



# **SYLLABUS**

**2015-2016**

**BASTAR UNIVERSITY, JAGDALPUR**

**CHHATTISGARH 494001**

# BASTAR UNIVERSITY, JAGDALPUR

**CHHATTISGARH 494001**

**SYLLABUS FOR 2015-16**

## M. Sc. ZOOLOGY

FIRST SEMESTER	Paper No. *	Title of Paper	Marks	
			(External)	(Internal) **
July - Dec. 2015	I	Biosystematics, Taxonomy and Biodeversity	80	20
	II	Structure and Function of Invertebrates	80	20
	III	Population Genetics and Evolution	80	20
	IV	Tools & Techniques in Biology	80	20
	LC-I	Lab Course I (Based on paper I & II)	80	20
	LC-II	Lab Course II (Based on paper III & IV)	80	20
	SECOND SEMESTER	Paper No.	Title of Paper	Marks
Jan - June 2015	I	Molecular Cell Biology and Biotechnology	80	20
	II	General Physiology and Endocrinology	80	20
	III	Development Biology	80	20
	IV	Quantative Biology and Computer Application	80	20
	LC-I	Lab Course I (Based on paper I & II)	80	20
	LC-II	Lab Course II (Based on paper III & IV)	80	20
	THIRD SEMESTER	Paper No.	Title of Paper	Marks
July - Dec. 2016	I	Comparative Anatomy of Vertebrates	80	20
	II	Animal Behaviour	80	20

	III	Environment Physiology and Population Ecology	80	20
	IV	Immunology and Parasitism	80	20
	LC-I	Lab Course I (Based on paper I & II)	80	20
	LC-II	Lab Course II (Based on paper III & IV)	80	20
FOURTH SEMESTER	<b>Compulsory</b>		Marks	
			(External)	(Internal)
	I	Biochemistry	80	20
Elective Jan- June 2016	II	Neurophysiology	80	20
	<b>Optimal papers (Group I)*</b>			
	I	Fish (ichthyology) structure and function	80	20
	II	Cell biology	80	20
	III	Entomology	80	20
	IV	Wild life conservation	80	20
	V	Biology of Vertebrates immune system	80	20
	<b>Optimal paper (Group II)*</b>			
	I	Pisci culture and economic importance of fishes (Ichthyology)	80	20
	II	Cellular organization and molecular organization	80	20
	III	Applied entomology	80	20

	IV	Environment and Biodiversity conservation	80	20
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	V	Molecular endocrinology and reproductive technology	80	20
	LC-I	Lab Course I (Based on paper I & II)	80	20
	LC-II	Lab Course I (Based on paper III & IV)	80	20

\* Student has choice to opt. for one paper each (special paper) from group I & group II.

\*Each theory paper will have 5 questions of equal marks. First question will encompass all the five units without any internal choice, whereas rest questions will be unit wise with internal choice.

\*\*The respective teachers on each paper will ensure the internal evaluation by a class test and a seminar/ poster presentation of 10 marks each and submit the foil and counter foil to the HOD by the end the activity.

## **M. Sc. ZOOLOGY FIRST SEMESTER**

### **PAPER – I BIOSYSTEMATICS, TAXONOMY AND BIODIVERSITY**

(There will be 5 questions of equal marks. First question will encompass all the five units without any internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

1. Definition and basic concepts of biosystematics and taxonomy.
  - Historical resume of systematics.
  - Importance and applications of biosystematics in biology
2. Trends in biosystematics concepts of different conventional and newer aspects
  - 2.1 Chemotaxonomy
  - 2.2 Cytotaxonomy
  - 2.3 Molecular taxonomy

#### **UNIT-II**

3. Dimensions of speciation and taxonomic characters
  - 3.1 Mechanisms of speciation in panmictic and apomictic species
  - 3.2 Species concepts and species category.
  - 3.3 Theories of biological classification.
  - 3.4 Taxonomic characters and different kinds.

#### **UNIT-III**

4. Procedure keys in taxonomy.
  - 4.1 Taxonomic procedures-taxonomic collections, preservation, curation
  - 4.2 Taxonomic keys-different kinds of taxonomic keys, their merits and demerits.
  - 4.3 Process of typification and different Zoological types.
  - 4.4 International code of Zoological Nomenclature (ICZN)

#### **UNIT-IV**

## 5. Biodiversity

5.1 Types of Biodiversity

5.2 Hot spots of Biodiversity

5.3 Threats to Biodiversity

5.4 Conservation of Biodiversity

## 6. Evaluation of biodiversity indices

6.1 Shannon-Weiner index.

### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- **Biosystematics & Taxonomy**

**Dr.R.C.Tripathi**, University Book House JAIPUR.

- **Theory & Practice of Animal Taxonomy**

**V.C. Kapoor**, 5th Edition Oxford & IBH Publishing Co.

- **Principle of Animal Taxonomy**

**G.G. Simpson**, Oxford & IBH Publishing Co.

- **Elements of axonomy**

**Earnst Mayer**

- **Biodiversity**

**E.O. Vilson**, Acadmic Press Washington

- **The Biology of Biodiversity M. Kato,**

Springer

- **Molecular Markers - Natural History & Evolution J.C. Avise**

- **Sc. ZOOLOGY FIRST SEMESTER**

### **PAPER-II: STRUCTURE & FUNCTION OF INVERTEBRATES**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

##### 1. Organization of coelom

- 1.1 Acoelomates and Pseudocoelomates
- 1.2 Coelomates: Protostomia and Deuterostomia.
2. Locomotion
  - 2.1 Flagellar and ciliary movement in Protozoa.
  - 2.2 Hydrostatic movement in Coelenterata, Annelida and Echinodermata.

