CRITERIA 1.1.3

Different UG And PG Programme, Sample of Courses With Highlight On Ethics / Gender / Human Values / Environment And Sustainability Aspects Is Presented.

Programme: M.SC ZOOLOGY

1. ETHICS
2. GENDER
3. HUMAN VALUES
4. ENVIRONMENT AND SUSTAINIBILITY

SYLLABUS FOR B.Sc. ZOOLOGY HONS.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

DEPARTMENT OF ZOOLOGY

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

Head
Department of Zoology
Netaji Subhas University

Dean Academics
Netaji Subhas University
Jamshedpur, Jharkhand

NETAJI SUBHAS UNIVERSITY

DEPARTMENT OF ZOOLOGY

VISION:

The department promotes the discovery and broad knowledge about the biology of animals, evolution and their environments. The holistic development of the student and make them able to contribute effectively for their welfare and society in this dynamic era.

Understand the concepts and principles of biochemistry, immunology, physiology, etiology, endocrinology, developmental biology, cell biology, genetics, and molecular biology and microbiology and develop technical skills in biotechnology, bioinformatics and biostatistics.

MISSION:

Our mission is to offer high quality education dedicated to building minds with social and moral responsibility. We are committed to educating the students beyond the confine class room to make them better individuals and develop their personalities, enabling them to face the challenges of the modern world.

- To motivate the students for their fruitful life.
- To develop the broad knowledge about the biology of animals.
- To impart entrepreneurial skills through application-oriented subjects.
- To provide the best education for students to achieve their goals.
- To promote research and learning.
- To create awareness about health-related problems by curriculum

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M.sc Zoology

Professional ethics (PE), gender (GE), human values (HV), environment and sustainability (ES)

Course Code	Name of Course	PE	G	HV	ES
First Semester					
101	Animal Systematic			✓	✓
102	Biology of non-chordates			✓	✓
103	Molecular Biology	✓			
104	Bioinstrumentation	✓			✓
Second Semester					
201	Molecular Genetics			✓	✓
202	Human Physiology			✓	✓
203	Biology of Chordates			✓	✓
204	Developmental Biology			✓	✓
Third Semester					
301	Biomolecules and Structural Biology				✓
302	Quantitative Biology, Biodiversity and Wild life				✓
ELC 1	Aquatic Biology/ Computer application	✓		✓	✓
ELC 2	Limnology/Ecotoxicology	✓		✓	✓
Fourth Semester					
Group A					
401	Evolutionary Biology	✓			✓
402	Endocrinology	✓			✓
ELC 3	Applied Zoology/ Ichthyology				✓
ELC 4	Entomology/ Immune System	✓			✓

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The Programme Educational outcomes are as follows:

POE1	Students gain knowledge and skill in the fundamentals of Zoology, understands the complex interactions among various living organisms.
POE2	Analyze complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.
POE3	Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
POE4	Able to communicate the concepts, constructs and techniques involved in with ease and in a clear manner based on the animal evolution, animal behaviour, animal development and animal ecology topics.
POE5	Understand the environmental conservation processes and its importance, pollution control, protection of endangered species, Wildlife Management, Climatic changes and Global Management are discussed as a paper to improvise the subject knowledge for identifying any problems related and in helping the impacted environment and biodiversity.
POE6	Helps advancement in job, trades, and employment with the help of knowledge about of Agro-based Small Scale industries like sericulture, fish farming, butterfly farming and vermicompost preparation and helps create various opportunities in the educational, research and developmental, social entrepreneurial sectors related to the same.
POE7	Correlates the physiological processes of animals and relationship of organ systems. Techniques and Methodologies discussed in the vital topics like Cell Biology, Genetics, Molecular Biology manifest the knowledge in research specific areas.
POE8	Exhibit Skills in areas related to their individual specialization like genetic engineering, in relation to current developments and related fields in the domain; helps to apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
POE9	Apply ethical principles and commit to professional ethics and responsibilities in delivering his duties.
POE10	Apply Zoology discipline helps in adding Benefit by provisioning in-depth information regarding the socio-economic, bio-economic and economical branches to use the underlying concepts and core knowledge in enabling the industrial, social and environment benefits;

Programme specific outcomes are as follows :

PSO1	To understand the basic knowledge of the Zoology concepts and principles, various studies related to the Zoology and other biological sciences.
PSO2	Understand the concepts and principles of biochemistry, immunology, physiology, ethology, endocrinology, developmental biology, cell biology, genetics, molecular biology and microbiology and develop technical skills in biotechnology, bioinformatics and biostatistics.
PSO3	Understand the underlying concepts involved and become more aware of the current environmental issues having global impact.
PSO4	Participateinthescienceprogrammesandeffectivelybeabletoshowcasethe observational and appropriate skills required based on their understanding.
PSO5	Show the competence required for the non-major science subjects included and able to correlate the knowledge for various educational and industrial benefits.

