PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR
SYLLABUS FOR 2022-23
M. Sc. ZOOLOGY

Semester	Paper	Title	External marks	Internal marks	Credit
First JULY-DEC, 2022	I	Biosystematics, Taxonomy and Biodiversity	80	20	4
	II	Structure and Function of Invertebrates	80	20	4
	III	Population Genetics and Evolution Biology	80	20	4
	IV	Tools & Techniques in Biology	80	20	4
	LC-I	Lab Course 1 (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
Second JAN-JUNE, 2023	I	Molecular Cell Biology and Biotechnology	80	20	4
	II	General physiology and Endocrinology			4
	III	Human Reproductive Physiology	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 JULY-DEC, 2023	I	Comparative Anatomy of vertebrate	80	20	4
	II	Animal Behavior	80	20	4
	III	Immunology	80	20	4
	IV	Environment Physiology and Population Ecology	80	20	4

8.7.2022

	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
Compulsory					
Fourth JAN-JUNE, 2024	I	Biochemistry. Metabolic Regulation and Cell function	80	20	4
	II	Neurophysiology	80	20	4
	Optional papers (Group I)*				
	III	Fish (Ichthyology) structure and function	80	20	4
	III	Cell biology	80	20	4
	III	Entomology	80	20	4
	III	Wild life conservation	80	20	4
	III	Biology of Vertebrates immune system	80	20	4
	III	Ornithology(Avian Biology)			
(Group II)*		**Optional paper**			
	IV	Pisciculture and Economic importance of fishes (Ichthyology)	80	20	4
	IV	Cellular and Molecular organization	80	20	4
	IV	Applied entomology	80	20	4
	IV	Environment and Biodiversity conservation	80	20	4
	IV	Molecular endocrinology and reproductive technology	80	20	4
	IV	Avian Biology And Ecological Importance			
	LC-I	Lab Course I (Based on paper I & II) /	80	20	2

	LC-II	Lab Course II (Based on paper III & IV / Dissertation)	80	20	2
Total			**1920**	**480**	**80**

- Student has choice to opt for one paper each (special paper) from group I &group II.
- 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 toil to the HOD by the end the activity.
- The student may choose in Lab course II of fourth semester, either Practical based on paper III & IV or Dissertation.

M. Sc. ZOOLOGY FIRST SEMESTER

(July — December 2022)

PAPER — I

BIOSYSTEMATICS, TAXONOMY AND BIODIVERSITY

Course Objective

This paper is aimed to introducing the students for the salient features of Taxonomy and Evolution.

Theory

UNIT-I

- Definition and Basic concept of Biosystematics.
- Zoological nomenclature.
- History and theories of biological classification and uses.
- Different types of taxonomic characters.
- Taxonomic procedure, collection, preservation, and Identification.

UNIT-II-

- Newer trends in biosystematics-
- Morphological
- Embryological
- Behavioral
- Cytological
- Molecular
- Hierarchy of Categories.
- Types of taxonomic key their merits and demerits

UNIT-III

- Dimension of Speciation.
- Mechanism of speciation in Panmictic and Apomictic species.
- Species concept-Sub, eco, ceno, and super species.
- Different type of species categories-Biological, Evolutionary, Typological, Nomenalistic, and Polytyping.

UNIT-IV

- Conservation of biodiversity
- Types of Biodiversity.
- Hot Spots of Biodiversity.
- Threats to biodiversity.
- Evaluation of biodiversity indices
- Shannon-Weiner Index

Learning Outcomes

After successfully completing this course, the students will be able to

- Classify animals on the basis of their relation to other animals by body structure, external characters.
- Apply the International rules of Nomenclature to give a scientific name to animals which are found during research.
- Understand the gradual development and evolutionary history of different kinds of living organisms from earlier forms over several generations.
- Understand and demonstrate the internal anatomy of various animals, biodiversity and related indices
- To identify diversity of fauna on earth and implement conservation measures to save diversity
- To understand importance of wildlife and conservation measures, National parks and Sanctuaries.
- Analyze biological data mathematically and statistically

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Biosystematics & Taxonomy,
- Dr.R.C.Tripathi, University Book House JAIPUR.
- Theory & Practice of Animal Taxonomy
- V.C. Kapoor, 5th Edition Oxford & IBH Publishing Co.
- Principle of Animal Taxonomy
- G.G. Simpson, Oxford & IBH Publishing Co.
- Elements of Taxonomy
- Earnst Mayer
- Biodiversity
- E.O. Wilson, Academic Press Washington
- The Biology of Biodiversity
- M. Kato, Springer
- Molecular Markers - Natural History & Evolution
- J.C. Avise

M. Sc. ZOOLOGY FIRST SEMESTER

(July — December 2022)
PAPER — II
Structure and Function of Invertebrates

Course Objective

This paper is aimed to introducing the students for structure & function of Invertebrate.

Theory

UNIT-I

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

UNIT-II

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

UNIT-III

Excretion

- Organs of excretion.
- Excretion and osmoregulation
- Primitive nervous system: Coelenterata and Echinodermata.
- Advanced Nervous system: Annelida, 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)

Learning Outcomes

After successfully completing this course, the students will be able to

- Understand the structure and organization of invertebrate animals.
- Explain modifications in various functions of animals during transition from invertebrates to vertebrates.
- Identify invertebrates and homology, analogy and modifications of mouthparts in relation to feeding habits, Respiration, Excretion, Locomotion..

SUGGESTED READING MATERIALS (ALL LATEST EDITION)

- Invertebrate Structure and function:- E.J W. Barrigton English language Book society UK.
- Invertebrate Zoology: Robert Barnes IVth Edition Holt Saunders International Edition Japan.
- The Cambridge Natural History Vol 9. S F Harmer, A.E. Shipley. Todays & Tomorrows Book agency, N Delhi India.
- A Text book of Zoology Invertebrate: Parker Haswell, Marshall & Williams. A ITBS Publishing & Distributers, Delhi
- The Invertebrates Vol. 1 – 9 Libbie Henrietta Hyman, McGraw Hill Book Company

M. Sc. ZOOLOGY FIRST SEMESTER

(July — December 2022)

PAPER-III

Population Genetics and Evolution Biology

Course objective

This paper is aimed to introducing the students for the salient features of Evolution and Speciation.

UNIT-I

- Origin of Life
- Concepts of evolution and theories of organic evolution: Lamarckism, Darwinism and Synthetic theory of Evolution .
- Evidences of evolution: anatomical, embryological, paleontological, physiological and Bio-chemical

UNIT-II

- Detailed account of destabilizing forces.
- Natural selection
- Mutation
- Variation
- Genetic Drift
- Hardy-Weinberg law of genetic equilibrium

UNIT-III

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

UNIT-IV

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

Learning Outcomes

After successfully completing this course, the students will be able to:

- Enable the students to understand the evolution of universe and life.
- Understanding on the process and theories in evolutionary biology.
- Develop an interest in the debates and discussion taking place in the field of evolutionary biology.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

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

M. Sc. ZOOLOGY FIRST SEMESTER (July - December 2022)

Paper IV

TOOLS & TECHNIQUES IN BIOLOGY

Course objective

The course objective is to provide students with a basic understanding of:
Various techniques used in biological sciences.

