Behavior, Migration, Orientation And Navigation; Domestication and Behavioral Changes

List of Recommended Books

1. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company
2. E. Mayer. Elements of Taxonomy.
3. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
4. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.
5. Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley & Sons, USA
6. Animal Behaviour, David McFarland, Pitman Publishing Limited, London, UK
7. Animal Behaviour, John Alcock, Sinauer Associate Inc., USA
8. Perspective on Animal Behaviour, Goodenough, McGuire and Wallace, John Wiley & Sons, USA
9. Exploring Animal Behaviour, Paul W. Sherman & John Alcock, Sinauer Associate Inc. ,Massachusetts, USA
10. An Introduction to Animal Behaviour, A. Manning and M.S Dawkins, Cambridge University Press, UK

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-III

Course no.: Zoo- 306E
Course Title: Aquaculture

MM: 80
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

Different systems for aquaculture: pond culture, cage culture, raceway culture.
Culture of important fish species (Mayer carps, common carps, Chinese carps, cat fish culture and Tilapia culture).

Unit-II

Integrated Aquaculture and waste water aquaculture
Pearl Culture
Frog culture
Prawn culture-Fresh and brackish water

Unit-III

Impact of Aquaculture on Environment
Methods of Fishing : Crafts and gear technology
Nutrition in Aquaculture: Nutrient and non-nutrient diet components, Preparation and processing of feed, feed formulae, Natural and supplementary feed and their utilization

Unit-IV

Role of genetics in aquaculture– gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish, impact of GMOs on aquatic biodiversity.

List of Recommended Books

1. Fishponds in Farming Systems, Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M. E. F., Bosma, R. H., and Beveridge, M. C. M., Wageningen Academic Publishers, Netherlands
2. Aquaculture Principles and Practices, Pillay, T. V. R., Blackwell Publishing, USA
3. Aquaculture and Fisheries Biotechnology Genetic Approaches, Dunham, R. A., CABI Publishing, USA

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-III

Course no.: Zoo-307E

MM: 80

Course Title: Biology of Population

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

Concept of evolution: Darwinism and Neo-Darwinism

Hardy-Weinberg law of genetic equilibrium

A detailed account of destabilizing forces: (i) Natural selection (ii) Mutation (iii) Genetic drift (iv) Migration

Unit II

Quantifying genetic variability

Genetic structure of natural populations

Phenotypic variation

Models explaining changes in genetic structure of populations

Factors affecting human disease frequency

Mendelian basis of transmission of disease

Unit III

Molecular population genetics

Patterns of change in nucleotide and amino acid sequences

Ecological significance of molecular variations

Emergence of Non-Darwinism-Neutral Hypothesis

Unit IV

Genetics of quantitative traits in populations

Quantitative traits and natural se

Estimation of heritability

Inbreeding depression and heterosis

Molecular analysis of quantitative traits

Phenotypic plasticity

Suggested Reading Material

1. Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
2. Futuyama, D.J. Evolutionary Biology, Suinaer Associates, INC Publishers, Dunderland.
3. Haldane, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
4. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
5. King, M. Species Evolution-The role of chromosomal change. The Cambridge University Press, Cambridge.
6. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester- III

Course no.: Zoo-309 LC

Course Title: Laboratory Course

M.M.: 150

Time: 6

Hrs.

1. Study of Dissections through chart: Rat/ Lab Mice /Fish.
2. Digestive system,
3. Reproductive system,
4. Arterial system,
5. Venous systems,
6. Cranial nerves and
7. Museum specimens and slides :
8. Protochordates –
9. Fishes
10. Amphibians
11. Reptiles
12. Birds
13. Mammals
14. To identify different endocrine glands with the help of charts
15. To study the histology of endocrine glands of animals with the help of charts
16. To determine the concentration of glucose in the diabetic samples.
17. To Isolate and purify a protein hormone and demonstration of bioactivity in an *in vivo* bio- assay (e.g. FSH)
18. To perform ELISA for any one hormone
19. To measure conc. of corticosterone in human plasma or given sample
20. *In vitro* biochemical assay for a hormone (LH or PRL).
21. Steroid and thyroid hormone assay by ELISA.
22. Calcium estimation following fluorometry in PTH/Calcitriol treated rats.
23. Observation of sex chromatin (Barr bodies) in buccal epithelial cells of human female
24. To study the effect of UV rays on the *Drosophila melanogaster*
25. To analyse the restriction pattern by agarose gel electrophoresis and to map restriction plasmid sites on plasmid DNA
26. To prepare ligation lambda/E CORI digest using T₄ DNA ligase and amylase ligated sample by agarose gel electrophoresis
27. To study normal human karyotype
28. To study chromosomal abnormalities
29. To study the various human pedigrees
30. Gene mapping by TPT cross
31. Study of chromosomes slides (autosomes and sex chromosomes)
32. To study primary and secondary sexual characteristic
33. To determine dissolved O₂, free CO₂, BOD, COD, salinity and hardness content in polluted and control samples
34. To study presence of pollutants specific microbes in samples

