

# **HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)**

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## **SCHEME OF EXAMINATION & SYLLABUS of M.Sc. (Zoology) Semester Exam UNDER FACULTY OF SCIENCE Session 2019-21**

**(Approved by Board of Studies)  
Effective from June 2019**

**HEMCHAND YADAV UNIVERSITY DURG  
CHHATTISGARH  
SYLLABUS FOR 2019-21  
M. Sc. ZOOLOGY**

Semester	Paper	Title	External marks	Internal marks	Credit
<b>First DEC, 2017</b>	I	Biosystematics, Taxonomy and Biodiversity	80	20	4
	II	Structure and Function of Invertebrates	80	20	4
	III	Population Genetics and Evolution	80	20	4
	IV	Tools & Techniques in Biology	80	20	4
	LC-I	Lab Course I (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
<b>Second MAY-JUNE, 2018</b>	I	Molecular Cell Biology and Biotechnology	80	20	4
	II	General Physiology and Endocrinology	80	20	4
	III	Development Biology	80	20	4
	IV	Quantitative Biology and Computer Application	80	20	4
	LC-I	Lab Course I (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
<b>Third DEC, 2018</b>	I	Comparative Anatomy of Vertebrates	80	20	4
	II	Animal Behavior	80	20	4
	III	Environment Physiology and Population Ecology	80	20	4
	IV	Immunology and Parasitism	80	20	4
	LC-I	Lab Course I (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
	<b>Compulsory</b>				

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<b>Fourth MAY-JUNE, 2019</b>	I	Biochemistry	<b>80</b>	<b>20</b>	<b>4</b>
	II	Neurophysiology	<b>80</b>	<b>20</b>	<b>4</b>
<b>Optional papers (Group I)*</b>					
	I	Fish (ichthyology) structure and function	<b>80</b>	<b>20</b>	<b>4</b>
	II	Cell biology	<b>80</b>	<b>20</b>	<b>4</b>
	III	Entomology	<b>80</b>	<b>20</b>	<b>4</b>
	IV	Wild life conservation	<b>80</b>	<b>20</b>	<b>4</b>
	V	Biology of Vertebrate immune system	<b>80</b>	<b>20</b>	<b>4</b>
<b>Optional paper (Group II)*</b>					
	I	Pisciculture and economic importance of fishes (Ichthyology)	<b>80</b>	<b>20</b>	<b>4</b>
	II	Cellular organization and molecular organization	<b>80</b>	<b>20</b>	<b>4</b>
	III	Applied entomology	<b>80</b>	<b>20</b>	<b>4</b>
	IV	Environment and Biodiversity conservation	<b>80</b>	<b>20</b>	<b>4</b>
	V	Molecular endocrinology and reproductive technology	<b>80</b>	<b>20</b>	<b>4</b>
	LC-I	Lab Course I (Based on paper I & II)	<b>80</b>	<b>20</b>	<b>2</b>
	LC-II	Lab Course I (Based on paper III & IV)	<b>80</b>	<b>20</b>	<b>2</b>
<b>Total</b>			<b>1920</b>	<b>480</b>	<b>80</b>

\* 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 four units without any internal choice, whereas rest questions will be unit wise with internal choice.

UGC guideline should be strictly followed for animal dissections. Animal dissections can be performed by using alternate methods like clay modeling.

\*\*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.

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**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 four units without any internal choice, whereas rest questions will be unit wise with internal choice).

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

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

**UNIT-IV**

- Biodiversity
  - Types of Biodiversity
  - Hot spots of Biodiversity
  - Threats to Biodiversity
  - Conservation of Biodiversity
- Evaluation of biodiversity indices
  - Shannon-Weiner index.

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## **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**, Academic Press Washington
- **The Biology of Biodiversity M. Kato**, Springer
- **Molecular Markers - Natural History & Evolution J.C. Avise**

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# M.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

- Organization of coelom
  - Acoelomates and Pseudocoelomates
  - Coelomates: Protostomia and Deuterostomia.
- Locomotion
  - Flagellar and cilliary movement in Protozoa.
  - Hydrostatic movement in Coelenterata, Annelida and Echinodermata.

### UNIT-II

- Nutrition and Digestion
  - Patterns of feeding and digestion in Protozoa
  - Filter feeding in polychaeta.
- Respiration
  - Organs of respiration Gills, lungs and trachea.
  - Respiratory pigments.

### UNIT-III

- Excretion
  - Organs of excretion.
  - Excretion and osmoregulation
- Nervous System
  - Primitive nervous system: Coelenterata and Echinodermata.
  - Advanced Nervous system: Arthropoda (Crustacea and insecta) and Mollusca (Cephalopoda)

### UNIT-IV

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

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

- **Invertebrate Structure and function:-**  
E.J.W. Barrigton English language Book society UK.
- **Invertebrate Zoology:**  
Robert Barnes IV Edition Holt Saunders International Edition japan.
- **The Cambrige Natural History Vol 1 - 9.**  
S F Harmer, A.E. Shipley.  
Todays & Tomorrows Book agency, New 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

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# 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

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

### Unit-II

- Hardy-Weinberg law of genetic equilibrium
- Detailed account of destabilizing forces.
  - Natural selection (i) Mutation  
(ii) Genetic drift  
(iii) Meiotic drive
- Phenotypic variation