UNIT-I

- Principles and application of-
- Ultracentrifugation
- Electrophoresis
- Chromatography (various types)
- Lambert-Beers Law and colorimetery and spectrophotometery
- Flow cytometery.

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

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

UNIT-IV

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

Learning outcomes

- After successfully completing this course, the students will be able to
- Explain Microscopy, Colorimetry, Chromatography
- Principle, process, applications and working of related instruments.
- .Demonstrate Microbiological, Cytological, Histological, Molecular biological techniques.
- Apply and demonstrate Immunological Surgical Immuno detection and Cell culture techniques.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **Introduction to InstrumentalAnalysis**
- **Robert Braun,** McGraw Hill International Edition

M. Sc. ZOOLOGY FIRST SEMESTER (July — December 2022)
LAB COUSE-I

(PRACTICAL BASED ON PAPER I & II)

Biosystematics and Taxonomy

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

Structure and function of invertebrates

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

M. Sc. ZOOLOGY FIRST SEMESTER (July — December 2022)

LAB COUSE-II

(PRACTICAL BASED ON PAPER III & IV)

Population Genetics and Evolution Biology

Comparative anatomy of Vertebrates

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

TOOLS & TECHNIQUES IN BIOLOGY

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

M. Sc. ZOOLOGY SECOND SEMESTER (January — June, 2023)

PAPER — I

MOLECULAR CELL BIOLOGY AND BIOTECHNOLOGY

Course Objective

The course provides an insight into the life processes at the cellular and molecular levels. Other important aspects include DNA and molecular genetics including gene cloning, sequencing and gene mapping in addition to the powerful techniques that revolutionized the pharmaceutical, health and agricultural industries

UNIT-I

Biomembrane –

- Molecular composition and arrangement
- Transport across membrane
- Structure and function of-
- Mitochondria
- Golgi complex
- Lysosome
- Ribosome

UNIT-II

- DNA replication
- Transcription
- Translation
- Genetic code
- Mechanisms of initiation, elongation and termination
- Regulation of translation

UNIT-III

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

UNIT-IV

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

Learning outcomes

Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario

This course teaches RDNA technology techniques and their application in the field of genetic engineering.

Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields.

Apply their knowledge in problem solving and future course of their career development in higher education and research.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

MOLECULAR CELLBIOLOGY Lodish, W.H. Freeman & Co. NewYork **Lehninger**

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

MOLECULAR CELL BIOLOGY Lodish M. Baltimore, Scientific American books

ESSENTIALS OF CELL & MOLECULAR BIOLOGY
Roberties & Roberties, Halt Saunders International Edition.

CELL & MOLECULAR CELL BIOLOGY
Gerald Karp, Willey & Sons Co.

MEDICAL CELL BIOLOGY
Flickinger E.J. Brown J.C. Halt Saunders International Edition.

CELL BIOLOGY
Powar C.B. Himalaya Publishing House

M. Sc. ZOOLOGY SECOND SEMESTER (January — June, 2023)

PAPER — II

General Physiology and Endocrinology

Course Objective

The course deals with various physiological functions in mammals, Endocrine function and Hormone synthesis. It also gives an account of the metabolic/ biochemical pathways.

UNIT-I

- Digestion and Metabolism-
- Mechanism of digestion
- Mechanism of absorption
- Respiration-
- Respiratory pigments
- Role of Hemoglobin
- Mechanism and regulation of breathing.
- Transport of Gases
- Internal Respiration
- Regulation of body pH

UNIT-II

- Anatomy of muscle
- Muscle Function and Movement
- Mechanism of muscle contraction
- Regulation of muscle contraction
- Nervous System
- Neurons and membrane excitation
- Action potentials
- Synapses and neurotransmitters
- Cardiac Cycle and Its regulation

UNIT-III

Sensory Transduction-

- Auditory receptors
- Chemoreceptor: taste and smell
- Vision and Photoreception
- Thermoregulation and Cold Tolerance
- Heat balance and exchange
- Endotherms Vs Ectotherms
- Torpor, hibernation and aestivation
- Endocrinology

UNIT-IV

- Structure and functions of endocrine glands (Pituitary, pineal, pancreas, adrenal, thyroid etc.)
- Biosynthesis of hormones (thyroid, Adrenal and gonadial)
- Hormones and Reproduction

Learning Outcomes

At the end of the course students should:

1. Have an enhanced knowledge and appreciation of mammalian physiology;
2. Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems;
3. Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail;
4. be able to perform, analyse and report on experiments and observations in physiology;
5. be able to recognise and identify principal tissue structures.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Tortora, G.J. and Derrickson, B.H. (2009) Principles of Anatomy and Physiology (12th edition) John Wiley and Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology (9th edition) McGraw Hill.
- Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology (12th edition) Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
- Marieb, E. (1998) Human Anatomy and Physiology (4th edition) Addison-Wesley.

Kesar, S. and Vashisht, N. (2007) Experimental Physiology, Heritage Publishers.

- Turner, C. D. (1971) General Endocrinology, Pub- Saunders Toppan.
- Nussey, S.S.; and Whitehead, S.A. (2001) Endocrinology: An Integrated Approach, Oxford: BIOS Scientific Publishers.
- Hadley, M.E. and Levine J.E. (2007) Endocrinology (6th edition) Pearson Prentice-Hall, New Jersey.
- David, O.N. (2013) Vertebrate Endocrinology.

M. Sc. ZOOLOGY SECOND SEMESTER (January — June, 2023)

PAPER — III

Human Reproductive Physiology

Course Objective

The major objective of this course is to provide students with a sound coverage of human reproductive biology within the framework of Human Biology. It also envisages the detailed structure and function of the male and female reproductive tracts, gametogenesis, fertilization, early embryogenesis, foetal development and preparation for birth, and maternal adaptations to pregnancy.

UNIT-I

- Structure and function of female reproduction.
- Sexual differentiation
- Puberty and Ovarian cycle
- Formation of ova.
- Physiology of ovulation,
- menstrual cycle

UNIT-II

- Structure and function of male reproduction.
- Formation of sperm and fertility of individual.
- Biochemistry of semen, Phallus erection, Ejaculation, Y-specific probes
- male-Endocrine control of testicular function.

UNIT-III

- Process of fertilization-Pre and Post fertilization event
- Biochemistry of fertilization
- Implantation and formation of the foetus and placenta;
- Pregnancy,
- foetal development; Labour and birth
- lactation and neonatal life
- Role of hormone in Parturition and Lactation
- Reproductive Ageing; Menopause

UNIT-IV

- Sexually transmitted diseases
- Cancers of the reproductive system
- Adenomyosis
- Birth Control
- chronic infection of uterus,
- congenital uterine anomalies;
- Ovarian cysts,
- pelvic varicosities.

