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 2023-25

(Approved by Board of Studies)
Effective from June 2023

01/06/23
Dr. Anil Kumar

01/6/23
M.K. Meshram

HEMCHAND YADAV UNIVERSITY DURG
CHHATTISGARH
SYLLABUS FOR 2023-25
M. Sc. ZOOLOGY

Semester	Paper	Title	External marks	Internal marks	Credit
First	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
Second	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
Third	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

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

* Student has to choose one optional paper (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 followed strictly 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.

04/06/23

M. Sc. ZOOLOGY FIRST SEMESTER
PAPER – I
BIOSYSTEMATICS 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

- Concept of taxonomy
- Chemotaxonomy
- Cytotaxonomy
- Molecular taxonomy and mapping of phylogenetic tree

UNIT-II

Dimensions of speciation and taxonomic characters

- Species, types of species and mechanism of speciation.
- 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, curetting
- 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

- Concept and types of Biodiversity
- Methods of study of terrestrial, aquatic and aerial biodiversity
- Significance of wetland biodiversity
- Conservation methods of biuodiversity
- Climate change and biodiversity
- Biosphere reserves
- Threat to biodiversity and IUCN Red list
- Hot spots of Biodiversity- Biodiversity legislation of India, USA,UK,Canada.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

Biosystematics & Taxonomy by Dr. R. C. Tripathi, University Book House, Jaipur

Theory & Practice of Animal Taxonomy by V.C. Kapoor, 5th Edition Oxford & IBH Publishing Co.

Principle of Animal Taxonomy by G.G. Simpson, Oxford & IBH Publishing Co.

Elements of taxonomy by Earnst Mayer

Biodiversity. E.O. Wilson, Academic Press Washington

The Biology of Biodiversity by M. Kato, Springer

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

01/06/23

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, Tracheae and supplementary organs
- 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)

5/05/23

SUGGESTED READING MATERIALS (ALL LATEST EDITION)

- Invertebrate Structure and function,E.J.W. Barrington English language Book society UK.
- Invertebrate Zoology: Robert Barnes, IV Edition ,Holt Saunders International ,Edition Japan.
- The Cambrige Natural History Volume 1 -9.S F Harmer, A.E. Shipley, Todays & Tomorrows Book agency, New Delhi India.
- A Text book of Zoology
  InvertebrateParker Hasvell, Marshall &
  Williams. ITBS Publishing &
  Distributers, Delhi
- The Invertebrates Vol. 1 –9, Libbic Henrietta Hyman, McGraw Hill Book Company

01/06/23

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, palaentological, 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
- Calculation of genotypic frequency
- Calculation of allelic frequency
- Molecular 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
- Genetic alterations and human diseases

UNIT-IV

- Origin of higher categories
- Micro-and Macro-evolution
- Evolution of horse, elephant, camel, man
- Ethical legal and social issues in human genetics.

07/06/13

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Gene & Evolution by Jha A.P. John Publication, New Delhi
- Evolution & Genetics by Merrel D.J. Holt Rinchert & Wiston INC.
- The Genetics & Origin of Species by Dobzhansky, Columbia University Press.
- Evolution by 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)
  - Colorimetry and spectrophotometry
  - Flow cytometry.

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

- ELISA
- PCR
- 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
  - Sequencing of proteins and nucleic acids
- Cryopreservation
- Chromosomal isolation and preparation of Cladogram
- Separation of DNA from animal/human sample

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SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Introduction to Instrumental Analysis by 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 by Upadhyay and Nath, Meerut Publications
- Instrumentation and Techniques by 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 and preservation of 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 and computation of index
- Other exercise related to theory paper

Structure and Function of Invertebrates

- Identification, and taxonomic determination,
- 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).
- Model preparation and study of various organ system of Invertebrates, viz- Digestive, Nervous, Respiratory, reproductive and vascular systems.
- Study of various adaptations among insect fauna
- Collection and study of soil nematodes.
- Collection and study of Apterygota.
- Permanent preparations of different materials to be provided for study.