SEMESTER-I

Code	Theory/Practical	Credit	Examination Scheme		
			External	Internal	Total
101	Animal Systematics	4	70	30	100
102	Biology of non-chordates	4	70	30	100
103	Molecular Biology	4	70	30	100
104	Bioinstrumentation	4	70	30	100
Practical -1	Practical (Based on Theory Paper 101 &102)	4	75	25	100
Practical -2	Practical (Based on Theory Paper 103 &104	4	75	25	100
		24			**600**

SEMESTER -II

Code	Theory/Practical	Credit	Examination Scheme		
			External	Internal	Total
201	Molecular Genetics	4	70	30	100
202	Human Physiology	4	70	30	100
203	Biology of Chordates	4	70	30	100
204	Developmental Biology	4	70	30	100
Practical -3	Practical (Based on Theory Paper 201 &202)	4	75	25	100
Practical -4	Practical (Based on Theory Paper 203 &204	4	75	25	100
		24			**600**

SEMESTER –III

Code	Theory/Practical	Credit	Examination Scheme		
			External	Internal	Total
301	Biomolecules and Structural Biology	4	70	30	100
302	Quantitative Biology, Biodiversity and Wild life	4	70	30	100
Elective -1	Aquatic Biology OR Computer Application	4	70	30	100
Elective -2	Limnology OR Eco- Toxicology	4	70	30	100
Practical -5	Practical (Based on Theory Paper 301 &302)	4	75	25	100
Practical -6	Practical (Based on Elective -1 &2)	4	75	25	100
		24			**600**

SEMESTER –IV

Code	Theory/Practical	Credit	Examination Scheme		
			External	Internal	Total
401	Evolutionary Biology	4	70	30	100
402	Endocrinology	4	70	30	100
Elective -3	Applied Zoology OR Icthyology	4	70	30	100
Elective -4	Entomology OR Immune System	4	70	30	100
Practical -5	Practical (Based on Theory Paper 401 & 402)	4	75	25	100
Practical -6	Practical (Based on Elective -3 &4)	4	75	25	100
		24			**600**

Semester I

101: ANIMAL SYSTEMATICS

The course objectives of *Animal Systematics* typically include:

1. **Understanding Systematics and Taxonomy** – Explain the principles of systematics, taxonomy, and classification of animals.
2. **Classification and Nomenclature** – Learn taxonomic hierarchy, binomial nomenclature, and rules of classification.
3. **Phylogenetic Relationships** – Understand evolutionary relationships and the construction of phylogenetic trees.
4. **Morphological and Molecular Approaches** – Explore traditional and modern methods used in systematics, including morphological, anatomical, and molecular techniques.
5. **Biodiversity and Conservation** – Assess species diversity, distribution, and their significance in conservation biology.

Unit -I:

Introduction to science of taxonomy, Principles of taxonomy, History of biological classification.

Unit -II:

Theories of biological classification. Hierarchy of categories and higher taxa.

Unit -III:

(a) Taxonomic procedures: taxonomic collections, preservation, enrating, cataloging and identification.

(b) Taxonomic characters; procedure of classification.

(c) International Code of Zoological Nomenclature (ICZN); Interpretation of Rules of Nomenclature (in Brief).