## **UNIT-II**

3. Nutrition and Digestion
  - 3.1 Patterns of feeding and digestion in Protozoa
  - 3.2 Filter feeding in polychaeta.
4. Respiration
  - 4.1 Organs of respiration Gills, lungs and trachea.
  - 4.2 Respiratory pigments.

## **UNIT-III**

5. Excretion
  - 5.1 Organs of excretion.
  - 5.2 Excretion and osmoregulation
6. Nervous System
  - 6.1 Primitive nervous system: Coelenterata and Echinodermata.
  - 6.2 Advanced Nervous system: Annelida, Arthropoda (Crustacea and insecta) and Mollusca (Cephalopoda)

## **UNIT-IV**

7. Invertebrate larvae
  - 7.1 Larval forms of free-living and parasitic invertebrates
8. Minor Phyla
  - 8.1 Organization and general characters of (Ctenophore, Rotifera, Ectoprocta, Endoprocta)

## **SUGGESTED READING MATERIALS (ALL LATEST EDITION)**

### **1. Invertebrate Structure and function:-**

E.J.W. Barrington English language Book society UK.

### **2. Invertebrate Zoology:**

Robert Barnes IVth Edition Holt Saunders International Edition Japan.

### **3. The Cambridge Natural History Vol 1 - 9.**

S F Harmer, A.E. Shipley.

Todays & Tomorrows Book agency, N Delhi India.

### **• A Text book of Zoology Invertebrate:**

Parker Hasvell, Marshall & Williams. AITBS  
Publishing & Distributers, Delhi

- **The Invertebrates Vol. 1 - 9**

Libbic Henrietta Hyman, McGraw Hill Book Company

## **M. Sc. ZOOLOGY FIRST SEMESTER**

### **PAPER-III: POPULATION GENETICS & EVOLUTION**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

1. Concepts of evolution and theories of organic evolution: Lamarckism, Darwinism and Synthetic theory of evolution
2. Evidences of evolution: anatomical, embryological, palaeontological, physiological and Bio-chemical

#### **Unit-II**

3. Hardy-Weinberg law of genetic equilibrium
4. Detailed account of destabilizing forces.
  - 4.1 Natural selection
  - 4.2 Mutation
  - 4.3 Genetic drift
  - 4.4 Meiotic drive
5. Phenotypic variation

#### **UNIT-III**

6. Patterns and mechanisms of reproductive isolation
7. Phylogenetic and biological concepts of species
8. Gene Evolution, Evolution of gene families
9. Factors affecting human disease frequency

#### **UNIT-IV**

10. Origin of higher categories
11. Micro-and Macro-evolution
12. Evolution of horse, elephant, camel, man

### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- **Gene & Evolution**

Jha A.P. John Publication, New Delhi

- **Evolution & Genetics**  
Merrel D.J. Holt rinchert & Wiston INC.
- 3. **The Genetics & Origin of Species**  
  
Dobzhansky, Columbia University Press.
- **Evolution**  
Dobzhansky, Ayala F.J., Stebbins G.L. & Valentine J.M.  
Surjeet Publication New Delhi.
- **Species Evolution - The Role of Chromosomal Change**  
King M. Cambridge University Press. Cambridge
- **A Primer of Population Genetics**  
Hartl D.L. Suinaer Associates INC, Massachusetts
- **Evolutionary Genetics**  
Smith J.M. Oxford University Press, NewYork
- **Evolutionary Biology**
- Futuyama D.J. Suinaer Associates INC publishers,  
Dunderland
- **Evolution**  
Strikberger M.W. Johns & Bartett Publishers, Boston London

## **M. Sc. ZOOLOGY FIRST SEMESTER**

### **PAPER-IV: TOOLS & TECHNIQUES IN BIOLOGY**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

1. Principles and application of
  - 1.1 Ultracentrifugation
  - 1.2 Electrophoresis
  - 1.3 Chromatography (various types)
  - 1.4 Lambert-Beers Law and colorimetry and spectrophotometry
  - 1.5 Flow cytometry.

#### **UNIT-II**

2. Principles and Application of
  - 2.1 Light Microscopy and micrometry
  - 2.2 Phase Contrast microscopy
  - 2.3 Interference microscopy
  - 2.4 Fluorescence microscopy



- 2.5 Transmission Electron microscopy.
- 2.6 Scanning Electron microscopy.

### **UNIT-III**

- 3. Assay
  - 3.1 Chemical assays
  - 3.2 Biological assays-in vivo and in vitro
- 4. Principles of cytological and cytochemical techniques
  - 4.1 Fixation: chemical basis of fixation by formaldehyde, gluteraldehyde, chromium salts, mercury salts, osmium salts, alcohol and acetone
  - 4.2 Chemical basis of staining of carbohydrate, protein lipids and nucleic acids.