EXAMINATION SCHEME

Based on paper I	35 marks
Based on paper II	35 marks
Viva	10 marks
Sessional (Internal)	20 mark
Total	**80+20 (100)**

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

Population genetics and evolution

- Preparation of human chromosomes map, demonstration of chromosomal deficiencies.
- Study of model-based pedigree analysis.
- Study of evolution of horse and human by model or skeletal evidence
- Study of evolution through homologous and analogous organs.
- Calculation of Body mass index
- Morphometric analysis

Tools and techniques in biology: Principles and use of following instruments for different techniques

- Analysis of electrical conduction using conductivity meter
- Analysis of pH of sample by using pH meter
- Analysis of chemicals /Biochemicals using colorimeter /spectrophotometer
- Separation of compound using chromatography
- Separation of molecules using centrifuge
- Separation of DNA/protein using electrophoresis
- Identification of hormones or the compound using ELISA
- Amplification of Nucleic acid using PCR

EXAMINATION SCHEME

Based on paper III	35 marks
Based on paper IV	35 marks
Viva	10 marks
Sessional (Internal)	20 Mark
Total	**80+20 (100)**

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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

- DNA replication-Enzymes of DNA replication, Mechanism of DNA replication, Regulation of DNA replication.
- DNA damage and repair, causes consequences of DNA damage
- Mutation- Mutagen, molecular basis of mutation & types of mutation.
- DNA repair- Direct, Excision, Mismatch, Recombination and SOS repair.

UNIT-II

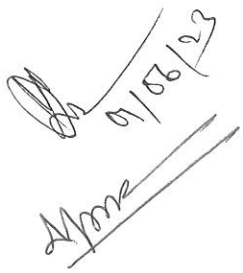
- Transcription- RNA polymerase, prokaryotic and eukaryotic mechanism, post transcriptional modification
- Translation- Process of translation, regulation and post translation modification
- DNA recombination-types and models of homologous recombination, biological importance og recombination
- Maintenance of DNA sequence role of methylation, phosphorylation, acetylation and deacetylation.

UNIT-III

- cDNA library- Mechanism and applications
- Molecular markers- RAPD, RFLP, AFLP, SSR etc.
- Genome sequencing- techniques and applications, human genome projects, ethical, legal and social issues
- Gene therapy – gene delivery, gene replacement, augmentation and application

UNIT-IV

- Application of molecular biology in health sectors.
- Application of molecular biology in agricultural sector
- Application of molecular biology in environment
- Embryonic stem cell technology and its application



SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- MOLECULAR CELL BIOLOGY by Lodish, W.H. Freeman & Co. New York
- Lehninger's PRINCIPLES OF BIOCHEMISTRY, Fourth Edition - David L [1]. Nelson, Michael M. Cox
- MOLECULAR CELL BIOLOGY by Lodish M. Baltimore, Scientific American books
- ESSENTIALS OF CELL & MOLECULAR BIOLOGY by Roberties & Roberties, Halt Saunders International Edition.
- CELL & MOLECULAR CELL BIOLOGY Gerald Karp, Willey & Sons Co.
- MEDICAL CELL BIOLOGY by Flickinger E.J. Brown J.C. Halt Saunders International Edition.
- CELL BIOLOGY by 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

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
- Nave 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.)

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- Some New Hormones :Ghrelin, Leptin, Amylin, Renin, ANF.
- Biosynthesis of hormones (thyroid and gonads)
- Hormones and Reproduction -Pregnancy, Parturition, Lactation
- Hormonal Control - Estrous Cycle, menstrual cycle, Menarche Puberty Menopause

UNIT-IV

- Mechanism of Hormone action
- Hormone receptors
- Endocrine disruptors
- 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.

01/06/23

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 cleavage, Egg types

UNIT-III

Formative movements

- Fate maps - Organogenesis
- Utility and comparative topographical relationship of the Presumptive areas in early embryosof- Amphioxus, Fishes, Amphibian and Birds
- Organogenesis of eye, heart and brain

UNIT-IV

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

SUGGESTED READINGS MATERIALS

- Animal Gametes – Vishmanath, Asia Publishing House
- Foundation Of Embrology–Bradley M.Patten, McGrow 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

01/06/23

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

- Organization of data
- Presentation of data
- Measures of central tendency
- Measures of dispersion

