

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG FIRST SEMESTER

SESSION – 2014-15



SCHOOL OF BIOLOGICAL SCIENCES (SBS)

**DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 121
PINCIPLES OF TAXONOMY

L	T	P	C
4	0	0	4

Unit I

Definition and basic concepts of biosystematics

Alfa, beta, Gamma Taxonomy

Newer trends in Taxonomy (Molecular, Cytological taxonomy, etc.)

History of Theories of Taxonomy

Theories of Taxonomy

Unit II

Species categories

Polytypic species

Hierarchy of categories

Unit III

Taxonomic collection and process of classification

Taxonomic characters

Unit IV

Qualitative and quantitative analysis of Variation

Procedure of Classifying

Unit V

Taxonomic publications

Principles and application of Zoological Nomenclature

6 hours/unit

Suggested Reading Material (All latest editions)

1. M.Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise, Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson, Biodiversity, Academic Press, Washington.
4. G.G. Simpson, Principle of Animal taxonomy, Oxford IBH Publishing Company.
5. E. Mayer, Elements of Taxonomy.
6. E.O. Wilson, The Diversity of Life (The College Edition), W.W. Northerm & Co.
7. B.K. Tikadar, Threatened Animals of India, ZSI Publication, Calcutta.

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 122
BIOSYSTEMATICS & TAXONOMY

L	T	P	C
0	0	4	1

LIST OF PRACTICALS

1. Recent classification of animals exemplified by museum specimens.
2. Identification of animal species with the help of taxonomic keys.
 - a. Insect fauna up to order
 - b. Fish fauna up to families
 - c. Identification of earth
3. Methods of taxonomic collection and preservations. Collection of local fauna.
4. Morphological variations in animal phyla.
5. Evaluation of biodiversity indices.

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 123
BIostatISTICS AND COMPUTATIONAL BIOLOGY

L	T	P	C
4	0	0	4

Unit I

1. Matrices and Vectors
2. Exponential functions
3. Periodic functions and differential equations
4. Mathematical modeling

Unit II

1. Sampling, Data collection and recording.
2. Central tendency – concept; arithmetic mean, mode, median for ungrouped and grouped data.
3. Measures of dispersion: absolute and relative measures; range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability.

Unit III

1. Skewness, Kurtosis
2. Probability - normal, poisson and binomial
3. Analysis of variance

Unit IV

1. Statistical Methods: Hypothesis testing, significance and correlation. Correlation.
2. Linear models and regressions. Pearson and other correlation coefficients. Multiple regressions.
3. Distribution- Normal, t and chi square test

Unit V

1. Basic concepts of computer, hardware and operating systems: Windows, Android, iOS
2. Use of common application software in biology: word processing, spreadsheets, graphics and data base.
3. Introduction to web browsing software and search engines with special reference to online resources.
4. Definition, history, scope and applications of bioinformatics, Biological Databases: primary & Secondary Databases e.g. GenBank, EMBL, DDBJ, Entrez, OMIM, SWISS-Prot etc. Use of PubMed, BLAST etc.

6 Hours/unit

Suggested Reading Material

1. Batschelet, E., Introduction to mathematics for life scientists. Springer-Verlag, Berlin.
2. Jorgensen, S.E., Fundamentals of ecological modeling, Elsevier, New York.
3. Swartzman, G.L., and S.P.O. Kaluzny, Ecological simulation primer, Mac millan, New York.
4. Lendren, D., Modelling in behavioral ecology, Chapman & Hal, London, U.K.
5. Sokal, R.R. and F.J. Rohlf, Biometry, Freeman, San Francisco.
6. Snedecor, G.W. and W.G. Cochran, Statistical methods, Affiliated East-West Press, New Delhi (Indian ed.).
7. Green, R.H., Sampling design and statistical methods for environmental biologists, John Wiley & Sons, New York.
8. Murray, J.D., Mathematical biology, Springer-Verlag, Berlin.
9. Pielou, E.C., The interpretation of ecological data: A primer on classification and ordination.

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 124
BIostatistics AND COMPUTATIONAL BIOLOGY

L	T	P	C
0	0	4	1

LIST OF PRACTICALS

Numerical Based on:

1. Matrices.
2. Mean, median and mode.
3. Mean deviation, variance, standard deviation and standard error.
4. Representation of data: Bar diagrams, *π -diagrams*, Histograms, Frequency polygons and ogives.
5. t-test
6. F-test
7. Chi square test
8. ANOVA
9. Demonstration of PubMed in searching scientific literature using authors name, fields, limits etc.
10. Demonstration of BLAST in comparing Protein Sequences.
11. Use of Sigma Stat/Prism Software for Statistical analysis.
12. Use of Search engines and online resources.

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 125
COMPARATIVE ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

L	T	P	C
4	0	0	4

Unit-I : Digestion, Excretion & Osmotic regulation

1. Feeding Mechanisms and Physiology of digestion in different phyla.
2. Energy Metabolism: Metabolic rate and body size, Physiological time, Effect of high altitude.
3. Patterns of nitrogen excretion among different animal groups.
4. Osmoregulation in Invertebrates and Vertebrates.
5. Terrestrial environment & Vertebrates.

Unit-II: Respiration & Circulation

1. Physiology of Respiration in Air and Water.
2. Respiration in Insects, Respiration in Birds and Eggs.
3. Air breathing Fishes, Mammalian Lungs.
4. Principles of circulation in Invertebrates & Vertebrates.
5. O₂ & CO₂ Transport in Blood: dissociation curves & respiratory pigments.

Unit-III : Temperature, Locomotion & Senses

1. Thermoregulation: Extreme temperature limits of life (high, cold & freezing).
2. Heat Exchange interactions between environment & animals.
3. Temperature regulation in Ectotherms & Endotherms.
4. Movement: Amoeboid, ciliary & flagellar
5. Muscle & biomechanics.
6. Nerves & Nervous system.
7. Synapse: Excitation, inhibition & computation.
8. Information & Senses: Taste & smell, vibration & sound, light & vision, electricity.

Unit-IV: Hormone action

1. Discovery and Classification of hormones
2. General principles and nature of hormone action
3. Phylogeny and ontogeny of endocrine glands
4. Neuroendocrine system and neurosecretion
5. Hormone receptors-signal transduction mechanisms

Unit-V: Biosynthesis of hormones and its regulation

1. Biosynthesis of steroid hormones *de novo*
2. Biosynthesis and amino-acid derived small size hormones (e.g.-T₄. Epinephrine etc.)
3. Biosynthesis and simple peptide hormones-Pre and Pro-hormones
4. Hormonal regulation of carbohydrate, nitrogen and lipid metabolism
5. Hormones and Homeostasis

Suggested Reading Material

1. Schiemdt-Nielsen Animal Physiology: Adaptation and Environment. Cambridge
2. C.L. Prosser Comparative Animal Physiology W.B. Saunders & Company
3. R. Eckert Animal physiology: Mechanism and Adaptation W.H.Freeman& Company.
4. W.S. Hoar General and comparative Animal Physiology.
5. E.J.W. Barrington, General and Comparative Endocrinology, Oxford, Clarendon Press.
6. P.J. Bentley, Comparative Vertebrate Endocrinology, Cambridge University Press.
7. R.H. Williams, Text Book of Endocrinology, W.B. Saunders.
8. C.R. Martin, Endocrine Physiology, Oxford University Press.
9. A. Gorbman et. al. Comparative Endocrinology, John Wiley & Sons.

6 hours/unit

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 126
COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY

L	T	P	C
0	0	4	1

List of Practical:

1. Enzymatic activity of human salivary amylase.
2. Effect of PH & temperature on amylase activity.
3. Effect of substrate concentration on rate of reaction.
4. Demonstration of oxygen consumption of a laboratory animal.
5. Demonstration of respiratory rate by estimation of dissolved oxygen (DO).
6. Study of capillary circulation in the web of frog.
7. Measurement of blood pressure by Sphygmomanometer.
8. Counting of blood cells in an insect / vertebrate by haemocytometer.
9. Determination of bleeding time.
10. Demonstration of role of Malpighian tubules in insect excretion.
11. Test of Ammonia, urea, uric acid and creatinine in urine sample.
12. Study of color change mechanism in fish & frog.
13. Study of osmotic haemolysis and chemical haemolysis.
14. Histological study of different endocrine glands (Pituitary, Thyroid, Parathyroid, Adrenal, Thymus, Gonads and Pancreas).
15. Study of estrous cycle of rat.

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 127
MOLECULAR CELL BIOLOGY

L	T	P	C
4	0	0	4

Unit-I

- 1.1 Composition, structure and function of bio-molecules (carbohydrates, lipids, proteins, nucleic acids and vitamins)
- 1.2 Biomembranes
- 1.3 Membrane potential
- 1.4 Transport across cell membrane - diffusion, active transport and pumps, uniports, symports and antiports
- 1.5 Co-transport by symports or antiports
- 1.6 Transport across epithelia

Unit-II

- 2.1 Cytoskeleton
- 2.2 Microfilaments and microtubules-structure and dynamics
- 2.3 Microtubules and mitosis
- 2.4 Cell movements-intracellular transport, role and kinesin and dynein, signal transduction mechanism
- 2.5 Cilia and Flagella
- 2.6
 - a. Cell-Cell signaling
 - b. Cell surface receptors
 - c. Second messenger system
 - d. MDP kinase pathways
 - e. Signaling from plasma membrane to nucleus

Unit-III

- 3.1 Cell-Cell adhesion and communication
- 3.2 Ca⁺⁺ dependent homophilic cell-cell adhesion
- 3.3 Ca⁺⁺ independent homophilic cell-cell adhesion
- 3.4 Gap junctions and connexins
- 3.5
 - a. Cell matrix adhesion
 - b. Integrins
 - c. Collagen
 - d. Non-collagen components
 - e. Cellulose fibril synthesis and orientation

Unit-IV

- 4.1 Cell cycle
- 4.2 Cyclins and cyclin dependent kinases
- 4.3 Regulation of CDK-cyclin activity
- 4.4 Genome organization
- 4.5 Hierarchy in organization
- 4.6 Chromosomal organization of genes and non-coding DNA
- 4.7 Mobile DNA
- 4.8 Morphological and functional elements of eukaryotic chromosomes

Unit-V

- 5.1 Genetic analysis in Cell Biology
- 5.2
 - a. Intracellular protein traffic
 - b. Protein synthesis on free and bound polysomes
 - c. Uptake into ER
 - d. Membrane proteins, Golgi sorting, post-translational modifications
 - e. Trafficking mechanism
- 5.3 Biology of cancer
- 5.4 Biology of aging
- 5.5 Apoptosis-definition, mechanism and significance

6 hours/unit

Suggested Reading Material

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. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones.

