

**M.Sc. ZOOLOGY SYLLABUS  
(SEMESTER SYSTEM)  
2011 - ONWARDS**

**M. Sc. Zoology 2011-2012 Onwards**

**(B) SCHEME OF EXAMINATION**

**FIRST SEMESTER**

<b>Number &amp; Title of the course</b>	<b>Max. Marks</b>	<b>Min. Marks for Passing</b>	<b>Min. Aggr. Marks For Passing</b>
<b>(A) THEORY PAPERS</b>			
I Biosystematics, taxonomy and evolution	35	12	
II Structure and function of Invertebrates	35	12	
III Quantitative Biology, biodiversity and wild life	35	12	
IV Biomolecules and structural Biology	35	12	
<b>(B) PRACTICALS</b>			
<b>I (based on Course I &amp; II)</b>	50	20	
<b>II (based on course III &amp; IV)</b>	50	20	
<b>(C) INTERNAL ASSESSMENT /</b>			
<b>CCE *4 Written Test based on each course (each of 15 marks)</b>	60	5 in each test	
<b>Project/Assignment/Seminar</b>	50	20	
<b>TOTAL</b>	<b>350</b>	-----	<b>140</b>

\* Candidate has to pass in each test separately

**SECOND SEMESTER**

<b>Number &amp; Title of the course</b>	<b>Max. Marks</b>	<b>Min. Marks for Passing</b>	<b>Min. Aggr. Marks For Passing</b>
<b>(A) THEORY PAPERS</b>			
V General and comparative animal physiology and endocrinology	35	12	
VI Population ecology and environmental physiology	35	12	
VII Tools and techniques in Biology	35	12	
VIII Molecular cell biology and genetics	35	12	
<b>(B) PRACTICALS</b>			
<b>I (based on Course V &amp; VI)</b>	<b>50</b>	<b>20</b>	
<b>II (based on course VII &amp; VIII)</b>	<b>50</b>	<b>20</b>	
<b>(C) INTERNAL ASSESSMENT</b>			
<b>CCE *4 Written Test based on each course (each of 15 marks)</b>	<b>60</b>	<b>5 in each test</b>	
<b>Project/Assignment/Seminar</b>	<b>50</b>	<b>20</b>	
<b>TOTAL</b>	<b>350</b>	----- ----	<b>140</b>

\* Candidate has to pass in each test separately

**THIRD SEMESTER**

Number & Title of the course	Max. Marks	Min. Marks for Passing	Min. Aggr. Marks For Passing
<b>(A) THEORY PAPERS</b>			
IX Comparative Anatomy of vertebrates	35	12	
X Limnology	35	12	
XI Eco toxicology	35	12	
XII Aquaculture	35	12	
<b>(B) PRACTICALS</b>			
I (based on Course XI & X)	50	20	
II (based on course XI & XII)	50	20	
<b>(C) INTERNAL ASSESSMENT</b>			
CCE *4 Written Test based on each course (each of 15 marks)	60	5 in each test	
Project/Assignment/Seminar	50	20	
<b>TOTAL</b>	<b>350</b>	-----	<b>140</b>

Candidate has to pass in each test separately.

**FOURTH SEMESTER**

Number & Title of the course	Max. Marks	Min. Marks for Passing	Min. Aggr. Marks For Passing
<b>(A) THEORY PAPERS</b>			
XIII Animal behavior and neurophysiology	35	12	
XIV Gamete Biology, development and differentiation	35	12	
<b>OPTIONAL THEORY PAPERS</b>			
XV Optional (special paper group-1)	35	12	
XVI Optional (special paper group-2)	35	12	
<b>(B) PRACTICALS</b>			
I (based on Course XI & X)	50	20	
II (based on course XI & XII)	50	20	
<b>(C) INTERNAL ASSESSMENT</b>			
CCE *4 Written Test based on each course (each of 15 marks)	60	5 in each test	
Project/Assignment/Seminar	50	20	
<b>TOTAL</b>	<b>350</b>	-----	<b>140</b>

\* Candidate has to pass in each test separately

**M. Sc. Zoology 2011-2012 Onwards**  
**M.Sc. Zoology**  
**First –semester**  
**Paper-1**  
**Biosystematics, Taxonomy and evolution**

### Unit I

- . Definition and basic concepts of biosystematics taxonomy and classification.
- History of Classification
- Trends in biosystematics : Chemotaxonomy cytotaxonomy and molecular taxonomy
- Dimensions of speciation and taxonomic characters.
- Species concepts : species category, different species concepts, subspecies
- and other infra-specific categories.
- Theories of biological classification: hierarchy of categories.

### Unit II

- Taxonomic Characters . Different kinds.
- Origin of reproductive isolation, biological mechanism of genetic incompatibility.
- Taxonomic procedures: Taxonomic collections , preservation ,cureting, process of identification.
- Taxonomic keys, different types of keys, their merits and demerits.
- International code of Zoological Nomenclature (ICZN):
- Operative principles, interpretation and application of important rules: Formation of Scientific names of various Taxa.

### Unit III

- Taxonomic categories.
- Evaluation of biodiversity indices.
- Evaluation of Shannon . Weiner Index.
- Evaluation of Dominance Index.
- Similarity and Dissimilarity Index.

### Unit IV

Concepts of evolution and theories of organic evolution.

Neo Darwinism and population genetics:

A- Hardy-Weinberg law of genetic equilibrium.

B . A detailed account of destabilizing forces:

i- Natural selection

ii- Mutation

iii- Genetic Drift

iv- Migration

v- Meiotic Drive.

Trends in Evolution

Molecular Evolution

a) Gene evolution

b) Evolution of gene families

c) Assessment of molecular variation

## Unit V

- Origin of higher categories
- Phylogenetic . gradualism and punctuated equilibrium.
- Major trends in the origin of higher categories
- Micro and macro evolution.
  
- Molecular population genetics
- Pattern of changes in nucleotide and amino acid sequence.
- Ecological significance of molecular variations (genetic polymorphism)
- Genetic & Speciation
- Phylogenetic and biological concept of species.
- Patterns and mechanism of reproductive isolation.
- Modes of speciation (allopatry & sympatry)
- Origin and Evolution & Economically important microbes and animals.

### **Suggested Reading Materials:**

1. M. Koto-The. Biology of biodiversity-Springer
2. E.O. Wilson-Biodiversity-Academic Press Washington.
3. G.G.-Simpson-Principle of animal taxonomy Oxford IBH Publication company.
4. E-Mayer-Elements of Taxonomy
5. Bastchelet-F-Introduction to mathematics for life scientists Springer Verlag, Berling.
6. Skoal R.R. and F.J.Rohiff Biometry-Freeman, San-Francisco.
7. Snecdor, G.W. and W.G. Cochran Statistical Methods of affiliated-East-West Press, New Delhi.
8. Murry J.D. Mathematical Biology-Springer, Verlag, Berlin.