### **UNIT-IV**

- 5. Principle and techniques of
  - 5.1 Nucleic acid hybridization and cot curve
  - 5.2 Sequencing of proteins and nucleic acids
- 6. Freeze techniques
- 7. Media preparation and sterilization
- 8. Inoculation and growth monitoring

### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- **Introduction to Instrumental Analysis**
  - **Robert Braun**, McGraw Hill International Edition
- **A biologist guide to principles and techniques of practical biochemistry**
  - **K Wilson and K. H. Goulding** ELBs Edition
- **Instrumentation**
  - **Upadhyay and Nath**, Meerut Publications
- **Instrumentation and Techniques**
  - **R.C. Bajpayee**, Himalayan Publications

### **M. Sc. ZOOLOGY FIRST SEMESTER**

### **LAB COUSE-I: (PRACTICAL BASED ON PAPER I & II)**

### **I. Biosystematics and Taxonomy**

1. Study of biodiversity among various invertebrates and vertebrates (Listing of all the animals found in and around your house and also try to find out their Zoological names).
2. Collection of various insect species.
3. Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report.
4. Study of adaptive characteristics of various invertebrates and vertebrates in different climate.
5. Taxonomic key formation and conversion.
6. Study of biodiversity in grassland and pond water by using Shannon -Weiner index
7. Other exercise related to theory paper

### **II. Structure and function of invertebrates**

1. Identification, classification and study of distinguishing features of important representatives from various groups (Protozoa to Hemichordata).
  2. Study of permanent prepared slides (from Protozoa to Hemichordata).
  3. Dissection; Reproductive, Excretory, nervous and haemocoelomic systems of leech.
  4. Dissection Reproductive system of cockroach; general anatomy, nervous and reproductive systems of grasshopper; nervous system of crab; nervous and reproductive systems of scorpion.
  5. Nervous system of Mytilus, Sepia and Aplysia, general anatomy of Aplysia.
  6. Study of sections of the arm of a starfish; general anatomy of a Holothurian; Aristotle's lantern of a sea urchin complete as well as disarticulated parts of the Aristotle's lantern.
  7. Permanent preparations of different materials to be provided for study.
  8. Wonder invertebrates
  9. Other exercise related to theory paper.
- \* UGC guideline should be followed.

#### **EXAMINATION SCHEME**

Based on paper I	40 marks
Based on paper II	40 marks
Viva	10 marks
Sessional (Internal)	10 mark
<b>Total</b>	<b>100</b>

### **M. Sc. ZOOLOGY FIRST SEMESTER LAB COUSE-II: (PRACTICAL BASED ON PAPER III & IV)**

### **III. Population genetics and evolution**

1. Problems on genetics (complete and incomplete linkage; dominance, sex-linked inheritance) Demonstration of Hardy-Weinberg law
2. Preparation of human chromosomes map, demonstration of chromosomal deficiencies.
3. Experiments based on population genetics, pedigree analysis.

4. Study of evolution of horse by way of models.
5. Study of evolution through homologous and analogous organs.
6. Other exercises related to theory paper.

#### **IV. Tools and techniques in biology**

1. Parts study, principles and use of following instruments for different techniques:
  - a. pH meter: Determination of pH of different soil and water samples.
  - b. Spectrophotometer: Preparation of absorption spectrum.
  - c. Chromatography: Paper and thin layer chromatography.
  - d. Centrifuge: Extraction proteins and carbohydrates from tissues.
  - e. Electrophoresis: Paper and gel electrophoresis.
  - f. Microscope: Parts study and principles of various microscopes.
  - g. Demonstration of cryostat.
2. Other exercise related to theory paper.

#### EXAMINATION SCHEME

Based on paper III	40 marks
Based on paper IV	40 marks
Viva	10 marks
Sessional (Internal)	10 Mark
Total	<b>100</b>

### **M. Sc. ZOOLOGY SECOND SEMESTER**

#### **PAPER – I: MOLECULAR CELL BIOLOGY AND BIOTECHNOLOGY**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

1. Biomembranes  
Molecular composition and arrangement  
Transport across membrane
2. Structure and function  
Mitochondria

Golgi complex  
Lysosome  
Ribosome

## **UNIT-II**

3. DNA replication
4. Transcription
5. Translation
  - 5.1 Genetic code
  - 5.2 Mechanisms of initiation, elongation and termination
  - 5.3 Regulation of translation

## **UNIT-III**

6. Genome organization
  - 6.1 Chromosomal organization: morphological and structural types.
  - 6.2 Non-coding DNA
7. Molecular mapping of genome
  - 7.1 Genetic and physical maps
  - 7.2 Polymerase Chain Reaction (PCR) and blotting techniques
  - 7.3 Molecular markers in genome analysis.

## **UNIT-IV**

8. Transgenic animals and knock-outs
  - 8.1 Production and applications
  - 8.2 Embryonic stem cells
9. Application of genetic engineering
  - 9.1 Medicine
  - 9.2 Agriculture
  - 9.3 Industry

### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- **MOLECULAR CELL BIOLOGY**

**Lodish, W.H. Freeman & Co. NewYork**

- **Lehninger PRINCIPLES OF BIOCHEMISTRY,**

Fourth Edition - David L [1]. Nelson, Michael M. Cox

- **MOLECULAR CELL BIOLOGY**

Lodish M. Baltimore, Scientific American books

- **ESSENTIALS OF CELL & MOLECULAR BIOLOGY**

**Roberties & Roberties**, Halt Saunders International Edition.

- **CELL & MOLECULAR CELL BIOLOGY**

**Gerald Karp**, Willey & Sons Co.

- **MEDICAL CELL BIOLOGY**

**Flickinger E.J. Brown J.C.** Halt Saunders International Edition.

- **CELL BIOLOGY**

**Powar C.B.** Himalaya Publishing House

## **M. Sc. ZOOLOGY SEMESTER - II**

### **PAPER – II: GENERAL PHYSIOLOGY AND ENDOCRINOLOGY**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

##### 1. Digestion and Metabolism

1.1 General organization of alimentary canal

1.2 Mechanism of digestion

1.3 Mechanism of absorption

##### 2. Gas Exchange and Acid-base Balance

2.1 Oxygen and Carbon dioxide transport in blood

2.2 The role of hemoglobin

2.3 Regulation of body pH

#### **UNIT-II**

##### 3. Muscle Function and Movement

3.1 Anatomy of muscle

3.2 Mechanism of muscle contraction

3.3 Regulation of muscle contraction

##### 4. Nervous System

- 4.1 Neurons and membrane excitation
- 4.2 Action potentials
- 4.3 Synapses and neurotransmitters