Unit-IV:

(a) General characters and classification of invertebrate phyla (Protozoa to Echinodermata)

(b) General characters and classification of Minor phyla

Unit–V

(a) General characters and classification of Protochordata

(b) General characters and classification of Chordata

References:

1. Ernest Mayr. 1997. Principles of systematic Zoology. Tata-McGraw-Hill, New Delhi.428 pp.

2. Simpson, G.G.1961. Principles of animal Taxonomy.Columbia University Press, New York.247 pp.

3. Barnes, R.D.1968. Invertebrate Zoology.IIEd. Saunders, Philadelphia.

4. Barrington, E.J.W.1967. Invertebrate Structure and Function, Nelson, London.

The **Course Outcomes** of *Animal Systematics* typically include:

CO1.Knowledge of Taxonomic Principles – Demonstrate an understanding of the principles, rules, and importance of taxonomy in classifying animals.

CO2.Identification of Animal Groups – Accurately classify and differentiate between major animal taxa based on morphological and molecular characteristics.

CO3.Understanding Phylogenetic Relationships – Analyze evolutionary relationships among animal species using phylogenetic trees and cladistics.

CO4.Application of Taxonomic Tools – Utilize taxonomic keys, dichotomous keys, and molecular techniques for species identification.

CO5.Appreciation of Biodiversity and Conservation – Evaluate the significance of biodiversity and conservation efforts through systematic studies.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	0	2	2	3	0	1	0
CO2	3	1	1	2	0	3	1	2	3	1
CO3	2	3	1	1	3	0	2	1	3	2
CO4	1	1	2	1	1	1	1	3	2	3
CO5	1	2	1	1	3	2	1	1	1	1
	1.8	1.8	1.6	1	1.8	1.6	1.6	1.4	2	1.4

102 - BIOLOGY OF NON-CHORDATES

The **Course Objectives** of *Non-Chordates* typically include:

1. **Understanding Non-Chordate Diversity** – Explore the classification, characteristics, and diversity of non-chordate animals.
2. **Taxonomic Classification** – Learn the hierarchical classification, distinguishing features, and evolutionary significance of different non-chordate phyla.
3. **Morphology and Anatomy** – Study the structural organization, including external and internal anatomy, of representative non-chordate organisms.
4. **Physiological Processes** – Understand vital physiological processes such as digestion, respiration, circulation, excretion, and reproduction in non-chordates.
5. **Development and Life Cycles** – Analyze the developmental stages, reproductive strategies, and life cycles of non-chordate species.

Unit-I:

Locomotion: Principles of hydrostatic movements, Amoeboid and flagellar movements and Locomotion in Arthropods

Unit-II:

a) Nutrition and Digestion: Food and feeding habits of non-chordates, Filter feeding in Mollusca and Echinodermata, Symbiotic nutrition.

b) Respiration and Excretion: Organs of respiration; Gills, trachea and Lungs, Respiratory pigments, Mechanisms of respiration, Organs of excretion- Coelomoducts, Nephridia, malphigian tubules, Coxal Glands and mechanism of excretion.

Unit-III:

Nervous system: Primitive nervous system: Coelenterate and Echinodermata, Advanced nervous system: Annelida, Arthropod (Crustacea and Insecta)

Unit-IV:

Reproduction: Patterns of reproduction in invertebrates, larval forms of free living, larval forms of parasites

Unit-V:

Minor Phyla: General characters and affinities of Chaetognatha, Ctenophore, Phoronida and Pogonophora.

References:

1. Barrington. E J W. 1967.Invertebrate structure and function, Nelson, London.

2. Barnes, R. D 1968. Invertebrate Zoology, 2nd Ed. Saunders, Philadelphia.

3. Hyman L H. 1940-67. The Invertebrates, Vol. I-VI. McGraw-Hill, New York.

4. Russell-hunter. W D. 1968.Biology of lower invertebrates, Macmillan Company, New York.

5. Marshall, A.J and Williams, W D (Eds). 1995. Text book of Zoology-Invertebrates. VII Ed., Vol. I, A.L.T.B.S. Publishers.

The **Course Outcomes** of *Biology of Non-Chordates* include:

CO1.Understanding Non-Chordate Diversity – Demonstrate knowledge of the classification, structural organization, and characteristics of different non-chordate phyla.

CO2.Taxonomic Identification – Accurately classify and differentiate non-chordate groups using taxonomic keys and diagnostic features.

CO3.Morphological and Anatomical Analysis – Describe and compare the external and internal anatomy of representative non-chordates.

CO4.Understanding Physiological Processes – Explain key physiological functions such as digestion, respiration, circulation, excretion, and reproduction in non-chordate organisms.