Learning outcomes

Upon successful completion of this course, students should be able to:

Explain and contrast the processes of spermatogenesis, oogenesis.

Demonstrate an understanding of the hormonal control of reproduction in males and how this is regulated;

Distinguish between the main stages of embryonic, foetal and neonatal development and causes of foetal disorders.

Understand the origin and characteristics of common congenital malformations;

Know how sexually transmitted diseases may contribute to altered neonatal or reproductive function.

Suggested reading material-

1. Developmental Biology, 2'[d]edition.Leon, W.B Saunders College publishing
2. Current topics in Developmental Biology eds. R.A.Pederson and G.P. Schatten
3. Principles of animal development biology: S.C. Goel, Himalaya Publishing house
4. Developmental biology, S.F Gilbert, 4[th] edition, Sinauer Assoc. Inc. Publishers
5. An introduction to Developmental biology : D.A. Ede

6.Principles of Developmental Biology:Paul Weiss edited by HafnerPublishngCo.,NY altimore.

7. Gary C.S.; Steven B.B.; Philip R.B. and Philippa H.F. (2014) Larsen's Human Embryology (5th edition) Elsevier.

6. 8. Gilbert, S.F. (2016) Developmental Biology (11th edition) Sina Cells into organs: 2[n] edition the forces that shape the embryo John PhillipTrinkaused. Tom Aloisi
7. Principles of development: LewisWolpert ct al 1998. Oxford Univ. Press
8. Foundations of" embryology ; B.M Pattern & B.M. Carlson, Tata McCiraw Hill Publications, New Delhi

to. An introduction to embryology: Balinsky 1981 5' [h] ed. (CBS College publishing)

11 Embryonic and foetal development Cambridge Univ press. By Austin and Short 1982, 1992 2[nd] Ed.

13. Marshall physiology of reproduction: Longmont Green and Co. London Voll and 2, lamming 1984,2000
14. Developmental biology; Gudrick
15. Endocrinology: Hadley
16. Endocrinology: Negi

M. Sc. ZOOLOGY SECOND SEMESTER (January – June, 2023)
PAPER – III

Quantitative biology, computer application and research methodology
Course objective

The course is aimed at introduction the application of statistics and basic computer in biology. It provides foundation on statistical methods to enable students to compute and interpret basic statistical parameters. As an interdisciplinary field it integrates biology, computer science, and statics together sequence analysis structure analysis and functional analysis of biology. It will provide basic knowledge about research and to understand the scientific writing, review of literature and report writing.

UNIT-I

- Basic knowledge of hardware and software
    - Introduction to digital computer
    - CPU (Central Processing Unit)
    - Input and Output devices
    - Auxiliary storage system
    - Operating system and Binary number system
    - Introduction to MS office: Word, Excel and Power point
    - Computer application in biostatistics

UNIT-II Biostatistics

- Biological data: Type of Data, Collection, Analysis, Interpretation and Presentation of data
- Sample and sampling
    - Measures of central tendency
    - Measures of dispersion
- Hypothesis testing: Null and alternate hypothesis, Tests of significance, Chi-square test, Student's t-test, Analysis of Variance, Correlation

Unit – III Research Methodology & Research design

- Introduction to Research,
    - Types of research,
    - Characteristics of research,
    - Objectives of Research,
    - Importance and scope of Research.
- Identification of research problem, Selection of research problem, Formulation of research objectives
- Research design: Components, Importance and Types.
- Basic Principles of Experimental Designs, Developing a Research Plan.

Unit – IV Scientific writing: Review of Literature and report writing

- Forms of scientific writing: Article, Notes, Reports, Review article, monographs, Dissertation.
- Elementary idea about: Citation & indexing, Research ethics, IPR, Plagiarism.
- Literature review: Elementary idea and types - evaluative, exploratory, and instrumental.
- Report Writing: Layout and Types of report writing.

Learning outcomes

After successfully completing this course, the students will be able to:
Know the theory behind fundamental biostatics analysis methods.

Be familiar with widely used databases.

Know basic concepts of probability and statistics.

Describe statistical methods and probability distributions relevant for molecular biology Data.Know the applications and limitations of different bioinformatics and statistical methods.

SUGGESTED READING MATERIALS

Batasclielet. E. Introduction to inatlielnatics for site scientist springer-verlag, berl ing
-Lenderen D. Modelling in behavioral ecology. Chapman & Hall Lolidoii U.K.

- Snedecor, G.W. and W.G. cochran, statical methods, Affi1 ited East, West Press New Delhi (Indian ed.)
- Muray , J.D. Methamatical B iology, Springer Verlag Berlin
- Pelon, E.C. The interpretation of ecological data : A promer on c lassificatioti and ordination.

A. lewis . B iostatics

- B.K. Mahajan Methods in B iostatics
- J. D. M urrey Mathematical Biology
- Georgs & Wilians Startical method
- Kothari, C.R. (2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi
- Arya., P.P. and Pal, Y. (2001), Research Methodology in Management: Theory and Case Studies, Deep and Deep Publishers Pvt. Ltd., New Delhi
- Robert A. Day (1998), How To Write & Publish a Scientific Paper. Oryx Press; 5 edition
- Suresh C. Sinha and Anil K. Dhiman, (2002), Research Methodology (2 Vols-Set) Vedams Books (P) Ltd.
- Buranen L and Roy AM Perspectives on Plagiarism and Intellectual Property in a Post-Modern World
- Gilmore B Plagiarism: Why it happens, How to prevent it?
- R. Panneerselvam: Research Methodology

- Cooper, Harris M. (1998). Synthesizing Research: A Guide for Literature Reviews. Applied Social Research Methods (3rd ed.). Thousand Oaks, California.

M. Sc. ZOOLOGY SEMESTER – II

LAB COURSE – I (PRACTICAL BASED ON PAPER I & II)

I. Molecular biology and Biotechnology

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

II. General physiology and endocrinology

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

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

III. Human Reproductive Physiology

- Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems;
- Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
- Sperm count and sperm motility in rat
- Study of modern contraceptive devices
- Other exercises related to theory paper.

IV. Quantitative biology, computer application and research Methodology

- 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
- Exercise based on research methology
- Other exercises related to theory paper.

M. Sc. ZOOLOGY THIRD SEMESTER (July-December, 2023)

PAPER — I

Comparative Anatomy of Vertebrates

Course objective

The objective of this course is to develop a proper understanding of evolution and structure of the vertebrates.

Theory

UNIT-I

- Origin of Chordates
- Amphibians, Reptiles, Birds and Mammals.
- Classification of Vertebrates
- Amphibians
- Reptiles
- Birds
- Mammals.