### **UNIT III**

#### 5. Sensory Transduction

- 5.1 Auditory receptors
- 5.2 Chemoreceptor: taste and smell
- 5.3 Vision and Photoreception

#### 6. Thermoregulation and Cold Tolerance

- 6.1 Heat balance and exchange
- 6.2 Endotherms Vs Ectotherms
- 6.3 Torpor, hibernation and aestivation

### **UNIT-IV**

#### 7. Endocrinology

- 7.1 Structure and functions of endocrine glands (Pituitary, pineal, pancreas, adrenal, thyroid etc.)
- 7.2 Biosynthesis of hormones (thyroid and gonadal)
- 7.3 Hormones and Reproduction

### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- Comparative vertebrate Endocrinology – by **Gorbman & Bern**
- Human Physiology – by **Dr. C. C. Chatterjee**
- Comparative Endocrinology – by **Barrington**
- Applied Animal Endocrinology – by **Squires**
- **Endocrinology** – Basic & Clinical principles - by **Melmed & Cohn**

## **PAPER – III: DEVELOPMENT BIOLOGY**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

### **UNIT-I**

#### 1. Oogenesis

- 1.1 Differentiation and growth of oocytes.
- 1.2 Organization of egg cytoplasm and egg cortex.
- 1.3 Vitellogenesis

- Spermatogenesis

- 2.1 Differentiation and ultra structure of sperm
- 2.2 Capacitation

### **UNIT-II**

- Fertilization

- 3.1 Biological role of fertilization.
- 3.2 Basic requirements of fertilization.
- 3.3 Activation of egg metabolism
- 3.4 Biochemistry of fertilization

- Cleavage

- Characteristics and mechanisms of cleavages

### **UNIT-III**

#### 5. Formative movements

#### 6. Fate maps

- 6.1 Utility and comparative topographical relationship of the Presumptive areas in early embryos of

- 6.1.1 Amphioxus

- 6.1.2 Fishes

- 6.1.3 Amphibian

- 6.1.4 Birds

#### 7. Differentiation

### **UNIT-IV**

#### 8. Cell and tissue interactions in development

- 8.1 Primary embryonic induction
- 8.2 Competence
- 8.3 Concept of organizer
- 9. Metamorphosis
- 10. Teratology

### **SUGGESTED READINGS MATERIALS**

- **Animal Gametes –**

Vishmanath, Asia Publishing House

- **Foundation Of Embrology –**

Bradley M.Patten, McGraw Publication

- **Fertilization In Animals –**

Brain Dale, Arlond Heiniman, Gulab Vazerani Publication

- **Development Biology -**

N.J. Berril, Tata McGraw Hill Publication N. Delhi

- **Embryology Of Vertebrates -**

Nelson

### **M. Sc. ZOOLOGY SEMESTER - II**

#### **PAPER – IV: QUANTITATIVE BIOLOGY AND COMPUTER APPLICATION**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

1. Introduction to digital computer and application
  - 1.1 Basic knowledge of hardware and software
  - 1.2 CPU (Central Processing Unit)
  - 1.3 Input and Output devices
  - 1.4 Auxiliary storage system



1.5 Operating system and Binary number system

## **UNIT-II**

2. Computer application

2.1 Introduction to MS office

2.1.1 Word

2.1.2 Excel

2.1.3 Power point

3. Computer application in biostatistics

4. Simple computation and elementary knowledge of flow chart

## **UNIT-III**

5. Types of biological data

6. Representation of data

7. Sample and sampling

8. Measures of central tendency

9. Measures of dispersion

10. Hypothesis testing: Null and alternate hypothesis

## **UNIT-IV**

11. Tests of significance

11.1 Chi-square test

11.2. Student's t-test

12. Analysis of Variance

13. Simple linear regression

14. Correlation

15. Probability distribution: normal and binomial

## **SUGGESTED READING MATERIALS**

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling  
 -Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.  
 - Snedecor, G.W. and W.G. Cochran, statistical methods, Affiliated East, West Press New Delhi (Indian ed.)  
 - Muray, J.D. Mathematical Biology, Springer Verlag Berlin  
 - Pelon, E.C. The interpretation of ecological data : A primer on classification and ordination.  
 A. Lewis . Biostatistics  
 - B.K. Mahajan Methods in Biostatistics  
 - J.D. Murray Mathematical Biology  
 - Geogis & Wilians Statistical method

**M. Sc. ZOOLOGY SEMESTER – II**  
**LAB COURSE – I: (PRACTICAL BASED ON PAPER I & II)**

**I. Molecular biology and Biotechnology**

- 1 Isolation of DNA/RNA
- 2 Study of mitochondria from buccal epithelium by staining with supravital stains.
- 3 Culture of amoeba, paramecium, euglena.
- 4 Study of cell division mitosis/meiosis by squash and smear preparation of root tip and cockroach/grasshopper testis.
- 5 Study of giant chromosome in the salivary gland of Chironomous larvae or Drosophila. .
- 6 Study of Barr body and human chromosome.
- 7 Culture and study of drosophila.
- 8 Preparation of culture media and culture of bacteria.
- 9 Other exercise .related to theory paper.