### UNIT-III

- Patterns and mechanisms of reproductive isolation
- Phylogenetic and biological concepts of species
- Gene Evolution, Evolution of gene families
- Factors affecting human disease

### UNIT-IV

- Origin of higher categories
- Micro-and Macro-evolution
- Evolution of horse, elephant, camel, man

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

- **Gene & Evolution**  
Jha A.P. John Publication, New Delhi
- **Evolution & Genetics**  
Merrel D.J. Holt rinchert & Wiston INC.
- **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, New York
- **Evolutionary Biology**  
Futuyama D.J. Suinaer Associates INC publishers, Dunderland
- **Evolution**  
Strikberger M.W. Johns & Bartett Publishers, Boston London

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**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**

- Principles and application of
  - Ultracentrifugation
  - Electrophoresis
  - Chromatography (various types)
  - Lambert-Beers Law and colorimetry and spectrophotometry
  - Flowcytometry.

**UNIT-II**

- Principles and Application of
  - Light Microscopy and micrometry
  - Phase Contrast microscopy
  - Interference microscopy
  - Fluorescence microscopy
  - Transmission Electron microscopy.
  - Scanning Electron microscopy.

**UNIT-III**

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

**UNIT-IV**

- Principle and techniques of
  - Nucleic acid hybridization and cot curve
  - Sequencing of proteins and nucleic acids
- Freeze techniques
- Media preparation and sterilization
- Inoculation and growth monitoring

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## **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

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

● **Biosystematics and Taxonomy**

- 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).
- Collection of various insect species.
- Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report.
- Study of adaptive characteristics of various invertebrates and vertebrates in different climate.
- Taxonomic key formation and conversion.
- Study of biodiversity in grassland and pond water by using Shannon -Weiner index
- Other exercise related to theory paper

● **Structure and function of invertebrates**

- Identification, classification and study of distinguishing features of important representatives from various groups (Protozoa to Hemichordata Ciliary Feeders).
- Study of permanent prepared slides (from Protozoa to Hemichordata).
- Dissection by using alternate methods like clay modeling : Reproductive, Excretory, nervous and haemocoelomic systems of leech.
- Dissection by using alternate methods like clay modeling: Reproductive system of cockroach; general anatomy, nervous and reproductive systems of grasshopper; nervous system of crab; nervous and reproductive systems of scorpion.
- Dissection by using alternate methods like clay modeling: Nervous system of Mytilus, Sepia and Aplysia, general anatomy of Aplysia.
- 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.
- Permanent preparations of different materials to be provided for study.
- Wonder invertebrates
- Other exercise related to theory paper.
- UGC guideline should be followed.

EXAMINATION SCHEME

Based on paper I	35 marks
Based on paper II	35 marks
Viva	10 marks
Sessional (Internal)	20 mark
<b>Total</b>	<b>80+20 (100)</b>

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

**Population genetics and evolution**

- Problems on genetics (complete and incomplete linkage; dominance, sex-linked inheritance) Demonstration of Hardy-Weinberg law
- Preparation of human chromosomes map, demonstration of chromosomal deficiencies.
- Experiments based on population genetics, pedigree analysis.
- Study of evolution of horse by way of models.
- Study of evolution through homologous and analogous organs.
- Other exercises related to theory paper.

**Tools and techniques in biology**

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

**EXAMINATION SCHEME**

Based on paper III	35 marks
Based on paper IV	35 marks
Viva	10 marks
Sessional (Internal)	20 Mark
Total	<b>80+20 (100)</b>

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## 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

- Biomembranes
  - Molecular composition and Organization of -
    - Plasma membrane
    - Mitochondria
    - E.R.
    - Cytosome
    - Golgi body
  - Transport across The biomembranes – Mitochondria
    - Plasma membrane, E.R.
    - Ribosome and its Biogenesis

#### UNIT-II

- DNA replication
- Protein Synthesis - Central Dogma Regulation of translation
- Genetic Code.

#### UNIT-III

- Genome organization
  - Chromosomal organization: morphological and structural types. (Lamprash, Polyline, Heterochromatin)
  - Non-coding DNA
- Molecular mapping of genome
  - Genetic and physical maps
  - Polymerase Chain Reaction (PCR) and blotting techniques
  - Molecular markers in genome analysis.

#### UNIT-IV

- Transgenic animals and knock-outs
  - Production and applications
  - Embryonic stem cells
- Application of genetic engineering
  - Medicine
  - Agriculture
  - Industry

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

- **MOLECULAR CELL BIOLOGY**  
**Lodish**, W.H. Freeman & Co. New York
- **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

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## 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

- Digestion and Metabolism
  - General organization of alimentary canal
  - Mechanism of digestion
  - Mechanism of absorption
- Gas Exchange and Acid-base Balance
  - Oxygen and Carbon dioxide transport in blood
  - Structure and Significance hemoglobin
  - Regulation of body pH
- Thermoregulation and Cold Tolerance
  - Heat balance and exchange
  - Endotherms Vs Ectotherms
  - Torpor, hibernation and aestivation