LIST OF PRACTICALS
M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (CORE COURSE) IN ZOOLOGY
Course Code ZOO C 128
MOLECULAR CELL BIOLOGY

L	T	P	C
0	0	4	1

List of practical:

1. Experiments showing osmosis.
2. Separation of proteins by electrophoresis.
3. Antigen-antibody reaction.
4. Apoptosis-Chick embryo (4/6 days limb formation)
5. Histochemistry-Carbohydrate/Cholesterol
6. Staining of Golgi bodies and mitochondria

M.Sc. COURSE, SESSION - 2014-15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 122 A
Cancer Biology & Therapeutics

L	T	P	C
2	0	1	3

Unit I: Origin, progress and dissemination of the disease, common forms and their diagnosis.

Unit II: Genetic and epigenetic association

- 1.1 Heritable traits
- 1.2 histone modifications and DNA methylation
- 1.3 micro RNAs and their role

Unit III: Radio-protectors, immuno-modulators and chemo-prevention

- 3.1 Anti-carcinogenicity of novel drug prototypes isolated from herbal/plant sources

Unit IV: Cellular therapy

- 4.1 Basic introduction to cellular engineering methods including Dendritic cell based nano-therapeutics

Unit V: Translational oncology

- 5.1 Basic understanding to epithelial-mesenchymal transition
- 5.2 Stem cell therapeutics
- 5.3Pharmaco-surveillance and nano-medicine

6 hours/unit

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 122 B

LIST OF PRACTICALS

1. Cancer cell culture
2. Dendritic cell culture
3. Immunophenotyping
4. Isolation and characterization of active principles from herbal sources
5. Preparation of molecular vectors and characterization

M.Sc. COURSE, SESSION - 2014-15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 123 A
Vermibiotechnology

L	T	P	C
2	0	1	3

Unit 1.0 : Earthworms

- 1.1 Basic structure
- 1.2 Life cycle
- 1.3 Life span

Unit 2.0: Ecological Groups of Earthworms

- 2.1 Ecological requirements of earthworms
- 2.2 Earthworm species used in vermiculture

Unit 3.0: Vermicompost

- 3.1 Vermicompost materials
- 3.2 Preliminary treatment of composting materials
- 3.3 Method of vermicompost production
- 3.4 Benefits of vermicompost
- 3.5 Nutrient profile of vermicompost
- 3.6 Problems and their solutions

Unit 4.0: Vermiwash

- 4.1 Composition of vermiwash
- 4.2 Method of preparation
- 4.3 Method of application
- 4.4 Benefits of vermiwash

Unit 5.0: Wormery

- 5.1 Methods to establishment of wormery unit
- 5.2 Harvesting of earthworms
- 5.3 Grading and counting of earthworms
- 5.4 Transportation of live worms and cocoons
- 5.5 Precautions and requirements of wormery
- 5.6 Factors effecting the worm production
- 5.7 Vermi -entrepneurship

6 hours/unit

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 123 B

LIST OF PRACTICALS

- 1: Collection and Identification of the epigeic earthworm species suitable for vermicomposting.
- 2: Different techniques for developing small and high scale vermireactors.
- 3: Grading and counting of Coccons and their method of transportation.
- 4: Preparation of Vermiwash and Vermimeal.

M.Sc. COURSE, SESSION - 2014-15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 124 A

Neurobiology

L	T	P	C
2	0	1	3

Unit-I Plasticity of brain and neurogenesis

Unit-II Organization of nervous system

- 2.1 Brain structure
- 2.2 Neurons and glia
- 2.3 Cerebrospinal fluid
- 2.4 Neural network
- 2.5 Blood brain barrier
- 2.6 Autonomic nervous system

Unit-III Axonal and synaptic transmission

- 3.1 Types of neurons
- 3.2 Membrane potential and action potential
- 3.3 Types of synapses
- 3.4 Excitatory and inhibitory post-synaptic potential
- 3.5 Chemical transmission, neurotransmitters (acetylcholine, catecholamines, serotonin and GABA), neuropeptides

Unit-IV 4.1 Molecular basis of learning and memory

- 4.2 Brain and behavior
- 4.3 Brain imaging using CAT, PET and MRI

Unit-V 5.1 Brain aging

- 5.2 Neuropathology
 - 5.2.1 Strokes
 - 5.2.2 Epilepsy
 - 5.2.3 Alzheimer disease
 - 5.2.4 Huntington disease
 - 5.2.5 Parkinson disease
 - 5.2.6 Hepatic Encephalopathy

Books Recommended

1. Ganong: Review of Medical Physiology (22nd ed 2005, Lang Medical Publications)
2. Guyton and Hall: Text Book of Medical Physiology (11th ed 2006, W.B. Saunders)
3. Keel et al: Samson Wright's Applied Physiology (14th ed 1989, Oxford Press)
4. West: Best and Taylor's Physiological Basis of Medical Practice (11th ed 1981, Williams and Wilkins)
5. Longstaff: Neuroscience (2002, Viva Books)
6. Shepherd: Neurobiology (1994, Oxford Univ Press)
7. Squire et al: Fundamental Neuroscience (2003, Academic Press)
8. Eric Kandel: Principles of Neural Science (2000, Mc Graw Hill)

6 hours/unit

M.Sc. COURSE, SESSION – 2014–15
PG FIRST SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 124 B

LIST OF PRACTICALS

1. Studies on learning and memory in rat/mouse model by Morris-Water-Maze Test or by using a zigzag or T-shaped maze in an animal model of Hepatic Encephalopathy
2. Behavioural analysis through motor function tests (catalepsy test, footprinting test, rotarod test).
3. a). Isolation of neurons and glia by differential centrifugation
b). Characterization of isolated cells types using specific marker

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG SECOND SEMESTER

SESSION – 2014-15



SCHOOL OF BIOLOGICAL SCIENCES (SBS)

**DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

P.G. COURSE, SESSION 2014-15
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 221
POPULATION GENETICS AND EVOLUTION

L	T	P	C
3	0	0	3

Unit-I	1.0	Concepts of evolution and theories of organic evolution with an emphasis on Darwinism
	2.0	Neo-Darwinism .
	2.1	Hardy-Weinberg law of genetic equilibrium
	2.2	A detailed account of destabilizing forces: (i) Natural selection (ii) Mutation (iii) Genetic drift (iv) Migration (v) Meiotic drive
	3.0	Quantifying genetic variability
	3.1	Genetic structure of natural populations
	3.2	Phenotypic variation
	3.3	Models explaining changes in genetic, structure of populations
	3.4	Factors affecting human disease frequency
Unit-I I	4.0	Molecular population genetics
	4.1	Patterns of change in nucleotide and amino acid sequences
	4.2	Ecological significance of molecular variations
	4.3	Emergence of Non-Darwinism-Neutral Hypothesis
	5.0	Genetics of quantitative traits in populations
	5.1	Analysis of quantitative traits
	5.2	Quantitative traits and natural selection
	5.3	Estimation or heritability
	5.4	Genotype-environment interactions
	5.5	Inbreeding depression and heterosis
Unit-III	5.6	Molecular analysis of quantitative traits
	5.7	Phenotypic plasticity
	6.0	Genetics of speciation
	6.1	Phylogenetic and biological concept of species
	6.2	Patterns and mechanisms of reproductive isolation
	6.3	Models of speciation (Allopatric, sympatric, parapatric)
	7.0	Molecular Evolution
	7.1	Gene Evolution
	7.2	Evolution of gene families, Molecular drive
	7.3	Assessment of molecular variation
Unit-IV	8.0	Origin of higher categories
	8.1	Phylogenetic gradualism and punctuated equilibrium
	8.2	Major trends in the origin of higher categories
	8.3	Micro-and Macro-evolution
	9.0	Molecular phylogenetics
	9.1	How to construct phylogenetic trees?

	9.2	Phylogenetic inference-Distance methods, parsimony methods, maximum likelihood method
	9.3	Immunological techniques
	9.4	Amino acid sequences and phylogeny
	9.5	Nucleic acid phylogeny-DNA-DNA hybridizations, Restriction Enzyme sites, Nucleotide sequence comparisons and homologies
	9.6	Molecular clocks
Unit-V	10.0	Origin and evolution of economically important microbes and animals
	11.0	Population genetics and ecology
	11.1	Metapopulations
	11.2	Monitoring natural populations
	11.3	Why small populations become extinct?
	11.4	Loss of genetic variations
	11.5	Conservation of genetic resources in diverse taxa

6 hours/unit

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, Sunderland.
4. Hartl, 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. Strikberger, M.W. Evolution. Jones and Bartlett Publishers, Boston London.

P.G. COURSE, SESSION 2014-15
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 222
POPULATION GENETICS AND EVOLUTION

L	T	P	C
0	0	3	1

List of Practical

1. Distribution of gene frequency in a particular population (Brahmins, Saxenas etc.) with reference to:
 - a. Size of second finger.
 - b. Freeness ear lobes.
 - c. Blood groups, A,B, AB, O, Rh, MNS etc.
2. Phenotypic plasticity in
 - a. Butterfly
 - b. Rasbora
 - c. Ophiocephalus or Notopterus
3. Electrophoretic pattern of DNA fragments belonging to Horse, Man, Monkey, Cow etc after treatment with particular restriction endonuclease.
4. Distribution of frequency of serum isozymes like, LDH & DH, Glutamate dehydrogenase, glucose-6-phosphate dehydrogenase etc in a population.
5. Some numerical problems on Hardy Weinberg's law.

P.G. COURSE, SESSION 2014-15
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 223
GAMETE BIOLOGY

L	T	P	C
3	0	0	3

Unit-I	1.0	Heterogamy in eukaryotes
	2.0	Comparative account of differentiation of gonads in a mammal and an invertebrate
	3.0	Leydig cells
	3.1	Morphology
	3.2	Differentiation
	3.3	Function and its regulation
	4.0	Spermatogenesis
	4.1	Morphological basis in Rodents
	4.2	Morphological basis in any Invertebrate
	4.3	Gamete specific gene-expression and genomics
	5.0	Biochemistry of Semen
	5.1	Semen composition and formation
	5.2	Assessment of sperm functions
	5.3	Y-specific probes
Unit-II	6.0	Fertilization
	6.1	Pre-fertilization events
	6.2	Biochemistry of fertilization
	6.3	Post-fertilization events
	7.0	Collection and cryopreservation of gametes and embryos
	8.0	Ovarian follicular growth and differentiation
	8.1	Morphology
	8.2	Endocrinology
	8.3	Molecular Biology
	8.4	Oogenesis and vitellogenesis
	8.5	Ovulation and ovum transport in mammals
Unit-III	9.0	Biology of sex-determination and sex-differentiation a comparative account
	10.0	Multiple ovulation and embryo transfer technology (MOET)
	10.1	<i>In vitro</i> oocyte maturation
	10.2	Superovulation
	10.3	In vitro fertilization
	11.0	Transgenic animals and knock-outs
	11.1	Production
	11.2	Applications
	11.3	Embryonic stem cells

Unit-IV	12.0	Care and breeding of experimental animals including bioethics
	14.0	Assisted reproduction technologies
	14.1	Embryo sexing and cloning
	14.2	Screening for genetic disorders
	14.3	ICSI, GIFT etc.
	14.4	Cloning of animals by nuclear transfer
Unit-V	15.0	Teratological effects of Xenobiotics.
	15.0	Immunocontraception
	15.1	Gamete specific antigens
	15.2	Antibody mediated fertilization block and termination of gestation
	15.3	Other contraceptive technologies
	15.1	Surgical methods
	15.2	Hormonal methods
	15.3	Physical barriers
	15.4	IUCD

6 hours/unit

Suggested Reading Material

1. Austen, C.R and Short, RV. Reproduction in animals.
2. Schatten and Schatten. Molecular biology of fertilization.
3. F.T. Longo. Fertilization, Chapman & Hall.
4. R.G. Edwards. Human Reproduction.