**II. General physiology and endocrinology**

1. Estimation of RBC, hemoglobin, hematocrit/PVC, blood group and Rh factor blood clotting time.
2. Determine the blood pressure of man.
3. Determination of urea, glucose and ketone bodies in urine.
4. Demonstration of osmosis.
5. Dissection and exposure of major endocrine glands in an experimental animals.
6. Study of histology of endocrine glands in different animal types through permanent slides and microtomy.
7. Other exercise related to theory paper.

**EXAMINATION SCHEME**

Exercise based on paper I	40 marks
Exercise based on paper II	40 marks
Viva	10 marks

Sessional (Internal)	10 Mark
Total	<b>100</b>

**M. Sc. ZOOLOGY SEMESTER – II**  
**LAB COURSE-II: (PRACTICAL BASED ON PAPER III & IV)**

**III. Development biology**

1. Study of slides of development of frog.
2. Study of development of Hen's egg, by cover glass window method, staining and mounting of blastodisc.
3. Study of caudal regeneration in Teleost (Meal time effect).
4. Study of embryological slides: spermatogenesis, oogenesis, histology of gonads.
5. Study of effect of NaF/urea on growth of fish fingerlings.
6. Study of effect of thyroid hormone on metamorphosis of tadpole
7. Other exercises related to theory paper

**IV. Quantitative biology and computer application**

1. Preparation of frequency tables and graphs.
2. Calculation of standard deviation, variance and standard error of mean.
3. Calculation of probability and significance between means using t-test, Chi-square test, ANOVA
4. Calculation of correlation, regression and probability distribution.
5. Computer software use for computational tasks, data presentation, design task and communication
6. Other exercises related to theory paper.

EXAMINATION SCHEME

Exercise based on gametic biology (dissection/ microtomy/ spot- 1- 5)	40 mark
Exercise on Environmental Physiology and Ecology	40 mark
Viva	10 mark
Sessional (Internal)	10 Mark
Total	<b>100</b>

**M. Sc. ZOOLOGY SEMESTER - III**

## **PAPER-I: COMPARATIVE ANATOMY OF VERTEBRATES**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise) with internal choice.

### **UNIT-I**

1. Origin of Chordates
  - 1.1 Amphibians, Reptiles, Birds and Mammals.
2. Classification of Vertebrates
  - 2.1 Amphibians
  - 2.2 Reptiles
  - 2.3 Birds
  - 2.4 Mammals.

### **UNIT-II**

3. Vertebrate integument and its derivatives.
  - 3.1 General structure and functions of Integument.
  - 3.2 Structure and functions of glands, scales, horns, claws, nails, hoof, feather and hair.
4. Skeletal system in vertebrates.
  - 4.1 Comparative account of (i) Jaw suspensorium, (ii) Limbs and Girdles.

### **UNIT-III**

5. Respiration in Vertebrates.
  - 5.1 Comparative account of respiratory organs (structure and functions).
6. Circulation in Vertebrates.
  - 6.1 Structure and function of blood.
  - 6.2 Evolution of heart.
  - 6.3 Evolution of aortic arches.

### **UNIT-IV**

7. Nervous System – Central, Peripheral and Autonomic.
8. Sense organs.
  - 8.1 Comparative account of Sensory Receptors.
9. Evolution of Urinogenital system in vertebrates.

### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- **Vertebrate life** :- William N. Ferland, F. Harvey pough, Tom J Gode, John B. Heiser
- Collier MacNille International edition
- **Chordate morphology** :-Malcom Jollie

- Reinhold Publishing Corporation NewYork
- **Chordate –Structure & Function** :- Arnold G. Khage, B.E. Fry Johanson
- Mc Millan Publishing Co. INC. NewYork
- **Comparative Animal Physiology** :- Orosser
- Satish Book Enterprises, Agra
- **The Vertebrate Body** :- Alfred Sherwood Romer
- Vakils, Feffer & Simons Publications Ltd.

### **M. Sc. ZOOLOGY SEMESTER – III**

#### **PAPER-II: ANIMAL BEHAVIOUR**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise) with internal choice.

#### **UNIT- I**

1. Historical perspectives- Ethology
2. Behavioural patterns
3. Innate behaviour
4. Biological rhythms
  - 4.1 Types of biological rhythm
  - 4.2 Biological clock

#### **UNIT- II**

5. Communications
  - 5.1 Auditory
  - 5.2 Visual
  - 5.3 Chemical
6. Learning and Memory
  - 6.1 Conditioning
  - 6.2 Habituation
7. Reasoning
8. Reproductive behaviour.

#### **UNIT-III**

9. Orientation
10. Echolocation in bats
11. Bird migration and navigation.
12. Fish migration.

13. Neural and hormonal control of behaviour

#### **UNIT-IV**

14. Hormonal effect on behavioural patterns.

15. Social behaviour

15.1 Social organization in insects and primates

15.2 Schooling in fishes and Flocking in birds

15.3 Homing, territoriality, dispersal

15.4 Altruism

15.5 Host–parasite relation

#### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- **ANIMAL BEHAVIOR – Mc Farland** (English Language Book Society)
- **ANIMAL BEHAVIOR – Arora M.P.** (Himalaya Publishing House, Mumbai)
- **ANIMAL BEHAVIOR - Reena Mathur** (Rastogi Publications, Meerut)

#### **M. Sc. ZOOLOGY SEMESTER – III**

#### **PAPER – III: ENVIRONMENT PHYSIOLOGY AND POPULATION ECOLOGY**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT – I**

Population dynamics:

1. Demography, life table, reproductive rates, reproductive values
2. Population growth, exponential, non overlapping
3. Stochastic and time lag models of population growth
4. Population density
5. Population evolution
6. Community dynamics: Characteristics, development and classification

#### **UNIT-II**

1. Adaptations

1.1 Levels of adaptation.

1.2 Mechanisms of adaptation.

2. Adaptations to different environments.

2.1 Marine, shores and estuaries.

2.2 Freshwater.

## 2.3 Terrestrial Life.

### **UNIT-III**

#### 4. Stress Physiology

- 4.1 Basic concepts of environmental stress and strain, Concept of elastic and plastic strain.
- 4.2. Stress avoidance, stress tolerance and stress resistance.
- 4.3. Acclimatization, acclimation and adaptation.
- 4.4. Endothermic and physiological mechanism of regulation of body temperature.