UNIT-IV

Tests of significance

Chi-square test

Student's t-test

- Analysis of Variance
- Regression
- Correlation
- Probability

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, Affilited East,West Press New Delhi (Indian ed.)
- Muray , J.D. Methamatical Biology, Springer Verlag Berlin Pelon, E.C. The interpretation of ecological data :
- A promer on classification and ordivation. lewis . Biostatics
- B.K. Mahajan Methods in Biostatics
- J.D. Murrey Mathematical Biology Georgs & Wilians Starticalmethod

01/06/23

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.
- 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.
- Study of micronuclei
- Separation of mitochondria
- Organelles fractionation
- Electrophoresis separation of DNA
- RAPD, RFLP, AFLP

General physiology and endocrinology

- Estimation of RBC, hemoglobin, hematocrit/PVC, blood group and Rh factor blood clotting time.
- Determination of urea, glucose and ketone bodies in urine.
- Determination of bilirubin ALP, total protein, globulin
- Demonstration of osmosis.
- Study of histology of endocrine glands in different animal types through permanent slides and microtomy.
- Configuration of hormones by antigen-antibody test system.

EXAMINATION SCHEME

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

Sessional (Internal)	20 Mark
Total	**80+20 (100)**

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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 Na, K/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	**80+20 (100)**

01/06/23

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 vertebrates
- Origin of fish & Amphibian.
- Origin of 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 Monkeys

UNIT-II

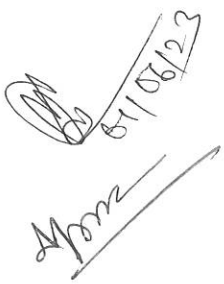
- Comparative studies of Integument system in vertebrates
- Comparative study of derivatives of integuments in vertebrates
- Skeletal system in vertebrates.
- Comparative study of Jaw suspensorium,
- Comparative study of Limbs and Girdles in vertebrates

UNIT-III

- Comparative study of Respiratory system among vertebrates.
- Comparative study of respiratory pigments among vertebrates
- Comparative study of heart in vertebrates
- Comparative study of Aortic arch in vertebrates

UNIT-IV

- Comparative studies of digestive system in vertebrates
- Comparative study of brain among vertebrates.
- Comparative study of sense organs among vertebrates
- Comparative study of urinogenital system among vertebrates



SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Vertebrate life :– William N. Ferland, F. Harvey pough, Tom J Gode, John B. Heiser, Collier MacNillem International edition
- Chordate morphology :–Malcom Jollie, Reinhold Publishing CorporationNewYork
- 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 BEHAVIOR

(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

Ethology

- Historical perspectives of ethology
- Behavioral patterns
- Innate behavior
- Biological rhythms
  - Types of biological rhythm
  - Biological clock

UNIT- II

Communications

- Auditory
- Visual
- Chemical

Learning and Memory

- Conditioning
- Habituation
- Reasoning
- Reproductive behavior.

UNIT-III

Orientation

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

UNIT-IV

Hormonal effect on behavioral patterns.

- Social behavior
- Social organization in insects and primates
- Schooling in fishes and Flocking in birds
- Homing, territoriality, dispersal

- Altruism
- 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)

07/06/23

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

- Terrestrial Adaptation in vertebrates
- Aquatic adaptation in vertebrates
- Aerial adaptation in vertebrates
- Cave adaptations in vertebrates

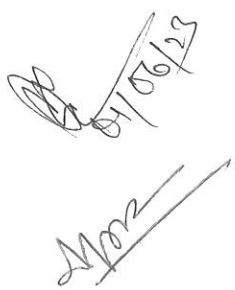
UNIT-III

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



SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- ECOLOGY with special reference to animal & man by S. Charles, Kendeigh Prentice hall of India Pvt. Ltd. New Delhi

- ELEMENTS OF TROPICALECOLOGY by Yanney Ewusie (English language Book Society, Heine mann educational book publication)

- FUNDAMENTALS OF ECOLOGY by 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.-Shiemidt Nielsen, Cambridge
- GENERAL & COMPARATIVE ANIMAL PHYSIOLOGY By Hoar W.S. Princeton Hall of India
- ENVIRONMENTALPHYSIOLOGY by Willmer, P.G. Stone & Johansan I, Blackwell Science Oxford

01/06/23

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 and organs of immune system
- Antigen and antibody structure
- Antigen-Antibody interaction
- Monoclonal antibody
- Primary and Secondary lymphoid organs