UNIT-II

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

UNIT-III

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

UNIT-IV

- Evolution And Comparative account of Urinogenital system
- Nervous system-
- Comparative account of the brain in relation to its function
- Comparative anatomy of spinal cord
- comparison of cranial nerves.

Learning Outcomes

- Students recognize vertebrate structural principles by studying all body systems of vertebrates in an evolutionary perspective.
- Compare and contrast the anatomical systems of different vertebrates and identify common traits across species and groups.

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

M. Sc. ZOOLOGY Third SEMESTER (July-December, 2023)

PAPER — II
Animal behaviour
Course out comes

To gain a comprehensive understanding of the behavior of animals.

UNIT- I

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

UNIT- II

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

UNIT-III

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

UNIT-IV

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

8/9/23

Learning Outcomes

-
- Understand types of animal behaviour and their importance to the organisms.
- Enhance their observation, analysis, interpretation and documentation skills by taking short projects pertaining to Animal behaviour and chronobiology.
- Relate animal behaviour with other subjects such as Animal biodiversity, Evolutionary biology, Ecology, Conservation biology and Genetic basis of the behaviour.
- Understand various process of chronobiology in their daily life such as jet lag.
- Learn about the biological rhythm and their application in pharmacology and modern medicine.
- Realize, appreciate and develop passion to biodiversity; and will respect the nature and environment.

UGGESTED READING MATERIALS - (ALL LATEST EDITION)

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

M. Sc. ZOOLOGY THIRD SEMESTER (July-December, 2023)

PAPER — III
Immunology

Course Objective

This course aims to provide students with an understanding of the immune system and its components, the defense mechanisms that can establish a state of immunity against infection, and Immune-related diseases disease.

Theory

UNIT-I

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

UNIT-II

- Immunoglobulin structure and function
- Molecular structure of Immunoglobulin
- Types of Immunoglobulin-IgM,IgG,IgD.IgE
- Monoclonal antibodies

UNIT-III

Antigens -

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

UNIT-IV

- Ageing and immune factor
- Immuno tolerance.
- Hypersenstivity and its types.
- .Immune system in Health disease
- Immune response to infectious disease
- Immune response in cancer
- AIDS

Learning Outcomes

- After going through this unit student shall be able to: .
- The students will be able to identify the cellular and molecular basis of immune responsiveness will be able to describe the roles of the immune system in both maintaining health and contributing to
- Trace the history and development of immunology.
- Describe surface membrane barriers and their protective functions.
- Explain the importance of phagocytosis and natural killer cells in innate body defense.
- Describe the roles of different types of T cells, B cells and APCs.
- Compare and contrast the origin, maturation process, and general function of B and T lymphocytes..

SUGGESTED READING MATERIALS

Immunology
Kuby, W.H. Froeman USA

Fundamental of Immunology
W. Paul,

Essential Immunology
I.M. Roitt, ELBs Edition

Immunology
Richard M. Hyde, Robert A. Patnode, A Wiley Medical Publications

Reproductive Physiology
Gayton,

M. Sc. ZOOLOGY Third SEMESTER (July-December, 2023)
PAPER — IV
Environmental Physiology and Population Ecology
course objective

Students will be able to: define population and explain the relationship between species and populations , Basic concepts of environmental stress Levels and Mechanisms of adaptation

UNIT – I

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

UNIT-II

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

UNIT-III

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

UNIT -IV

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

Learning out comes

- The goal of this course is familiarize you with ecological theory and its applications.
- To gain an understanding of the broad biological significance of ecological theory.
- To gain an understanding of the questions that ecologists study, the methods they use, and the questions that remain unanswered.
- To develop your ability to apply quantitative skills to analyze and interpret ecological data.

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

ECOLOGY with special reference to animal & man

- **S. Charles, Kendeigh** Prentice hall of India Pvt. Ltd. New Delhi

- **ELEMENTS OF TROPICAL ECOLOGY**
- **Yanney Ewusie** (English language Book Society, Heine mann educational book publication)
- **FUNDAMENTALS OF ECOLOGY**
- **Odum P.**
- **ANIMAL PHYSIOLOGY, MECHANISM AND ADAPTATION -**
- **Eckert, R.,** W,H, Freeman and Co.
- **BIOCHEMICAL ADAPTATION -**
- **Hochachka, P.W, and Somero S.N,** Princeton, New Jersey

M. Sc. ZOOLOGY Third SEMESTER (July — December 2023)
LAB COUSE-I

(PRACTICAL BASED ON PAPER I & II)

Comparative anatomy of Vertebrates

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

II. Animal Behaviour

- To study the phototactic response in earthworm or grain/pulse pest.
- To study the food preference and cleaning behaviour of housefly.
- To study the food preference in tribolium or grain/pulse pests.
- To study the web construction and habituation in spider.
- Estimation of body temperature and pulse rate on daily time scale.
- Estimate the time perception among various individuals at two different time points on daily time scale.
- Determination of effect of time on schooling behaviour in fish
- Other exercise related to theory paper

M. Sc. ZOOLOGY THIRD SEMESTER (July — December 2023)
LAB COUSE-I

(PRACTICAL BASED ON PAPER III & IV)

III. Immunology

- Dissection of primary and secondary immune organs from fish/fowl- Preparation and study of cell suspension from spleen (spleenocytes) of Fish / fowl.
- Total and differential counting of leucocytes.
- Protein estimation by Lowry's method in normal and infected blood sample.
- Determination of Blood group.

- Study of permanent slides (for spotting); thymus, lymph nodes, spleen, bone marrow, types of cells of various types, adipose tissue, mitotic and meiotic chromosomes and their different phases cancer cells of various types etc.
  - Study of parasites in fish
  - Study of various parasites through slides and specimen.
  - Other exercises related to theory paper.

IV. Environmental Biology and Population ecology

- Study of biotic community in a pond/grassland ecosystem.
- Study of population growth rate (curve) in protozoan culture.
- Population dynamics of *Tribolium* sp.
- Study of biogeochemical cycles by way of models Visit to some natural habitats and man made habitats to study the human impact on environment.
- Water analysis for fresh and waste water (Dissolve oxygen and chloride).
- Other exercises related to theory paper..

M. Sc. ZOOLOGY FOURTH SEMESTER — IV (January - June, 2024)

PAPER— I

(Compulsory)

BIOCHEMISTRY

The course provides an introduction to the structure of bio molecules with emphasis on the techniques used for structure determination and analysis.

UNIT-I

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

UNIT-II

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

UNIT-III

- Vitamins
- Water and Fat soluble vitamins,
- Chemistry, occurrence and physiological role.
- Enzymes- Classification and nomenclature Regulation of Enzyme, Activity and Function of coenzyme.

UNIT-IV

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

Metabolism of nucleic acids

Learning Outcomes

- After successfully completing this course, the students will be able to:
- Understand about the importance and scope of biochemistry.
- Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
- Understand the concept of enzyme, its mechanism of action and regulation.
- Understand in detail about amino acid structures, types of amino acids, classifications, structure of proteins and types of proteins.