#### UNIT-II

- Muscle Function and Movement
  - Anatomy of muscle
  - Mechanism of muscle contraction
  - Regulation of muscle contraction
- Nervous System
  - Neurons and membrane excitation
  - Resting Membrane & Action Potential
  - Nerve Impulse
  - Synapses and neurotransmitters
  - Synaptic transmission
- Sensory Transduction
  - Auditory receptors
  - Chemoreceptor: taste and smell
  - Vision and Photoreception – Photo Chemistry of vision

#### UNIT-III

- Endocrinology
  - Structure and functions of endocrine glands (Pituitary, pineal, pancreas, adrenal, thyroid etc.)
  - Some New Hormones Ghrelin, Leptin, Amylin, Renin, Ang.
  - Biosynthesis of hormones (thyroid and gonadal)
  - Hormones and Reproduction -Pregnancy, Parturition, Lactation
  - Hormonal Control - Estrous Cycle menstrual cycle Menarche Puberty Menopause

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#### UNIT-IV

- Mechanism of Hormone action
- Hormone receptors
- Hormonal regulation of metabolism carbohydrate, Proteins and fats.
- Hormones & Homeostasis

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

- Comparative vertebrate Endocrinology – by **Gorbman & Bern**
- Medical Physiology by Guyton and Hall
- Physiology by **Antonio Lucanio**
- Human Physiology – by **Dr. C. C. Chatterjee**
- Comparative Endocrinology – by **Barrington**
- Applied Animal Endocrinology – by **Squires**
- **Endocrinology** – Basic & Clinical principles - by **Melmed & Cohn**
- **T.B. of Endocrinology** by **Griffin.**
- **Endocrinology** by **Hardly.**

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M. Sc. ZOOLOGY SEMESTER - II 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**

- Oogenesis
- Differentiation and growth of oocytes.
- Organization of egg cytoplasm and egg cortex.
- Vitellogenesis
- Spermatogenesis
- Differentiation and ultra-structure of sperm
- Spermatocytogenesis Spermiation

**UNIT-II**

- Fertilization
  - Biological role of fertilization.
  - Basic requirements of fertilization.
  - Activation of egg metabolism
  - Capacitation
  - Biochemistry of fertilization
- Cleavage
  - Characteristics and mechanisms of cleavages, Egg types

**UNIT-III**

- Formative movements
  - Fate maps - Organogenesis
  - Utility and comparative topographical relationship of the Presumptive areas in early embryos of
    - Amphioxus
    - Fishes
    - Amphibian
    - Birds
- Differentiation

**UNIT-IV**

- Cell and tissue interactions in development
  - Primary embryonic induction
  - Competence
  - Concept of organizer
- Metamorphosis
- Teratology

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## 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

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**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**

- Introduction to digital computer and application
  - Basic knowledge of hardware and software
  - CPU (Central Processing Unit)
  - Input and Output devices
  - Auxiliary storage system
  - Operating system and Binary number system

**UNIT-II**

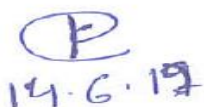
- Computer application
  - Introduction to MSoffice
    - Word
    - Excel
    - Power point
- Computer application in biostatistics
- Simple computation and elementary knowledge of flow chart

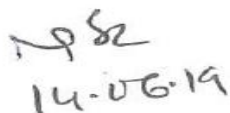
**UNIT-III**

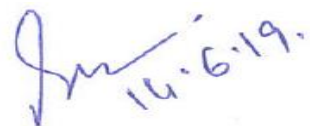
- Types of biological data
- Representation of data
- Sample and sampling
- Measures of central tendency
- Measures of dispersion
- Hypothesis testing: Null and alternate hypothesis

**UNIT-IV**

- Tests of significance
  - Chi-square test
  - Student's t-test
- Analysis of Variance
- Simple linear regression
- Correlation
- Probability distribution: normal and binomial

  
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## 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.)

Murray, J.D. Mathematical Biology, Springer Verlag Berlin

Pelton, 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

Georgs & Wilians Statistical method

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

• **Molecular biology and Biotechnology**

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

**General physiology and endocrinology**

- Estimation of RBC, hemoglobin, hematocrit/PVC, blood group and Rh factor blood clotting time.
- Determine the blood pressure of man.
- Determination of urea, glucose and ketone bodies in urine.
- Demonstration of osmosis.
- Dissection by using alternate methods like clay modeling and exposure of major endocrine glands in an experimental animals.
- Study of histology of endocrine glands in different animal types through permanent slides and microtomy.
- Other exercise related to theory paper.

EXAMINATION SCHEME

Exercise based on paper I	35 marks
Exercise based on paper II	35 marks
Viva	10 marks

Sessional (Internal)	20 Mark
Total	<b>80+20 (100)</b>

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

**Development biology**


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

**Quantitative biology and computer application**


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

EXAMINATION SCHEME

Exercise based on paper III	35 mark
Exercise based on paper IV	35 mark
Viva	10 mark
Sessional (Internal)	20 Mark
Total	<b>80+20 (100)</b>

  
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## **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**

- Origin of Chordates
- Amphibians, Reptiles, Birds and Mammals.
  - Classification of Vertebrates and specialty of respective classes
- Amphibians, Gymnophiona Neoteny, Parental case
- Reptiles – Extinct reptiles
- Birds – Palate in Birds
- Mammals. – New world and old world Mankeys

#### **UNIT-II**

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

#### **UNIT-III**

- Respiration in Vertebrates.
- Comparative account of respiratory organs (structure and functions).
- Circulation in Vertebrates.
- Structure and function of blood.
- Evolution of heart.
- Evolution of aortic arches.