P.G. COURSE, SESSION 2014-15
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 224
GAMETE BIOLOGY

L	T	P	C
0	0	3	1

List of Practical

1. Demonstration of different types of Ovarioles in insects. e.g. in (i) Cockroach/Grasshopper (Panoistic type) (ii) *Dysdercus/Bagrada/Sphaerodema* (Acrotrophic type) and (iii) *Musca/Drosophila* (polytrophic type).
2. Squash preparation of testes of male insects to demonstrate spermatogenesis.
3. Section of ovaries of mammals showing oogenesis, development of graafian follicles and corpus luteum.
4. Section of testes of a mammal (rat/rabbit) showing spermatogenesis.
5. Effect of xenobiotics on teratogenesis using snail egg masses as model material.
6. Development of chick showing morphogenesis & organogenesis by using 2,4,6,8,10 days incubated hen's eggs.

P.G. COURSE, SESSION 2014-15
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 225
TOOLS AND TECHNIQUES FOR BIOLOGY

L	T	P	C
4	0	0	3

Unit-I	1.0	Assay
	1.1	Definition and criteria of reliability
	1.2	Chemical assays
	1.3	Biological assays-in vivo and in vitro assays
	2.0	Principles and uses of analytical instruments - balance, pH meter, spectrophotometer, centrifuge
Unit-II	3.0	Microscopy - Principle of light, phase-contrast, fluorescence, confocal, electron microscopes
	4.0	Microbiological techniques
	4.1	Media preparation and sterilization
	4.2	Inoculation and growth monitoring
	4.3	Use of fermentors
	4.4	Microbial assays
	5.0	Cell culture techniques
	5.1	Design and functioning of tissue culture laboratory
	5.2	Culture media preparation and cell harvesting methods
	5.3	Cell proliferation measurements
Unit-III	5.4	Cell viability testing
	6.0	Cryotechniques
	6.1	Cryopreservation for cells, tissue, organisms
	6.2	Cryotechniques for microscopy
	6.3	Freeze-drying for physiologically active substances
	7.0	Separation techniques in biology
	7.1	Molecular separations by chromatography and electrophoresis
	7.2	Organelle separation by centrifugation etc.
Unit-IV	7.3	Cell separation by flow cytometry, density gradient centrifugation
	8.0	Computer aided techniques for data presentation, data analyses, statistical techniques, special software for specific tasks
	9.0	Radioisotope and mass isotope techniques in biology
	9.1	Sample preparation for radioactive counting
	9.2	Autoradiography
	9.3	Metabolic labeling
	9.4	Magnetic Resonance Imaging
Unit-V	10	Immunological techniques based on antigen-antibody interactions

- 11 Surgical techniques
- 11.1 Organ ablations (eg: ovariectomy, adrenalectomy etc.)
- 11.2 Perfusion techniques
- 11.3 Indwelling catheters
- 11.4 Stereotaxy
- 11.5 Parabiosis
- 12 Biosensors

Suggested Reading Material (All latest Editions)

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. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.H. Goulding, ELBS Edn.

6 hours/unit

P.G. COURSE, SESSION 2014-15
M.Sc. SECOND SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 226
TOOLS AND TECHNIQUES FOR BIOLOGY

L	T	P	C
0	0	3	1

List of Practical

1. Procedure of microtomy for animal tissue
2. Demonstration of microscopy: phase-contrast, fluorescence, confocal and electron
3. Isolation of Protein from plant/animal tissues
4. Demonstration of protein precipitation
5. Estimation of proteins by spectrophotometer
6. Separation of proteins by SDS-PAGE
7. Isolation of nucleic acids from plant/animal tissues
8. Estimation of nucleic acids by spectrophotometer
9. Separation of nucleic acids by agarose gel electrophoresis
10. Demonstration of PCR and RT-PCR
11. Demonstration of cell viability assays

P.G. COURSE, SESSION 2014-15
M.Sc. II SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 227
Biochemistry

L	T	P	C
3	0	0	3

Unit I : Amino acids and proteins

1. Amino acids
2. Acids and bases
3. Protein structure
4. Myoglobin and hemoglobin
5. Collagen
6. Protein purification
7. Electrophoresis of proteins
8. Protein sequencing and peptide synthesis
9. Amino acid metabolism

Unit II : Enzymes

1. Introduction to enzymes
2. Thermodynamics
3. Enzyme kinetics
4. Enzyme inhibition
5. Regulation of enzyme activity

Unit III : Nucleic Acids

1. DNA structure
2. DNA replication in prokaryotes & eukaryotes
3. RNA structure
4. Transcription in prokaryotes & eukaryotes
5. Regulation of transcription by RNA Pol II
6. Processing of eukaryotic pre-mRNA
7. Ribosomal RNA
8. Transfer RNA

Unit IV : Protein Synthesis

1. The genetic code
2. Translation in prokaryotes
3. Translation in eukaryotes
4. Protein targeting
5. Protein glycosylation

Unit V : Carbohydrate & Lipid metabolism

1. Monosaccharides, disaccharides, Polysaccharides and oligosaccharides
2. Glycolysis & Gluconeogenesis
3. Pentose phosphate pathway
4. Glycogen metabolism & its regulation
5. Structures and roles of fatty acids
6. Fatty acid breakdown & synthesis
7. Triacylglycerols
8. Cholesterol
9. Lipoproteins

6 hours/unit

Suggested readings:

1. B.D. Hames. Instant Notes in Biochemistry. Bios Pub. UK.
2. Voet D. and Voet J.G., Biochemistry, John Willey and Sons.
3. Nelson D.L., Cox M.M. Lehninger, Principles of Biochemistry, MacMilan , USA.
4. Metzler D.E. and Metzler C.M. , Biochemistry, Wiley – Liss.
5. Devlin T.M. , Text book of Biochemistry , Willey-Liss.

P.G. COURSE, SESSION 2014-15
M.Sc. II SEMESTER (CORE COURSE) IN ZOOLOGY
Paper Code ZOO C 228
Biochemistry

L	T	P	C
0	0	3	1

Practical:

1. Preparation of standard graph of protein for quantitative estimation of protein
2. Preparation of standard graph of DNA for quantitative estimation of DNA
3. Preparation of standard graph of RNA for quantitative estimation of RNA
4. Preparation of standard graph of P_i for determining V-max of mitochondrial ATPase enzyme
5. Effect of substrate concentration, temperature and pH on mitochondrial ATPase enzyme
6. Chromatography ; TLC and Paper chromatography
7. DNA isolation
8. RNA isolation

Suggested readings:

1. Plummer D.T. , Practical Biochemistry , Tata McGraw-Hills.
2. Wilson K. and Walker K. , Principles & Techniques of Practical Biochemistry. Cambrigde Uni.Press.

M.Sc. COURSE, SESSION - 2014-15
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 222 A
Environmental Health

L	T	P	C
2	0	1	3

Unit I: Molecular toxicology

1.1 Basic understanding of environmental health impact

Unit II: Epigenetic traits and determinants

2.1 Basic understanding of tools and techniques used for pragmatic analysis of human exposome

Unit III: Impact assessment of technological advancements

- 3.1 Synthetic pesticides
- 3.2 radiation and nuclear technology
- 3.3 cell phones
- 3.4 genetically modified products.

Unit IV: Occupational medicine

- 4.1 Detection and control of environmentally transmitted microbial hazards
- 4.2 industrial hygiene
- 4.3 occupational safety management

Unit V: Environmental law, regulation and policy

- 5.1 Articulate the implications of human-environmental interactions for social decision making
- 5.2 environmental regulation and allocation of public health resources

6 hours/unit

M.Sc. COURSE, SESSION – 2014–15
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 222 B

L	T	P	C
2	0	1	3

LIST OF PRACTICAL

1. Histone modifications and DNA methylation
2. Hands-on-experience to exposome analytics (HPLC, GC etc.) used for evaluating dose-response and exposure-response relationship
3. Basic toxicogenomic profiling through software-user interface

M.Sc. COURSE, SESSION - 2014-15
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 223 A
Medical Biochemistry

L	T	P	C
2	0	1	3

Unit-I 1.1 Biochemical basis of diseases/disorders, diagnosis and treatment

1.2 Molecular deficiency disorders

- 1.2.1 Enzyme deficiency: inborn errors of metabolism
 - 1.2.1.1 Alkaptonuria
 - 1.2.1.2 Phenylketonuria
 - 1.2.1.3 Lesh-Nyhan syndrome
- 1.2.2 Protein defects/ deficiency
 - 1.2.2.1 Cystic fibrosis
 - 1.2.2.2 Sickel cell anaemia
 - 1.2.2.3 Thalassemia

Unit-II Transport/storage associated disorders

- 2.1 Hypercholesterolemia and atherosclerosis
- 2.2 A-Beta-lipoproteinemia
- 2.3 Tay-Sachs disease
- 2.4 Gout

Unit-III Apoptosis and its implications in health and disease

- 3.1 Process of apoptosis
 - 3.1.1 Induction and biochemical changes
 - 3.1.2 Execution
 - 3.1.3 Phagocytosis of apoptotic bodies
- 3.2 Regulation of apoptosis
- 3.3 Implications
 - 3.3.1 Programmed cell death and development
 - 3.3.2 Development of immunological tolerance
 - 3.3.3 Neurological disorders

Unit-IV Cancer

- 4.1. Biochemical alterations during carcinogenesis
- 4.2. Regulatory mechanisms as targets for cancer therapy

Univ-V 5.1 Drug action, abuse and catabolism

- 5.1.1 Mechanisms
- 5.1.2 Drug addiction, alcohol toxicity
- 5.1.3 Catabolism of drugs