UNIT-II

- B-cell generation, activation and differentiation
- T-cell maturation, activation and differentiation
- T-cell receptors
- Complement system
- Cytokines

UNIT-III

- Major histocompatibility organ
- Cell mediated cytotoxic response
- Hypersensitivity reaction
- Autoimmune diseases
- Transplantation immunology
- Vaccine development

UNIT-IV

- Immune response in cancer, AIDS, SARS-Cov2
- Immune response to helminth parasite infection
- Immune response to protozoan parasite infection
- Immune response to bacterial infection
- Immune response to viral infection

07/06/23

SUGGESTED READING MATERIALS

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

07/08/23

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 and reproductive system of major vertebrate classes.
- Comparative study of embryos of fish, amphibia and aves.
- Comparative study of skull &jaw of vertebrates
- Comparative study of fins of fishes
- Other exercise related to theory paper

Animal Behavior

- To study the photo tactic 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.
- 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	**80+20 (100)**

04/06/23

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

Immunology and Parasitism

- Total and differential counting of leucocytes.
- Preparation of blood film & identification of cell
- Determination of agglutination reaction
- Study of permanent slides (for spotting); thymus, lymph nodes, spleen, bone marrow, blood cells, stages of cancer cells
- ODD test for antigen-antibody pattern
- DOT ELISA test
- Rocket Immuno electrophoresis
- Study of parasites in fish, birds and other vertebrates
- **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 manmade habitats to study the human impact on environment.
- Determination of heavy metals from water & soil, viz. As, Fluoride, cadmium, chromium, iron, lead etc.
- Determination of BOD from sewage samples
- Determination of COD from sewage sample
- Determination of dissolved oxygen from water sample
- Determination of total dissolved solid, conductivity and hardness of water sample.

01/06/23

SUGGESTED READING MATERIALS

- Immunology by Kuby, W.H. Froeman USA
- Fundamental of Immunology by W. Paul
- Essential Immunology by I.M. Roitt, ELBs Edition
- Immunology by Richard M. Hyde, Robert A. Patnode, A Wiley Medical Publications
- Reproductive Physiology by Gayton,
- 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	**80+20 (100)**

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

- Amino acids-Structure and classification
  - Structure of proteins
  - Biosynthesis of amino acids
  - Catabolism of protein

UNIT-II

- Structure &classification of carbohydrate
- Metabolism of carbohydrate
- Structure & classification of lipid
- Biosynthesis of fatty acid

UNIT-III

- Vitamins
  - Water- and Fat-soluble vitamins, Chemistry, Classification, Occurrence and Physiological role.
  - Enzymes Classification and nomenclature.
  - Mechanism of enzyme action
  - Kinetics of enzymes
  - Enzyme immobilization

UNIT-IV

- Nucleic Acid Structure and Types
- Metabolism of nucleic acid
- Hormonal regulation of carbohydrate metabolism
- Hormonal regulation of protein metabolism
- Hormonal regulation of lipid metabolism

04/06/23

Suggested Reading

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

5/10/23

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

- Histogenesis and types of nerve cells
- Histological structure of nerves system
- Physiological properties of nerve fiber
- Synapse and synaptic transmission

UNIT - II

- Spinal cord – arrangement of grey and white matter
- The spinal nerves
- The tract- ascending tract
- The tract- descending tract

UNIT - III

- Cerebrum
- Brain stem – mid brain, pons varolii, medulla oblongata
- Cerebellum
- Thalamus

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; verities, 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)
- Neuroanantomyby H.G.Snell
- Clinical Neurophysiology-Guide for Authors - Elsevier
- Foundations of Cellular Neurophysiology (Bradford Books): Daniel Johnston, Optional papers

11/06/13

M.Sc. ZOOLOGY SEMESTER – IV
Paper- III (Optional paper)

The following optional papers are being suggested as below

- Fish (Ichthyology) structure and function
  Or
- Cell Biology Or
  or
- Entomology
  Or
- Wild life conservation
  Or
- Biology of vertebrate's immune system

OPTIONAL (SPECIAL PAPER) GROUP 2

- Pisci culture and economic importance of fishes Ichthyology)
  Or
- Cellular organization andmolecular 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

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

- Accessary respiratory organs
- Air bladder and its functions
- Weberian ossicles their homologies and functions
- Excretion and osmoregulation
- Acoustico-lateral line system

Unit-3

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

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 ase-1, Hypersensitivity in relation to gene activity and chromatin organization.
- Specialized chromosomes II : structural organization and functional significance of lampbrush chromosome.
- Organization and significance of heterochromatin.