M.Sc. Zoology

First semester

Paper –II

**STRUCTURE AND FUNCTION OF INVERTEBRATES**

## UNIT I

- Origin of metazoa
- Organization of Coelom
  - o Acoelomates
  - o Pseudo coelomates
  - o Coelomates
- Locomotion.
  - o Amoeboid, Flageller and Ciliary movement in protozoa
  - o Hydrostatic movements in Coelenterata
  - o Annelida and Echinodermata

## UNIT II

- Nutrition and Digestion
- Patterns of Feeding and digestion in lower metazoa, Mollusca, Echinodermata, Filter feeding in polychaeta.
- Respiration
- Organs of respiration : Gills, lungs and trachea.
- Respiratory pigments.
- Mechanism of respiration.

## UNIT III

- Excretion in lower invertebrates
- Excretion in higher invertebrates.
- Mechanism of Osmoregulation.

## UNIT IV

### Nervous System

- a. Primitive Nervous systems:-Coelentrata and Echinodermata.
- b. Advanced nervous system :- Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)

## UNIT V

1. Invertebrate larval forms and their evolutionary significance
  - a. Trematoda and Cestoda
  - b. Larval forms of Crustacea
  - c. Larval forms of Mollusca
  - d. Larval forms of Echinodermata.
2. Structure affinities and life history of the following minor Phyla
  - a. Rotifera
  - b. Entoprocta
  - c. Phoronida
  - d. Ectoprocta

### Suggested Reading Materials:

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.

**M. Sc. Zoology 2011-2012 Onwards**

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 and London.
6. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
7. Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co. Ltd., London.
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol. V.Mc.Graw Hill Co., New York.
9. Read, C.P. Animal Parasitism. Parasitism. prentice Hall Inc., New Jersey.
10. Sedgwick, A.A. Student text book of Zoology. Vol. I,II and III. Central Book Depot, Allahabad.
11. Parker, T.J., haswell W.A. Text book of Zoology, Macmillan Co., London.

**M.Sc. Zoology  
First semester  
Paper-III**

**Quantitative biology, biodiversity and wildlife**

**Unit I**

Quantitative biology

## **M. Sc. Zoology 2011-2012 Onwards**

- Distribution of the data in biology- mean, mode and median
- Measures of dispersion : range, mean deviation, IQD , standard deviation and coefficient of variation
  - Chi square test
- Normal distribution
- Experimental designing and sample theory

### **Unit II**

- Probability distribution, properties and probability theory
- Completely randomized design and randomized block design
- Analysis of variance
- Co-relation- types of correlation
- Karl pearson, coefficient correlation
- Regression

### **Unit III**

#### Biodiversity

- concept and principal of biodiversity
- causes for the loss of biodiversity
- Biodiversity conservation methods
- Medicinal uses of forest plant

### **Unit IV**

#### Wildlife of India, types of wildlife

- Values of wildlife, positive and negative
- Wildlife protection Act
- Conservation of wildlife in India
- Endangered and threatened species

### **Unit V**

#### Wildlife and conservation

- National Parks and Sanctuaries
- Project Tiger
- Project Gir Lion and Crocodile breeding project
- Wildlife in M.P. with references to Reptiles Birds and mammals
- Biospheres reserves

### **Suggested Reading Materials:**

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling
- Jorgenserr, S.E. Fundamental of Ecological modling E. sevier New York
- Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.
- Sokal, R.R. and F. J. Rohit Biometry Freeman San Francisco
- Snedecor, G.W. and W.G. cochran, stational methods, Affiliated East, West Press New Delhi (Indian ed.)
- Muray , J.D. Methamatical Biology, Springer Verlag Berlin
- Pelon, E.C. The interpretation of ecological data : A promer on classification and ordination.



**M. Sc. Zoology 2011-2012 Onwards**

- A. Lewis . Biostatistics
- B.K. Mahajan Methods in Biostatistics
- V.B. Saharia wildlife in India
- S.K. Tiwari wildlife in central India
- J.D. Murrey Mathematical Biology
- Georgs & Wiliams Startical method
- R.K. Tondon Biodiversity Texonomy & Ecology
- M.P. Arora An Introduction to prevantology
- P.C. Kotwal Biodiversity and conservation

**M.Sc. Zoology  
First semester  
Paper IV**

**BIOMOLECULES AND STRUCTURAL BIOLOGY**

**Unit I**

Chemical Foundation of biology

- PH, PK, acids bases, buffers, weak bonds

- Free energy, resonance, isomerisation
- Acid soluble pool of living tissues . aminoacids, monosaccharides, oligosaccharides, nucleotides, peptides.
- Nanoparticles
- Biomaterials

### **Unit II**

1. Primary, Secondary, tertiary and quaternary structures of proteins, protein folding and denaturation
2. DNA & RNA: Double helical structure of DNA, Structure of RNA, role of RNA in gene expression
3. DNA replication, recombination and repair
4. Functional importance of lipid storage and membrane lipids
5. Membrane channels and pumps

### **Unit III**

1. Basic concepts of metabolism: Coupled and interconnecting reactions of metabolism cellular energy resources and ATP synthesis
2. Glycolysis and Gluconeogenesis
3. Citric acid cycle
4. Oxidative phosphorylation : Protein and its regulation
5. Fatty acid metabolism: Synthesis and degradation of fatty acids

### **Unit IV**

1. RNA synthesis and splicing
2. Biosynthesis of amino acids
3. Biosynthesis of nucleotides
4. Biosynthesis of membrane lipids and steroids
5. Protein synthesis

### **Unit V**

1. Enzymes: Terminologies, classification and basics of enzyme kinetics
2. Mechanism of enzyme catalysis
3. Regulation of enzyme reaction
4. Concept of free energy and thermodynamic principals in biology
5. Energy rich bonds, compound and biological energy transducers

### **Suggested Reading Materials:**

1. Voet, D. and J.G. Voet. Biochemistry John Wiley & Sons.
2. Freifelder, D. Physical Biochemistry W.H. Freeman & Co.
3. Segal, I.H. Biochemical calculations John Wiley and Sons
4. Creighton, T.E. Protein Structure and Molecular Properties W.H. Freeman & Co.
5. Freifelder, D. Essentials of Molecular Biology
6. Wilson, K. and K.H. Goulding A Biologists Guide to Principals and Techniques of Practical Biochemistry
7. Cooper, T.G. Tools of Biochemistry
8. Hawk, Practical Physiological Chemistry
9. Garret, R.H. and C.M. Grisham. Biochemistry. Saunders college Publishers.