Suggested Reading

Lehninger Principles of Biochemistry, Fourth Edition

David L. Nelson, Michael M. Cox
Publisher: W. H. Freeman

Biochemistry

Donald Voet, Hardcover: 1616 pages,

Publisher: Wiley; 3 edition

Principles of Biochemistry With a Human Focus

Reginald H. Garrett, Charles M. Grisham
Publisher: Brooks Cole

The Molecular Basis of Cell Cycle and Growth Control

Gary S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt, Publisher: Wiley-Liss

Experiments in Biochemistry: A Hands-On Approach

Shawn O. Farrell, Ryan T. Ran

M. Sc. ZOOLOGY SEMESTER — IV (January - June, 2024)
PAPER II (Compulsory)
NEURO PHYSIOLOGY

Course Objective

To gain an understanding of the principles of neurophysiology by using molecular, synaptic and cellular processes to explain brain function

UNIT - I

- Physiological role of neurosecretory cells
- Histological structure of neurons and neuroglial cells
- Physiological properties of neural fibres
- Synapsis and synaptical transmission
- Myoneural junction and neuromuscular transmission
- Degeneration and regeneration of nerve fibre

UNIT - II

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

UNIT - III

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

UNIT - IV

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

Learning Outcomes

- After successfully completing this course, the students will be able to:
- Understand the structure of brain and improved methods to study it.
- Understand the structure of different lobes of the brain and their corresponding functions.
- Understand intricacies of nerve impulse conduction.

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)

Neuroanantomy by H.G.Snell

Clinical Neurophysiology-Guide for Authors - Elsevier

Foundations of Cellular Neurophysiology (Bradford Books): Daniel Johnston

M.Sc. ZOOLOGY SEMESTER – IV (January - June, 2024)

Optional papers

The following optional papers are being suggested as below

- **OPTIONAL (SPECIAL PAPER) GROUP 1**
- A. Fish (Ichthyology) structure and function
- B. Cell Biology
- C. Entomology
- D. Wild life conservation
- E. Biology of vertebrates immune system

OPTIONAL (SPECIAL PAPER) GROUP 2

- A. Pisci culture and economic importance of fishes (Ichthyology)
- B. Cellular organization and molecular organization
- C. Applied entomology
- D. Environment and Biodiversity conservation
- E. Molecular endocrinology and reproductive technology

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

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- III A Optional paper)
Ichthyology (Fish) Structure and Function

Course outcomes

To provide students with an interactive learning environment whereby critical thinking is developed and knowledge is acquired on various aspects of fish anatomy, function, biology and academic writing.

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Learning out comes

- Enhance your familiarity with taxonomic diversity of fishes
- Improve your knowledge on the basic physiological, ecological and behavioural adaptations of fishes to life in water,
- Understand the ecological importance of different life history and reproductive strategies

Suggested reading materials

1. Zingron-Fish and fisheries in India
2. Gavelander-Fish biology
3. KarkLegler-Fresh water fisheries
4. Nikolaski-Fish biology
5. Identification of fishes-Days fauna
6. Khanna-Introduction to fish
7. Parihar-Fish biology
8. Norman-Introduction to fishes
9. Mishra-Identification of fishes in India

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper III B
Cell Biology

Course objectives

Explain the role of compartmentalization and signalling in cellular biology;
Evaluate and apply knowledge of modern techniques in cellular biology

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

- Drosophila development
- Cleavage
- Grastrulation

Origin of Anterior —Posterior (Maternal effect genes ans segmentation genes

- Drosophila development II origin of dordal ventral polarity
- Basic idea of homoetic selector genes and homeotic mutation
- Basic idea of organization ofhomeo boxes
- Evolutionary significance of homeo boxes

Learning Outcomes

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- Students will understand how these cellular components are used to generate and utilize energy in cells
- Students will understand the cellular components underlying mitotic cell division.
- Students will apply their knowledge of cell biology to selected examples of changes in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Suggested Reading Materials:

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

M.Sc. Zoology Semester-IV (January - June, 2024)
Paper- III C (Optional)
Entomology

Course objective

Understanding the history of insect taxonomy and the bases of modern taxonomy.
Compare and assess the concepts and principles behind scientific theories regarding the significance of the specific structure in the insect body.

UNIT-I

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

UNIT-II

- Sclerotisation and tanning of the cuticle
- Structure of alimentary canal and Physiologyof digestion
- Malphighian tubules — anatomical organization , Transport mechanism
- Structure of circulatory system
- Cellular elements in thehaemolymph

UNIT-III

- Cell mediated and humoral immunity
- Structure of compound eye and Physiology of Vision
- Sound Production in insect
- Structure and function of endocrine glands

UNIT-IV

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

Learning outcomes

- After completing this course student should be able to:
- Understand the principles of the human – insect relationship.
- Demonstrate the link the basic morphological characteristic of insects including the integument and its components.
- Describe the structure and function of various organs.
- Demonstrate the the internal anatomy of insects.
- Develop the ability to design and perform a scientific study on insects, and to analyze results.

Suggested Reading Materials:

- The Insect: Structure and function by R.F. Chapman
- Comparative Insect physiology, Biochemistry and Pharmacology .Vol :1-13. Edited by G.A. Kerkut and L.I. Gilbert.
- Entomophagous Insect by Clausen
- Entomology bu Gilbert
- Principles of Insect Physiology by Wigglesworth.
- Fundamentals of Entomology byElzinga
- Hand book of economic Entomology for South India by Ayyar.
- Insect cytogenetics byR.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

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- III D (Optional)

Wild Life Conservation

Course objectives

It provide understanding and knowledge on modern concepts in wildlife management, also provide an insight into relevant conservation policies and legislation and their enforcement mechanism at Global and Local Level.

UNIT-I

- Wild life -Values of wild life - positive and negative.
- Our conservation ethics.
- Importance of conservation.
- Causes of depletion.
- World conservation strategies.
- Habitat analysis, Evaluation and management of wild life.
- Physical parameters - Topography, Geology, Soil and water.
- Biological Parameters - food, cover, forage, browse and cover estimation.
- Standard evaluation procedures - remote sensing and GIS.
- Management of habitats -
- Setting back succession.
- Theories behind Cave Adaptations of Animals
- Cave Organisms identified from Chhattisgarh and their notable troglomorphism
- Energy sources in caves
- Prey-predator relationship in the cave.
- .

UNIT-II

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

Cave biology:Define caves and their typical characteristics

- Origin of Biospeleology
- Classification of Cave Animals
- Trglomorphism
-

UNIT-III

- Eco tourism / wild life tourism in forests.
- Concept of climax persistence.

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

UNIT-IV

- 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.