#### **UNIT-IV**

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

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## SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **Vertebrate life** :- William N. Ferland, F. Harvey Pough, Tom J Gode, John B. Heiser
- Collier MacMillan International edition
- **Chordate morphology** :- Malcolm Jollie
- Reinhold Publishing Corporation New York
- **Chordate –Structure & Function** :- Arnold G. Khage, B.E. Fry Johanson
- Mc Millan Publishing Co. INC. New York
- **Comparative Animal Physiology** :- Orosser
- Satish Book Enterprises, Agra
- **The Vertebrate Body** :- Alfred Sherwood Romer
- Vakils, Feffer & Simons Publications Ltd.

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## 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

- Historical perspectives- Ethology
- Behavioural patterns
- Innate behaviour
- Biological rhythms
  - Types of biological rhythm
  - Biological clock

### UNIT- II

- Communications
  - Auditory
  - Visual
  - Chemical
- Learning and Memory
  - Conditioning
  - Habituation
- Reasoning
- Reproductive behaviour.

### UNIT-III

- Orientation
  - Echolocation in bats
  - Bird migration and navigation.
  - Fish migration.
  - Neural and hormonal control of behaviour

### UNIT-IV

- Hormonal effect on behavioural patterns.
  - Social behaviour
  - Social organization in insects and primates
  - Schooling in fishes and Flocking in birds
  - Homing, territoriality, dispersal
  - Altruism
  - Host–parasite relation

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**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)

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**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:

- Demography, life table, reproductive rates, reproductive values
- Population growth, exponential, non overlapping
- Stochastic and time lag models of population growth
- Population density
- Population evolution
- Community dynamics: Characteristics, development and classification

**UNIT-II**

- Adaptations
  - Levels of adaptation.
  - Mechanisms of adaptation.
- Adaptations to different environments.
  - Marine, shores and estuaries.
  - Freshwater.
- Terrestrial Life.

**UNIT-III**

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

**UNIT -IV**

- Stress physiology in different conditions
  - Osmoregulation in aqueous and terrestrial habitats.
  - Physiological response to oxygen deficient stress.
  - Physiological response to body exercise.
  - Effect of meditation and yoga

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**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

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## 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

- Cells of immune system
- B-Lymphocytes, T-lymphocytes ( N K Cells, Helpa Cells, Killer Cells)
- Mononuclear cells
- Granulocytic cells (Neutrophils, Eosinophils and Basophils)
- Mast cells
- Dendritic cells
- Organs of immune system
- Primary lymphoid organs (Thymus, bone marrow)
- Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue, cutaneous associated lymphoid tissue)

### UNIT-II

- Immunoglobulin structure and function
- Molecular structure of Ig, Light chain and Heavy chain
- Immunoglobulin classes
- IgG
- IgM
- IgE
- IgD
- Monoclonal antibodies

### UNIT-III

- Antigens Immunogenicity
- Contribution of the immunogens.
- Contribution of Biological system.
- Antigen - Antibody Interaction
- Antibody affinity and activity
- Cross reactivity
- Agglutination reactions
- Precipitation Reaction
- Vaccine
- Active and passive immunization
- Whole organism vaccine
- Recombinant vector vaccines
- DNA vaccines

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#### **UNIT-IV**


- Immune system in Health disease
- Immune response to infectious disease
- Immune response in cancer
  - Pathophysiology of parasitic infection
  - Viral infections
  - Bacterial infection
  - Helminths infection
- 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,**

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

- **Comparative anatomy of Vertebrates**
- Identification, classification and study of distinguishing features of important representatives, museum specimens and slides (Protochordates and Chordates)
- Comparative studies of integumentary, skeleton and reproductive system of major vertebrate classes.
- Dissections by using alternate methods like clay modeling: fowl/snake cranial nerves
- Wondervertebrates
- Other exercise related to theory paper.

**Animal Behavior**

- To study the phototactic response in earthworm or grain/pulse pest.
- To study the geotaxis behavior of earthworm.
- To study the food preference and cleaning behavior of housefly.
- To study the food preference in tribolium or grain/pulse pests.
- To study the web construction and habituation in spider.
- Estimation of body temperature and pulse rate on daily time scale.
- Estimate the time perception among various individuals at two different time points on daily time scale.
- Determination of effect of time on schooling behavior in fish.
- Toxicological response of fish opercular and surfacing activity.

**EXAMINATION SCHEME**

Based on paper I	35 mark
Based on paper II	35 mark
Viva	10 mark
Sessional (Internal)	20 Mark
Total	<b>80+20 (100)</b>

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

**Immunology and Parasitism**

- Dissection of primary and secondary immune organs from fish/fowl- Preparation and study of cell suspension from spleen (spleenocytes) of fish / fowl.
- Total and differential counting of leucocytes.
- Protein estimation by Lowry's method in normal and infected blood sample.
- Determination of Blood group.
- 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.
- Study of parasites in fish
- Study of various parasites through slides and specimen.
- Other exercises related to theory paper.
- **Environmental Biology, Population ecology**
- Study of biotic community in a pond/grassland ecosystem.
- Study of population growth rate (curve) in protozoan culture.
- Population dynamics of *Tribolium* sp.
- Study of biogeochemical cycles by way of models.
- Visit to some natural habitats and man made habitats to study the human impact on environment.
- Water analysis for fresh and waste water (Dissolve oxygen and chloride).
- Other exercises related to theory paper.