**M.Sc. Zoology  
Second -semester  
Paper-I**

**GENERAL AND COMPARATIVE ANIMAL PHYSIOLOGY AND  
ENDOCRINOLOGY**

**Unit I**

1. Respiratory pigments through different phylogenetic groups
2. Transport of oxygen and carbon dioxide in blood and body fluids
3. Regulation of respiration
4. Physiology of impulse transmission through nerves and synapses
5. Autonomic nervous system, neurotransmitters and their physiological functions

**Unit II**

1. Patterns of nitrogen excretion in different animal groups
2. Comparative physiology of digestion
3. Osmoregulation in different animal groups
4. Thermoregulation in homeotherms, poikilotherms and hibernation
5. Physiology of pregnancy, placental hormones, pregnancy diagnosis tests, parturition and breast and lactation

**Unit III**

1. Comparative study of mechanoreception
2. Comparative study of photoreception
3. Comparative study of phonoreception
4. Comparative study of chemoreception
5. Comparative study of equilibrium reception

**Unit . IV**

1. Bioluminescence as means of communication among animals
2. Pheromones and other similar chemicals as means of communication among animals
3. Chromatophores and regulation of their function among animals
4. Hormones, their classification and chemical nature
5. Mechanisms of hormone action

**Unit .V**

1. Phylogeny of endocrine glands (pituitary, pancreas, adrenal, thyroid)
2. Ontogeny of endocrine glands
3. Neuroendocrine system
4. Hormone receptors . signal transduction mechanisms
5. Hormones and reproduction
  - a. Seasonal breeders
  - b. Continuous breeders

**Suggested Reading Materials:**

1. EJW Barrington-General & comparative Endocrinology-Oxford, Clarendon Press
2. R.H. Williams-Text Book of Endocrinology-W.B. Saunders
3. C.R. Martin- Endocrine Physiology-Oxford University Press.
4. Molecular CellBiology-J. Darnell, H. Lodish and D. Baltimore-Scientific American Book USA
5. Molecular Biology of the cell-B. Alberts, D-Bray, J.Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Pub. New York.

**M. Sc Zoology  
Second Semester  
Paper II**

**Population Ecology and Environmental physiology**

**Unit I**

1. Populations and their characters.
2. Demography : Life tables, generation time, reproductive value.
3. Population growth: Growth of organisms with non-overlapping generations, stochastic and time lag models of population growth, stable age distribution.
4. Population regulation: Extrinsic and intrinsic mechanisms.

**Unit II**

1. Adaptations : Levels of adaptations, significance of body size.
2. Aquatic environments : Fresh water, marine, shores and estuarine

environments.

3. Eco-physiological adaptations to fresh water environments.
4. Eco-physiological adaptations to marine environments.
5. Eco-physiological adaptations to terrestrial environments.

### **Unit III**

1. Environmental limiting factors.
2. Inter and intra-specific relationship.
3. Predatory- prey relationship, predator dynamics, optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time).
4. Mutulism , evolution of plant pollinator interaction.

### **Unit IV**

Environmental pollution and human health.

1. Conservation management of natural resources .
2. Environmental impact assessment.
3. Sustainable development.

### **Unit V**

1. Concept of homeostasis.
2. Endothermic and physiological mechanism of regulation of the body temperature.
3. Physiological response to oxygen deficient stress.
4. Physiological response to body exercise.
5. Meditation, yoga and their effects.

### **Suggested Reading Materials:**

1. Cherrett,J.M. Ecological Concepts. Blackwell Science Publication, Oxford, U.K.
2. Elseth,B.D. and K.M. Baumgartner,population Biology,Van Nostrand Co., New York.
3. Jorgensen,S.E. Fundamentals of ecological modeling. Elsevier, New York.
4. Krebs, C.J. Ecology. Harper and Row, New York.
5. Krebs,C.J. Ecological Methodology. Harper and Row , New York.
6. Eckert, R. Animal Physiology: Mechanism and Adaptation. W.H. Freeman and Co., New York.
7. Hochachka, P.W. and G.N., Somero. Biochemical adaptation. Priceton, New Jersey.

**M. Sc Zoology  
Second Semester  
Paper III**

**Tools and techniques in Biology**

**Unit I**

1. Microscopy, principle & applications
  - Light microscope and phase contrast microscope
  - Fluorescence microscope
  - Electron microscope
  - Confocal microscopy
2. General Principle and applications of
  - Colorimeter
  - Spectrophotometer
  - Ultra centrifuge
  - Flame photometer
  - Beer and Lambert's law.
3. Microbiological techniques
  - Media Preparation and sterilization
  - Inoculation and growth monitoring.
  - Microbial assays.

## M. Sc. Zoology 2011-2012 Onwards

- Microbial identification (cytological staining methods for bacterial and fungal strains)
- Use of fermentors

### Unit II

1. Computer aided techniques for data presentation data analysis, statistical techniques.
  2. Cryotechniques
    - Cryopreservation of cells, tissues, organs and organisms.
    - Cryosurgery
    - Cryotomy
    - Freeze fracture and freeze drying.
  3. Separation techniques.
    - Chromatography, principle type and applicants.
    - Electrophoresis, Principles, types and applications PAGE and agarose gel electrophoresis.
- Organelle separation by centrifugation.

### Unit III

1. Radioisotope and main isotope techniques in biology.
  - a. Sample preparation for radioactive counting
  - b. Autoradiography.
2. Immunological techniques
  - Immunodiffusion (Single & Double)
  - Immuno electrophoresis
3. Techniques immuno detection
  - Immunocyto / histochemistry
  - Immunoblotting, immunodetection, immunofluorescence.
4. Surgical techniques.
  - Organ ablation (eg. Ovariectomy, adrenalectomy)
  - Perfusion techniques
  - Stereotaxy
  - Indwelling catheters
  - Biosensors.

### Unit IV

1. Histological techniques
  - Principles of tissue fixation
  - Microtomy
  - Staining
  - Mounting
  - Histochemistry
2. Cell culture techniques.
  - Design and functioning of tissue culture laboratory
  - Culture media, essential components and Preparation
  - Cell viability testing.

### Unit V



1. Cytological techniques
  - Mitotic and meiotic chromosome preparations from insects and vertebrates.
  - Chromosome banding techniques (G.C.Q. R. banding)
  - Flowcytometry.
2. Molecular cytological techniques
  - In site hybridization (radio labelled and non-radio labelled methods)
  - FISH
  - Restriction banding
3. Molecular biology techniques
  - Southern hybridization
  - Northern hybridization
  - DNA Sequencing
  - Polymerase chain reaction (PCR)

**Suggested Reading Materials:**

1. Introduction to instrumental analysis-Robert Braun-McGraw Hill.
2. A biologist Guide to principles and Techniques of Practical Biochemistry- K, Wilson and K.H. Goulding EIBS Edn.
3. Clark & Swizer. Experimental Biochemistry. Freeman, 2000.
4. Locquin and Langeron. Handbook of Microscopy. Butterwaths, 1983
5. Boyer. Modern Experimental Biochemistry. Benjamin, 1993
6. Freifelder. Physical Biochemistry. Freeman, 1982.
7. Wilson and Wlaker. Practical Biochemistry. Cambridge, 2000.
8. Cooper. The Cell-A Molecular Approach. ASM, 1997
9. John R.W. Masters. Animal Cell culture- A practical approach. IRL Press.
10. Robert Braun. Introduction to instrumental analysis. McGraw Hill

