GOVT. M.H. COLLEGE OF HOME SCIENCE AND SCIENCE FOR WOMEN (AUTO.), JABALPUR (M.P.)

Department of Zoology

M.Sc. I & II Sem.

2023-24

M.Sc. ZOOLOGY 2023 – 24
FIRST –SEMESTER
PAPER - I BIOSYSTEMATICS, TAXONOMY AND EVOLUTION

MM : 35

UNIT I
- Definition and basic concepts of biosystematics taxonomy and classification
- History of Classification
- Trends in Biosystematics : Chemotaxonomy Cytotaxonomy and Molecular taxonomy
- Dimensions of Speciation and Taxonomic characters.
- Species concepts : Species Category, Different Species Concepts, Subspecies and other Infra-specific categories.
- Theories of biological classification: hierarchy of categories

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

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

UNIT IV
- Concepts of evolution and theories of organic evolution
- Neo Darwinism and population genetics :
  - A - Hardy-Weinberg law of genetic equilibrium
  - B - A detailed account of destabilizing forces :
    - a) Natural selection
    - b) Mutation
    - c) Genetic Drift
    - d) Migration
    - e) Meiotic Drive
- Trends in Evolution
- Molecular Evolution
  - a) Gene evolution
  - b) Evolution of gene families
  - c) Assessment of molecular variation

UNIT V
- Origin of Higher Categories
- Phylogenetic gradualism and punctuated equilibrium
- Major trends in the origin of higher categories
- Micro and macro evolution
- Molecular Population genetics
- Pattern of changes in nucleotide and amino acid sequence
- Ecological significance of molecular variations (Genetic - Polymorphism)
- Genetic & Speciation
- Phylogenetic and biological concept of species
- Patterns and mechanism of reproductive isolation
- Modes of speciation (Allopatry & Sympatry)
- Origin and Evolution & Economically important microbes and animals

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Dr. Rita Khondori

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SUGGESTED READING MATERIALS

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

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M.Sc. ZOOLOGY 2023 – 24

FIRST –SEMESTER

PAPER - I BIOSYSTEMATICS, TAXONOMY AND EVOLUTION

PSOS

- Taxonomy uses hierarchical classification as a way to help scientists understand and organize the diversity of life on our planet.
- Students Know basic concepts of Biosystematics taxonomy and Classification.
- They Gain Knowledge of Nomenclature and Taxonomic Procedures.
- They learn about concept and trends in Evolution.
- Students get Knowledge of Phylogenetic and Biological Concept of Species.

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M.Sc. ZOOLOGY 2023 – 24
FIRST –SEMESTER
PAPER – II STRUCTURE AND FUNCTION OF INVERTEBRATES

MM : 35

UNIT I

- Origin of Metazoan – Colonial Theory, Syncytial Theory and Polyphylatic Theory
- Organization of Coelom - Acoelomates, Pseudo coelomates, Coelomates
- Locomotion - Amoeboid, Flageller and Ciliary movement in protozoa
- Hydrostatic movements in Coelenterata, Annelida and Echinodermata

UNIT II

- Nutrition and Digestion –
  - (a) Patterns of Feeding and digestion in lower Metazoa
  - (b) Filter feeding in polychaeta, Mollusca and Echinodermata
- Respiration – (a) Organs of respiration : Gills, lungs and trachea
  - (b) Mechanism of Respiration
  - (c) Respiratory Pigments

UNIT III

- Excretion in Lower Invertebrates – Contractile Vacuole, Protonephridia and Solenocytes
- Excretion in Higher Invertebrates – Nephromixia, Metanephridia, coxcl gland, Malpighian tubules and organ of bojanus
- Mechanism of Osmoregulation with special Reference to Fresh Water Protozoa

UNIT IV

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

UNIT V

- Invertebrate larval forms and their evolutionary significance
  - (a) Larval forms of Platyhelminthes (b) Larval forms of Crustacea
  - (c) Larval forms of Mollusca (d) Larval forms of Echinodermata
- Structure affinities and life history of the following Minor Phyla
  - (a) Rotifera (b) Entoprocta
  - (c) Phoronida (d) Ectoprocta

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SUGGESTED READING MATERIALS

1. Hyman, L.H. The invertebrates, Nol. I.protozoa through Ctenophora, McGraw Hill Co., New York
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson anmd Sons Ltd., London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
5. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
6. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co.Philadelphia.
7. Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co.Ltd., London.
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol.V.Mc.Graw Hill Co., New York.
9. Read, C.P. Animal Parasitism. Parasitism. prentice Hall Inc., New Jersey.
10. Sedgwick, A.A. Student text book of Zoology. Vol. I,II and III. Central Book Depot, Allahabad.
11. Parker, T.J., haswell W.A. Text book of Zoology, Macmillan Co.,London.

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FIRST –SEMESTER

PAPER – II STRUCTURE AND FUNCTION OF INVERTEBRATES PSOS

- Students Know how to evolve multicellularity.
- Did learn about organization of coelom.
- They learn movements or filters in invertebrates.
- They learn about respiratory and excretory organ in invertebrates.
- They get knowledge of primitive and advanced nervous system.
- They learn about protostones and Duterostomes.
- They know about Minor phyla.