5.2. Recent trends in therapy

- 5.2.1 Biomolecules as diagnostic markers and therapeutic agents
- 5.2.2 Gene technology and gene therapy
- 5.2.3 Drug delivery and targeting

5.3. Medical gerontology

Books Recommended

1. Murray et al: Harper's Illustrated Biochemistry (27th ed 2006, McGraw Hill)
2. Ganong: Review of Medical Physiology (21st ed 2003, Lange Medical Publications)
3. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
4. Goldsby et al: Immunology (5th ed 2003, Freeman)
5. Bhagvan: Medical Biochemistry (4th ed 2004, Hap)
6. Goodman et al: The Pharmacological Basis of Therapeutics (7th ed 1991, Macmillan Publishers)
7. Smith & Marks: Basic Medical Biochemistry (2nd ed 2005, LWW Lippincott's)
8. Chatterjea & Shinde: Medical Biochemistry (6th ed 2005, Jaypee brothers)
9. Bennett & Brown: Clinical Pharmacology (9th ed 2005, Elsevier)
10. Saini & Kaur: Clinical Biochemistry (1st ed 2001, CBS Publ)

6 hours/unit

LIST OF PRACTICALS
M.Sc. COURSE, SESSION – 2014–15
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 223 B

1. Study of pathological condition in rat/mouse model: liver cirrhosis, diabetes and ascites tumor
2. Analysis of enzymatic/biochemical markers from serum/tissues of rat/mouse model
 - 2.1 Studies on the anti-oxidant enzymes (SOD, catalase and GPx) in normal and diseased rats
 - 2.2 Native-PAGE analysis of LDH isoforms
 - 2.3 Spectrophotometric assay of SGOT (AST) and SGPT (ALT)
 - 2.4 Estimation of bilirubin concentration
3. Study of apoptosis in liver cirrhotic/tumor model
 - 3.1 Analysis of DNA-degradation pattern using agarose gel electrophoresis
 - 3.2 Western blot analysis of release of cytochrome C from mitochondria
 - 3.3 Expression analysis of Bcl2, Bax and pro-apoptotic factors (Caspase3 and 9)
4. Demonstration of expression of a gene/protein during aging

M.Sc. COURSE, SESSION - 2014-15
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 224 A

Genetic Engineering

L	T	P	C
2	0	1	3

Unit-I Tools

- 1.1 Restriction enzymes and other enzymes for DNA manipulation
- 1.2 Vector types: cloning & expression
- 1.3 Probes

Unit-II Cloning strategies

- 2.1 cDNA & genomic libraries

Unit-III Screening of clones

- 3.1 Preparation of probes
- 3.2 Hybridization: Southern, Northern & Immunoscreening

Unit-IV Characterization of clones

- 4.1 Sequencing
- 4.2 Microarray

Unit-V Application:

- 5.1 Transgenic organism and genetically modified organisms animal cloning
- 5.2 Site-directed mutagenesis
- 5.3 Generation of knock out animals
- 5.4 Gene therapy

Books Recommended

1. Brown: Gene Cloning & DNA analysis (2001, Blackwell)
2. Lewin: Genes IX (2008, Jones & Bartlett)
3. Lodish et al : Molecular cell biology (6th edition 2007, Freeman)
4. Asubel et al : Current protocol in molecular biology (1944, Wiley)
5. Sambrook & Russell : Molecular cloning (2001, Cold Spring Harbour)

6 hours/unit

M.Sc. COURSE, SESSION – 2014–15
PG SECOND SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
Course Code ZOO E 224 B

LIST OF PRACTICALS

1. Demonstration of DNA gel electrophoresis
2. Demonstration of northern, southern hybridization
3. Structure, function & working of instruments: PCR & DNA sequencer.

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG THIRD SEMESTER

SESSION – 2014-15



SCHOOL OF BIOLOGICAL SCIENCES (SBS)

**DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M. Sc. III Semester
General Paper – I
STRUCTURE & FUNCTION IN INVERTEBRATES
Course code ZOO C 321

L	T	P	C
3	0	0	3

Unit – I

Principles of Animal taxonomy

- Special concept: International code of zoological nomenclature
- Taxonomic procedures: New trends in taxonomy
- Animal collection, handling and preservation

Organization of coelom

- Acoelomates
- Pseudocoelomates
- Coelomates: Protostomia and Deuterostomia

Unit – II

Locomotion

- Flagella and ciliary movement in Protozoa
- Hydrostatic movement in Coelenterate, Annelid and Echinoderm

Nutrition and digestion

- Patterns of feeding and digestion in lower metazoan
- Filter feeding in Polychaeta, Mollusca and Echinodermata

Unit – III

Respiration

- Organs of respiration: Gills, lungs and trachea
- Respiratory pigments
- Mechanism of respiration

Excretion

- Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules
- Mechanisms of excretion
- Excretion and osmoregulation

Unit – IV

Nervous System

- Primitive nervous system: Coelenterata and Echinodermata
- Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).
- Trends in neural evolution

Unit – V

Invertebrate Larvae

- Larval forms of free living invertebrates
- Larval forms of parasites
- Strategies and Evolutionary significance of larval forms

Minor Phyla

- Concept and significance
- Organization and general characters

9 hours/unit

M. Sc. III Semester
General Paper – I, Practical
STRUCTURE & FUNCTION IN INVERTEBRATES
Course code ZOO C 322

L	T	P	C
0	0	3	1

List of practical

1. Nervous System: Crab; Sepia/Loligo
2. Mounting: Nephridia and Spermatheca in Earthworm
3. Respiratory System: Mounting of Gills, Trachea and Book lungs
 PROTOZOA – Gregarines, Monocystis, Ceratium, Euplotes, Didinium, Noctiluca, Radiolaria, Stentor, Opalina
 PORIFERA – Sectional view of Sycon (T.S., L.S.), Grantia (T.S.)
 CNIDARIA – Slides of Obelia polyp and Medusa, Pennaria, Aurelia – Tentaculocysts
 Museum Specimens of Virgularia, Spongodus, Zoanthus, Favia
 HELMINTHES – Slides of Temnocephala
 Museum Specimens of ascaris lumbricoides, Taenia solium, Planaria
 ANNELIDA – Slide of Ozobranchus, Glossiphonia
 Museum Specimens of Eunice, Chloea flava, Polynoe, Terebella, Eurythoe
 ARTHROPODA – Slides of Cyclops, Daphnia, Chelifer, Section of Peripatus
 Museum Specimens of Balanus, Lepas, Palinurus, Uca, Pycna, Hippa, Gongylus, Belostoma, Limulus, Squilla, Eupagurus
 MOLLUSCA -
 Museum Specimens of Dolabella, Pteria, Nerita, Sanguinolaria, Chicoreus, Ficus, Lambis, tridacna Onchidium, Olvia, Murex, Turritella, Bulla, Cardium, Arca
 ECHINODERMATA –
 Museum Specimens of Linckia, Echinodiscus, Holothuria, Antedon
 MINOR PHYLA – Slides of Bugula, Plumatella, Cristatella, Pectinella
 Museum Specimens of phoronis, Dendrostoma
 SPECIMENS – Aurelia – Planula, Redia, Cercaria, Filiform of strongyloides, Trochophore, Nauplius, Zoea, Mysis, Phyllosoma, Trilobite larvae of limulus, Antlion, Veliger, Bipinnaria, Ophio and Echinopluteus, Auricularia, tornaria.

Suggested Reading Material

1. Hyman, L.H. The invertebrates Vol. I Protozoa through Ctenophora, McGraw Hill Co. New York.
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York&London.
4. Hyman, L.H. The Invertebrates Vol. 2 McGraw Hill Co. New York.
5. Hyman, L.H. The Invertebrates Vol. 8 McGraw Hill Co. New York 7 London
6. Barnes, R.D. Invertebrate Zoology, III edition. W.B. Saunders Co. Philadelphia.
7. Russel – Hunter, W.D. A biology of higher invertibrates, the Macmilan Co. Ltd. London
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol 5 McGraw Hill Co. New York
9. Read C.P. Animal Parasitism. Prentice Hall Inc. New Jersey

M. Sc. III Semester
General Paper – II
IMMUNOLOGY
Course code ZOO C 323

L	T	P	C
3	0	0	3

Unit - I: Components of the Immune System

1. Introduction to the Immune System
2. Cells, Tissues, and Organs of the Immune System
3. Antibodies
4. Complement
5. T Cell Receptors and MHC Molecules

Unit - II: Modes of Immune Response

1. Mechanisms of Innate Immunity
2. Mononuclear Phagocytes in Immune Defense
3. Antigen Presentation
4. Cell Cooperation in the Antibody Response
5. Cell-mediated Cytotoxicity
6. Regulation of the Immune Response
7. Immune Responses in Tissues
8. Hypersensitivity (Type I, II, III, IV)

Unit - III: Defense against Infectious Agents

1. Immunity to Viruses
2. Immunity to Bacteria and Fungi
3. Immunity to Protozoa and Worms
4. Primary Immunodeficiencies
5. AIDS, Secondary Immunodeficiency and Immunosuppression
6. Vaccination

Unit - IV: Immune Responses against Tissues

1. Immunological Tolerance
2. Autoimmunity and Autoimmune Disease
3. Transplantation and Rejection
4. Immunity to Cancers

Unit - V: Tools in molecular immunology

1. Antibody generation (mAb, pAb)
2. Evaluation of immune-response (ELISA, RIA, Western blot, Immuno-precipitation, immuno-fluorescence, flow cytometry)
3. Qualitative, quantitative and kinetic modes of expression: Real-time PCR, Microarray, LC-MS)
4. Large data acquisition and analysis: Functional genomics, Immune-seq, Systems biology

9 hours/unit

M. Sc. III Semester
General Paper - II, Practical
IMMUNOLOGY
Course code ZOO C 324

L	T	P	C
0	0	3	1

List of Practical

1. Immune system and organs in a mammalian animal model
2. Cells of the immune system (collection, isolation, characterization)
3. ELISA
4. Radial immuno-diffusion
5. Immunological diagnosis (Blood group)
6. Immunocytochemistry (Light, Fluorescent, Confocal Microscopy)
7. Flow cytometry (acquisition and analysis of immune cells)

Suggested Reading Material

1. Kuby Immunology, International Edition (2013) by Judy Owen, Jenni Punt and Sharon Stranford.
2. Fundamentals of Immunology, VII Edition (2012) by William E. Paul.
3. Immunology , VIII Edition (2013) by David Male, Jonathan Brostoff , David Roth and Ivan Roitt.