M. Sc Zoology  
Second Semester  
Paper IV

**Molecular Cell Biology and genetics**

**Unit . I**

Biomembrane

- Molecular composition arrangement and functional consequences
- Transport across cell membrane diffusion active transport, pumps, uniports, symports and antiports
- Micro filaments and microtubules structure and dynamics
- Cell movements intracellular transport, role of kinesin and dynein

**Unit . II**

Cell. Cell signaling

- Cell surface receptors
- Second messenger system
- Signaling from plasma membrane to nucleus
- Gap junctions and connexins
- Integrins

**Unit III**

Cell. Cell adhesion and communication

- Ca<sup>++</sup> dependant homophilic cell . cell adhesion
- Ca<sup>++</sup> independant homophilic cell .cell adhesion
- Gap junctions and connexins
- Genome organization, hierarchy in organization
- Chromosomal organization of genes and non-coding DNA

**Unit IV**

Sex determination

- Sex determination in Drosophila
- Sex determination in mammals
- Basic concept of dosage compensation
- Cytogenetic of human chromosomes
- Human genome project (HGP) purpose 2 implicate

**Unit V**

Genetic Diseases and Genomics

- Human gene therapy

- Prenatal diagnosis & genetic counseling
- Genetic screening
- Structural Genomics
- Functional Genomics
- Gene libraries
- Transgenic animals & their applications

**Suggested Reading Materials:**

- J. Darnell, H. Lodish and D. Baltimore molecular cell biology scientific American book. Inc. USA
- B. Alberts D. Bray, J. Lewis, M. raff, K. roberts and J.D. Wattson. molecular biology of the cell. Garland Publishing Inc. New York.
- John R. W. animal cell culture A practical approach masters. Irl. Press
- Alberts et. all Essentials cell biology garland publishing Inc. New York 1998
- J.M. Barry molecular biology
- Philip E. Hartman Gene Action
- L.C. dunn, principals of Genetics
- A.M. Winchester genetics
- Edgar Alterbrg Genetics
- L.C. Dunn genetics and the oregon of species
- Bengt A. Kihlman actions of chemicals of dividing cells

**Msc Zoology  
Third semester  
Paper- I**

**Comparative Anatomy of Vertebrates**

**Unit-1**

1. Origin of Chordata: Concept of Protochordata
2. Development, structure and functions of integument and its derivatives (glands, scales, feathers and hairs)
3. Respiratory system : Characters of respiratory tissue, external and internal respiration. Comparative account of respiratory organs.
4. Comparative account of Digestive System.

**Unit-2**

1. Evolution of heart.
2. Evolution of aortic arches and portal systems.
3. Blood circulation in various vertebrates groups.
4. Comparative account of jaw suspensorium and vertebral column.

**Unit-3**

1. Evolution of urinogenital system in vertebrates.
2. Comparative account of organs of olfactory and taste.
3. Comparative anatomy of brain and spinal cord (CNS).
4. Comparative account of peripheral and autonomous nervous system.

**Unit-4**

1. Comparative account of lateral line system.
2. Comparative account of electroreception.
3. Flight adaptations in vertebrates.
4. Aquatic adaptations in birds and mammals.

**Unit-5**

1. Origin, evolution general organization and affinities of Ostracoderms .
2. General organization, specialized, generalized and degenerated characters of Cyclostomes.
3. Origin, evolution general organization of early Gnathostomes .
4. General account of Elasmobranchi, Holocephali, Dipnoi and Crossoptergii.

**Suggested Reading Materials:**

1. Carter, G.S. Structure and habit in vertebrate evolution – Sedgwick and Jackson, London.
2. Kingsley, J.S. Outlines of Comparative Anatomy of Vertebrates, Central Book Depot. Allahabad,
3. Kent, C.G. Comparative anatomy of vertebrates
4. Malcom Jollie, Chordata morphology. East – West Pres Pvt. Ltd., New Delhi.
5. Milton I lildergrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
6. Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
7. Sedgwick, A.A. Students Text Book of Zoology, Vol.II.
8. Walter, H.E. and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.
9. Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia
10. Young J.Z. life of vertebrates. The oxford University Press, London
11. Parker & Haswell to III Rev. by Marshall willians latested Macmillan Co. ltd.
12. Young J.Z. Life of mammals. The Oxford University Press, London
13. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw Hall Book Co., New York.

**Unit-1**

1. Limnology – Definition, historical development and scope of Limnology.
2. Types of freshwater habitats and their ecosystem -
  - (a) Ponds, Streams and rivers.
  - (b) Lakes – Origin and classification.
3. Morphometry – Use of various morphometric parameters and Zonation.

**Unit-2**

Physico – Chemical Characteristics.

1. Light and Temperature-
  - (a) Light as an ecological parameter in freshwater.
  - (b) Temperature- Radiation, Stratification and Heat Budget.
2. Dissolved Solids – Carbonate, Bicarbonates, Phosphate and Nitrate.  
Physico – Chemical characteristics of freshwater with special reference to different parameters- Turbidity, dissolved gases (Oxygen, Carbon dioxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH.

**Unit-3**

1. Study of Biota
  - (a) Phytoplankton, Zooplankton and their inter-relationship.
  - (b) Aquatic insects, birds and their environmental significance.
2. Ecological classification of aquatic fauna higher aquatic plants and their significance.

**Unit-4**

1. Methods of water quality testing BOD and COD.
2. Sewage – Definition, composition and its treatment.
3. Bioindicators- Aquatic flora and fauna in relation to water quality in an aquatic environment.

**Unit-5**

1. Causes of pollution of Aquatic Resources, their management and conservation.
2. Resource Conservation – Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.
3. Use and misuse of inland waters.

**Suggested Reading Materials:**

Anathkrishnan : Bioresources Ecology

Goldman : Limnology

Odum : Ecology

Pawlosuske : Physico- chemical methods for water

Wetzel : Limnology

Trivedi & Goyal : Chemical and biological methods for water pollution studies

Welch : Limnology Vols. I-II

Perkins : Ecology

Arora : Fundamentals of environmental biology

**M. Sc. Zoology 2011-2012 Onwards**  
**Msc Zoology**  
**Third semester**  
**Paper- III**

**ECO- TOXICOLOGY**

**Unit-1**

1. General principles of Environmental Biology with emphasis on ecosystems.
2. Abiotic and biotic factors of ecosystems.
3. Communities of the environment, their structure & significance.
4. Energy flow in environment: Ecological energetic.

**Unit-2**

1. Productivity, Production and analysis.
2. Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation.
3. Remote sensing –basic concepts and applications of remote sensing techniques in environmental conservation.
4. Environmental indicators and their role in environmental balance.

**Unit-3**

1. Kinds of environmental pollution and their control methods.
2. Radioactive compounds and their impact on the environment.
3. Vehicular exhaust pollution causes and remedies.
4. Noise pollution.

**Unit-4**

1. Toxicology- Basic concepts, Principles and various types of toxicological agents.
2. Toxicity testing principles, hazards, risks and their control methods.
3. Food toxicants and their control methods.
4. Public Health Hazards due to environmental disasters.