### **UNIT -IV**

#### 5. Stress physiology in different conditions

- 5.1 Osmoregulation in aqueous and terrestrial habitats.
- 5.2 Physiological response to oxygen deficient stress.
- 5.3 Physiological response to body exercise.
- 5.4 Effect of meditation and yoga

### **SUGGESTED READING MATERIALS - (ALL LATEST EDITION)**

- **ECOLOGY** with special reference to animal & man
  - **S. Charles, Kendeigh** Prentice hall of India Pvt. Ltd. New Delhi
- **ELEMENTS OF TROPICAL ECOLOGY**
  - **Yanney Ewusie** (English language Book Society, Heine mann educational book publication)
- **FUNDAMENTALS OF ECOLOGY**
  - **Odum P.**
- **ANIMAL PHYSIOLOGY, MECHANISM AND ADAPTATION -**
  - Eckert, R., W,H, Freeman and Co.**
- **BIOCHEMICAL ADAPTATION -**
  - Hochachka, P.W, and Somero S.N,** Princeton, New Jersey
- **ANIMAL PHYSIOLOGY: ADAPTATION AND ENVIRONMENT.-**

- **Schiemidt Nielsen, Cambridge**  
**GENERAL & COMPARATIVE ANIMAL PHYSIOLOGY**

**Hoar W.S. Princeton Hall of India**

- **ENVIRONMENTAL PHYSIOLOGY**

**Willmer, P.G. Stone & Johanson I, Blackwell Science Oxford**

### **M. Sc. ZOOLOGY SEMESTER – III**

#### **PAPER – IV: IMMUNOLOGY AND PARASITISM**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise with internal choice).

#### **UNIT-I**

##### 1. Cells of immune system

1.1 B-Lymphocytes, T-lymphocytes, Null Cells

1.2 Mononuclear cells

1.3 Granulocytic cells (Neutrophils, Eosinophils and Basophils)

1.4 Mast cells

1.5 Dendritic cells

##### 2. Organs of immune system

2.1 Primary lymphoid organs (Thymus, bone marrow)

2.2 Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue, cutaneous associated lymphoid tissue)

#### **UNIT-II**

##### 3. Immunoglobulin structure and function

3.1 Molecular structure of Ig, Light chain and Heavy chain

3.2 Immunoglobulin classes



3.2.1 IgG

3.2.2 IgM

3.2.3 IgE

3.2.4 IgD

3.3 Monoclonal antibodies

### **UNIT-III**

4. Antigens

4.1 Immunogenicity

4.2.1 Contribution of the immunogens.

4.2.2 Contribution of Biological system.

5. Antigen - Antibody Interaction

5.1 Antibody affinity and activity

5.2 Cross reactivity

5.3 Agglutination reactions

5.4 Precipitation Reaction

6. Vaccine

6.1 Active and passive immunization

6.2 Whole organism vaccine

6.4 Recombinant vector vaccines

6.5 DNA vaccines

### **UNIT-IV**

7. Immune system in Health disease

7.1 Immune response to infectious disease

7.2 Immune response in cancer

8. Pathophysiology of parasitic infection

8.1 Viral infections

8.2 Bacterial infection

### 8.3 Helminths infection

### 9. AIDS

#### **SUGGESTED READING MATERIALS**

- **Immunology**
  - **Kuby, W.H.** Froeman USA
- **Fundamental of Immunology**
  - **W. Paul,**
- **Essential Immunology**
  - **I.M. Roitt,** ELBs Edition
- **Immunology**
  - **Richard M. Hyde, Robert A. Patnode,** A Wiley Medical Publications
- **Reproductive Physiology**
  - **Gayton,**

#### **M. Sc. ZOOLOGY SEMESTER – III**

##### **LAB COURSE-I: (PRACTICAL BASED ON PAPER I & II)**

##### **I. Comparative anatomy of Vertebrates**

1. Identification, classification and study of distinguishing features of important representatives, museum specimens and slides (Protochordates and Chordates)
2. Comparative studies of integumentary, skeleton and reproductive system of major vertebrate classes.
3. Dissections: fowl/snake cranial nerves
4. Wonder vertebrates
5. Other exercise related to theory paper.

##### **II. Animal Behaviour**

1. To study the phototactic response in earthworm or grain/pulse pest.

2. To study the geotaxis behaviour of earthworm.
3. To study the food preference and cleaning behaviour of housefly.
4. To study the food preference in tribolium or grain/pulse pests.
5. To study the web construction and habituation in spider.
6. Estimation of body temperature and pulse rate on daily time scale.
7. Estimate the time perception among various individuals at two different time points on daily time scale.
8. Determination of effect of time on schooling behaviour in fish.
9. Toxicological response of fish opercular and surfacing activity.