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M.Sc. ZOOLOGY 2023 – 24
FIRST – SEMESTER

SCHEME OF PRACTICAL - I

Time - 3 Hrs. Max. Marks - 50

1. Index of dominance, Density and Abundance, Frequency.
2. One Major dissection of various systems of invertebrates : Squilla, Prawn, Sepia.
3. One Minor Dissection- Aplysia, Hastate Plate of Prawn.
4. Spotting – Identification and Classification of Museum Specimens and Slides of Invertebrate phylum.
5. Viva
6. Sessional

SCHEME OF PRACTICAL - I

1. Exercise on species diversity indices	10
2. Major Dissection	08
3. Minor Dissection	05
4. Spotting (Any 8)	16
5. Viva	06
6. Sessional	05
TOTAL	50

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M.Sc. ZOOLOGY 2023 – 24

FIRST – SEMESTER

PAPER - III QUANTITATIVE BIOLOGY, BIODIVERSITY AND WILDLIFE

MM : 35

UNIT I

Quantitative Biology

- Distribution of the data in Biology- Mean, Mode and Median
- Measures of dispersion : Range, Mean deviation, IQD , Standard deviation and Coefficient of Variation
- Chi square test
- Normal distribution
- Experimental designing and sample theory

UNIT II

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

UNIT III

Biodiversity

- Concept and principle of biodiversity
- Causes for the loss of biodiversity
- Biodiversity conservation methods
- Medicinal uses of forest plant

UNIT IV

- Wildlife of India, Types of Wildlife
- Values of Wildlife, Positive and Negative
- Wildlife Protection Act
- Conservation of Wildlife in India
- Endangered and threatened species

UNIT V

Wildlife and Conservation

- National Parks and Sanctuaries
- Project Tiger
- Project Gir Lion and Crocodile Breeding Project
- Wildlife in M.P. With references to Reptiles Birds and Mammals
- Biospheres Reserves.

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SUGGESTED READING MATERIALS

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling
- Jorgenserr, S.E. Fundamental of Ecological modling E. sevier New York
- Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.
- Sokal, R.R. and F. J. Rohit Biometry Freeman San Francisco
- Snedecor, G.W. and W.G. Cochran, Statical 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.
- A. lewis . Biostatics
- B.K. Mahajan Methods in Biostatics
- V.B. Saharia wildlife in India
- S.K. Tiwari wildlife in central India
- J.D. Murrey Mathematical Biology
- Georgs & Wilians Startical method
- R.K. Tondon Biodiversity Texonomy & Ecology
- M.P. Arora An Introduction to prevantology
- P.C. Kotwal Biodiversity and conservation

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FIRST – SEMESTER
PAPER - III QUANTITATIVE BIOLOGY, BIODIVERSITY AND WILDLIFE

- They Gain Knowledge of Mean, Mode, Median, Variation, ANOVA and Chi Square Test.
- Central tendency refers to measures used to assess the average of observations.
- Analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of two or more independent (unrelated) groups.
- The Chi-Square test is a statistical procedure used by students to examine the differences between categorical variables in the same population.
- They Gain Knowledge of Principal and Conservation of Biodiversity.
- Biodiversity provides functioning of ecosystems.
- Students Know about Wildlife Protection act and its Types.
- They learn about rare species, National parks, Sanctuaries and Biosphere reserve.
- Wildlife provides stability to different processes of the nature.
- The goal of wildlife conservation is to ensure the survival of these species, and to educate people on living sustainably with other species.

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M.Sc. ZOOLOGY 2023 – 24
FIRST – SEMESTER
PAPER - IV BIOMOLECULES AND STRUCTURAL BIOLOGY

MM : 35

UNIT I

Chemical Foundation of Biology

- pH, pk, Acids, Bases, Biological Buffers, Weak bonds, Resonance, Isomerisation.
- Introductory knowledge of Bio-molecules of Cell – Protein, Carbohydrate, Fats, Nucleic acid
- Importance of Nanoparticles in biology
- Importance of Biomaterials type of importance in medical field.

UNIT II

- Primary, Secondary, tertiary and Quaternary Structures of Proteins, Protein folding and denaturation
- DNA and RNA : Double helical structure of DNA, Structure of RNA, role of RNA in gene expression
- DNA replication.DNA Recombination.DNA Repair Mechanism and diseases due to error in DNA Repair.
- Membrane phospholipids, Functional Importance of lipid
- Membrane Channels their types and importance
- Metabolic Pumps

UNIT III

Basic Concepts of Metabolism : Interconnecting Reactions of Metabolism

(a) Glycolysis
(b) Gluconeogenesis
(c) Citric acid cycle
(d) Fatty acid Metabolism: Beta Oxidation of Fat.
(e) Lac Operon

UNIT IV

- Biosynthesis of Amino acids-Phenylalanine and Tyrosine.
- Basic idea Phenylketoneuria and Albinism
- Biosynthesis of Nucleotides (1 Example of Purine and 1 Example of Pyrimidine)
- Biosynthesis of Membrane lipids-Cholesterol Biosynthesis
- RNA Splicing
- Protein Synthesis : Transcription and Translation in Prokaryotes.

UNIT V

- Enzymes: Terminologies, Classification and basics of Enzyme Kinetics
- Mechanism of Enzyme Catalysis
- Regulation of Enzyme Reaction
- Thermodynamic Principals in Biology
- Biological Energy Transducers: Mitochondria and Plastid.

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SUGGESTED READING MATERIALS

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

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M.Sc. ZOOLOGY 2023 – 24
FIRST – SEMESTER
PAPER - IV BIOMOLECULES AND STRUCTURAL BIOLOGY

- Student will learn about chemical foundation of biology that is acid base buffer system and Biomolecules.
- Students will learn about importance of nanoparticles and biomaterials in the field of biology which is important branch of modern biology.
- Students gain knowledge of proteins, nucleic acids, carbohydrates and fats with their importance for eukaryotes.
- Students also know about genetic material, Application and transport of materials by active and passive transport.
- Students will learn about basic concepts of metabolism and about biosynthesis of Biomolecules.
- They gain knowledge of Protein synthesis and enzymes. They also learn about principles of thermodynamics in biology and also about biological energy transducers.