CO5.Comprehending Life Cycles and Development – Analyze the reproductive strategies, larval forms, and life cycles of various non-chordates.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	0	2	2	3	0	1	0
CO2	3	1	1	2	0	3	1	2	3	1
CO3	2	3	1	1	3	0	2	1	3	2
CO4	1	1	2	1	1	1	1	3	2	3
CO5	1	2	1	1	3	2	1	1	1	1
	1.8	1.8	1.6	1	1.8	1.6	1.6	1.4	2	1.4

103 - MOLECULAR CELL BIOLOGY

The **Course Outcomes** of *Biology of Non-Chordates* typically include:

1. **Understanding Non-Chordate Diversity** – Demonstrate knowledge of the classification, structural organization, and characteristics of different non-chordate phyla.
2. **Taxonomic Identification** – Accurately classify and differentiate non-chordate groups using taxonomic keys and diagnostic features.
3. **Morphological and Anatomical Analysis** – Describe and compare the external and internal anatomy of representative non-chordates.
4. **Understanding Physiological Processes** – Explain key physiological functions such as digestion, respiration, circulation, excretion, and reproduction in non-chordate organisms.
5. **Comprehending Life Cycles and Development** – Analyze the reproductive strategies, larval forms, and life cycles of various non-chordates.

Unit-I : Introduction to molecular cell biology: Levels of organization. Cell as a morphologic and functional unit within organisms. The central dogma of molecular biology. The scope of modern cell biology.

Unit-II: Biochemistry of cell: Chemical components of the cell-

(a) Water, salts, ions and their properties,

(b) Proteins - primary, secondary and tertiary structures.

(c) Carbohydrates - Complex polysaccharides and glycoproteins,

(d) Lipids - triglycerides and compound lipids and

(e) Nucleic acid - A pentose, Phosphate and four Bases. Nucleotides, double helix formation. Structure of RNA, Nucleosome.

Unit –III: Bio-membranes: Molecular organization. Transport across cell membrane. Cell to cell communication and recognition. Modifications of membranes: Gap junctions and tight junctions, Membrane receptors, ion channels, gated channels.

Unit-IV: Molecular organization and functions of membrane organelles: endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, mitochondria and chloroplast. Molecular organization and function of cytoskeletal structures: Microfilaments, microtubules, cilia and flagella.

Unit –V: Structure of Gene. Gene transcription. Post-transcriptional processing of RNA. Reverse transcription. Introns and exons, RNA Interference. Cell cycle: Molecular events during different stages of cell cycle - regulation of cell cycle.

References:

1. Alberts,B., Bray Dennis, Lewis Julian, Raff Martin, Roberts.K and Watson, J.D. Molecular Biology of the Cell. Garland Publishing Inc. New York, 1994.

2. Bruce Alberts, Essential Cell Biology.

3. Cellis, J.E. Cell Biology: a Laboratory Handbook Vol. I and II. Academic Press, 1998.

4. Lodish, H., Berk,A., Zipuosky, L.S., Matsudaira, P., Baltimore,D& Darnell, J. Molecular Cell Biology IV Ed. W.H. Freeman & Co. 2001.

The **Course Outcomes** of *Molecular Biology* typically include:

CO1.Understanding Genetic Material – Demonstrate knowledge of the structure, function, and replication of DNA and RNA.

CO2.Comprehension of Gene Expression – Explain the mechanisms of transcription, translation, and gene regulation in prokaryotic and eukaryotic systems.

CO3.Application of Molecular Techniques – Gain proficiency in molecular biology techniques such as PCR, gel electrophoresis, cloning, and sequencing.

CO4.Analysis of DNA Repair and Mutations – Understand DNA repair mechanisms, mutations, and their implications in genetic diseases.