#### EXAMINATION SCHEME

Based on paper I	40 mark
Based on paper II	40 mark
Viva	10 mark
Sessional (Internal)	10 Mark
Total	<b>100</b>

### M. Sc. ZOOLOGY SEMESTER – III

#### LAB COURSE-II: (PRACTICAL BASED ON PAPER III & IV)

##### III. Immunology and Parasitism

1. Dissection of primary and secondary immune organs from fish/fowl- Preparation and study of cell suspension from spleen (spleenocytes) of Fish / fowl.
2. Total and differential counting of leucocytes.
3. Protein estimation by Lowry's method in normal and infected blood sample.
4. Determination of Blood group.
5. Study of permanent slides (for spotting); thymus, lymph nodes, spleen, bone marrow, types of cells squamous, cuboidal, columnar, epithelial cells, blood cells, nerve cells, muscles cells, connective tissue of various types, adipose tissue, mitotic and meiotic chromosomes and their different phases cancer cells of various types etc.
6. Study of parasites in fish
7. Study of various parasites through slides and specimen.
8. Other exercises related to theory paper.

##### IV. Environmental Biology, Population ecology

1. Study of biotic community in a pond/grassland ecosystem.
2. Study of population growth rate (curve) in protozoan culture.
3. Population dynamics of *Tribolium* sp.
4. Study of biogeochemical cycles by way of models.

5. Visit to some natural habitats and man made habitats to study the human impact on environment.
6. Water analysis for fresh and waste water (Dissolve oxygen and chloride).
7. Other exercises related to theory paper.

#### EXAMINATION SCHEME

Based on paper III	40 mark
Based on paper IV	40 mark
Viva	10 mark
Sessional (Internal)	10 Mark
Total	<b>100</b>

#### **M. Sc. ZOOLOGY SEMESTER – IV**

#### **PAPER– I (Compulsory) BIOCHEMISTRY**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise) with internal choice.

#### **UNIT-I**

1. Properties of Proteins
  - 1.1 Structure and properties of amino acids.
  - 1.2 Classification of proteins.
  - 1.3 Structure of proteins.
  - 1.4 Biological Functions of Proteins.
  - 1.5 Protein Metabolism.

#### **UNIT-II**

2. Carbohydrates
  - 2.1 Classification of carbohydrates.
  - 2.2 Structure and Functions of Carbohydrates.
  - 2.3 Carbohydrate metabolism.
3. Lipid
  - 3.1 Lipid structure and functions
  - 3.2 Lipid metabolism.

#### **UNIT-III**

4. Vitamins
  - 4.1 Water and Fat soluble vitamins,
  - 4.2 Chemistry, occurrence and physiological role.
5. Enzymes
  - 5.1 Classification and nomenclature.
  - 5.2 Mechanism of action
  - 5.3 Regulation of enzyme activity and functions of Co-enzymes.

## **UNIT-IV**

### 6. Nucleic acid

- 6.1 Chemistry of DNA.
- 6.2 Chemistry of RNA.
- 6.3 Biological importance of nucleic acids.
- 6.4 Nucleoproteins.
- 6.5 Metabolism of nucleic acids.

## **Suggested Reading**

- **Lehninger Principles of Biochemistry, Fourth Edition**  
David L. Nelson, Michael M. Cox  
Publisher: W. H. Freeman
  
- **Biochemistry**  
Donald Voet, Hardcover: 1616 pages,  
Publisher: Wiley; 3 edition
  
- **Principles of Biochemistry With a Human Focus**  
Reginald H. Garrett, Charles M. Grisham  
  
Publisher: Brooks Cole
  
- **The Molecular Basis of Cell Cycle and Growth Control**  
  
Gary S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt,  
Publisher: Wiley-Liss
  
- **Experiments in Biochemistry: A Hands-On Approach**  
Shawn O. Farrell, Ryan T. Ranallo,  
Publisher: Brooks Cole

## **M. Sc. ZOOLOGY SEMESTER – IV**

### **PAPER II (Compulsory) NEUROPHYSIOLOGY**

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise) with internal choice.

## **UNIT - I**

- Physiological role of neurosecretory cells
- Histological structure of neurons and neuroglial cells

- Physiological properties of neural fibres
- Synapsis and synaptical transmission
- Myoneural junction and neuromuscular transmission
- Degeneration and regeneration of nerve fibre

## **UNIT - II**

- Nerve fibre, peripheral nerves, receptors and effector endings, dermatomes and muscle activity
- The spinal cord and the ascending and descending tracts
- The cranial and spinal nerves

## **UNIT - III**

- The fore brain, brain stem, the cerebellum
- The meninges and cerebrospinal fluid
- Peripheral nervous system

## **UNIT - IV**

- Autonomic nervous system; sympathetic and para-sympathetic nervous system with special comparison to hormonal mechanism of transmission through autonomic nervous system
- Reflex action; varieties, characteristics, unconditional reflex, electrophysiology of spinal reflexes
- Sensation
- Electro encephalography and its physiological basis.

## **Suggested Reading**

- The Brain: Our Nervous System by Seymour Simon
- Mass Action in the Nervous System by Walter J. Freeman
- Human Anatomy and Physiology with Interactive Physiology 10-System Suite, 8th Edition by Elaine N. Marieb and Katja N. Hoehn (Jan 10, 2010)
- Neuroanatomy by H.G.Snell
- Clinical Neurophysiology-Guide for Authors - Elsevier
- Foundations of Cellular Neurophysiology (Bradford Books): Daniel Johnston,

- **Sc. 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
5. Alimentary canal and digestion

Unit-2

1. Accessory respiratory organs
2. Air bladder and its functions
3. Weberian ossicles their homologies and functions
4. Excretion and osmoregulation
5. Acoustico-lateral line system

#### Unit-3

1. Luminous organs
2. Colouration in fishes
3. Sound producing organs
4. Deep sea adaptations
5. Hill stream adaptations

#### Unit-4

1. migration in fishes
2. Sexual cycle and fecundity
3. parental care in fishes
4. Early development and hatching
5. 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

4. Organisation of eukaryotic transcriptional machinery promoter enhancers transcription factors polymerase activators and repressors.