**Unit-5**

1. Pesticides, types, nature and their effects on environment.
2. Important heavy metals and their role in environment.
3. Agrochemical use and misuse, alternatives.
4. Occupational Health Hazards and their Control.

**Suggested Reading Materials:**

1. Clark : Elements of ecology
2. Odum : Fundamentals of Ecology



3. South Woods : Ecological methods
4. Trivedi and Goel : Chemical and biological methods for water pollution studies

**Msc Zoology  
Third semester  
Paper- IV**

**Aquaculture**

**Unit-1**

1. Aquaculture: history, definition, scope & importance.

## **M. Sc. Zoology 2011-2012 Onwards**

2. Fishery resources of India in general & Madhya Pradesh in particular.
3. Abiotic & biotic factors of water necessary for fish life.
4. Ecological characteristics of lakes & rivers.
5. General ecological characteristics of reservoirs of India.

### **Unit-2**

1. Fish culture :- Mono, Poly, mixed and composite Fish culture.
2. Fresh water prawn culture and its prospects in India.
3. Culture of Mussels , clams,oysters & pearl culture.
4. Sewage fed fish culture, paddy cum fish culture
5. Frog culture.

### **Unit-3**

1. Fish breeding in natural conditions , bundh breeding, hypophysation & stripping.
2. Transport of live fish & seed.
3. Different types of crafts & gears used for fish catching.
4. Plankton- its definition, culture & indentification.
5. Common weeds of fish ponds and methods of their eradication.

### **Unit-4**

1. Fresh water fish farm engineering: selection of site, construction of fish farm & soil chemistry.
2. Designing, layout & construction of different types of fish ponds.
3. Setting and management of fresh water aquarium.
4. Preservation & processing of fish.
5. By products of fish Industry & their utility.

### **Unit-5**

1. Water pollution, its effects on fisheries and methods of its abatement.
2. Common fish diseases & their control.
3. Biochemical composition and nutritional value of fish.
4. Fisheries economics and marketing.
5. Fisheries managements and extension.

### **Suggested Reading Materials:**

1. C.B.L. Shrivastava : Fishes of India
2. Jhingaran : Fish and fisheries of India
3. S.S. Khanna : An Introduction to fishes
4. R.S. Rath : Fresh water Aquaculture
5. Gopalji Shrivastava : Fishes of U.P. & Bihar
6. H.D. Kumar : Sustanibility & Management of Aquaculture & Fisheries
7. A.J.K. Mainan : Identification of fishes
8. R. Sanatam : A Manual of fresh water Aquaculture
9. S.K. Gupta : Fish & Fisheries

10. P.D. Pandey : Fish & Fisheries
11. K.P. Vishwas : Fish & Fisheries

**M. Sc. Zoology 2011-2012 Onwards**  
**M.Sc Zoology**  
**Semester-IV**  
**Paper- I (Compulsory)**

**ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY**

**Unit-1**

1. Introduction:
  - Ethology as a branch of biology.
  - Animal psychology, classification of behavioural patterns, analysis of behaviour (ethogram)
2. Reflexes and complex behaviour.
3. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual.
4. Evolution and ultimate causation: Inheritance behaviour and relationships.

**Unit-2**

1. Neural and hormonal control of behaviour.
2. Genetic and environmental components in the development of behaviour.
3. Motivation: Drive, timing and interaction of drives, physiological basis of motivation, hormones and motivation, aggregation.
4. Communication: Chemical, visual, light and audio, evolution of language (primates).

**Unit-3**

1. Ecological aspects of behaviour: Habitat selection, food selection, optimal foraging theory, anti-predator defences, aggression, homing territoriality, dispersal, host parasite relations.
2. Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.
3. Learning and memory: Conditioning, habituation, insight learning, association learning and reasoning.

**Unit-4**

1. Reproductive behaviour. Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care.
2. Social behaviour. aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.

**Unit-5**

1. Thermoregulation: Homoeothermic animals, poikilotherms &

Hibernation.

2. Receptor physiology a comparative study –
  - Mechano receptor
  - Photo receptor
  - Phono receptor
  - Chemo receptor
  - Equilibrium receptor
3. Bioluminescence

**Suggested Reading Materials:**

1. Eibl-Eibesfeldt, I. Ethology. The biology of Behaviour. Holt, Rinehart & Winston, New York.
2. Gould, J.L. The mechanism and Evolution of Behaviour.
3. Kerbs, J.R. and N.B. davies : Behaviourable Ecology. Blackwell, Oxford, U.K.

**M. Sc. Zoology 2011-2012 Onwards**

4. Hinde, R.A. Animal Behaviour : A Synthesis of Ethology and Comparative Psychology. McGraw Hill, New York.
5. Alcock, J. Animal Behaviour : An Evolutionary approach. Sinauer Assoc. Sunderland, Massachusetts, USA.
6. Bradbury, J.W. and S.L. Vehrencamp. Principles of Animal Communication. Sinauer Assoc. Sunderland, Massachusetts, USA.

**M.Sc Zoology  
Semester-IV  
Paper- II(compulsory)**

**Gamete Biology, Development and  
Differentiation in vertebrates**

**Unit-1**

1. Comparative account of differentiation of gonads in mammals.
2. Spermatogenesis : Morphological basis in rodents.  
Gamete specific gene expression and genomics

## **M. Sc. Zoology 2011-2012 Onwards**

3. Biochemistry of Semen : Semen composition and formation, assessment of sperm function.
4. Fertilization: Prefertilization events Biochemistry of fertilization post fertilization events.

### **Unit-2**

1. Ovarian follicular growth and differentiation: morphology, endocrinology, molecular biology oogenesis and vitellogenesis, ovulation and ovum transport in mammals
2. Biology of sex determination and sex differentiation a comparative account.
3. Multiple ovulation and embryo transfer technology : in vitro oocyte maturation, super ovulation.

### **Unit-3**

1. Hormonal regulation of ovulation, pregnancy and parturition.
2. Hormonal regulation of development of mammary gland and lactation.
3. Endocrinology and Physiology of placenta.
4. Cryopreservation of gametes and Embryo.
5. Teratological effects of xenobiotics on gametes.

### **Unit-4**

1. Cell commitment and differentiation.
2. Germ cell determinants and germ cell migration.
3. Development of gonads.
4. Melanogenesis.

### **Unit-5**

1. Creating new cell types, the basic evolutionary mystery.
2. Cell diversification in early Amphibian embryo, totipotency and pluripotency.
3. Embryonic stem cells, renewal by stem cells, epidermis.
4. Connective tissue cell family
5. Haemopoietic stem cells : Blood cells formation, stem cell disorders.