EXAMINATION SCHEME

Based on paper III	35 mark
Based on paper IV	35 mark
Viva	10 mark
Sessional (Internal)	20 Mark
Total	<b>80+20 (100)</b>

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**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**

- Properties of Proteins
  - Structure and properties of amino acids.
  - Classification of proteins.
  - Structure of proteins.
  - Biological Functions of Proteins.
  - Protein Metabolism.

**UNIT-II**

- Carbohydrates
  - Classification of carbohydrates.
  - Structure and Functions of Carbohydrates.
  - Carbohydrate metabolism.
- Lipid
  - Lipid structure and functions
  - Lipid metabolism.

**UNIT-III**

- Vitamins
  - Water and Fat soluble vitamins,
  - Chemistry, occurrence and physiological role.
- Enzymes
  - Classification and nomenclature.
  - Mechanism of action
  - Regulation of enzyme activity and functions of Co-enzymes.

**UNIT-IV**

- Nucleic acid
  - Chemistry of DNA.
  - Chemistry of RNA.
  - Biological importance of nucleic acids.
  - Nucleoproteins.
  - Metabolism of nucleic acids.

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**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

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**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, Optional papers

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## M.Sc. ZOOLOGY SEMESTER – IV

- The following optional papers are being suggested as below
- OPTIONAL (SPECIAL PAPER) GROUP 1
- Fish (ichthyology) structure and function
- Or
- Cell Biology Or
- Entomology Or
- Wild life conservation Or
- Biology of vertebrates immune system
- OPTIONAL (SPECIAL PAPER) GROUP 2
- Pisciculture and economic importance of fishes (Ichthyology) Or
- Cellular organization and molecular organization Or
- Applied entomology Or
- Environment and Biodiversity conservation Or
- Molecular endocrinology and reproductive technology
- \*\* Student has choice to opt for one paper each (special paper) from group 1 and group 2

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## M. Sc Zoology Semester-IV

Paper- III A (optional paper)  
Ichthyology (Fish) Structure and Function

### Unit-1

- Origin and evolution of fishes
- Classification of fishes as proposed by Berg
- Fish integument
- Locomotion
- Alimentary canal and digestion

### Unit-2

- Accessory respiratory organs
- Air bladder and its functions
- Weberian ossicles their homologies and functions
- Excretion and osmoregulation
- Acoustico-lateral linesystem

### Unit-3

- Luminous organs
- Colouration in fishes
- Sound producing organs
- Deep sea adaptations
- Hill stream adaptations

### Unit-4

- migration in fishes
- Sexual cycle and fecundity
- parental care in fishes
- Early development and hatching
- Poisonous and venomous fishes.

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## M.Sc Zoology Semester-IV

Paper- III B (Optional) Cell Biology

### Unit-1

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

### Unit-2

- Structural organization of Eukaryotic genes, interrupted genes and overlapping genes and their evolution
- Gene families: organization, evolution and significance
- Transposable genetic elements of prokaryotes and eukaryotes Gene imitation and molecular mechanism of occurrence of mutation repair mechanism
- Organisation of eukaryotic transcriptional machinery promoter enhancers transcription factors polymerase activators and repressors.
- DNA binding domains of transcription apparatus zinc finger steroid receptors hemeo domains HILIX-loop, Helix and Leucine Zipper.

### Unit-3

- Eukaryotic transcription of Eukaryotic transcriptional control.
- Environmental modulation of gene activity (stress response) stress genes and stress proteins
- Molecular basis of thalasemias muscular dystrophy cystic fibrosis
- DNA rearrangement
- Amplification during development with special response to
- Ciliates
- Choriongenic
- 5 Ssribosomal RNA

### Unit-4

- Drosophila development
- Cleavage
- Gastrulation
- Origin of Anterior –Posterior (Maternal effect genes and segmentation genes
- Drosophila development II origin of dorsal ventral polarity
- Basic idea of homoetic selector genes and homeotic mutation
- Basic idea of organization of homeoboxes
- Evolutionary significance of homeoboxes

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**Suggested Reading Materials:**

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

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

Unit-1

- Insect head types and modification as per their habit and habitat
- Modification of mouth parts and feeding behaviour
- Structure types and function of antennae
- Hypothetical wing venation
- Structure of cuticle and pigment

Unit-2

- Sclerotisation and tanning of the cuticle
- Structure of alimentary canal and Physiology of digestion
- Malpighian tubules – anatomical organization , Transport mechanism
- Structure of circulatory system
- Cellular elements in the haemolymph

Unit-3

- Structure of compound eye and Physiology of Vision
- Sound Production in insect
- Structure and function of endocrine glands
- Pheromones

Unit-4

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

Suggested Reading Materials:

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

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

**Unit-1**

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

**Unit-2**

- Population estimation.
- Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio
- computation.
- Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method.
- National Organization.
- Indian board of wild life.
- Bombay Natural History Society.
- Voluntary organization involved in wild life conservation.
- Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.
- Management planning of wild life in protected areas.
- Estimation of carrying capacity

**Unit-3**

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

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#### Unit-4

- Quarantine.
- Common diseases of wild animal.
- Protected areas National parks & sanctuaries, Community reserve.
- Important features of protected areas in India.
- Tiger conservation - Tiger reserve in M.P, in India.
- Management challenges in Tiger reserve.