M.Sc. ZOOLOGY 2023 – 24
FIRST – SEMESTER

SCHEME OF PRACTICAL - II

Time - 3 Hrs. Max. Marks - 50

1. Exercise Based on Biostatistics - Calculation of Mean, Mode, Median, Chi Square Test, ANOVA
2. Exercise on Wild Life - Endangered and Threatened Species (Any 05) + Imp National parks & Sanctuaries of M.P. (Any 05)
3. Biochemical Exercise -
   (a) Biochemical detection of Carbohydrates, Protein, Lipid.
   (b) Physiological Exercise - Action of salivary amylase on starch.
4. Cytological exercise – Study of Mitosis in Onion Root Tip, Study of Permanent Slide of Meiosis, Study of Polytene chromosome in chironomous larva.
5. Viva
6. Sessional

SCHEME OF PRACTICAL - II

1.	Exercise on Biostatistics	12
2.	Exercise on Wild Life	10
3.	Biochemical Exercise	05
4.	Physiological Exercise	05
4.	Cytological Exercise	05
5.	Viva	08
6.	Sessional	05
	TOTAL	50

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M.Sc. ZOOLOGY 2023 – 24
SECOND – SEMESTER
PAPER - I GENERAL AND COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY

MM : 35

UNIT I

- Respiratory pigments through different phylogenic groups.
- Transport of oxygen and carbon dioxide in blood and body fluids
- Regulation of respiration
- Physiology of impulse transmission through nerves and synapses
- Autonomic nervous system.
- Neurotransmitters and their physiological functions

UNIT II

- Excretion – Types of Nitrogenous Waste Product, Structure of Kidney and Mechanism of Urine formation.
- Comparative physiology of digestion
- Osmoregulation in aquatic animals and Water Conservation in Terrestrial Animals.
- Thermoregulation in Homeotherms, Poikilothermas and hibernation & Aestivation
- Physiology of pregnancy- Placental hormones, pregnancy diagnosis tests, Hormones of parturition and lactation

UNIT III

- Comparative study of Mechanoreception
- Comparative study of Photoreception
- Comparative study of Phonoreception
- Comparative study of Chemoreception
- Comparative study of equilibrium reception

UNIT IV

- Bioluminescence as means of communication among animals
- Pheromones and other similar chemicals as means of communication among animals
- Chromatophores and regulation of their function among animals
- Hormones (Structural and Functional Classification) and Chemical Nature
- Mechanisms of hormone action

UNIT V

- Phylogeny of endocrine glands (Pituitary and Thyroid)
- Ontogeny of endocrine glands (Pituitary and Thyroid)
- Neuroendocrine system
- Hormone Receptors - Signal transduction mechanism
- Hormones and reproduction
  a) Seasonal breeders b) Continuous breeders

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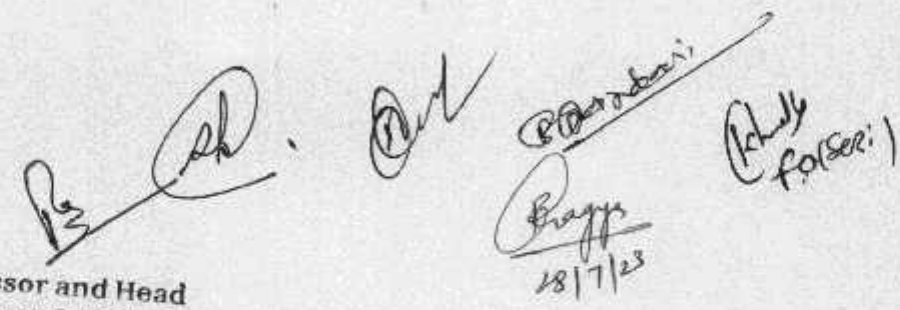
1. EJW Barrington-General & comparative Endoctrinology-Oxford, Claredon Press
2. R.H. Williams-Text Book of Endocrinology-W.B. Saunders
3. C.R. Martin- Endocrine Physiology-Oxford University Press.
4. Molecular CellBiology-J. Darnell, H. Lodish and D. Baltimore-Scientific American Book USA
5. Molecular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



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M.Sc. ZOOLOGY 2023 – 24

SECOND – SEMESTER

PAPER - I GENERAL AND COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY

- Student Know about Respiratory pigments, Transport of oxygen and carbon dioxide in blood and body fluids.
- Students will learn about Nitrogenous Waste Product, Structure of Kidney and Mechanism of Urine formation.
- They also Known as Comparative physiology of digestion.
- They also Known as Comparative study of Mechanoreceptor, Photoreception, Phonoreception and Chemoreception.
- They learn about Bioluminescence and Pheromones amongst fishes.
- Students gain knowledge of Phylogeny and Ontogeny of endocrine glands.