### **Suggested Reading Materials:**

1. Long J.A. Evan H.M. 1922 : the oestrous cycle in the Rat and its associated phenomenon.
2. Nalbandou. A.C. – Reproductive physiology
3. Prakash A.S. 1965-66 Marshall's, Physiology Reproduction (3 Vol.)
4. Gilbert, S.F. Developmental Biology , Sinauer Associated Inc. Massachusetts.
5. Ethan Bier, the cold Spring. The cold spring Harbor laboratory Press, New York.
6. Balinsky B.I. Introduction to Embryology sanders, Philadelphia.
7. Berril N.J. and Karp. G. Development Biology. McGraw Hill New York.
8. Davidson, E.H. Gene Activity During Early Development. Academic Press, New York.

**Msc Zoology  
Semester IV  
Optional papers**

**\* The following optional papers are being suggested as below**

**OPTIONAL (SPECIAL PAPER) GROUP 1**

- a. Fish (ichthyology) structure and function  
Or
- b. Cell Biology  
Or
- c. Entomology  
Or
- d. Wild life conservation  
Or



- e. Biology of vertebrates immune system

**OPTIONAL (SPECIAL PAPER) GROUP 2**

- a. Pisci culture and economic importance of fishes (Ichthyology)  
Or  
b. Cellular organization and molecular organization  
Or  
c. Applied entomology  
Or  
d. Environment and Biodiversity conservation  
Or  
e. Molecular endocrinology and reproductive technology

\*\* Student has choice to opt for one paper each (special paper) from group 1 and group 2

**M.Sc Zoology  
Semester-IV  
Paper- III A (optional paper)**

**Ichthyology (Fish) Structure and Function**

**Unit-1**

1. Origin and evolution of fishes
2. Classification of fishes as proposed by Berg
3. Fish integument
4. Locomotion

**Unit-2**

1. Alimentary canal and digestion
2. Accessory respiratory organs
3. Air bladder and its functions
4. Weberian ossicles their homologies and functions

**Unit-3**

1. Excretion and osmoregulation
2. Acoustico-lateral line system
3. Luminous organs
4. Colouration in fishes

**Unit-4**

1. Sound producing organs
2. Deep sea adaptations
3. Hill stream adaptations
4. migration in fishes

**Unit-5**

1. Sexual cycle and fecundity
2. parental care in fishes
3. Early development and hatching
4. Poisonous and venomous fishes.

**M.Sc Zoology  
Semester-IV  
Paper- III B (Optional)  
Cell Biology**

**Unit-1**

1. Molecular organization of eukaryotic chromosomes : structure of nucleosome particles and higher order compaction of mitotic chromosomes, chromatin remodeling
2. specialized chromosomes: structural organization and functional significance of polytene chromosomes
3. DNA methylation and DNA Aase-1 Hypersensitivity in relation to gene activity and chromatin organization.
4. specialized chromosomes II : structural organization and functional significance of lampbrush chromosome.
5. Organisation and significance of heterochromatin.

**Unit-2**

1. Structural organization of Eukaryotic genes, interrupted genes and overlapping genes and their evolution
2. Gene families: organization, evolution and significance
3. Transposable genetic elements of prokaryotes and eukaryotes Gene imitation and molecular mechanism of occurrence of mutation repair mechanism

**Unit-3**

1. Organisation of eukaryotic transcriptional machinery promoter enhancers transcription factors polymerase activators and repressors.
2. DNA binding domains of transcription apparatus zinc finger steroid receptors hemeo domains HILIX-loop, Helix and Leucine Zipper.
3. Eukaryotic transcription of Eukaryotic transcriptional control.

## M. Sc. Zoology 2011-2012 Onwards

4. Environmental modulation of gene activity (stress response) stress genes and stress proteins
5. Molecular basis of thalasemias muscular dystrophy cystic fibrosis

### Unit-4

1. DNA rearrangement
  2. Amplification during development with special response to
    - (a) Ciliates
    - (b) Chlorine gene
    - (c) 58 RNA genes
  3. Drosophila development
    - (a) Cleavage
    - (b) Gastrulation
- Origin of Anterior –Posterior (Maternal effect genes and segmentation genes)

### Unit-5

1. Drosophila development II origin of dorsal ventral polarity
2. Basic idea of homeotic selector genes and homeotic mutation
3. Basic idea of organization of homeoboxes
4. Evolutionary significance of homeoboxes

### Suggested Reading Materials:

1. Robertis, De and Robertis Cell and molecular biology Lea and Febiger.
2. Watson Hopkins Roberts Steitz Weiner, Molecular Biology of the Gene the Benjamin, Cummings Publishing Company inc.
3. Bruce A; berts Bray ewis Raff Roberts Watson Molecular Biology of the Cell, Garland Publishing inc.
4. Watson Gilman Witkowski Zoller Recombinant DNA Scientific American Books.
  - a) Karp Gerald Cell Biology.
  - b) Lewin B., Genes VII.
  - c) King Cell Biology.
  - d) Kaniel L. Hartl, Elizabeth W. Jones. Genetics Principles and Analysis, Jones and Bartlett Publishers.
5. Kuby, Immunology, W.H. Freeman and Company.
6. Roitt Male Snustad Immunology.

**M.Sc Zoology  
Semester-IV  
Paper- III C (Optional)**

**Entomology**

**Unit-1**

1. Insect head types and modification as per their habit and habitat
2. Modification of mouth parts and feeding behaviour
3. Structure types and function of antennae
4. Hypothetical wing venation

**Unit-2**

1. Structure of cuticle and pigment
2. Sclerotisation and tanning of the cuticle
3. Structure of alimentary canal and Physiology of digestion
4. Malpighian tubules – anatomical organization , Transport mechanism

**Unit-3**

1. Structure of circulatory system
  2. Cellular elements in the haemolymph
  3. Cell mediated and humoral immunity
- Structure of compound eye and Physiology of Vision

**Unit-4**

1. Sound Production in insect
2. Structure and function of endocrine glands
3. Pheromones
4. Embryonic membranous up to the formation of blastoderm

**Unit-5**

1. Metamorphosis
2. Insecticide effects on CNS
3. Important pest of Soybean

**Suggested Reading Materials:**

1. The Insect: Structure and function by R.F. Chapman
2. Comparative Insect physiology, Biochemistry and Pharmacology .Vol :1-13.  
Edited by G.A. Kerkut and L.I. Gilbert.
3. Entomophagous Insect by Clausen
4. Entomology bu Gilbert
5. Principles of Insect Physiology by Wigglesworth.
6. Fundamentals of Entomology by Elzinga
7. Hand book of economic Entomology for South India by Ayyar.
8. Insect cytogenetics by R.E.F.Symposium.
9. Insects and plants by Sting, Lawton and southwood.
10. Insect and hygiene by Busvine.
11. Insect Physiology by Wigglesworth.
12. Insect morphology by Mat Calf and Flint
13. Applied Agricultural Entomology by Dr. Lalit Kumar Jha

**M.Sc Zoology  
Semester-IV  
Paper- III D (Optional)**

**Wild Life Conservation**

**Unit-1**

1. Wild life -
  - (a) Values of wild life - positive and negative.
  - (b) Our conservation ethics.
  - (c) Importance of conservation.
  - (d) Causes of depletion.
  - (e) World conservation strategies.
2. Habitat analysis, Evaluation and management of wild life.
  - (a) Physical parameters - Topography, Geology, Soil and water.
  - (b) Biological Parameters - food, cover, forage, browse and cover estimation.
  - (c) Standard evaluation procedures - remote sensing and GIS.
3. Management of habitats -
  - (a) Setting back succession.
  - (b) Grazing logging.
  - (c) Mechanical treatment.
  - (d) Advancing the successional process.
  - (e) Cover construction.
  - (f) Preservation of general genetic diversity.