#### Suggested Reading Materials:

- Gopal Rajesh : Fundamentals of wild life management
- Agrawal K.C : Wild life India
- Dwivedi A.P (2008) : Management wild life in India
- Asthana D.K : Environment problem and solution
- Rodgers N.A & Panwar H.S : Planning of wild life / Protected area Network in India vol. the report, wild life Institute of India Dehradun.
- Odum E.P : Fundamentals of Ecology
- Saharia V.B : Wild life in India
- Tiwari S.K : Wild life in Central India
- E.P Gee : Wild life of India
- Negi S.S : Wild life conservation (Natraj Publishers)

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**M. Sc Zoology Semester-IV**  
**Paper- III E (Optional)**  
**Biology of vertebrate immune system**

**Unit-1**

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

**Unit-2**

- **T-cell** lineage and receptors
- T-cell activation
- B-cell lineage and receptors
- B-cell activation
- Immunoglobulin structure, Biological and physical properties of immunoglobulin
- Gene model for Immunoglobulin gene structure

**Unit-3**

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

**Unit-4**

- Delayed type cell mediated hypersensitivity type IV reaction.
- Enzyme linked immunosorbent assay (ELISA) technique and its applications.
- Immunofluorescence technique (Direct & Indirect and Sandwich antibody labelling techniques.
- Immunodiffusion techniques (Mancini and Ouchterlony immunodiffusion techniques) Monoclonal antibody technology (Hybridoma technology)

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## M.Sc Zoology Semester-IV

### Paper- IV A (Optional)

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

##### Unit-1

- Collection of fish seed from natural resources and transportation of fish seed.
- Breeding in fish, Bundh breeding and Induced breeding.
- Types of ponds required for fresh water fish culture farms.
- Management of fish farm.
- Physiochemical factors of freshwater for fish farming.

##### Unit-2

- Composite fish culture
- Prawn culture and pearl industries in India.
- Fisheries resources of C.G.
- Riverine fisheries.

##### Unit-3

- Costal fishries in India
- Offshore and deep sea fishery's in India
- Role of fishries in rural development
- Sewage fed fishries

##### Unit-4

- Methods of fish preservation
- Marketing of fish in India.
- Economic importance and by product of fishes
- Fish disease.

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

- JR. Norman - The History of fishes.
- Nagaraja Rao - An introduction to fisheries.
- Lagler Ichthyology.
- Herclen Jones Fishmigration.
- Marshal The life of fishes.
- Thomas - Diseases of fish.
- Greenwood - Inter relationship of fishes.
- Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
- Brown -Physiology of fishes Vol. I & II.
- Hoar and Randall -Fish physiology of fishes Vol. 1 & IX.
- Gunther Sterba C.N.H.-Freshwater fishes of the world
- W. Lanham -TheFishes.
- G.V. Nikolsky -The ecologyof Fishes,
- Borgstram -Fish as food Vol. I & II.
- Nilsson -Fish physiology -Recent Advances.
- P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
- Carl E. Bond -Biology of fishes.
- M. Jobling -Environmental Biology of fishes.
- Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
- S.K. Gupta-Fish and Fisheries
- K.P. Vishwas -Fish andFishries.
- Jhingaran -Fish andFishries.

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**M.Sc. Zoology Semester-IV**  
**Paper- IV B (Optional)**  
**Cellular Organization and Molecular Organization.**

**Unit-1**

- General organization and characterizes of viruses (Examples SV 40 and HIV).
- Yeast : Structure, reproduction and chromosome organization: Basic ideas of its applications as vectors for gene cloning.
- Molecular organization of reoiratory chain assemblies, ATP / ADP
- Translocase and FOF1 ATpase.
- Cell cycle: Cell cycle control in mammalian cells and xenopus.
- Cytochemistry of Golgin complex and its role in cell seretion.,

**Unit-2**


- Peroxisomes and training of paroxysmal proteins.
- Nucleolus: Structure and Biogenesis and functions of lysosomes.
- Intracellular digestion : Ultra structure and function of lysosomes.
- Synthesis and targeting of mitochondrial proteins.
- Secretary pathways and translocation of secretary proteins across the EPR membrane.

**Unit-3**


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

**Unit-4**

- Chromosomal abnormalities in human cancer.
- General idea of onchogens and proto onchogens.
- Onchogenec and cancer.
- Transforming Agents.
- Tumor Supressor geanes.
- Receptor – Ligand interaction and signal transduction. Cross – talk among various signaling pathways.