Learning outcomes

Students will have a greater knowledge of how wildlife conservation and management relates to the economy and environment, both currently and in the future

Students will understand the factors affecting the need to find sustainable practices for production of food, feed and fiber crops and how to implement them.

- Students will be competent in basic forest management principles and evaluation of forest stands for health, wildlife habitat and lumber use.

Students will be able to identify soil types and how they are formed and ways to modify soil structure and drainage to reduce erosion and improve water quality.

- Students will understand how soil fertility is determined and means of improving soil fertility and adding nutrients for plant growth..
- Students will understand the general principles of ecology as how they related to terrestrial and/or aquatic plant and animal conservation and management.

Students will be able to identify species, characteristics, habitat requirements and life cycles of birds, fish and/or mammalian wildlife species.

- Students will be able to apply knowledge to solve problems related to wildlife conservation and management.
- Students will be able to critically evaluate current events and public information related to wildlife conservation and management as being scientifically-based or opinion-based and contribute to the knowledge base of information.
- Students will be able to work with others to coordinate activities that achieve group/team objectives.

- **Suggested Reading Materials** Gopal Rajesh : Fundamentals of wild life management
- Agrawal K.C : Wild life India
- Dwivedi A.P (2008) : Management wild lite 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
- Tim ari S.K : Wild life in Central India
- E.P Gee : Wild life of India

Negi S.S : Wild life conservation (Natraj Publishers

Suggested Reading Materials:

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

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- III E(Optional)
Biology of vertebrate immune system

Course Objective

In this course, the students will be introduced to the basic concepts of immunology as it relates to human and animal health.

UNIT-I

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

UNIT-II

- T-cell lineage and receptors
- T-cell activation

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

UNIT-III

- Generation of antibody diversity (Light and heavychain)
- Immunization
- Immediate type of hypersensitivity reaction of Anaphylectic type-1.
- Antibody dependent cytotoxic type II reaction.

. Complex mediated type III reaction

UNIT-IV

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

Learning Outcomes

At the end of the course the student will be able:

- to gain a deep knowledge about the features and mechanisms of innate and adaptive immune response;
- to describes the mechanisms involved in acute and chronic inflammation;
- to apply the acquired knowledge on the immune response to explain defense mechanisms against infectious agents .
- to apply the acquired knowledge on the immune response to explain the mechanisms involved in immune system alterations and to comprehend the function of vaccines and immunotherapy;

Immunology
Kuby, W.H. Froeman USA

Fundamental of Immunology
W. Paul,

Essential Immunology
I.M. Roitt, ELBs Edition

Immunology
Richard M. Hyde, Robert A. Patnode, A Wiley Medical Publications

M.Sc. Zoology Semester-IV (January - June, 2024)

Paper- III F (Optional)

Ornithology (Avian Biology)

Course objectives

Students will be exposed to the diversity of bird life on Earth and to the myriad ways birds are adapted to fly and survive in all reaches of the planet.

Unit – I

Introduction to Ornithology

- Evolution of Birds
- Biogeography; Micro & Macro-ecology;
- Bird taxonomy: Systematic position of bird.
- Avian Diversity and Classification
- Speciation & Affinities of birds

Unit – II

Morphology of birds

- Stream lined body,
- Scales and Feathers,
- Coloration in birds,
- Beak types.
- Wings and Bipedal Locomotion

Unit – III

Anatomy and modification in Birds

- Alimentary canal and its modifications - Beak, Gizzard, Crop, etc.
- Excretory system,
- Reproductive system,
- Skeleton and muscles,

Unit – IV

Physiology

- Respiration in birds
- Excretion and osmoregulation.
- Flight and muscles function
- Neuroendocrine control of flight,

Learning Out comes

- By the end of this course, students will:
- appreciate the diversity of birds of the world and understand how birds are classified;
- learn how birds evolved and are still evolving;
- recognize some of the ways that birds are physically adapted to fly, communicate, find food, and attract mates;
- understand the role of birds in the world and how they interact with humans.

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- IV A Optional
Pisciculture and Economic Importance of Fishes (Ichthyology)

Course objective The students will gain knowledge of fish culture and cultivable species , rotational and simultaneous culture. Sewage fed fisheries, culture air breathing fishes. The students will gain knowledge farm Management.

UNIT-I

- 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-II

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

UNIT-III

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

UNIT-IV

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

Learning outcomes

- Acquire knowledge on best culture practices
- Demonstrate the different breeding techniques;
- explain growth promoters and live feed significance
- Describe the various culture methods and water quality maintenance in shrimp farming
- Analyse feeding, disease diagnosis in fish culture an Analyse water quality parameters
- Discuss various method of culture of live feed organisms
- Examine and estimate primary productivity
- Apply knowledge to enhance production of breeding ponds and hatcheries d methods of treatment 5
- Apply the knowledge on harvesting, preservation and export through agencies

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 physiologyof fishes Vol. 1 & IX.
- Gunther Sterba C.N.H.-Freshwater fishes of theworld
- W. Lanham -The Fishes.
- G.V. Nikolsky -The ecology ofFishes,
- Borgstram -Fish as food Vol. I & II.
- Nilsson -Fish physiology -Recent Advances.
- P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
- Carl E. Bond -Biology of fishes.
- M. Jobling -Environmental Biology offishes.
- Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
- S.K. Gupta -Fish and Fisheries
- K.P. Vishwas -Fish and Fishries.
- Jhingaran -Fish and Fishries.

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- IV B (Optional)
Cellular and Molecular Organization

Course objective

- Students gain knowledge about structure and different forms of DNA in the biological systems and to understand Cell at Molecular level.

UNIT-I

- 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.
- Cyto chemistry of Golgi complex and its role in cell secretion.,

UNIT-II

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

UNIT-III

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

UNIT-IV

- Chromosomal abnormalities in human cancer.
- General idea of oncogenes and proto oncogenes.
- Oncogene and cancer.
- Transforming Agents.
- Tumor Suppressor genes.

Receptor — Ligand interaction and signal transduction. Cross — talk among various signaling pathways.

Learning Out comes. Students will develop basic knowledge and skills in cell and molecular biology and become aware of the complexity and harmony of the cell. As students proceed through the modules, they will be able to apply this knowledge, skill, and awareness to topics like the following

- The structure and function of the nucleus
- Genes and chromosomes
- DNA replication
- Transcription
- Translation
- Cytoskeleton and cell motility
- Cellular reproduction
- Cell signalling
- Cancer

Suggested Reading Materials:

- DeRobertis and De Robertis Cell and Molecular Biology. Lea and Febiger.
- We 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 garland publishing inc.
- P.K. Gupta. Molecular Cell Biology Rastogi Publication.
- Watson Gilman Witkowski, Zoller Recorndinant D.N.A. scientific American Books.
- Gerald Karp. Cell Biology.
- Lewin B. Genes VII.
- King Cell Biology.
- Baniel L. HArtl Elizabeth W. Jones. Genetics Principles and analysis . Jones and Bartlett Publisher.
- Lodish, Berk Zipursky, Matsudaira Baltimore Demell Molecular Cell Biology W.H.Freeman and company.
- /. Travers Immunology current Biology limited.
- Kubey Immunology W.H. Freeman and Company.
- Riott. Male snustad Principles of genetics jolui weley and sons Inc.