5. DNA binding domains of transcription apparatus zinc finger steroid receptors hemeo domains HILIX-loop, Helix and Leucine Zipper.

#### Unit-3

3. Eukaryotic transcription of Eukaryotic transcriptional control.

4. Environmental modulation of gene activity (stress response) stress genes and stress proteins

5. Molecular basis of thalasemias muscular dystrophy cystic fibrosis

1. DNA rearrangement

2. Amplification during development with special response to

(a) Ciliates

(b) Chlorine gene

(c) 58 RNA genes

#### Unit-4

1. Drosophila development

(a) Cleavage

(b) Gastrulation

Origin of Anterior –Posterior (Maternal effect genes and segmentation genes)

2. Drosophila development II origin of dorsal ventral polarity

3. Basic idea of homeotic selector genes and homeotic mutation

4. Basic idea of organization of homeoboxes

5. 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
5. Structure of cuticle and pigment

#### Unit-2

2. Sclerotisation and tanning of the cuticle
3. Structure of alimentary canal and Physiology of digestion
4. Malpighian tubules – anatomical organization , Transport mechanism
5. Structure of circulatory system
6. Cellular elements in the haemolymph

#### Unit-3

3. Cell mediated and humoral immunity
- Structure of compound eye and Physiology of Vision
2. Sound Production in insect
  3. Structure and function of endocrine glands
  4. Pheromones

#### Unit-4

1. Embryonic membranous up to the formation of blastoderm
  2. Metamorphosis
  3. Insecticide effects on CNS
  4. Important pest of Soybean
- Modern concept of pest management

#### 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.

4. Management planning of wild life in protected areas.

5. Estimation of carrying capacity

Unit-3

1. Eco tourism / wild life tourism in forests.
2. Concept of climax persistence.
3. Ecology of perturbation.
4. Management of excess population & translocation.
5. Bio- telemetry.
6. Care of injured and diseased animal.

#### Unit-4

1. Quarantine.
2. Common diseases of wild animal.
3. Protected areas National parks & sanctuaries, Community reserve.
4. Important features of protected areas in India.
5. Tiger conservation - Tiger reserve in M.P, in India.
6. 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 : Environment 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
5. Immunoglobulin structure, Biological and physical properties of immunoglobulin
6. Gene model for Immunoglobulin gene structure

#### Unit-3

1. Generation of antibody diversity ( Light and heavy chain)
2. Immunization
3. Immediate type of hypersensitivity reaction of Anaphylectic type-1.
4. Antibody dependent cytotoxic type II reaction.
3. Complex mediated type III reaction

#### Unit-4

1. Delayed type cell mediated hypersensitivity type IV reaction.
2. Enzyme linked immunosorbent assay (ELISA) technique and its applications.
3. Immunofluorescence technique( Direct & Indirect and Sandwich antibody labelling techniques .
4. 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.
5. Drugs useful in induced breeding of fish
6. Types of ponds required for fish culture farms
7. Management of hatcheries, nurseries and rearing ponds
8. Management of stocking ponds

#### Unit-2

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

#### Unit-3

1. Coastal fisheries in India
2. Offshore and deep sea fishery's in India

3. Role of fishries in rural development
4. Sewage fed fishries

#### Unit-4

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.
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 ideas of its applications as vectors for gene cloning.
3. Molecular organization of respiratory chain assemblies, ATP / ADP Translocase and F<sub>0</sub>F<sub>1</sub> ATPase.
4. Cell cycle: Cell cycle control in mammalian cells and xenopus.
5. Cytochemistry of Golgi complex and its role in cell secretion.,

#### Unit-2

2. Peroxisomes and targeting of peroxisomal proteins.
3. Nucleolus: Structure and Biogenesis and functions of lysosomes.
4. Intracellular digestion : Ultra structure and function of lysosomes.
5. Synthesis and targeting of mitochondrial proteins.
6. Secretory pathways and translocation of secretory proteins across the ER membrane.

#### Unit-3

1. Genome complexity: C- value [paradox and cot value].
2. DNA sequences of different complexity.
3. Difference between normal cells and cancer cells.
  - a. Biochemical changes.
  - b. Cytoskeleton changes.
  - c. Cell surface changes.
4. Genetic basis of human cancer

#### Unit-4

1. Chromosomal abnormalities in human cancer.
2. General idea of oncogenes and proto oncogenes.
3. Oncogenesis and cancer.
4. Transforming Agents.
5. Tumor Suppressor genes.
6. 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 roberts steits, Weiner molecular biology of the gene, the Benjamin / Cummings Publishing 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 Recombinant 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 Dernel 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, Genetic control, Chemical control
3. Pests of Cotton
4. Pests of sugarcane
5. Pests of paddy
6. Pests of stored food grains
7. Pests of citrus fruits and mango
8. Pests of pulses
9. House hold insect pests

Unit-3

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-4

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

- 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.

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.
5. Hormonal regulation of energy metabolism

### Unit-3

1. Hormonal antagonism.
2. Hypothalamic nuclei and their physiological function.
3. Endocrine – Immune interaction
4. Extraction and estimation of pregnanediol from urine.
5. Extraction of Gonadotrophin from urine.

### Unit-4

1. Bioassay of Androgen.
2. Bioassay of progesterone.
3. Contraception.
4. Multiple ovulation and embryo transfer technology.
5. Study of estrous cycle by vaginal smear technology.
6. 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.