  
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## Suggested Reading Materials:

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

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

**Unit-1**

Classification according to imms

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

**Unit-2**

- Insect pest-Management strategies and tools
- Biological control, Genetic control, Chemical control
- Pests of Cotton
- Pests of sugarcane
- Pests of paddy
- Pests of stored food grains
- Pests of citrus fruits and mango
- Pests of pulses
- House hold insect pests

**Unit-3**

- Insects in relation to forensic science
- Insects migration, population fluctuation and factors
- Insects of medical and veterinary importance
- Ecological factors affecting the population and development of Insects

**Unit-4**

- Mulberry and non mulberry sericulture
- Apiculture
- Lac culture
- Insects as human food for future.

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**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
- 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-erosion 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.

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

- Arora: Fundamentals of environmental biology
- Anathakrishnan : Bioresources ecology
- Bottain : Environmental studies
- Bouhey : Ecology of populations
- Clark : Elements of ecology
- Dowdoswell : An introduction to animal ecology
- Goldman : Limnology
- Kormondy : Concepts of ecology
- May : Model ecosystems
- Odum : Ecology
- Perkins : Ecology
- Simmons : Ecology of estuaries and costal water
- Pawlosuske : Physico-chemical methods for water
- South Woods : Ecological methods
- Trivedi and Goel : Chemical and biological methods for water pollution studies
- Willington : Fresh water biology
- Wetzal : Limnology
- Welch : Limnology Vols. I-II

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**M.S c Zoology Semester-IV**  
**Paper- IV E (Optional)**  
**Molecular Endocrinology and Reproductive Technology**

**UNIT-1**

- Definition and scope of molecular endocrinology.
- Chemical nature of Hormones-
- Protein & polypeptides.
- Amino acid derivative
- Steroids
- Phospholipids derivative
- (tissue hormones)
- Purification and characterization of Hormones.

**UNIT-2**

- Receptor.
- Membrane Receptor.
- Nuclear Receptor.
- Orphan Receptor
- G-Protein
- Nuclear Receptor

**UNIT-3**

- Hormone – Transduction
- G-Protein & Cyclic Nucleosides.
- Calcium calmoduline & phospholipids.
- Miscellaneous Second Messengers.
- Phosphorylation & other non transcriptional effect of Hormones.
- Genetic control of formation of Hormone.
- Transcription.
- Post transcription.
- Translation.
- Post translation
- Secretion of Hormone.

**UNIT-4**

- Multiple ovulation and embryo transfer Technology.
- Study of estrous cycle by vaginal smear technology
- Surgical technique-
- Castration
- Ovariectomy
- Vasectomy
- Tuectomy
- Laprotomy.


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### **Suggested Reading Materials:**

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

  
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**M.Sc. ZOOLOGY - IV SEMESTER  
LAB COURSE-I (COMPULSARY)**

**PAPER- I BIOCHEMISTRY**

1. Estimation of antioxidant enzymes.
2. Estimation of amylase. analitatative shudy of a my lase
3. analitatative study of protem
4. analitatative study of CBH
5. Estimation of protein by Lowry method.
6. Estimation of Oil in seeds.
7. Estimation of Carbohydrate by anthrone reagent.
8. Other exercise related to theory paper.

**PAPER- II NEUROPHYSIOLOGY**

1. Study of slides of nervous system.
2. Neck nerve of squirrel by using alternate methods like clay modeling.
3. Study of Brain through Model.
4. Study of Cranial nerve of Bird, Amphibian, Reptile and Mammals by using alternate methods like clay modeling.
5. Other exercise related to theory paper.

**EXAMINATION SCHEME**

Based on paper I	35 marks
Based on paper II	35 marks
Viva	10 marks
Sessional (Internal)	20 mark
<b>Total</b>	<b>80+20 (100)</b>

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**M.Sc. SEMESTER-IV**  
**LAB COURSE-II**  
**OPTIONAL (SPECIAL PAPER) GROUP 1**

**PAPER-III(A) FISH (ICHTHYOLOGY) STRUCTURE AND FUNCTION**

1. Anatomy of various organ systems and mounting of fish materials
2. Cranial nerves of teleost fishes: *Wallago*, *Mystus*, *Labeo* and other fishes by using alternate methods like clay modeling
3. Osteology of fish: *Scoliodon*, carps, catfishes, murrels etc.
4. Accessory respiratory organs of air breathing fish by using alternate methods like clay modeling
5. Study of histological (permanent) slides
6. Study of museum specimens of the concerned group
7. Other exercise related to theory paper.

**PAPER –III(B) CELL BIOLOGY**

1. Study of mitosis from onion root tip.
2. Study of meiosis in grasshopper testis.
3. Study of polytene chromosome in Dipteran Larvae.
4. Demonstration of Barr-Body in Human Cheek cell.
5. Estimation of DNA.
6. Estimation of RNA.
7. Other exercise related to theory paper.

**PAPER –III(C) ENTOMOLOGY**

1. Anatomy of common grasshopper, cockroach, honey bee, wasp and dysdercus, mylabris, belestoma (Giant water Bugs) by using alternate methods like clay modeling.
2. Dissection by using alternate methods like clay modeling and exposure of:
  - (i) Sting apparatus of honey bee and wasp.
  - (ii) Tympanal organs of grasshoppers.
  - (iii) Testes of cockroach
  - (iv) Aristae of house fly.
  - (v) Different types of mouthparts of insects.
  - (vi) Different types of wings and antennae of insects.
  - (vii) Tentorium of grasshoppers.
3. Identification and comment on insects of different orders and families.
4. Identification with the help of keys of common insects from different orders and families.
5. Other exercise related to theory paper.