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M.Sc. ZOOLOGY 2023 – 24
SECOND – SEMESTER
PAPER - II POPULATION ECOLOGY AND ENVIRONMENTAL PHYSIOLOGY

MM : 35

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

UNIT II
- Adaptations : Levels of adaptations, significance of body size
- Aquatic environments: Fresh water, marine, shores and estuarine environments
- Eco-physiological adaptations to fresh water environments
- Eco-physiological adaptations to marine environments
- Eco-physiological adaptations to terrestrial environments

UNIT III
- Environmental limiting factors.
- Inter and intra-specific relationship.
- Predatory- Prey relationship, predator dynamics, optimal foraging theory
- Optimal foraging theory : Patch choice, diet choice, Prey selectivity, Foraging time
- Mutualism, evolution of plant pollinator interaction

UNIT IV
- Environmental pollution and human health
- Conservation management of natural resources
- Environmental impact assessment
- Sustainable development

UNIT V
- Concept of homeostasis
- Endothermic and physiological mechanism of regulation of the body temperature
- Physiological response to oxygen deficient stress
- Physiological response to body exercise
- Meditation, yoga and their effects

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SUGGESTED READING MATERIALS

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

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M.Sc. ZOOLOGY 2023 – 24
SECOND – SEMESTER
PAPER - II POPULATION ECOLOGY AND ENVIRONMENTAL PHYSIOLOGY

- Student Know about Populations : Growth & Regulation and Demography.
- Students will learn about Eco-physiological adaptations to terrestrial, marine and fresh water environments.
- Students will learn about Environmental limiting factors and Inter and intra-specific relationship.
- Students will gain knowledge of Environmental pollution, Impact and effect on human health.
- Students will learn about Meditation, yoga and their effects.

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SECOND – SEMESTER

SCHEME OF PRACTICAL I

Time - 3 Hrs. **Max. Marks - 50**

General and Comparative Physiology & Endocrinology, Population Ecology & Environmental Physiology.

1. Experiment on Haematology, Blood group, Total and differential Counts.
2. Spotting related to Theory.
3. Exercise based on Population ecology, Inter and intra-specific relationship and adaptations.
4. Detection of Nitrogenous waste products in given samples (Ammonia, Urea, Uric Acid, Creatin).
5. Viva voce
6. Practical records and collection.

SCHEME OF PRACTICAL - I

1. Experiment on Haematology, Blood group, Total and differential count 10
2. Spotting related to Theory 14
3. Adaptations 06
4. Exercise on Population ecology 05
5. Detection of Nitrogenous waste products in given samples 05
6. Viva voce 05
7. Practical records and collection 05

TOTAL.....50

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SECOND – SEMESTER
PAPER - III TOOLS AND TECHNIQUES IN BIOLOGY

MM : 35

UNIT I

- Microscopy: Principle & Applications
  - a) Light microscope and phase contrast microscope
  - b) Fluorescence microscope
  - c) Electron microscope
  - d) Confocal microscopy
- General Principle and applications of :
  - a) Colorimeter
  - b) Spectrophotometer
  - c) Ultra centrifuge
  - d) Flame photometer
  - e) Beer and Lamberts law.
- Microbiological techniques
  - a) Media Preparation and sterilization
  - b) Inoculation and growth monitoring
  - c) Microbial assays
  - d) Use of Fermentors
  - e) Microbial identification (cytological staining methods for bacterial and fungal strains)

UNIT II

- Computer aided techniques for data presentation data analysis, Statistical techniques.
- Cryotechniques
  - a) Cryopreservation of cells, tissues, organs and organisms
  - b) Cryosurgery
  - c) Cryotomy
  - d) Freeze fracture and freeze drying
- Separation techniques.
  - a) Chromatography, principle type and applicants.
  - b) Electrophoresis, Principles, types and applications PAGE and Agarose gel electrophoresis.
  - c) Organelle separation by centrifugation.

UNIT III

- Radioisotope and main isotope techniques in biology
  - a) Sample preparation for radioactive counting
  - b) Autoradiography.
- Immunological techniques
  - a) Immunodiffusion (Single & Double)
  - b) Immuno Electrophoresis
- Techniques Immuno detection
  - a) Immunocyto/histochemistry
  - b) Immunoblotting, Immunodetection, Immunofluroscence.
- Surgical techniques
  - a) Organ ablation (Eg. Ovariactomy, adrenalectomy)
  - b) Perfusion techniques
  - c) Stereotaxy
  - d) Indwelling cathethers
  - e) Biosensors

UNIT IV

- Histological techniques
  - a) Principles of tissue fixation
  - b) Microtomy
  - c) Staining
  - d) Mounting
  - e) Histochemistry
- Cell Culture techniques.
  - a) Design and functioning of tissue culture laboratory
  - b) Culture media, essential components and Preparation
  - c) Cell viability testing.

UNIT V

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

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SUGGESTED READING MATERIALS

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

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M.Sc. ZOOLOGY 2023 – 24
SECOND – SEMESTER
PAPER - III TOOLS AND TECHNIQUES IN BIOLOGY

- Students gain knowledge of various types of Microscope, Principle & Applications of Various Lab Instrument like as Colorimeter, Spectrophotometer and Ultra centrifuge.
- Students will learn about Media Preparation and sterilization.
- Students will learn about Use of Fomenters and Microbial identification.
- Students gain knowledge of Computer aided techniques for data presentation data analysis and Statistical techniques.
- Students gain knowledge of Radioisotope and main isotope techniques related to biology.
- Students will learn about Immunological and Surgical techniques.
- Students will learn about Cytological and Molecular biology techniques.