CO5.Understanding Protein Synthesis and Regulation – Describe the process of protein synthesis, post-translational modifications, and their significance.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	0	2	2	3	0	1	0
CO2	3	1	1	2	0	3	1	2	3	1
CO3	2	3	1	1	3	0	2	0	0	2
CO4	1	1	2	1	1	1	1	3	2	3
CO5	1	2	0	0	3	2	1	1	0	1
	1.8	1.8	1.6	1	1.8	1.6	1.6	1.4	2	1.4

104- BIOINSTRUMENTATION

The **Course Objectives** of *Biostatistics* typically include:

1. **Understanding Basic Statistical Concepts** – Introduce fundamental principles of biostatistics and their applications in biological and health sciences.
2. **Data Collection and Organization** – Learn methods for collecting, organizing, and summarizing biological data.
3. **Descriptive and Inferential Statistics** – Understand measures of central tendency, dispersion, probability distributions, hypothesis testing, and confidence intervals.
4. **Probability and Distributions** – Explain probability concepts and common statistical distributions such as normal, binomial, and Poisson distributions.
5. **Statistical Testing and Hypothesis Analysis** – Apply statistical tests (t-tests, chi-square tests, ANOVA, regression analysis) to analyze biological data.

Unit-I:

Microscopy: Light, phase contrast, dark - field fluorescence. Electron microscopy - transmission and scanning.Histological and histochemical staining techniques.

Unit-II:

Separation techniques and instrumentation: Paper Chromatography. Thin layer Chromatography, Ion exchange chromatography, Gel filtration chromatography, HPLC and Gas chromatography.

Unit-III:

Separation techniques and instrumentation: Electrophoresis and electrofocusing, SDS-PAGE, 2-D Gel Electrophoresis; Centrifugation- types and functions.

Unit-IV:

Spectroscopy: UV-Visible spectroscopy, Infrared spectroscopy, NMR spectroscopy, Flow cytometry and FISH.

Unit-V:

Radioisotopes and tracer techniques: Definition, properties of radioisotopes. Units of measurement of radioactivity. Autoradiography and its utility. Radioimmunoassay, radiometric enzyme assays. Liquid scintillation counters.

References:

1. Robert Brown. Introduction to instrumental analysis. McGraw Hill International Editions.
2. Wilson, K &Goulding, K.H. A Biologists Guide to Principles and Techniques of Practical Biochemistry.

The **Course Outcomes** of *Biostatistics* typically include:

1. **Understanding Statistical Principles** – Demonstrate knowledge of basic biostatistical concepts and their applications in biological and health sciences.
2. **Data Collection and Summarization** – Apply appropriate methods for collecting, organizing, and summarizing biological data.
3. **Descriptive and Inferential Analysis** – Use statistical measures such as mean, median, standard deviation, and probability distributions to interpret biological data.
4. **Statistical Testing and Hypothesis Evaluation** – Conduct hypothesis testing using t-tests, chi-square tests, ANOVA, and regression analysis.
5. **Correlation and Regression Interpretation** – Analyze relationships between biological variables using correlation and regression techniques.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	2	1	1	1	1	0	2	2
CO2	1	2	1	1	1	1	2	1	1	1
CO3	0	2	1	2	2	2	2	0	0	2
CO4	1	1	3	1	0	2	1	2	2	1
CO5	1	1	0	3	2	1	0	3	1	1
AVR	1.4	1.4	1.4	1.6	1.2	1.4	1.2	1.4	1.4	1.4

Practical of 102 & 103

1. Study of locomotory organs of Amoeba/Paramecium/Ant/Spider
2. Dissect and display the Digestive / Nervous system of Cockroach.
3. Food, feeding habits and mouth parts of Mosquito/ Housefly/Honeybee/Butterfly/Bed bug.
4. Study of life cycle in Harmful and useful insects. Harmful insects (Termite/Housefly/Wasps) Useful insects (Honeybee/Silk moth/Lac insect)
5. Identification and classification up to orders with reasons of the animal species belonging from Phylum Protozoa to Class Mammalia.
6. Animal species exhibiting phylogenetic inter-relationships: Peripatus: (Annelida-Arthropoda) Balanoglossus: (Protochordates- chordate) Archeopteryx: (Reptiles-Aves).