**PAPER-III(D) WILD LIFE CONSERVATION**

1. Anatomy of (by using alternate methods like clay modeling):
  - (a) Toad / Frog.
  - (b) Lizard / Snake / Turtle.
  - (c) Pigeon / Parrot.
  - (d) Rat / Squirrel.
2. Ecological survey of National Parks and Sanctuaries.
3. Mounting: Permanent preparation of parts of internal organs.
4. Study of slides of different microscopic structure.
5. Identification of wild animal species as objects of museum and zoo and specimens of photographs.
6. Osteology of wild animals.
7. Ecological comments on wild species of different niche and habits. Candidates would be required to keep records of exercise in laboratory, field types, sanctuaries and parks of importance and collections.
8. Other exercise related to theory paper.

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### **PAPER-III(E) BIOLOGY OF VERTEBRATE IMMUNE SYSTEM**

1. Dissection by using alternate methods like clay modeling of primary and secondary immune organs from mice:
  - a. Preparation of single cell suspension from bone marrow and spleen (spleenocytes) of mice.
  - b. Cell counting and viability testing of the spleenocytes prepared.
2. Preparation and study of phagocytosis by splenic/peritoneal macrophages.
3. Raising polyclonal antibody in mice, serum collection and estimating antibody titre in serum by following methods:
  - a. Ouchterlony (double diffusion) assay for Antigen -antibody specificity and titre.
  - b. ELISA
4. Antibody purification from the serum collected from immunized mice:  
affinity purification/chromatography.
5. Immunoelectrophoresis.
6. Demonstration of Western blotting:
  - a. Protein estimation by Lowry's method /Bradford's method
  - b. SDS-PAGE.
  - c. Immunoblot analysis.
7. Other exercise related to theory paper

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## OPTIONAL (SPECIAL PAPER) GROUP 2

### PAPER –IV(A) PISCI CULTURE AND ECONOMIC IMPORTANCE OF FISH (ICHTHYOLOGY)

1. Systematic identification of freshwater fishes with particular reference to C.G.
2. Age determination with the help of scales / otolith
3. Pigmentary behaviour in fish
4. Qualitative zooplankton analysis
5. Nutrient analysis of water
6. Analysis of gut contents
7. Microtomy of fish materials
8. Other exercise related to theory paper

### PAPER-IV(B) CELLULAR ORGANIZATION AND MOLECULAR ORGANIZATION

1. Histochemical demonstration of Mitochondria
2. Histochemical demonstration of Golgi complex
3. Histochemical demonstration of Lactate dehydrogenase
4. Histochemical demonstration of Succinate dehydrogenase
5. Isolation and characterization of Nuclei from liver
6. Isolation and characterization of Mitochondria
7. Isolation of DNA from any tissue
8. Separation of lipids using thin layer chromatography
9. Separation of various proteins using column chromatography
10. Study of metaphase chromosomes from rat bone marrow
11. G banding of metaphase chromosomes
12. C- banding of metaphase chromosomes
13. Estimation of Mitotic Index
14. Measurement of cell size using oculometer.
15. Other exercise related to theory paper

### PAPER- IV(C) APPLIED ENTOMOLOGY

1. Insect collection and preservation for systematic studies
2. Identification of different insects upto orders
3. Identification of insects upto families of economically important insect orders
4. Identification of insects upto species: Mosquitoes, honeybees, stored grain beetles, aquatic insects, important crop and household pests
5. Analysis of honey and its quality control
6. Field studies of insects to understand their habit, habitat environmental impact, beneficial and harmful activities etc.
7. Study of beneficial insects, benefits derived from them and useful products
8. Study of destructive insects, damage caused by them and damaged products
9. Study of insecticidal formulations and insect control appliances
10. Experiments on insect control like LC-50 /LD-50, knock down and recovery effect, repellency/antifeedance tests, percentage damage tests for leaf eating insects, and stored grain pests
11. Other exercise related to theory paper

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**PAPER- IV(D) ENVIRONMENT AND BIODIVERSITY CONSERVATION**

- (i) Environmental hazards, destruction of habitat and extrication of species causes and preventive measures.
- (ii) Environmental planning of rural and urban development.
- (iii) Management of soil resources.
- (iv) UNESCO's role in ecology, earth summit, SARC, ED trust fund.
- (v) Biodiversity, its significance and conservation measures.
- (vi) Role of biodiversity in species development.
- (vii) Other exercise related to theory paper

**PAPER- VI(E) MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE TECHNOLOGY**

- 1. Chromatography method (separation of Androgen & Progesterone).
- 2. Bioassay of  $\alpha$ -Ketosteroids.
- 3. Bioassay of Gonadotropins.
- 4. Study of slide related to endocrine glands.
- 5. Estimation of cholesterol.
- 6. Estimation of catecholamine.
- 7. Dissection by using alternate methods like clay modeling of endocrine glands.
- 8. Other exercise related to theory paper.

**EXAMINATION SCHEME**

Based on paper III	35 marks
Based on paper IV	35 marks
Viva	10 marks
Sessional (Internal)	20 mark
<b>Total</b>	<b>80+20 (100)</b>

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