Unit-2

- Structural organization of Genes, interrupted genes and overlapping genes and their evolution
- Transposable genetic elements of prokaryotes and eukaryotes Gene , molecular mechanism of mutation and repair mechanism.
- Organization 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 and its regulation.
- Environmental modulation of gene activity (stress response), stress genes and stress proteins.
- Molecular basis of Monogenetic diseases, muscular dystrophy ,cystic fibrosis etc.
- DNA rearrangement.
- Amplification during development with special response to ciliates.
- Si-RNA, mi-RNA.

Unit-4

- Drosophila development,
- Cleavage,
- Grastrulation,
- Genetic regulation for origin of Anterior –Posterior development,
- Genetic regulation for origin of dordal ventral polarity in Drosophila,
- Basic idea of homoetic selector genes and homeotic mutation.
- Basic idea of organization of homeoboxes,

- Evolutionary significance of homeoboxes.

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 PublishinCompanyinc.
- Bruce A; berts Bray ewis Raff Roberts Watson Molecular Biology of the Cell,Garland Publishinginc.
- 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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Paper- III
C (Optional) Entomology

Unit-1

- Insect head types and modification as per their habit and habitat
- Modification of mouth parts and feeding behavior
- 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
- Malphighian 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
- Metamorphosis
- Pheromones

Unit-4

- Chemical Control of Pest -- insecticides- Classification, Structure and Mode of action.
- Biological Control of Pest
- Integrated pest control Management
- Pest attractants and repellents.

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 byClausen
- 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

Paper- III D (Optional) Wild Life Conservation

Unit-1

- Wildlife and significance of its conservation,
- Ethics of conservation.
- World conservation strategies.
- Habitat analysis, Evaluation and management of wild life.
- Physical parameters - Topography, Geology, Soil and water.
- Biological Parameters - Food , forage, and browse.
- Standard evaluation procedures - remote sensing and GIS.
- Management of habitats –Grazing logging, Mechanical treatment. Advancing the successional process. Cover construction. Preservation of general genetic diversity.

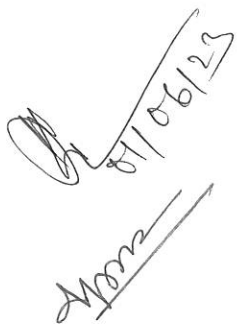
Unit 2-

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio, Fecal analysis of ungulates and carnivores

- 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 perturbance.
- Management of excess population & translocation.
- Bio-telemetry.
- Care of injured and diseased animal.



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 : Envionment 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

- Organs of Immune system- Primary secondarylymphoid organs, structure and functions

- Cellular basis of Immunity
- Antigen and Antibodies
- Interaction of antigen and antibodies

Unit-2

- **T-cell** lineage and receptors
- T-cell activation
- B-cell lineage and receptors
- B-cell activation
- Genetic model for Immunoglobulin

Unit-3

- MHC
- Immunization- Vaccine types and mechanism of development.
- Hypersensitivity reaction .
- Antibody dependent cytotoxic type II reaction.
- Complex mediated type III reaction

Unit-4

- Enzyme linked immunosorbent assay (ELISA) technique and its applications.
- Immuno fluorescence technique (Direct & Indirect and Sandwich antibody labeling techniques.
- Immunodiffusion techniques (Mancini and oucheterlony immunodiffusion techniques) Monoclonal antibodytechnology(Hybridomatechnology)
- RIA for immunological estimation.

M. Sc. Zoology Semester-IV

Paper- IV A (Optional)

Unit-1 **Pisci Culture and Economic Importance of Fishes (Ichthyology)**

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

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 Fish migration.
- Marshal The life offishes.
- Thomas - Diseases offish.
- 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. Lanharn -The Fishes.
- G.V. Nikolsky -The ecology of 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 offishes.
- M. Jobling -Environmental Biology of fishes.
- Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
- S.K. Gupta-Fish and Fisheries

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- K.P. Vishwas -Fish and Fisheries.
- Jhingaran -Fish and Fisheries.