M. Sc. III Semester
CELL BIOLOGY (SPECIAL PAPER) III
CELL ARCHITECTURE : Course code ZOO C 325

L	T	P	C
4	0	0	4

Unit – I

Prokaryotic and eukaryotic cell organization

Various types of microscopy to study cell architecture

Sorting cells and their parts: flow cytometry, fractionation, centrifugation

Unit – II

Cytoskeleton: microtubules, microfilaments and related proteins

Microtubule polymerization, dynamic instability and treadmilling

Actin polymerization dynamics, cell crawling

Unit – III

Cell wall architecture: lipid and protein in cellular membrane, protein lipid interaction

Specialized regions of the plasma membrane: pancreatic acinus, plasma membrane of intestinal epithelial cell, microvilli

Cell junction: tight junction, gap junction

Unit – IV

Integrins, Collagen and non – collagen components

Nucleus

Interphase nucleus

Biogenesis of nucleus

Unit – V

Endoplasmic reticulum,

Golgi complex,

Mitochondria,

Lysosomes, Vacuoles, peroxisomes

12 hours/unit

Suggested Reading Material

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. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones.

M. Sc. III Semester
CELL BIOLOGY (SPECIAL PAPER) IV
CELL PHYSIOLOGY : Course code ZOO C 327

L	T	P	C
4	0	0	4

Unit – I

Transport across prokaryotic cells

Osmosis: movement of water and regulation of cell volume in animal cells

Internalization of macromolecules and particles: endocytosis, exocytosis, pinocytosis, phagocytosis

Unit – II

Concept of receptors, receptor ligand binding, endocrine, paracrine and autocrine signaling

Receptor mediated endocytosis

Extracellular receptors and their coupling to different signals transducing machinery: ion channels, active transport and ion pumps

Unit – III

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways

Second messengers and regulation of signaling pathways: phosphatidylinositol, inositol trisphosphate, DAG, cAMP, cGMP, prostaglandins

Receptor regulation

Unit – IV

Oxygen consumption of cells: aerobic oxidation

Glycolysis and fermentation: anaerobic oxidation

Cell oxidation with emission of light: luminescence

Bioenergetics and Oxidative phosphorylation

Unit – V

Action potential of cells and conduction of electrical impulse

Coupled reaction, Group transfer, Biological energy transducers

Development, propagation and transmission of action potential

Synapses and impulse transmission, Neurotransmitter receptors

12 hours/unit

Suggested Reading Material

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. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones.

M. Sc. III Semester
CELL BIOLOGY (SPECIAL PAPER) PRACTICAL
Course code ZOO C 326 & ZOO C 328

L	T	P	C
0	0	12	4

List of Practical

1. Visualization methods for cells and sub-cellular components: light microscopy, phase contrast microscopy, scanning and transmission microscopes, laser scanning confocal microscope and atomic force microscope
2. Demonstration of cell sorting by flow cytometry
3. Use of different types of centrifuge
4. Staining of Golgi complex, mitochondria, peroxisomes etc
5. Experiment on osmosis
6. Study of hemolysis
7. Introduction to nucleic acid and protein sequence databases: data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation

M. Sc. III Semester
Environmental Biology (SPECIAL PAPER) III
Course Code ZOO C 325

L	T	P	C
4	0	0	4

Unit I

- Definition, principles and scope of Environmental Science.
- Earth, Man and Environment. Ecosystems, Pathways in Ecosystems.
- Physico-chemical and Biological factors in the Environment.

Unit II

- Geographical classification and zones.
- Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.
- Natural resources, conservation and sustainable development.

Unit III

- **Chemical composition of Air** : Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical smog.
- **Water Chemistry** : Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential.
- **Soil Chemistry** : Inorganic and organic components of soil, Nitrogen pathways and NPK in soils.

Unit IV

- **Toxic Chemicals in the environment – Air, Water** : Pesticides in water.
- Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, Os and PAN Pesticides, Insecticides, MIC.
- Carcinogens in the air, water and soil.

Unit V

- **Principles of Analytical Methods** : Titrimetry, Gravimetry, Colourimetry, Spectrophotometry.
- Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC, HPLC.
- Electrophoresis. X – ray fluorescence, X – ray diffraction, Flame photometry.

M. Sc. III Semester
Environmental Biology (SPECIAL PAPER) IV
Course Code ZOO C 327

L	T	P	C
4	0	0	4

Unit I

- Structure and functions, Abiotic and Biotic components, energy flows, Food chains, Food web, Ecological pyramids, types and diversity.
- Ecological Succession, Population, Community ecology and Parasitism, Prey – predator relationships.

Unit II

- Common flora and fauna in India
- Aquatic : Phytoplankton, Zooplankton and Macrophytes.
- Terrestrial : Forests
- Endangered and Threatened Species

Unit III

- Biodiversity and its conservation : Definition, ‘Hotspot’s of Biodiversity, Strategies for Biodiversity conservation. National Parks and Sanctuaries. Gene pool.
- Microflora of Atmosphere : Air Sampling techniques. Identification of aeroallergens. Air – borne diseases and allergies.
- Environmental Biotechnology : Fermentation Technology, Vermiculture technology, Biofertilizer technology.

Unit IV

- Sun as source of energy; solar radiation and its spectral characteristics.
- Fossil fuels-classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas.
- Principles of generation of hydroelectric power, tidal, Ocean Thermal Energy Conversion, wind, geothermal energy; solar collectors, photovoltaics, solar ponds.
- Nuclear energy-fission and fusion; magnetohydrodynamic power.
- Bioenergy-energy from biomass and biogas, anaerobic digestion.
- Energy use pattern in different parts of the world.

Unit V

- Environmental implication of energy use.
- CO₂ emissions, global warming.
- Air and thermal pollution.
- Radioactive waste and radioactivity from nuclear reactors.
- Impact of large-scale exploitation of Solar, Wind, Hydro and Ocean energy.

M. Sc. III Semester
Environmental Biology (SPECIAL PAPER)
PRACTICAL
Course Code ZOO C 326 & ZOO C 328

L	T	P	C
0	0	12	4

- A visit to aquatic ecosystem and methods for water and plankton collection
- Plankton identification and quantification from river / lake water samples. 2
- Vegetation studies by line, quadrates and belt transect methods and their analysis
- Studies on different types of eco-system models.
- Food chains and food webs in different eco systems.
- Light as limiting factor in photosynthesis.
- Different biogeochemical cycles.
- Interspecies relationships: prey-predator relation, mutualism, commensalisms & parasitism etc.
- Social organization.
- Methods for calculation of population density.
- Different types of ecological pyramids.
- Experiment to demonstrate green house effect.
- Resources & their conservation.
- Estimation of alkali metals in various samples by flame-photometry.
- Water analysis for physico-chemical characteristics.

M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) III
STRUCTURE & FUNCTION OF INSECTS
Course Code ZOO C 325

L	T	P	C
4	0	0	4

Unit – I

Head: Segmentation, structure, endoskeleton, antenna

Mouth: Structure and mechanism of feeding, Types of mouth parts

Thorax: Structure, endoskeleton, structure and modification of legs

Wings: Origin, structure, modification and function of wings

Unit – II

Integument: Structure and chemistry

Abdomen: Structure, pregenital appendages, cerci and external genitalia

Digestive system: Structure and anatomy of the alimentary canal

Unit – III

Respiratory system: Structure in aquatic and terrestrial insects

Circulatory system: Circulatory organs, types and functions of hemocytes

Excretory system: Structure of excretory organs.

Unit – IV

Nervous system

Neuron endocrine system: Structure of neuroendocrine glands, structure and role of hormones, Endocrine control of metamorphosis and reproduction

Sense organs: photoreception, mechanoreceptor and chemoreception, sound production in insects

Unit – V

Reproductive System: structure of male and female reproductive system

Embryology: Pre and post embryonic development. Types of larvae and pupae, type of metamorphosis, diapauses

12 hours/unit

M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Course Code ZOO C 326

L	T	P	C
0	0	6	2

List of practical

1. Types of antenna and mouth parts
2. Different types of wings, tegmina, hemielytra, different types of wings venation.
Male genitalia: Grasshopper and coleoptera
Female genitalia: Grasshopper, Gryllus, Coleoptera
3. Sting of honey bee and wasp
4. Preparation of pericardial cells, oenocytes and nephrocytes
5. Different types of spiracles, opening and closing mechanism respiratory organs in aquatic insects
6. Auditory and sound producing organs
7. Neuroendocrine system of cockroach, grasshopper and bugs
8. Sympathetic and central nervous system of the above mentioned insects
9. reproductive system of male and female insects

M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) IV
TAXONOMY
Course Code ZOO C 327

L	T	P	C
4	0	0	4

Unit – I

Origin and evolution of insects

Molecular markers in insects: Classes of molecular marker

Classification of insects up to orders following Imms revised by Richards and Davis Vol. I & II

Unit – II

Classification up to super families following Imms revised by Richards and Davis Vol. I & II

Apterygota: *Thysanura, Diplura, Protura, Collembola*

Pterygota: Palaeoptera, Odonata

Orthopteroid: *Orthoptera*

Unit – III

Classification up to superfamilies:

Orthopteroid: Dictyoptera, Isoptera

Hemipteroid: Hemiptera (Homoptera, Heteroptera)

Neuropteran: Coleoptera

Panorgod insects: Diptera, Lepidoptera, Hymenoptera

Unit – IV

Biology and Control of insect pests of:

Cash crop: soybean, sugar cane

Oil seeds: cotton, sunflower, mustard

Cereal: pea, arhar, masoor, moong

Unit – V

Stores grain pests wheat, gram and rice

Vegetable: cabbage, bhindi, brinjal, tomato, potato

Fruits: mango, citrus, papaya

12 hours/unit

M. Sc. III Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Course Code ZOO C 328

L	T	P	C
0	0	6	2

List of practical

1. Collection
2. Identification
3. Classification of insects belonging to the different orders as follows:

Apterygota: *Thysanura*, *Diplura*, *Protura*, *Collembola*

Pterygota: Palaeptera, Odonata

Orthopteroid: Orthoptera

Orthopteroid: Dictyoptera, Isoptera

Hemipteroid: Hemiptera, Isoptera

Neuropteran: Coleoptera

Panorgod insects: Diptera, Lepidoptera, Hymenoptera

M. Sc. III Semester
FISH (SPECIAL PAPER) III
FISH STRUCTURE AND FUNCTION
Course Code ZOO C 325

L	T	P	C
4	0	0	4

Unit – I

Structural modifications in fins of fishes
Integumentary System (Histomorphology and Function of Skin, Dermal Derivatives, Placoid, Cosmoid, Ganoid, Bony ridges scales, Colouration)

Unit – II

Osteology (Axial Skeleton-Skull; Loose bones of visceral skeleton, vertebral column and Ribs; Appendicular Skeleton)
Weberian Apparatus (Structure, Homology and function)

Unit – III

Lateral Line System (Lateral line canal, Neuromast Organs, Histology of Lateral line canal, Special types of Neuromast)
Air Bladder (Gases in Air Bladder, Histo-morphology, Blood supply, Function and Economic Importance)

Unit – IV

Electric organs (Structure and functioning mechanism)
Sound producing organs (Sonic mechanism in various fishes and significance of sound production in fishes)
Poison glands (Difference between poisonous and venomous fishes, chemical nature of Fish toxins)
Light Producing Organ (structure of organ and mechanism of light emission)

Unit – V

Adaptations in fishes (Definition and significance
Structural modification in Deep-sea fishes
Structural modification in Hill streams

12 hours/unit

M. Sc. III Semester
FISH (SPECIAL PAPER) IV
FISH ANATOMY & PHYSIOLOGY
Course Code ZOO C 327

L	T	P	C
4	0	0	4

Unit – I

Gill Respiration (Structure of gill, blood supply and mechanism of respiration)

Digestive System (Structure and adaptive modification in Alimentary canal, Physiology of Digestion)

Unit – II

Nervous System (structure and function of CNS and PNS, Cranial Nerves)

Circulatory system (Structure of heart, arterial system, Venous System, Physiology of Circulation)

Unit – III

Neuroendocrine integration in fish

Endocrine glands (Structure and function of pituitary gland, thyroid gland, Adrenal gland, Corpuscles of Stannius, Ultimobranchial glands, Pancreatic Iselets, Pineal Organs)

Unit – IV

Excretion (Structure of Kidney and physiology of excretion)

Osmoregulation and Ionic Balance in marine and freshwater teleost.