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M.Sc. ZOOLOGY 2023 – 24
SECOND – SEMESTER
PAPER - IV MOLECULAR CELL BIOLOGY AND GENETICS

MM : 35

UNIT I

Biomembrane

- Molecular composition, arrangement and functional consequences
- Transport across cell membrane:Diffusion,Active transport,Uniports, Symports and Antiports, Sodium potassium Pumps
- Micro filaments and Microtubules structure and dynamics
- Role of Kinesin and Dynein in Intracellular Transport
- Role of Kinesin and Dynein in Cell Movement

UNIT II

Cell-Cell signaling

- Cell surface receptors
- Second messenger system
- Signaling from plasma membrane to nucleus
- Structure and functions of Gap junction
- Integrins, Selectin, immunoglobulin

UNIT III

Cell - Cell adhesion and communication

- Ca++ dependant Cell -Cell adhesion
- Ca++ independent Cell - Cell adhesion
- Connexins
- Genome organization: Genome in prokaryotes , Eukaryotes: Nucleosome, Solenoid model
- Chromosomal organization of genes:Repetitive DNA,Split gene,Overlapping genes,Pseudogenes

UNIT IV

Sex determination

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

UNIT V

Genetic Diseases and Genomics

- Genetic Diseases-Sickle cell anaemia,Haemophilia,Colour blindness
- Human gene therapy
- Prenatal diagnosis and genetic counseling
- Genetic screening
- Structural Genomics
- Functional Genomics
- Gene libraries
- Transgenic animals and their applications

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SUGGESTED READING MATERIALS

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

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M.Sc. ZOOLOGY 2023 – 24
SECOND – SEMESTER
PAPER - IV MOLECULAR CELL BIOLOGY AND GENETICS

- Students will learn about biomembranes, transport process, cell skeleton and cell movement.
- They will learn about Cell to cell signaling through cell surface receptors and second messenger system.
- Students will gain knowledge of Cell adhesion and cell communication process along with genome organization and non coding DNA, which helps in understanding of genomic material and their function.
- Students will learn about some basics about sex determination in Drosophila and mammals. They also get familiar with human genome project.
- Students will gain knowledge of some basic but very important topics like human gene therapy, prenatal diagnosis, genetic screening, gene library and transgenic animals.

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M.Sc. ZOOLOGY 2023 – 24
SECOND – SEMESTER

SCHEME OF PRACTICAL - II

Time - 3 Hrs. Max. Marks - 50

1. Comments upon the structure and Application of analytical instruments.
   - I. Colorimeter
   - II. Spectrophotometer
   - III. Ultracentrifuge
   - IV. ESR & NMR Spectrometer
2. Microtomy – Block making, Section cutting, stretching and staining.
3. Chromatography - Paper Chromatography (Amino acid),
4. Problem based on Genetics and Genetic diseases.
5. Estimation of Gene and Genotype frequencies in light of Hardy -Weinberg Law on facial traits.
6. Viva voce
7. Practical record.

SCHEME OF PRACTICAL - II

1. Microtomy	10
2. Chromatography	5
3. Principle and application of Instrument	5
4. Problem based on Genetics/genetic diseases	10
5. Estimation of Gene & Genotype frequencies in light of Hardy Weinberg law on facial traits/Blood group	10
6. Viva voce	05
7. Practical record	05
TOTAL	50

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Department of Zoology

M.Sc. III & IV Sem

2023-24

M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - I COMPARATIVE ANATOMY OF VERTEBRATES

MM : 35

UNIT I

- Origin of Chordata : Concept of Protochordata
- Development, structure and functions of integument and its derivatives (Glands, Scales, Feathers and Hairs)
- Respiratory System : Characters of respiratory tissue, External and Internal Respiration
- Comparative account of respiratory organs
- Comparative account of Digestive System

UNIT II

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

UNIT III

- Evolution of Urinogenital system in vertebrates (Reptiles, Birds and Mammals)
- Comparative account of organs of olfactory and taste (Reptiles, Birds and Mammals)
- Comparative anatomy of brain and spinal cord (CNS) (Reptiles, Birds and Mammals)
- Comparative account of peripheral and autonomous nervous system in mammals.

UNIT IV

- Comparative account of lateral line system
- Comparative account of electroreception
- Flight adaptations in vertebrates
- Aquatic adaptations in birds and mammals

UNIT V

- Origin, evolution general organization and affinities of Ostracoderms
- General organization, specialized, generalized and degenerated characters of Cyclostomes
- Origin, evolution general organization of early Gnathostomes
- General account of Elasmobranchi, Holocephali, Dipnoi and Crossoptergii

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Dr. A. Dave.   Dr. Rita Bhandari   PRAGYA NAIDU 28/7/23

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SUGGESTED READING MATERIALS

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

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - I COMPARATIVE ANATOMY OF VERTEBRATES

- Students will learn about Origin of Chordata : Concept of Protochordata.
- Students can be able to identify all organs and organ systems of vertebrates.
- Students able to explain the evolutionary significance and function of each of these system.
- Students able to identify all classes of vertebrates by their various anatomical features.
- Students can explain and apply the concept of homology, analogy, morphogenesis, ontogeny and phylogeny related to the anatomical features of vertebrates.

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - II LIMNOLOGY

MM : 35

UNIT I

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

UNIT II

- Physico–Chemical characteristics of freshwater with special reference to different parameters - Turbidity, Dissolved gases (Oxygen, Carbon dioxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH
- Dissolved Solids – Carbonate, Bicarbonates, Phosphate and Nitrate
- Light : Light as an ecological parameter in freshwater
- Temperature - Radiation, Stratification and Heat Budget, its effects & adaptations of animals for temperature

UNIT III

- Study of Biota
  - (a) Phytoplankton, Zooplankton and their inter-relationship
  - (b) Aquatic Insects, Birds and their environmental significance
- Ecological classification of aquatic fauna higher aquatic plants and their significance

UNIT IV

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

UNIT V

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

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SUGGESTED READING MATERIALS

- Anathakrishnan : Bioresources Ecology Goldman : Limnology
- Odum : Ecology
- Powlosuske : Physico- chemical methods for water
- Wetzal : Limnology
- Trivedi & Goyal : Chemical and biological methods for water pollution studies
- Perkins : Ecology
- Arora : Fundamentals of environmental biology

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - II LIMNOLOGY

- Students will be able to learn about the new branch of zoology i.e. limnology is its scope, definition and historical development.
- Students will gain the knowledge of different physiological parameter of freshwater.
- Students will learn about plankton and their interrelationship and aquatic flora and fauna.
- Students will learn about Bioindicators and Sewage treatment.
- Students will gain the knowledge of aquatic pollution its causes control and legislation.
- Students will be aware about aquatic birds & Insects and Their Environmental Significance.