**Unit-2**

1. Population estimation.
  - (a) Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation.
  - (b) Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method.
2. National Organization.
  - (a) Indian board of wild life.
  - (b) Bombay Natural History Society.
  - (c) Voluntary organization involved in wild life conservation.
3. Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.

**Unit-3**

1. Management planning of wild life in protected areas.
2. Estimation of carrying capacity.
3. Eco tourism / wild life tourism in forests.

4. Concept of climax persistence.
5. Ecology of perturbation.

**Unit-4**

1. Management of excess population & translocation.
2. Bio- telemetry.
3. Care of injured and diseased animal.
4. Quarantine.
5. Common diseases of wild animal.

**Unit-5**

1. Protected areas National parks & sanctuaries, Community reserve.
2. Important features of protected areas in India.
3. Tiger conservation - Tiger reserve in M.P, in India.
4. Management challenges in Tiger reserve.

**Suggested Reading Materials:**

1. Gopal Rajesh : Fundamentals of wild life management
2. Agrawal K.C : Wild life India
3. Dwivedi A.P (2008) : Management wild life in India
4. Asthana D.K : Envionment problem and solution
5. Rodgers N.A & Panwar H.S : Planning of wild life / Protected area Network in India  
vol. the report, wild life Institute of India Dehradun.
6. Odum E.P : Fundamentals of Ecology
7. Saharia V.B : Wild life in India
8. Tiwari S.K : Wild life in Central India
9. E.P Gee : Wild life of India
10. Negi S.S : Wild life conservation (Natraj PUBLISHERS)

**M.Sc Zoology  
Semester-IV  
Paper- III E (Optional)**

**Biology of vertebrates immune system**



**Unit-1**

1. Tissues of Immune system- Primary lymphoid organs, structure and functions (Thymus and Bursa of Fabricius)
2. tissues of Immune system- Secondary lymphoid organs, structure and functions (Spleen, lymphnode and Payers patches)
3. Antigen processing
4. Antigen presentation

**Unit-2**

1. T-cell lineage and receptors
2. T-cell activation
3. B-cell lineage and receptors
4. B-cell activation

**Unit-3**

1. Immunoglobulin structure, Biological and physical properties of immunoglobulin
2. Gene model for Immunoglobulin gene structure
3. Generation of antibody diversity ( Light and heavy chain)
4. Immunization

**Unit-4**

1. Immediate type of hypersensitivity reaction of Anaphylectic type-1.
2. Antibody dependent cytotoxic type II reaction.
3. Complex mediated type III reaction
4. Delayed type cell mediated hypersensitivity type IV reaction.

**Unit-5**

1. Enzyme linked immunosorbent assay (ELISA) technique and its applications.
2. Immunofluorescence technique( Direct & Indirect and Sandwich antibody labelling techniques .
3. Immunodiffusion techniques ( Mancini and Ouchterlony immunodiffusion techniques) Monoclonal antibody technology (Hybridoma technology)

**M.Sc Zoology  
Semester-IV  
Paper- IV A (Optional)**

**Pisci Culture and Economic Importance of Fishes (Ichthyology)**

**Unit-1**

1. Collection of fish seed from natural resources.
2. Dry bundh breeding of carps.

3. Wet bundh breeding of carps.
4. Hypophysation and breeding of Indian major carps.

**Unit-2**

1. Drugs useful in induced breeding of fish
2. Types of ponds required for fish culture farms
3. Management of hatcheries, nurseries and rearing ponds
4. Management of stocking ponds

**Unit-3**

1. Composite fish culture
2. Prawn culture and pearl industries in India.
3. Fisheries resources of MP
4. Riverine fisheries.

**Unit-4**

1. Coastal fisheries in India
2. Offshore and deep sea fisheries in India
3. Role of fisheries in rural development
4. Sewage fed fisheries

**Unit-5**

1. Methods of fish preservation
2. Marketing of fish in India.
3. Economic importance and by product of fishes
4. Shark liver oil industry in India  
Transport of live fish & fish seed.

**Suggested Reading Materials :**  
**Paper III A & IV A**

1. JR. Norman - The History of fishes.
2. Nagaraja Rao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones Fish migration.
5. Marshal The life of fishes.
6. Thomas - Diseases of fish.
7. Greenwood - Inter relationship of fishes.
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
9. Brown -Physiology of fishes Vol. I & II.

## **M. Sc. Zoology 2011-2012 Onwards**

10. Hoar and Randall -Fish physiology of fishes Vol. 1 & IX.
11. Gunther Sterba C.N.H.-Freshwater fishes of the world
12. W. Lanham -The Fishes.
13. G.V. Nikolsky -The ecology of Fishes,
14. Borgstram -Fish as food Vol. I & II.
15. Nilsson -Fish physiology -Recent Advances.
16. P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
17. Carl E. Bond -Biology of fishes.
18. M. Jobling -Environmental Biology of fishes.
19. Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
20. S.K. Gupta -Fish and Fisheries
21. K.P. Vishwas -Fish and Fishries.
22. Jhingaran -Fish and Fishries.

### **M.Sc Zoology**

#### **Semester-IV**

#### **Paper- IV B (Optional)**

#### **Cellular Organization and Molecular Organization.**

##### **Unit-1**

1. General organization and characterizes of viruses (Examples SV 40 and HIV).
2. Yeast : Structure, reproduction and chromosome organization: Basic ides of its applications as vectors for gene cloning.
3. Molecular organization of reoiratory chain assemblies, ATP / ADP Translocase and F0F1 AT pase.
4. Cell cycle: Cell cycle control in mammalian cells and xenopus.

##### **Unit-2**

1. Cytochemistry of Golgin complex and its role in cell seretion.,
2. Peroxisomes and training of paroxysmal proteins.
3. Nucleolus: Structure and Biogenesis and functions of lysosomes.

4. Intracellular digestion : Ultra structure and function of lysosomes.

**Unit-3**

1. Synthesis and targeting of mitochondrial proteins.
2. Secretory pathways and translocation of secretory proteins across the EPR membrane.
3. Genome complexity: C- value [paradox and cot value].
4. DNA sequences of different complexity.

**Unit-4**

1. Difference between normal cells and cancer cells.
  - a. Biochemical changes.
  - b. Cytoskeleton changes.
  - c. Cell surface changes.
2. Genetic basis of human cancer.
3. Chromosomal abnormalities in human cancer.