Unit – V

Reproductive System (Structure of male and female reproductive organs)

Events in relation to development of fish

Parental Care

12 hours/unit

M. Sc. III Semester
FISH (SPECIAL PAPER) PRACTICAL
Course Code ZOO C 326 & ZOO C 328

L	T	P	C
0	0	12	4

List of Practical

1. Dissections:
 - a. Major Dissection:
 - i. Cranial nerves of Wallago and Scoliodon
 - ii. Internal ear, air bladder connection in Mystus and Wallago
 - b. Minor Dissection:
 - i. Afferent arteries of Scoliodon
 - ii. Cranial nerves of Torpedo and Trygon
 - iii. Weberian ossicles of Clarias
2. Age determination in Fish
3. Sexual dimorphism in Fish
4. Modification in digestive system as per the feeding behavior in Fish
5. Experiments on induced breeding
6. Mounting (Permanent): ctenoid and cycloid scales
7. Study of histological slides of various tissues of Fish
8. Microtomy:
 - a. Section cutting of various tissues of fish
 - b. Serial T. S. of fish embryo
 - c. Alizarin preparation of fish

M.Sc. COURSE, SESSION - 2014-15
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 322 A
Molecular Reproduction & Development

L	T	P	C
2	0	1	3

Unit I: Male reproductive physiology

1.1 Overview of spermatogenesis and male infertility factors

Unit II: Female reproductive physiology

2.1 Overview of oogenesis and factors affecting female fertility regulation

Unit III: Development

1.1 Principles of animal development

1.2 Maternal information

1.3 Induction and regulation of gene expression during development

Unit IV: Developmental genetics

4.1 Organization of human genome

4.2 pattern of mendelian inheritance

4.3 genomic imprinting

Unit V: Biochemical basis of genetic diseases

1.1 Human genetic disorders

1.2 Genetics of childhood cancer

1.3 Genetic counselling and prenatal diagnostics

6 hours/unit

M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Course Code ZOO E 322 B

1. Basic evaluation of male and female reproductive tract in a mammalian model
2. Introduction to human genome mapping
3. Chromosomal analysis using software interface

M.Sc. COURSE, SESSION - 2014-15
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 323 A
Molecular Taxonomy and DNA Barcoding

L	T	P	C
2	0	1	3

Unit 1.0: Basics of Molecular Taxonomy

- 1.1 Description, Illustration and communicating molecular biodiversity
- 1.2 DNA barcode for Tree of Life

Unit 2.0: Molecular Taxonomy tools and Protocols

- 2.1 Introduction of mitochondrial DNA for molecular taxonomy
- 2.2 Techniques of extraction of mDNA.
- 2.3 Amplification technique of *coi* gene
- 2.3 Quantification and documentation of DNA and PCR product

Unit 3.0: Barcode analysis Software

- 3.1 Introduction of alignment of sequence
- 3.2 Phylogenetic analysis of ecological communities using DNA barcode

Unit 4.0: Laboratory Information Management System (LIMS) for DNA Barcoding

Unit 5.0: Introduction of Barcode of Life Data Base (BOLD)

6 hours/unit

M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Course Code ZOO E 323 B

- 1: Collection and preservation of biological Specimens for Molecular studies.
- 2: Extraction and Quantification of mDNA of preserved specimen
- 3: Amplification of *coi* gene.
- 4: Bioinformatics based sequence assembly, alignment and analysis.

M.Sc. COURSE, SESSION - 2014-15
PG THIRD SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 324 A
Free Radicals, Oxidative Stress and Antioxidants

L	T	P	C
2	0	1	3

Unit 01 : Introduction

- 1.1 General aspects of Oxidative stress;
- 1.2 Types of free radicals and their formation;
- 1.3 Reactive oxygen species (ROS)/ Reactive Nitrogen species (RNS);
- 1.4 Interaction with biological molecules.

Unit 02 : Antioxidant Mechanisms

- 2.1 Mechanisms of antioxidant action;
- 2.2 Repair systems and inducible defenses against oxidant stress;
- 2.3 Vitamins and antioxidant enzymes.

Unit 03: Oxidative Stress: Molecular mechanisms and biological effects

- 3.1 Free radical mediated damage to biomolecules
- 3.2 Mitochondrial biology and oxidative stress
- 3.3 Oxidative stress in Cancer Biology.

Unit 04 : Techniques to Analyse Free Radicals

- 4.1 Electron spin resonance (ESR) or electron paramagnetic resonance (EPR) spectroscopy;
- 4.2 Dichlorofluorescein diacetate (DCF-DA), Diaminofluorescein diacetate (DAF-2DA), Dihydroethidium (DHE) dyes
- 4.3 Assays of antioxidant enzymes.

Unit 05 : Free Radicals in Health and Disease

- 5.1 Toxicity of oxygen;
- 5.2 Pathological systems and toxic responses;
- 5.3 Pathological and Physiological Significance.

Suggested Readings:

1. An introduction to Free Radical Chemistry by A. F. Parsons, 2000.
2. Free Radicals: An Introduction by A. F. Trotman-Dickenson, 1959.
3. Cellular antioxidant defence mechanisms by Ching Kuang Chow, 1988.
4. Free Radicals, oxidative stress and antioxidants. Pathological and physiological significance. Edited by Tomris Ozben. NATO ASI Series, Series A: Life Sciences Vol. 296.
5. Laboratory Techniques in biochemistry and molecular biology by C.A. Rice-Evans, A.T. Diplock, M.C.R. Symons.

6 hours/unit

M. Sc. III Semester
PAPER V (ELECTIVE COURSE) PRACTICAL
Course Code ZOO E 324 B

L	T	P	C
2	0	1	3

Practical Course:

1. Detection of free radicals (OH⁻, NO) by fluorescence microscopy.
2. Antioxidant enzyme assays by ELISA.

SYLLABUS FOR M.Sc. COURSE IN ZOOLOGY

PG FOURTH SEMESTER

SESSION – 2014-15



SCHOOL OF BIOLOGICAL SCIENCES (SBS)

**DR. HARI SINGH GOUR UNIVERSITY
SAGAR (M.P.) 470 003**

M. Sc. IV Semester
General Paper – I
Structure and Function in Vertebrates
Course code ZOO C 421

L	T	P	C
3	0	0	3

Unit – I

Classification of Vertebrates
Origin of Vertebrates
Comparative account of Petromyzontia and Myxinoidea
Characters and Classification of Placodermi
General organization and Classification of Elasmobranchii
General organization and Classification of Osteichthyes
Brief account of Dipnoi, Holocephali

Unit – II

General organization and Classification of Amphibians, Limbless Amphibian
Origin of Amphibia
General organization and Classification of Reptilians
Brief account of Chelonia, Dinosaurs, Crocodiles, Lizards and snakes

Unit – III

General organization and Classification of Birds
Origin of Birds
Flight adaptation in Birds
Brief account of Archaeopteryx and Flightless Birds

Unit – IV

Characters and Classification of Mammals
Brief account of Prototheria , Metatheria, and Eutheria

Unit – V

Brief account of-
Primate, Chiropterans, Cetacean, Carnivores, Proboscidea, Rudentia
Aquatic Mammals, Stomach in Ruminants

9 hours/unit

M. Sc. IV Semester
General Paper – I, PRACTICAL
Structure and Function in Vertebrates
Course code ZOO C 422

L	T	P	C
0	0	3	1

List of Practical

1. Dissections: Rat/mouse/Scoliodon – Digestive, Reproductive, Arterial, Venous systems, neck nerves.
2. Museum specimens and slides
Protochordates – Salpa-sexual, Salpa-asexual, Botryllus, Herdmania, Fishers
3. Museum Specimens (Protochordates to mammals)
4. Slides: sections of skin, alimentary canal, lungs, gills, kidney, ovaries and testes of different groups of vertebrates.
5. Dissection: (major and minor in Scoliodon/electric ray)
 - a. Fish
 - a) afferent blood vessels
 - i. b) Efferent blood vessels
 - b. Frog
 - c) Cranial Nerves
 - i. d) Spinal nerves
 - ii. e) Digestive system
 - iii. f) Urinogenital system
 - iv. g) Sense organs e.g. Eye, Internal ear, Lateral line
6. General anatomy of Herdmania
7. Preparation of permanent slides of test and pharyngeal wall of Herdmania, Amphioxus: anterior region: w.m., different types of scales in fishes in fishes, ampulla of Lorenzini.
8. Microtomy to prepare stained, permanent mounts of different organs e.g. skin, liver, lung, kidney and gonads etc.
9. Skeletal system: fish, amphibian, reptilian, aves and mammal.
10. Accessory respiratory organs in fishes.
11. Blood supply to air tube in *Heteropneustes*.