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER

SCHEME OF PRACTICAL - I

Time - 3 Hrs. Max. Marks - 50

1. Study of Specimens, Slides & Vertebral Column of Various Vertebrates.
2. Major Dissection – Cranial nerves of Labeo.
3. Estimation of D.O., Chloride, BOD, COD, Hardness, pH & Alkalinity of Water.
4. Study of Fresh water Ecosystem and Bioindicators.

SCHEME OF PRACTICAL - I

1.	Major Dissection	10
2.	Spotting (Any 08)	16
3.	Limnological exercise	08
4.	Fresh water Ecosystem / Bioindicators	06
5.	Practical Record	05
6.	Viva	05
	TOTAL	50

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - III ECO - TOXICOLOGY

MM : 35

UNIT I
- General principles of Environmental Biology with emphasis on ecosystems
- Abiotic and biotic factors of ecosystems
- Energy flow in environment: Ecological energetic
- Communities of the environment, their structure & significance

UNIT II
- Productivity, Production and analysis
- Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation
- Remote sensing –basic concepts and applications of remote sensing techniques in environmental conservation
- Environmental indicators and their role in environmental balance

UNIT III
- Kinds of environmental pollution and their control methods
- Radioactive compounds and their impact on the environment
- Vehicular exhaust pollution causes and remedies
- Noise pollution

UNIT IV
- Toxicology- Basic concepts, Principles and various types of toxicological agents
- Toxicity testing Principles, hazards, risks and their control methods
- Food toxicants and their control methods
- Public Health Hazards due to environmental disasters

UNIT V
- Pesticides, types, nature and their effects on environment
- Important heavy metals and their role in environment
- Agrochemical use and misuse, alternatives
- Occupational Health Hazards and their Control

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SUGGESTED READING MATERIALS

- Clark : Elements of ecology
- Odum : Fundamentals of Ecology
- South Woods : Ecological methods
- Trivedi and Goel : Chemical and biological methods for water pollution studies

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - III ECO - TOXICOLOGY

- Students will gain the knowledge of Environmental Biology with emphasis on ecosystems.
- Students will learn about remote sensing techniques in environmental conservation.
- Students will gain the knowledge of Radioactive compounds and their impact on the environment.
- They will learn about Food toxicants and their control methods.
- Students will learn about Toxicology and various types of toxicological agents.
- Students will be aware about Public Health Hazards due to environmental disasters.

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - IV AQUACULTURE

MM : 35

UNIT I
- Aquaculture: history, definition, scope & importance.
- Inland Fishery resources of India in General and M.P. with special reference to Narmada
- Riverine fisheries –
  - (a) Ecology and fishes of major river system : Ganga, Bramhaputra
  - (b) East cost river system : Godavari & Kaveri
- Cold water fisheries and Costal fisheries in India
- General ecological characteristics of reservoirs of India

UNIT II
- Fish culture : Mono, Poly, mixed and composite Fish culture
- Fresh water prawn culture and its prospects in India
- Culture of Oysters & pearl
- Frog culture – Life cycle and steps of culture in outdoor & Indoor Culture

UNIT III
- Overview of integrated fish culture
- Paddy cum fish culture
- Sewage fed fish culture
- Brackish water culture
- Cage culture

UNIT IV
- Fresh water fish farm engineering : Selection of site, Construction of fish farm & soil chemistry
- Designing, layout and construction of different types of fish ponds
- Setting and management of fresh water aquarium
- Aquarium fishes – Type and Characteristics, breeding of aquarium fishes
- Different types of croft and gears in fisheries

UNIT V
- Water pollution, its effects on fisheries and methods of its abatement
- Common fish diseases and their control
- Biochemical composition and nutritional value of fish
- Nutrigenomics with special reference to fishes

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SUGGESTED READING MATERIALS

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

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER
PAPER - IV AQUACULTURE

- Students will gain the knowledge of Sustainability & Management of Aquaculture & Fisheries.
- Students will gain the knowledge of Mono, Poly, mixed and composite Fish culture.
- They also learn about Prawn culture and Frog culture.
- Students will learn about Fresh water fish farm engineering.
- Students will learn about Designing, layout and construction of different types of fish ponds
- Students will gain the knowledge of Different types of craft and gears in fisheries.
- Students will gain the knowledge of Biochemical composition and nutritional value of fish.

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M.Sc. ZOOLOGY 2023 – 24
THIRD – SEMESTER

SCHEME OF PRACTICAL - II

Time - 3 Hrs. Max. Marks - 50

1. Study of Phytoplankton and Zooplankton.
2. Construction, Preparation & Maintenance of Aquarium.
3. Study of common weeds of fish Pond (Utricularia, Ceratophylum, Hydrilla, Lemna, Vallisneria, Potemogeton , Eichhornia, Pistia, Nymphea, Wolfia)
4. Study of abiotic factors of water related to fish life (Turbidity Conductivity)
5. Determination of different toxic chemical in samples of Soil, Water & Air.
6. Toxicological testing methods, general test, acute toxicity test and LD_{50} test.
7. Comments on Aquaculture animals.