**Unit-5**

1. General idea of oncogenes and proto oncogenes.
2. Oncogenesis and cancer.
3. Transforming Agents.
4. Tumor Suppressor genes.
5. Receptor – Ligand interaction and signal transduction.  
Cross – talk among various signaling pathways.

**Suggested Reading Materials:**

1. DeRobertis and De Robertis Cell and Molecular Biology. Lea and Febiger.
2. We Watson Hopking reberts steits, Weiner molecular biology of the gene, the Benjamin / Cummings Publishin Company Inc.
3. Bruce alberts, Bray, Lewis, Raff, Roberts, Watson molecular Biology of the cell garland publishing inc.
4. P.K. Gupta, Molecular Cell Biology Rastogi Publication.
5. Watson Gilman Witkowski, Zoller Recominant D.N.A. scientific American Books.
6. Gerald Karp. Cell Biology.
7. Lewin B. Genes VII.
8. King Cell Biology.
9. Baniel L. HArtl Elizabeth W. Jones, Genetics Principles and analysis . Jones and Bartlett Publisher.
10. Lodish, Berk Zipursky, Matsudaira Baltimore Dornell Molecular Cell Biology W.H.Freeman and company.
11. J. Travers Immunology current Biology limited.
12. Kubey Immunology W.H. Freeman and Company.
13. Riott, Male snustad Principles of genetics john weley and sons Inc.

**M.Sc Zoology  
Semester-IV  
Paper- IV C (Optional)**

**Applied Entomology**

**Unit-1**

Classification according to imms

1. Classification of apterygota upto families.
2. Classification of following insect orders  
(a) orthoptera (b) hemiptera (c) diptera.
3. Classification of following insect order  
(a) hymenoptera (b) lepidoptera (c) coleoptera
4. Collection and preservation of insects.

**Unit-2**

1. Insect pest-Management strategies and tools
2. Biological control
3. Genetic control
4. Chemical control

**Unit-3**

1. Pests of Cotton
2. Pests of sugarcane
3. Pests of paddy

4. Pests of stored food grains
5. Pests of citrus fruits and mango
6. Pests of pulses
7. House hold insect pests

**Unit-4**

1. Insects in relation to forensic science
2. Insects migration, population fluctuation and factors
3. Insects of medical and veterinary importance
4. Ecological factors affecting the population and development of Insects

**Unit-5**

1. Mulberry and non mulberry sericulture
2. Apiculture
3. Lac culture
4. Insects as human food for future.

**M.Sc Zoology  
Semester-IV  
Paper- IV D (Optional)**

**Environment & Biodiversity Conservation**

**Unit I**

- Basic concept of Environmental Biology  
Scope and Environmental Science
- Biosphere and Biogeochemical cycles.
- Environmental monitoring and impact assessment.
- Environmental and sustainable development.
- Water conservation, rain water harvesting, water shed management.

**Unit II**

- Cause, effects and remedial measure of Air pollution, Water pollution.
- Noise. radioactive and thermal pollution.
- Agriculture pollution
- Basic concepts of Bioaccumulation.
- Solid waste management.

**Unit III**

- Global warming and disaster management
  - Cause of global warming
  - Impact of global warming – acid rains and ozone depletion, green house effect.
  - Control measures of global warming
    - (a) Afforestation (b) reduction in the use of CFCS
- Disaster management -floods, earthquake, Cyclones landslides.
- Environmental legislation.

**Unit IV**

Natural Resources:-

**Forest -**

- Use and over exploitation of forests.
- Timber extraction.

**Land**

- Land degradation. Landslides.
- Soil-ersion and desertification.

**Water**

- Use and over utilization of surface and ground water
- Floods. Drought dams- benefits and problems

**Mineral**

- Use and exploitation ,
- Environmental effect of extracting and using mineral resources

**Food**

- World food problem
- Effects of modern agriculture and overgrazing

**Energy**

- Conventional and nonconventional energy resources.
- Using of alternate energy sources
- Role of an individual in conservation of natural resources
- Equitable use of resources for sustainable life

**Unit V**

- Conservation of Biodiversity
  - Biodiversity crisis – habitat degradation poaching of wild life.
  - Socio economic and political causes of loss of biodiversity.
  - In situ and exsitu conservation of biodiversity
  - Value of biodiversity.
  - Hot spots of Biodiversity.

**Suggested Reading Materials:  
Paper III D & IV D**

1. Arora : Fundamentals of environmental biology
2. Anathakrishnan : Bioresources ecology
3. Bottain : Environmental studies
4. Bouhey : Ecology of populations
5. Clark : Elements of ecology
6. Dowdoswell : An introduction to animal ecology
7. Goldman : Limnology
8. Kormondy : Concepts of ecology
9. May : Model ecosystems
10. Odum : Ecology
11. Perkins : Ecology
12. Simmons : Ecology of estuaries and costal water
13. Pawlosuske : Physico-chemical methods for water
14. South Woods : Ecological methods
15. Trivedi and Goel : Chemical and biological methods for water pollution studies
16. Willington : Fresh water biology
17. Wetzel : Limnology
18. Welch : Limnology Vols. I-II



**M.Sc Zoology  
Semester-IV  
Paper- IV E (Optional)**

**Molecular Endocrinology and Reproductive Technology**

**Unit-1**

1. Definition and scope of molecular endocrinology.
2. Chemical nature of hormones.
3. Purification and characterization of hormones.
4. Production of hormone by r DNA technology

**Unit-2**

1. Structure – function relationship in hormones comparative analysis and evolutionary perspectives.
2. Eicosanoids and hormone action.
3. Concentration and transport of hormones in the blood.
4. Genetic analysis of hormonal disorders.

**Unit-3**

1. Hormonal regulation of energy metabolism.
2. Hormonal antagonism.
3. Hypothalamic nuclei and their physiological function.
4. Endocrine – Immune interaction

**Unit-4**

1. Extraction and estimation of pregnanediol from urine.
2. Extraction of Gonadotrophin from urine.
3. Bioassay of Androgen.
4. Bioassay of progesterone.

**Unit-5**

1. Contraception.
2. Multiple ovulation and embryo transfer technology.
3. Study of estrous cycle by vaginal smear technology.
4. Surgical technique—castration, ovariectomy, vasectomy, tubectomy and laprotomy.

**Suggested Reading Materials:**

1. Benjamin Lewin – Genes VII/ VIII, oxford University press.
2. Lodish et al- Molecular Cell Biology.
3. Zarrow, M.X., Yochin J.M. and Machrthy, J.L. – Experimental Endocrinology.
4. Chatterji C.C.- Human Physiology (Vol- II).
5. Bentley, P.J. – Comparative Vertebrate endocrinology.
6. Hadley Mac. E.- Endocrinology.
7. Chinoy, N.J. Rao, M.V., Desarai, K.J. and High land, H.N. – Essential techniques in reproductively physiology and Endocrinology.
8. Norris, D.O. – Vertebrate Endocrinology.