M. Sc. IV Semester
General Paper – II
Environmental Biology and Ethology
Course code ZOO C 423

L	T	P	C
3	0	0	3

Unit I: Environmental health and toxicology

1. Introduction to Toxicology
2. Kinds of Toxic Substances
3. Toxicity-Influencing Factors
4. Exposure to Toxic Substances
5. Dose–Response Relationships
6. Xenobiotic and Endogenous Substances
7. Toxification and Detoxification
8. Synergism, Potentiation, and Antagonism
9. Behavioral and Physiological Responses
10. Reproductive and Developmental Effects

Unit II : Conservation and management of natural resources

1. Natural resources conservation and Management
2. Biodiversity: Need for conservation of biodiversity
3. Benefits and threats to biodiversity
4. Endangered species management and biodiversity protection
5. Alternative sources of Energy

Unit III : Global Environmental Issues

1. Global Warming and Global Cooling
2. Green House Effect
3. Ozone Depletion
4. Acid Rain
5. Sea level rise
6. Antarctica: Environmental politics & resource development regimes

Unit IV : Environmental Protection and Impact Assessment

1. The Environmental protection Act, 1986
2. Air Pollution Act, 1981 and Motor Vehicle Act, 1988
3. Water Protection Act, 1974
4. The Wildlife Protection Act, 1972
5. Introduction to environmental impact analysis.
6. Environmental impact Statement and Environmental Management Plan.
7. EIA guidelines 1994, Notification of Government of India.
8. Impact Assessment Methodologies.

9. Procedure for reviewing Environmental impact analysis and statement.
10. Guidelines for Environmental audit.

Unit V : Ethology

- Introduction to animal behaviour
- Genetic and neural basis of behavior
- Habitat selection and foraging behaviour
- Animal signals and communication
- Sexual conflict: Parental care, Sexual selection
- Social organization: Theories of social behavior, Altruism

9 hours/unit

M. Sc. I Semester
Environmental Biology- Practicals
Course Code ZOO C

L	T	P	C
0	0	12	4

List of practical:

1. Field visit to river/lake and water and wastewater treatment plants.
2. Water analysis of municipal and industrial wastes for the detection of DO, BOD, COD, Alkalinity, pH, turbidity, and temperature.
3. Soil analysis for the detection of N, P, & K.
4. Waste water treatment methods.
5. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
6. Biodegradation of pesticides.
7. Models of non-conventional energy resources
8. Wild life: endangered and frightened species
9. Experiment to demonstrate green house effect.
10. Resources & their conservation.
11. Biosphere reserves, National parks and wildlife sanctuaries in India.
12. Demonstration of reflexes in man
13. Study of learning behaviour.
14. Display of electric organ of an electric ray.
15. Demonstration of parental care / nest building / sexual dimorphism.
16. Study of learning behaviour in mice by using a zigzag or T-shaped maze
17. Study of wall-seeking behaviour in mice
18. A field study of play behaviour or parent-young interactions in a troop of rhesus monkeys
19. A field study of foraging or trail making behaviour in a seed harvester or predatory ant species

Suggested Reading Material

1. Alcock : Animal Behaviour: An Evolutionary Approach (7th ed 2005, Sinaur).
2. Bolhuis & Giraldeau: The Behavior of Animals: mechanisms, function, and evolution (2005, Blackwell)
3. Drickamer, Vessey & Jakob: Animal Behavior: Mechanisms, Ecology, Evolution (2007, McGraw-Hill)
4. Krebs & Davis: Behavioural Ecology. (3rd ed 1993, Blackwell)
5. Lehner: Hand Book of Ethological Methods.(2nd ed 1996, Garland)
6. Manning & Dawkins: An introduction to Animal Behaviour (5th ed 1998, Cambridge Univ. Press)

M. Sc. IV Semester
CELL BIOLOGY (SPECIAL PAPER) III
Cytogenetics: Course code ZOO C 425

L	T	P	C
4	0	0	4

Unit – I

Structure of eukaryotic chromosome

Euchromatin and Heterochromatin

Organization of genes and chromosomes: Operon, interrupted genes, gene families

Unit – II

Normal human karyotype, G – banding

Human sex chromosomes and determination of sex

Human chromosomal abnormalities: Sex chromosomal anomalies, autosomal anomalies

Structure of chromatin and chromosomes, unique and repetitive DNA, transposons

Unit – III

Major classes of eukaryotic DNA

Genetic map of the human chromosome

Somatic cell genetics, hybrid and their applications, heterokaryon

Cytogenetic effect of ionizing and non – ionizing radiation

Unit – IV

Genetic transfer in bacteria (bacterial recombination): conjugation, transduction, transformation

Mobile DNA with reference to transposons in bacteria

Types of bacteriophages

Conformations of nucleic acids (A-, B-, Z-DNA, t-RNA, micro-RNA) and their stability, C-value paradox

Unit – V

The genetic code, codon – anticodon recognition

Structure and types of RNA

Properties of t – RNA for pairing and proof reading

Concept of gene therapy

12 hours/unit

M. Sc. IV Semester
CELL BIOLOGY (SPECIAL PAPER) IV
Molecular Biology: Course code ZOO C 427

L	T	P	C
4	0	0	4

Unit – I

DNA replication: unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons

DNA damage and repair mechanisms

Transcription (gene expression): mechanism and regulation, transcription factors and machinery

RNA processing, RNA editing and splicing

Post transcriptional modifications

Unit – II

Translation: mechanism and regulation

Post translational modifications

Control of gene expression at transcription and translation levels

Antisense molecules in regulation of gene expression and gene silencing

Unit – III

Molecular markers: RFLPs, RAPDs, Minisatellites, Microsatellites

Genetic maps of mouse & fruitfly using molecular markers

Cytogenetics maps using molecular markers: flow sorting, PFGE, microdissection, radiation hybrids

Physical maps using molecular markers: deletions ISH, YAC

Unit – IV

Gene cloning techniques, Enzymes used in genetic engineering

Cloning vectors: plasmids, phages, cosmids, phagemids, viruses, transposons, YAC, MAC

PCR: working mechanism and applications

Unit – V

DNA fingerprinting, DNA footprinting

DNA isolation and sequencing

Southern, northern and western blotting, Dot blots and Slot blots

Gene transfer methods in animals: transgenic animals

12 hours/unit

M. Sc. IV Semester
CELL BIOLOGY (SPECIAL PAPER) PRACTICAL
Course code ZOO C 426 & ZOO C 428

L	T	P	C
0	0	12	4

List of Practical

1. Study of normal human karyotype
2. Study of chromatin by Feulgen staining
3. UV Spectrophotometer estimation of DNA, RNA and protein
4. Isolation and purification of genomic DNA & RNA and plasmid
5. Isolation and separation methods for analysis of proteins
6. Separation of proteins by SDS-PAGE
7. Separation of DNA by agarose gel electrophoreses

M. Sc. IV Semester
Environmental Sciences (SPECIAL PAPER) III
Course code ZOO C 425

L	T	P	C
4	0	0	4

Unit-I

1. Air : Natural and anthropogenic sources of pollution. Primary and Secondary pollutants. Transport and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere. Methods of monitoring and control of air pollution SO₂, NO_x, CO, SPM. Effects of pollutants on human beings, plants, animals, materials and on climate. Acid Rain. Air Quality Standards.
2. Water : Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard.
3. Soil : Physico-chemical as bacteriological sampling as analysis of soil quality. Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro-organisms and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil.

Unit-II

1. Noise : Sources of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health.
2. Marine : Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system-coastal management.
3. Radioactive and Thermal Pollution.

Unit-III

1. Introduction to environmental impact analysis.
2. Environmental impact Statement and Environmental Management Plan.
3. EIA guidelines 1994, Notification of Government of India.
4. Impact Assessment Methodologies.
5. Procedure for reviewing Environmental impact analysis and statement.
6. Guidelines for Environmental audit.

Unit-IV

1. Introduction to Environmental planning.
2. Base line information and predictions (land, water, atmosphere, energy, etc.).
3. Restoration and rehabilitation technologies.
4. Landuse policy for India.
5. Urban planning for India.
6. Rural planning and landuse pattern.

Unit-V

1. Concept and strategies of sustainable development.
2. Cost-Benefit analysis.
3. Environmental priorities in India and sustainable development.

12 hours/unit

M. Sc. IV Semester
Environmental Sciences (SPECIALPAPER) IV
Course code ZOO C 427

L	T	P	C
4	0	0	4

Unit I

1. Sources and generation of solid wastes, their characterization, chemical composition and classification.
2. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes)
3. Recycling of waste material.
4. Waste minimization technologies.
5. Hazardous Wastes Management and Handling Rules, 1989.

Unit II

1. Resource Management, Disaster Management and Risk analysis.
2. Environment protection-issues and problems.
3. International and National efforts for Environment Protection.
4. Provision of Constitution of India regarding Environment (Article 48A and 58A).
5. Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control.

Unit III

1. Wildlife Protection Act, 1972 amended 1991.
2. Forest Conservation Act, 1980.
3. Indian Forests Act (Revised) 1982.
4. Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988.
5. The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975.
6. The Environment (Protection) Act, 1986 and Rules 1986.
7. Scheme of labelling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991.

Unit IV

1. Environmental Education and Awareness. Environmental Ethics and Global imperatives.
2. Global Environmental problems-ozone depletion, global warming and climatic change.
3. Current Environmental issue in India. In context to Narmada Dam and Tehri Dam etc.
4. Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil.
5. Waste lands and their reclamation.
6. Desertification and its control.
7. Vehicular pollution and urban air quality.

Unit V

1. Depletion of Nature resources.
2. Biodiversity conservation and Agenda – 21.
3. Waste disposal, recycling and power generation, Fly ash utilization. Water Crises- Conservation of water.
4. Environmental Hazards.
5. Eutrophication and restoration of Indian lakes. Rain water harvesting. Wet lands conservation.
6. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic).

12hours/unit

M. Sc. IV Semester
Environmental Sciences (SPECIAL PAPER)
PRACTICAL
Course code ZOO C 426 & ZOO C 428

L	T	P	C
0	0	12	4

List of practical:

1. Comparative analysis of air sampling from clean and polluted area using key parameters.
2. Collection and Interpretation of weather data.
3. Field visit to river/lake and water and wastewater treatment plants.
4. Water analysis of municipal and industrial wastes for the detection of DO, BOD, COD, CO₃, HCO₃, Cl₂, Alkalinity, pH, turbidity, and temperature.
5. Soil analysis for the detection of N, P, K, NO₃, SO₄, Cl₂, CO₃ etc.
6. Waste water treatment methods.
7. Detection of heavy metals in water samples.
8. Detection of pesticide residues by TLC.
9. Calculation of LC₁₀₀, LC₅₀, LC₀, sub-lethal concentration, LD₁₀₀, LD₅₀, LD₀ and sub-lethal doses.
10. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
11. Biodegradation of pesticides.
12. Models of non-conventional energy resources
13. Vermiculture and composting.
14. Wild life: endangered and frightened species
15. Biosphere reserves, National parks and wildlife sanctuaries in India.