M. Sc. Zoology Semester-IV (January - June, 2024)

Paper- IV C(Optional)

Applied Entomology

Course Objective

To know about the identification of major insect pests of agricultural and urban sectors, their control methods and pesticide application equipment. To know about the importance of entomological cottage industries and other beneficial aspects of insects.

UNIT-I

Classification according to imms

- Classification of apterygota upto families.
- Classification of following insect orders

(a) orthoptera (b) hemiptera (c) diptera.

- Classification of following insect order

(a) hymenoptera (b) lepidoptera (c) coleoptera

- Collection and preservation of insects.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Learning outcomes

At the end of the course, the student has learned the basic knowledge of Applied Entomology.

The student is able to criticize conventional insect pest control and to know integrated pest management.

Information given to the students it permits to understand how to determine some insect and arthropod species.

A possible sustainable methods and techniques are preferably considered in respect of pest control. This is acquired due to knowledge of general entomology and studies on biological insect cycles, their natural enemies, plus the knowledge of the main insect pest species infesting our agro ecosystems and urban environments.

Suggested Reading Materials:

- The Insect: Structure and function by R.F. Chapman
- Comparative Insect physiology, Biochemistry and Pharmacology .Vol :1-13.
- Edited by G.A. Kerkut and L.I. Gilbert.
- Entomophagous Insect by Clausen
- Entomology bu 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

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- IV D (Optional)
Environment & Biodiversity Conservation

Course Objective

- Understanding the basics of science of biodiversity in an ecological context .
- Learning tools and techniques relevant to monitoring of biological diversity .
- Ability to design a field based project with rationale and appropriate methodology.

UNIT-I

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

UNIT- II

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

Unit- III

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

UNIT-IV

- Natural Resources:- Forest
- Use and over exploitation of forests.
- Timber extraction.
- Land
- Land degradation. Landslides.
- Soil-erosion and desertification. Water
- Use and over utilization of surface and ground water
- Floods. Drought dams- benefits and problems Mineral

Use and exploitation Environmental effect of extracting and using Mineral resources

Food

World food problem, Effects of modem agriculture and overgrazing Energy

- Conventional and nonconventional energy resources.
- Using of alternate energy sources
- Role of an individual in conservation of natural resources
- Equitable use of resources for sustainable life
- Biodiversity crisis — habitat degradation poaching of wild life.
- Socio economic and political causes of loss of biodiversity.
- In situ and ex situ conservation of biodiversity
- Value of biodiversity.
- Cave conservation

- Major threats to cave biodiversity
- Conservation measures for cave bats
- Tourism Versus Conservation

- **Learning Out comes**
- Students will be able to apply knowledge to solve problems related to wildlife conservation and management.
- Students will be able to critically evaluate current events and public information related to wildlife conservation and management as being scientifically-based or opinion-based and contribute to the knowledge base of information.
- Students will be able to work with others to coordinate activities that achieve group/team objectives. Upon successful completion, students will have the knowledge and skills to:
- Articulate why society strives to conserve biodiversity.
- Identify key threats to biodiversity.
- Evaluate which management options are likely to be effective for conserving biodiversity in different settings.
- Develop appropriate policy options for conserving biodiversity in different settings.
- Communicate informed critique or analysis of biodiversity conservation policy and practice across a range of mediums.

Suggested Reading Materials:

Paper III D & IV D

- Arora : Fundamentals of environmentalbiology
- Anathakrishnan : Bioresourcesecology
- Bottain : Environmental studies
- Bouhey : Ecology of 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
- Cave Science Insights from the Indian Subcontinent

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- IV E (Optional)
Molecular Endocrinology and Reproductive Technology

Course objectives

The multidisciplinary the diverse interests of the faculty make possible many approaches to the study of both endocrinology and reproduction.

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Learning outcomes

Students will gain detailed theoretical knowledge of reproductive and Endocrine biology while gaining experience of academic and transferable skills, as well as practical skills within a vibrant research environment.

They will focus on the basic sciences and their application to selected clinical aspects of the subject.

also will gain a valuable qualification and sound training for a further career in scientific research or in assisted reproduction.

It provided with an in-depth knowledge of molecular and cellular aspects of reproduction..

Suggested Reading Materials:

- Beiamin Lewim — Genes VI I/ V I I I. oxford University press.
- Lodish etal- Molecular Cell Biology .
- Zarro u , M.X., Yochin J.M. and Machrthy. J.L. — Experimental Endocrinology .
- Chatte•i i C.C.- Human Physiology (Vol- 11).
- 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.

M. Sc. Zoology Semester-IV (January - June, 2024)
Paper- IV F (Optional)

Avian Biology and Ecological Importance

Course objectives

A course on the ecology, evolution, physiology, behavior, and conservation of birds,

Unit – I: Behavior of birds.

- Flying pattern
- Nesting.
- Migration
- Parental care
- Flocking and Hunting party,

Unit – II:

- Foraging Behavior;
- Mating and Breeding Behavior
- Social Behavior;
- Vocal Behavior,
- Birds of prey.

Unit – III: Bird population

- Concepts of Bird Populations and Bird Communities.
- Mixed species flocks;
- Studying Bird Populations and Communities: Techniques
- Tools on bird watching.
- Bird counting methods – Line transect and Point count.

Unit – IV: Conservation and Economic Importance of birds

- Threats to bird population
- Rare species of birds
- Birds of Chhattisgarh
- Role of birds in ecosystem and agro-forest habitat
- Birds as an important Bio-indicator
- Avian Disease
- Basics of Research areas on Avifauna.
- Citizen Science in Ornithology eBirds.

Learning out comes

- By the end of this course, students will be able to:
- Identify species in the field and in the laboratory using prepared specimens.
- Conduct field inventories of birds and present scientific surveys. •
- Describe the general knowledge regarding the evolutionary history, taxonomy, ecology, behavior, and conservation of birds

M. Sc. ZOOLOGY — IV SEMESTER (January - June, 2024)
Lab course I

Paper I & II (Compulsary)

PAPER- I BIOCHEMSTRY

- Estimation of antioxidant enzymes.
- Estimation of amylase.
- Estimation of protein by Lowry method.
- Estimation of Oil in seeds.
- Estimation of Carbohydrate by anthrone reagent.
- Other exercise related to theory paper.