SCHEME OF PRACTICAL - II

1.	Spotting (Any 08)	16
2.	Exercise on toxicology	10
3.	Study of common weeds of fish Pond	04
4.	Maintenance of Aquarium	05
5.	Viva	05
6.	Collection and Practical Record	10
	TOTAL	50

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M.Sc. ZOOLOGY 2023 – 24
FOURTH– SEMESTER
PAPER - I ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY

MM : 35

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

- Reproductive behavior. Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care in fishes, Amphibia & mammals.
- Social behaviour : Aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates

UNIT V

- Thermoregulation: Homoeothermic animals, poikilotherms & Hibernation
- Receptor physiology a comparative study –
  - (a) Mechano receptor
  - (b) Photo receptor
  - (c) Phono receptor
  - (d) Chemo receptor
- Equilibrium receptor
- Bioluminescence

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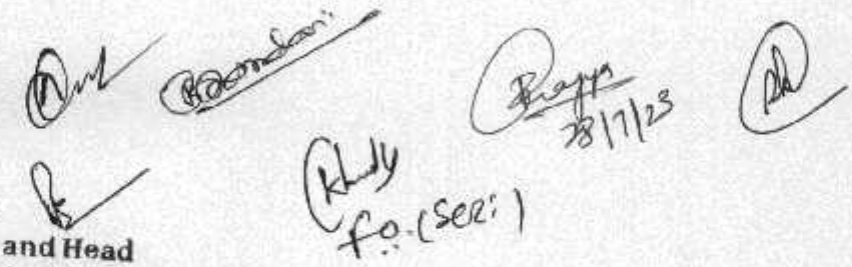
1. Eibl-Eibesfeldt, I. Ethlogy. The biology of Behaviour. Holt, Rineheart & Winston, New York.
2. Gould, J.L. The mechanism and Evolution of Behaviour.
3. Kerbs, J.R. and N.B. davies : Behaviourable Ecology. Blackwell, Oxford, U.K.
4. Hinde, R.A. Animnal Behaviour : A Synthesis of Ethology and Comparative Psychology. McGraw Hill, New York.
5. Alcock, J. Animal Behaviour : An Evolutionary approach. Sinauer Assoc. Sunderland, Massachsets, USA.
6. Bradbury, J.W. and S.L. Vehrencamp. Principles of Animal Communication. Sinauer Assoc. Sunderland, Massachsets, USA.



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M.Sc. ZOOLOGY 2023 – 24
FOURTH– SEMESTER
PAPER - I ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY

- Students will gain the knowledge of the biology of Behaviour, and Comparative Psychology.
- Students will learn about Principles of Animal Communication.
- They will learn about Neural and hormonal control of behaviour and Ecological aspects of behaviour.
- Students will learn about Social behaviour and Reproductive behavior of various animals.
- Students will gain the knowledge of Biological rhythms, Learning and memory in various animals.
- Students will gain the knowledge of Thermoregulation and comparative study of Receptor physiology.

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M.SC. ZOOLOGY 2023 – 24
FOURTH– SEMESTER
PAPER - II GAMETE BIOLOGY, DEVELOPMENT AND DIFFERENTIATION IN VERTEBRATES

MM : 35

UNIT I

- Comparative account of differentiation of gonads in mammals
- Spermatogenesis : Morphological basis in rodents. Gamete specific gene expression and genomics
- Biochemistry of Semen : Semen composition and formation, assessment of sperm function
- Fertilization: Prefertilization events Biochemistry of fertilization post fertilization events

UNIT II

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

UNIT III

- Hormonal regulation of ovulation, pregnancy and parturition
- Hormonal regulation of development of mammary gland and lactation
- Endocrinology and Physiology of placenta
- Cryopreservation of gametes and Embryo
- Teratological effects of xenobiotics on gametes

UNIT IV

- Cell commitment and differentiation
- Germ cell determinants and germ cell migration
- Development of gonands
- Melanogenesis.

UNIT V

- Creating new cell types, the basic evolutionary mystery
- Cell diversification in early Amphibian embryo, totipotency and pleuripotency
- Embryonic stem cells, renewal by stem cells, epidermis
- Connective tissue cell family
- Haemopoietic stem cells : Blood cells formation, stem cell disorders

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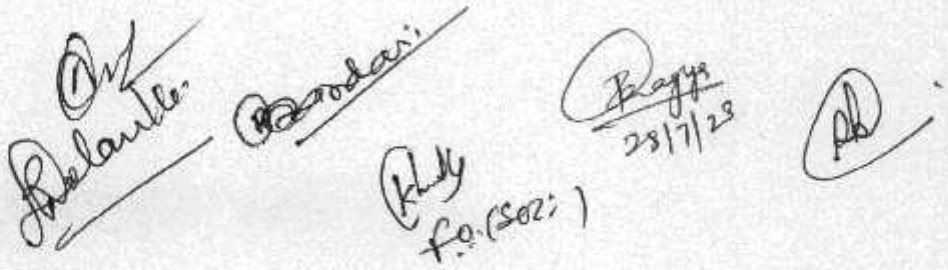
SUGGESTED READING MATERIALS

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



M.SC. ZOOLOGY 2023 – 24

FOURTH– SEMESTER

PAPER - II GAMETE BIOLOGY, DEVELOPMENT AND DIFFERENTIATION IN VERTEBRATES

- Students will learn about differentiation and Developments of gonads in mammals.
- Students will gain the knowledge of Spermatogenesis, oogenesis and vitellogenesis.
- Students will gain the knowledge of Cryopreservation of gametes and Embryo.
- Students will gain the knowledge of development of mammary gland and lactation.
- Students will learn about Haemopoietic and Embryonic stem cells.