M. Sc. IV Semester
FISH (SPECIAL PAPER) III
TAXONOMY, SYSTEMATIC AND ECOLOGY OF FISHES
Course code ZOO C 425

L	T	P	C
4	0	0	4

Unit – I

Evolution and Phylogeny of Fishes

Placoderms (Salient features and Affinities)

Unit – II

Elasmobranchs (Salient features and outline classification)

Holocephali (Salient features and Affinities)

Unit – III

Dipnoi (Origin, Distribution, Key characters, Biology, Affinity)

Berg's Classification of Teleostomii

Unit – IV

Fish parasites and their control

Indigenous Cultivable Fishes

Migration in Fishes

Unit – V

Plankton and their significance in fish culture

Fishing methods in India

12 hours/unit

M. Sc. IV Semester
FISH (SPECIAL PAPER) IV
PISCICULTURE AND ECONOMIC IMPORTANCE OF FISHES
Course code ZOO C 427

L	T	P	C
4	0	0	4

Unit – I

Economic importance and by-products of Fishes
Physico-Chemical and Biological Factors in Fish

Unit – II

Construction and Maintenance of Fish Farm
Composite Fish Culture

Unit – III

Fish culture in fresh water
Sewage Fed Fisheries

Unit – IV

Inland Fisheries
Marine fisheries

Unit – V

Methods of fish Preservation
Aquarium fishes and maintenance of aquarium
Larvivorous fishes

12 hours/unit

M. Sc. IV Semester
FISH (SPECIAL PAPER) PRACTICAL
Course code ZOO C 426 & ZOO C 428

L	T	P	C
0	0	12	4

List of Practical

Systematic

Collection and Identification of fishes (local fauna) with the help of fish fauna
Identification of various weeds of fish pond

Fish

Study of endoskeleton of Labeo/Catla and Wallago/Mystus
Study of kidney and single nephron in a local fish

Experimentation:

Experiment of colour change mechanism in fish
Schooling behaviour of fish
Gonadectomy and spinalectomy in fish
Effect of respiratory depressant in a fish
Determination of oxygen consumption in fish

Dissections:

Major Dissection:

Cranial nerves of *Mystus*
Lateral line system of *Scoliodon*
Internal ear of *Scoliodon*

Minor Dissection:

Air tube and its blood supply in *Heteropneustes*

Mounting:

Placoid scale of *Scoliodon*
Ampulla of Lorenzini of *Scoliodon*

Microtomy: serial T.S. of fish embryo

M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) III
Physiology and Biochemistry
Course code ZOO C 425

L	T	P	C
4	0	0	4

Unit – I

Integument: Moulting and sclerotization

Physiology of digestion and assimilation of nutrients

Unit – II

Physiology of circulation and biochemistry of haemolymph

Physiology of respiration in terrestrial and aquatic insects

Unit – III

Physiology of excretion

Physiology of reproductive system

Physiology of nervous system

Unit – IV

Insect immunity: Cellular and humoral

Coloration in insects

Bioluminescence: Structure of bioluminescent organs and physiology of bioluminescence.

Unit – V

Carbohydrate, protein and lipid metabolism

Detoxification mechanism in insects

Physiology and biochemistry of ageing

12 hours/unit

M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Physiology and Biochemistry
Course code ZOO C 426

L	T	P	C
0	0	6	2

List of practical

1. Salivary glands of *Drosophila* larvae and *Chironomus* larvae.
2. Physiology experiments to show: (i) functions of malpighian tubules (ii) insects produce moisture from the spiracles during flight
3. Study of histochemical techniques in insect tissues
4. Study of protein, carbohydrate and lipid estimation in insect tissues
5. Determination of haemocyte count of a given insect
6. Identification of different types of haemocytes

M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) IV
Applied Entomology & Insect Ecology
Course code ZOO C 427

L	T	P	C
4	0	0	4

Unit – I

Basic principles of insect control

Chemical control: insecticides, their classification and mode of action

Insect resistance to insecticides, 3rd generation pesticides, chemosterilants and radiations

Unit – II

Insect pest control: role of hormones, pheromones, antifeedents, attractants, repellents, plant products

Biological control: Principle, procedure, success and limitation

Unit – III

Beneficial insects: Life cycle & Polymorphic forms of Honey Bee & Termite

Importance of beneficial insects: apiculture, sericulture, lac culture

Integrated pest management (IPM)

Unit – IV

Insects in medical, veterinary sciences: Common vector insects, their mode of transmission, life cycle, diseases & control

Insect in forensic and forest sciences: Common insects & their life cycle

Unit – V

Principles of insect ecology

Effect of temperature, humidity and light on the biology of insects

Social behaviour of insects: migration, adaptation and distribution

12 hours/unit

M. Sc. IV Semester
ENTOMOLOGY (SPECIAL PAPER) PRACTICAL
Applied Entomology & Insect Ecology
Course code ZOO C 428

L	T	P	C
0	0	6	2

List of practical:

1. Collection, identification and classification of insects belonging to the different orders
2. Collections of insects of medical importance and their life cycle
3. Collection of polymorphic forms of honey bee and termites
4. Effect of an insecticides on a household pest
5. Effects of abiotic factors like temperature, humidity and light on insects.

M.Sc. COURSE, SESSION - 2013-14
PG FOURTH SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 422 A
Molecular Medicine

L	T	P	C
2	0	1	3

Unit I: Technology & Society

- 1.1 Historical perspectives
- 1.2 evolution & dynamics of modern biology

Unit II: Biomedical basis of disease: From Gene to Protein to Disease

- 2.1 Cause and molecular/cellular progression of key diseases including infectious
- 2.2 inherited diseases
- 2.3 emphasising specially on cancer

Unit III: Analytical Technology

- 3.1 Basic principles of DNA sequencing
- 3.2 flow cytometry
- 3.3 laser scanning confocal microscopy
- 3.4 Real Time PCR

Unit IV: Genetic & Molecular Epidemiology

- 4.1 Basic principles
- 4.2 Bioinformatic tools
- 4.3 key tests and data interpretation using cutting-edge platforms

Unit V: Translational Research

- 5.1 Integrating pharmacogenetic approaches to health-care systems

6 hours/unit

M. Sc. IV Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 422 B

Practical Course:

- 1. Hands on experience to basic molecular tools and techniques
- 2. Medline database search and basic bioinformatics.

M.Sc. COURSE, SESSION - 2013-14
PG FOURTH SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 423
Methods in Molecular Biology

L	T	P	C
2	0	1	3

Unit-I: Methods in Protein Biochemistry

- 1.1 Protein purification and separation methods
- 1.2 Application of centrifugation techniques
- 1.3 Chromatographic separation techniques
- 1.4 Electrophoresis – principle and methods

Unit-II: Protein Purification and Characterization

- 2.1 Protein isolation from plants and animal tissues, and cell cultures
- 2.2 Protein quantification
- 2.3 Catalytic identification of enzymes on electrophoresis

Unit-III: Methods in Nucleic Acids - DNA

- 3.1 DNA isolation from plants and animal tissues, and cell cultures
- 3.2 DNA purification methods
- 3.3 DNA quantification
- 3.4 Agarose gel electrophoresis – principle and methods (DNA and RNA)

Unit-IV: Methods in Nucleic Acids - RNA

- 4.1 Total RNA isolation from plants and animal tissues, and cell cultures
- 4.2 RNA purification and quantification
- 4.3 Agarose gel electrophoresis for RNA

Unit-V: Basics of gene expression analysis

- 5.1 Polymerase chain reaction – principles and methods
- 5.2 Real-Time PCR
- 5.3 Application of RNA for PCR amplification in analysis of gene expression

6 hours/unit

Suggested Reading Material

1. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John M. Walker.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.

**M. Sc. IV Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 423 B**

List of Practical:

1. Demonstration of spectrophotometry
2. Demonstration of chromatographic techniques
3. Isolation of Protein from plant/animal tissues
4. Demonstration of protein precipitation
5. Estimation of protein by spectrophotometer
6. Separation of proteins by SDS-PAGE
7. Isolation of nucleic acids from plant/animal tissues
8. Estimation of nucleic acids by spectrophotometer
9. Separation of nucleic acids by agarose gel electrophoresis
10. Demonstration of PCR and RT-PCR

M.Sc. COURSE, SESSION - 2013-14
PG FOURTH SEMESTER, (ELECTIVE COURSE) IN ZOOLOGY
COURSE CODE ZOO E 424 A
Bioinformatics

L	T	P	C
2	0	1	3

Unit 01: Introduction

- 1.1 History and Scope of Bioinformatics
- 1.2 Definitions of Bioinformatics
- 1.3 Importance of Bioinformatics

Unit 02: Computers, Internet, World Wide Web and NCBI

- 2.1 Computers and Programs
- 2.2 Internet
- 2.3 World Wide Web & Browsers
- 2.4 EMBnet& NCBI

Unit 03: DNA, RNA and Proteins

- 3.1 Principles of DNA sequencing
- 3.2 Principles of RNA sequencing
- 3.3 Principles of Protein sequencing
- 3.4 Gene & Protein Expression Analysis
- 3.5 DNA microarray
- 3.6 Human Genome Project

Unit 04: Databases, Tools and their Uses

- 4.1 Importance of databases
- 4.2 Nucleic acid sequence databases
- 4.3 Protein sequence databases
- 4.4 Primary sequence databases- GenBank; NCBI; EMBL; ODBI
- 4.5 Subsidiary sequence databases-SWISS-PROT; TrEMBL; UniProt
- 4.6 Organism specific resources-OMIM; Unigene
- 4.7 Database Formats; Medline; PubMed; Web of Science
- 4.8 Uses of databases

Unit 05: Analyzing and Retrieving Databases

- 5.1 Sequence alignment methods
- 5.2 Pairwise and Multiple sequence alignment
- 5.3 Analyzing Protein sequences
- 5.4 Analyzing DNA sequences
- 5.5 Analyzing RNA sequences
- 5.6 BLAST; ClustalW
- 5.7 Phlogenetic Trees-Phylip

6 hours/unit

Suggested Readings:

1. “Understanding Bioinformatics” by Marketa J. Zvelbil; Publisher-Garland Science; ISBN-10:0815340249.
2. “Introduction to Bioinformatics” by Arthur M. Lesk; Publisher-Oxford University Press; ISBN-10:0199208042.
3. “Basic Bioinformatics” by S. Iganacimuthu; Publisher-Narosa; ISBN-978-81-7319-540-9.
4. “Bioinformatics for Dummies” by Jean-Michel Claverie, Publisher-For Dummies; ISBN-10:0470089857.

**M. Sc. IV Semester
ELECTIVE COURSE PRACTICAL
Course Code ZOO E 424 B**

List of Practical:

1. Demonstration of PubMed in searching scientific literature using authors name, fields, limits etc.
2. Demonstration of BLAST in comparing Protein Sequences.
3. Demonstration of ClustalW in Multiple sequence alignment.
4. Demonstration of Rasmol in Protein structure visualisation.
5. Designing PCR primers.