M.Sc. Zoology Semester-IV

Paper- IV B (Optional)

Cellular 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 respiratory chain assemblies, ATP / ADP
- Translocase and F0F1 ATPase.
- Cell cycle: Cell cycle control in mammalian cells and xenopus.
- Cytochemistry of Golgi complex and Ribosome.

Unit-2

- Peroxisomes and 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 complexities.
- Cancer Biology
- Genetic basis of Cancer

Unit-4

- Chromosomal abnormalities and human cancer.
- General idea of oncogenes and proto oncogenes..
- Transforming Agents.
- Tumor Suppressor genes.
- Receptor – Ligand interaction and signal transduction. Cross – talk among various signaling pathways.

01/06/23

Suggested Reading Materials:

- DeRobertis and De Robertis Cell and Molecular Biology.
- Lea and Febiger. W. Watson Hopking reberts 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 garlandpublishing 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 CellBiology.
- 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 andcompany.
- J. Traver's 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
- Orthoptera (b) Hemiptera (c) Diptera.
- Classification of following insect order
- 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
- Pests of pulses
- House hold insect pests

Unit-3

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

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
- Biosphere and Biogeochemical cycles.
- Environmental monitoring and impact assessment.
- Environmental alterations 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, Cyclone, 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 sustainable exploitation,

- Environmental effect of extracting and using mineral resources

Food

- World food problem
- Effects of modern agriculture and overgrazing
- Increasing Heat Wave and Crop Yield.

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
- Socio economic and political causes of loss of biodiversity.
- In situ and ex situ conservation of biodiversity
- Value of biodiversity.

Suggested Reading Materials: Paper III D & IV D

- Arora: Fundamentals of environmental biology
- Anathakrishnan : Bioresources ecology
- Bottain : Environmentalstudies
- Bouhey : Ecologyof populations
- Clark : Elements ofecology
- Dowdoswell : An introduction to animal ecology
- Goldman : Limnology
- Kormondy : Concepts ofecology
- 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-I

Definition and scope of molecular endocrinology.

Chemical nature of Hormones-

- Peptide Hormones
- Amino acid derivative
- Steroids
- Phospholipids derivative
- (tissue hormones)

Purification and characterization of Hormones.

UNIT-2

Receptors.

- Membrane Receptor.
- Nuclear Receptor.
- Orphan Receptor
- Cytoplasmic Receptor

UNIT-3

- Hormone – Transduction
- G-Protein & Cyclic Nucleosides.
- Calcium calmodulin & phospholipids.
- Secondary Messengers.
- Phosphorylation & other non-transcriptional effect of Hormones.
- Biosynthesis of Steroid and Amino acid Derivative Hormones

UNIT-4

- Multiple ovulation and embryo transfer Technology.
- Study of estrous cycle by vaginal smear technology
- Surgical technique- Castration, Ovariectomy, Vasectomy, Tubectomy, Laparotomy
- *In Vitro* Fertilization techniques

Suggested Reading Materials:

- Benjamin Lewis – Genes VII/ VIII, oxford University press.
- Lodish - 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
BIOCHEMSTRY

1. Estimation of antioxidant enzymes.
2. Estimation of amylase. analitative study of amylase
3. Analitative study of protein
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
Total	**80+20 (100)**

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

PAPER-III(A) FISH (ICHTHYOLOGY) STRCTURE 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 claymodeling
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 Check 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.

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8. Other exercise related to theory paper.

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 spleenic/peritoneal macrophages.

3. Raising polyclonal antibody in mice, serum collection and estimating antibody title in serum by following methods:

   a. Ouchterlony (double diffusion) assay for Antigen -antibody specificity and title.
   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 (ICTHYOLOGY)

1. Systematic identification of freshwater fishes with particular reference toC.G.
2. Age determination with the help of scales / otolith
3. Pigmentary behavior 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 insects up to 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 usefulproducts
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

PAPER- IV(D) ENVIRONMENT AND BIODIVERSITY CONSERVATION

(i) Environmental hazards, destruction of habitat and extinction 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 α-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)/ Project Work/ Seminars	20 mark
Total	**80+20 (100)**

01/06/23

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