- Estimation of Protein by the Biuret, Lowry, Brad ford and Eosine-a comparasion
- Determination of N-terminal Amino acids by the Sangers reagent (FDND)
- Paper chromatographic separation of Amino acids
- Quantitative estimation of Protein, carbohydrate, Mucosaccharide, Lipids and Enzyme (Bromphenol blue, PAS, Alcian blue, aldehyde fucsin, Acetylcholinestrase technique)
- Identification of hypothalamic nuclei histological, hystochemical and Immunocytochemical method
- Isolation and characterization of Pituitary cell
- Estimation of MAC, MCH and MCHC
- Total count of WBC and RBC
- Differetial count of WBC
- Haemoglobin estimation and PCV estimation or ESR estimation
    - Quantitative estimation of blood serum by Colorimetry (I) Blood Urea (II) Blood glucose
- (III) Blood Calcium (IV) Blood Creatine (V) Blood cholesterol (VI) Blood Cholesterol
- (VI) Blood Protein (VII) Blood Albumin (m)Blood clotting time
- ECG Recording
- Blood Pressure estimation
- EEG

PAPER- II NEUROPHYSIOLOGY

- Study of slides of nervous system.
- Neck nerve of squirrel.
- Study of Brain through MODEL.
- Study of Cranial nerve of Bird, Amphibian, Reptile and Mammals.
- Other exercise related to theory paper.

SEMESTER-IV (January - June, 2024)

LAB COURSE-II

OPTIONAL (SPECIAL PAPER)

Paper III and IV

PAPER-III(A) FISH (ICHTHYOLOGY) STRCTURE AND FUNCTION

- 1. Anatomy of various organ systems and mounting of fish materials
- Cranial nerves of teleost fishes: *Wallago , Mystus, Labeo* and other fishes
- Osteology of fish: Scoliodon, carps, catfishes, murrels etc.
- Accessory respiratory organs of air breathing fish
- Study of histological (permanent) slides
- Study of museum specimens of the concerned group
- Other exercise related to theory paper.

PAPER —IV(A) PISCI CULTURE AND ECONOMIC IMPORTANCE OF FISH (ICTHYOLOGY)

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

PAPER —III(B) CELL BIOLOGY

- Study of mitosis from onion root tip.
- Study of meiosis in grasshopper testis.
- Study of polytene chromosome in Dipteran Larvae.
- Demonstration of Barr-Body in Human Cheeck cell.
- Estimation of DNA.
- Estimation of RNA.
- Other exercise related to theory paper.

PAPER-IV(B) CELLULAR ORGANIZATION AND MOLECULAR ORGANIZATION

- Histochemical demonstration of Mitochondria
- Histochemical demonstration of Golgi complex
- Histochemical demonstration of Lactate dehydrogenase
- Histochemical demonstration of Succinate dehydrogenase
- Isolation and characterization of Nuclei from liver
- Isolation and characterization of Mitochondria
- Isolation of DNA from any tissue
- Separation of lipids using thin layer chromatography
- Separation of various proteins using column chromatography
- Study of metaphase chromosomes from rat bone marrow

- G banding of metaphase chromosomes
- C- banding of metaphase chromosomes
- Estimation of Mitotic Index
- Measurement of cell size using oculometer.
- Other exercise related to theory paper

PAPER —III(C) ENTOMOLOGY

- Anatomy of common grasshopper, cockroach, honey bee, wasp
- Dissection and mounting of:
- Sting apparatus of honey bee and wasp.
- Tympanal organs of grasshoppers.
- Testes of cockroach
- Aristae of house fly.
- Different types of mouthparts of insects.
- Different types of wings and antennae of insects.
- Tentorium of grasshopper.
- Identification and comment on insects of different orders and families.
- Identification with the help of keys of common insects from different orders and families.
- Other exercise related to theory paper.

PAPER- IV(C) APPLIED ENTOMOLOGY

- Insect collection and preservation for systematic studies
- Identification of different insects upto orders
- Identification of insects upto families of economically important insect orders
- Identification of insects upto species: Mosquitoes, honeybees, stored grain beetles, aquaticinsects, important crop and household pests
- Analysis of honey and its quality control
- Field studies of insects to understand their habit, habitat environmental impact, beneficial and harmful activities etc.
- Study of beneficial insects, benefits derived from them and useful products
- Study of destructive insects, damage caused by them and damaged products
- Study of insecticidal formulations and insect control appliances
- 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 1 1.Other exercise related to theory paper

PAPER-III(D) WILD LIFE CONSERVATION

- Visit to an area to document environmental assets including natural resources/flora/fauna, etc. . Identification and study of common insects, fish, birds, mammals of a particular area.
- To determine the physical conditions of water: Depth, Viscosity, Density, Buoyancy.
- To determine the chemical conditions of water: pH, dissolved oxygen and carbon-di-oxide, hardness etc.
- To determine Cl, SO4, NO3 in soil and water samples from different locations.
- To study acidity and alkalinity of sample water by methyl orange and phenolphthalein
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural).

PAPER-(IVD) Environmemt and BioDiversity conservation

- There are no structured class lab experiments involved. However the students are expected to visit various sites on the web, make teams for group-discussion indulge in debates, collect justifiable information from various sources, make historical report on the following major global environmental issues :
- 1Atmosphere Management: Pollution, global warming/climate change, Stratospheric ozone depletion its impact and possible solutions
- Fresh water Management: Pollution, reasons, severity of problem, impact for the present and the future, its impact and possible solutions
- Marine Ecosystem: Pollution of marine ecosystem, its impact and possible solutions
- Soil degradation and Desertification
- Solid Waste Management
- Human health and Toxicology

PAPER-(VE)Biology of Vertebrate Immune System

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

PAPER-(VIE)Molecular Endocrinology and Reproductive Technology

- Dissection and demonstration of Endocrine glands in laboratory bred rat*.
- Study of the permanent slides of all the endocrine glands.
- Compensatory ovarian/ adrenal hypertrophy in vivo bioassay in laboratory bred rat*.
- Demonstration of Castration/ ovariectomy in laboratory bred rat*.
- Estimation of plasma level of any hormone using ELISA.
- Designing of primers of any hormone.
- Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems;
- Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
- Sperm count and sperm motility in rat

Paper III (F) Ornithology (Avian Biology)

- Systematic identification of birds with particular reference to C.G.
- Anatomy of various organ systems and mounting of Cranial nerves of fowl
- Osteology of fowl
- Study of histological slides (Permanent).
- Microtomy of fish materials
- Study of museum specimen of Birds/Digital Specimen.
- Collection of various bird species (Digital).
- Other exercise related to theory paper

Note: (Birds materials should be collected from local chicken market)

Paper – IV (F) Avian Biology and Ecological Importance

- Identify and classify the local bird species and submit report to the department.
- Count bird species in campuses using point count and line transect method.
- Count bird species in your own house and backyard using line transect and point count method.
- Calculate the Shannon-Weiner index for Bird diversity in Campus and local habitat.
- Study of bird diseases.
- Study of adaptive characteristics of birds.
- Identify the problems of bird population in local area.
- Identify the issues and challenges in bird conservation at local habitat.
- Other exercise related to theory paper