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M.Sc. ZOOLOGY 2023 – 24
FOURTH – SEMESTER

SCHEME OF PRACTICAL - I

Time - 3 Hrs. Max. Marks - 50

1. Exercise on Animal behavior
   a. Taxes
   b. Reflexes
   c. Biological clocks
   d. Social behavior
   e. Learning behavior
   f. Reproductive behavior

2. Developmental Biology
   a. Study of embryological slides
   b. Study of gametes of frog & chick
   c. Study of Fate maps (gastrula)
   d. Study of different stages of spermatogenesis & oogenesis.
   e. Different stages of Chick Embryology in lab.

SCHEME OF PRACTICAL - I

1. Exercise based on Animal behavior (Any two) 18
2. Exercise based on developmental biology..... 16
3. Viva..... 06
4. Practical record and Collection 10

TOTAL..... 50

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M.SC. ZOOLOGY 2023 – 24
FOURTH– SEMESTER
PAPER - III (ICHTHYOLOGY) STRUCTURE AND FUNCTION

MM : 35

UNIT I
- Origin and evolution of fishes
- Classification of fishes as proposed by Berg
- Fish integument
- Locomotion

UNIT II
- Alimentary canal and digestion
- Respiratory System
- Accessory Respiratory Organs
- Air bladder and its functions
- Weberian ossicles their homologies and functions

UNIT III
- Circulatory system
- Excretion and Osmoregulation
- Acoustico-lateral line system
- Luminous organs
- Colouration in fishes

UNIT IV
- Nervous System
- Sound producing organs
- Deep sea adaptions
- Hill stream adaptions
- Migration in fishes

UNIT V
- Sexual cycle and fecundity
- Parental care in fishes
- Early development and hatching
- Poisonous and venomous fishes
- Electric organs

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Professor and Head
Deptt. of Zoology & Biotechnology
Govt. Auto. M.H. College of H.Science
and Science JABALPUR (M.P.)

M.SC. ZOOLOGY 2023 – 24
FOURTH– SEMESTER
PAPER - III (ICHTHYOLOGY) STRUCTURE AND FUNCTION

- Student gain knowledge of evolution and classification of fishes.
- They know about specific organ of fishes weberian ossiclel, air bladder, lateral line system and electric organs.
- Student will learn respiratory, excretory and digestive system.
- They learn migration and Osmoregulation in fishes.
- They gain knowledge of deep sea and Hill stream adaptation.
- Students know about early development and parental care in fishes.

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M.SC. ZOOLOGY 2023 – 24
FOURTH– SEMESTER
PAPER- IV A (ICHTHYOLOGY)
PISCI CULTURE AND ECONOMIC IMPORTANCE OF FISHES

MM : 35

UNIT I
- Collection of fish seed from natural resources
- Dry bundh breeding of carps
- Wet bundh breeding of carps
- Hypophysation and breeding of Indian major carps

UNIT II
- Drugs useful in induced breeding of fish
- Types of ponds required for fish culture farms
- Management of hatcheries, nurseries and rearing ponds
- Management of stocking ponds

UNIT III
- Composite fish culture
- Prawn culture and pearl industries in India.
- Fisheries resources of M.P.
- Riverine Fisheries.

UNIT IV
- Costal fishries in India
- Offshore and deep sea fisheries in India
- Role of fishries in rural development
- Sewage fed fisheries

UNIT V
- Methods of fish preservation
- Marketing of fish in India and transport of livestock
- Economic importance and by product of fishes
- Shark liver oil industry in India
- Application of Genetic Engineering in Fishes

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Academic Council Approved

M.SC. ZOOLOGY 2023 – 24
FOURTH– SEMESTER
PAPER- IV A (ICHTHYOLOGY)
PISCI CULTURE AND ECONOMIC IMPORTANCE OF FISHES

- Students will be able to learn about collection of fish seed and hypophysation and breeding of fishes.
- Students will gain the knowledge about the drugs useful in indeed breeding of fishes.
- They will also learn about types of points required for fish culture.
- Students will be able to learn about composite fish culture and prawn culture and riverine fisheries.
- Students will learn about coastal fisheries in India.
- They will gain the knowledge about rule of history in rural development.
- Students will learn about methods of fish preservation and marketing of fish in India.
- Students will gain the knowledge of shark liver oil industry in India and genetic engineering in fishes.

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M.Sc. ZOOLOGY 2023 – 24
FOURTH – SEMESTER

SCHEME OF PRACTICAL - II (ICHTHYOLOGY)

Time - 3 Hrs. Max. Marks - 50

1. Major dissection (Nervous system of wallago, Mystus, Torpedo)
2. Minor dissection - Accessory Respiratory organ, Weberian ossicles
3. Age determination of fish with the help of scales.
4. Identification of fish (Any 12 Collected Fish).
5. Study of Museum specimen, Slides & Bones.

SCHEME OF PRACTICAL II

1. Major dissection	06
2. Minor dissection	04
3. Age determination of fish with the help of scales	05
4. Identification of fish	06
5. Spotting of Museum Specimen, Slides & Bones	14
6. Viva	05
7. Practical Records & Collection	10
TOTAL	50

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