35. To determine physiochemical characteristics of polluted water and soil
36. To study concentration of air pollutant with the help of high volume sampler in the air
37. To study concentration of air pollutant with the help of personal sampler around the person
38. Spirometric analysis of pollution impact and its implications
39. To prepare a phylogenetic tree on the basis of taxonomic characteristics of annelid
40. To prepare phylogenetic tree on the basis of taxonomic character revealing their heirarchial position of Echinodermata
41. To prepare phylogenetic tree on the basis of taxonomic character revealing their heirarchial position of Mollusca
42. Learning/ Conditioning
43. Memory
44. Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India.
45. Collection and identification of aquatic weeds and aquatic insects.
46. Study of feeding habits of fishes by gut content analysis.
47. Aquarium design and maintenance.
48. Formulation and preparation of artificial fish food for Indian major carps and Prawns.
49. Analysis of proximate composition of fish and processed products.
50. visit to freshwater/ marine fish farm.
51. To study normal human karyotype
52. To study chromosomal abnormalities
53. To study the various human pedigrees
54. Gene mapping by TPT cross
55. Study of chromosomes slides (autosomes and sex chromosomes)
56. To study primary and secondary sexual characteristics

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-IV

Course no.: Zoo-401C
Course Title: Biosafety & Ethics In Science

MM: 80
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

Mechanism of Radioactive Decay, Interactions of beta and gamma radiation with matter, electron capture, Decay schemes and energy level diagrams. Physical, biological and effective half lives, Radionuclide hazards. Radiation measurement instruments; Contamination monitoring; Exposure – Internal and External exposure Safe handling of radioactive sources.

UNIT II

Social issues: genetic discrimination: insurance and employment, human cloning, foeticide, sex determination.

Ethical issues: somatic and germ line gene therapy, clinical trials, ethical committee function. Social and ethical issues

UNIT III

Bio-safety-Definition, Requirement, Bio-safety containment facilities, Bio-safety against infectious agents/microorganism; bio-safety levels for infectious agents and infected food/animals; introduction of biological safety cabinets; biohazards, Biosafety for human health and environment; designing and management of laboratory and culture room as per the norm of GLP, GMP and FDA.

UNIT IV

Bio-safety issues related with GMOs; the risk of introducing genetically engineered organism to environment- ecological safety; Indian government bio-safety guidelines; role of RCGM (review committee on genetic manipulation), role of GEAC (genetic engineering approval committee), role of IBSC (institute bio-safety committee) in research and development of GMOs (transgenics), in medicine, food and agriculture; guidelines for environmental release of GMOs; risk assessment, risk management;

List of Recommended Books

1. Radioisotope Gauges for Industrial Process Measurements (Measurement Science and Technology) by Geir Anton Johansen and Peter Jackson (Jul 26, 2004).
2. Radioisotope Laboratory Techniques by R. A. Faires, etc. and G. G. J. Boswell (Dec 1980).
3. Radiotherapy in Practice: Radioisotope Therapy by Peter J. Hoskin (Mar 22, 2007).
4. Radioisotopes in Biology (Practical Approach Series) by Robert J. Slater (Feb 1, 2002).
5. Clinical Use of Radioisotopes by William Beierwaltes (1957).
6. Biological Safety: Principles And Practices (Biological Safety: Principles & Practices) by Diane O., Ph.D. Fleming and Debra Long Hunt (Aug 30, 2006).
7. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials by National Research Council (U. S.) (Dec 1989).
8. Genetically Modified Organisms: A Guide to Biosafety (Cabi) by George T Tzotzos (May 1995).
9. Biotechnology, Biosafety, and Biodiversity: Scientific and Ethical Issues for Sustainable Development by Sivramiah Shantharam, Jane F. Montgomery and Satellite Symposium on Biotechnology and Biodiversity (Apr 1999).

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2015-16

Semester-IV

Course no.: Zoo- 402C
Course Title: Vermiculture

MM: 80
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:

Introduction to earthworms, their taxonomy and nomenclature. Distribution, ecology and the food habits of earthworms.

UNIT-II:

Vermiculture-the use of earthworms and their influence on soil structure, composition and infiltration.

UNIT-III:

Role of earthworms in agro-ecosystems, land reclamation and sustainable soil fertility.

UNIT-IV:

Methods of vermicomposting, changes during vermicomposting, chemical composition of vermicast and the economics of vermiculture.

List of Recommended Books

1. Edwards CA & Bater JE. 1977. Biology of Earthworms. Chapman & Hall.
2. Edwards CA. 1998. Earthworm Ecology. CRC Press.
3. Sultan A Ismail. 1997. Vermicology- the Biology of Earthworms. Orient Longman.