Practical of 103 &104

1. Study of Mitosis in onion root tips.
2. Study of Simple, Compound and Binocular Microscope.
3. Preparation of stains and fixatives.
4. Study of prokaryotic cell and its characteristics.
5. Comparison of Light and Electron microscope.
6. Separation of plant pigments using Paper chromatography.
7. Separation of Amino acids using Paper chromatography.
8. Separation of Amino acids using thin layer chromatography.
9. Caring and Handling of Laboratory instruments
10. To check the purity of DNA using UV-Visible spectroscopy
11. To check the purity of Protein using UV-Visible spectroscopy
12. To check the purity of RNA using UV-Visible spectroscopy

201- MOLECULAR GENETICS

Course Objectives of Molecular Genetics:

1. **Understanding Genetic Material** – Explain the molecular structure, function, and properties of DNA and RNA.
2. **Gene Expression and Regulation** – Study the mechanisms of transcription, translation, and gene regulation in prokaryotic and eukaryotic organisms.
3. **DNA Replication, Repair, and Mutations** – Explore the molecular mechanisms of DNA replication, repair pathways, and mutations.
4. **Genetic Variation and Inheritance** – Understand the molecular basis of genetic variation, recombination, and Mendelian and non-Mendelian inheritance.
5. **Genomics and Functional Genetics** – Introduce genome organization, sequencing techniques, and functional genomics approaches.
6. **Techniques in Molecular Genetics** – Learn laboratory techniques such as PCR, gel electrophoresis, DNA sequencing, CRISPR, and recombinant DNA technology.

Unit-I:

History and scope of molecular genetics.Identification of DNA as genetic material.Properties, storage and transmission of genetic information.Overview of Mendalism and deviations.

Unit-II:

DNA Replication: Semi conservative model of DNA. DNA polymerases and ligases.Events in replication fork.Discontinuousreplication.Leadingstrand.Circular DNA and its replication.

Unit-III:

Transcription: Prokaryotic transcription. RNA polymerases. Transcription signals. Classes of RNA molecules-messenger, ribosomal and transfer. RNA modification: RNA- 5-cap formation, 3-end processing, polyadenylation, splicing, editing.

Unit-IV:

Translation: The genetic code. Structure of t- RNA.Translation in prokaryotes.The Wobble hypothesis. Gene Regulation: Operon model.Lac Operon and Tryptophan Operon.Auto regulation and feedback initiation.

Unit-V:

Mutation: Types of mutations. Biochemical bases of mutations. Mutagenesis-base analogue mutation, ultraviolet irradiation, intercalating substances and transposable elements.

References:

1. Atherly.A.G. Girten,J.R and Mcdonald, J.F. The Science of Genetics. Saunders College, 1999.
2. Gardner, E.J., Simmons, M.J and Snustad, D.P. Genetics IIIEd. John Willy & Sons, New York, 1990.
3. Stickberger, N.W. Genetics. MacMillan Publishing Co. New York, 1985.
4. Watson, J.D et al., Recombinant DNA. W.H.Freeman& Co, 1992.
5. Trevor,B.B and Julian Burke. Gene structure and transcription. Oxford Univ Press, 1998.
6. Benjamin Lewin. Genes Vols I-IV. Oxford Univ Press, 1995.

Course Outcomes of Molecular Genetics:

1. **Knowledge of Molecular Genetic Principles** – Demonstrate a deep understanding of DNA, RNA, and gene function at the molecular level.
2. **Application of Genetic Techniques** – Utilize molecular techniques such as PCR, sequencing, and CRISPR for genetic analysis.
3. **Understanding of Gene Regulation** – Explain how genes are regulated in different organisms and how this impacts development and disease.
4. **Analysis of DNA Replication and Repair** – Identify mechanisms of DNA replication, repair, and mutation and their role in genome stability.
5. **Interpretation of Genetic Variations** – Analyze genetic mutations, recombination, and their role in inheritance and evolution.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	0	2	2	3	0	1	0
CO2	1	2	1	2	0	3	1	2	3	1
CO3	2	3	0	1	3	0	2	1	0	2
CO4	1	1	2	1	1	1	1	3	2	3
CO5	1	2	1	1	1	2	1	1	1	1
	1.6	2.0	1.5	1	1.4	1.6	1.6	1.4	1.4	1.4

202- HUMAN PHYSIOLOGY

Course Objectives of Human Physiology:

1. **Understanding Basic Physiological Principles** – Explain the fundamental principles governing human body functions at the cellular, tissue, organ, and system levels.
2. **Homeostasis and Body Regulation** – Understand the mechanisms of homeostasis and how different organ systems work together to maintain internal stability.
3. **Study of Organ Systems** – Explore the structure and function of major physiological systems, including the nervous, cardiovascular, respiratory, digestive, endocrine, and renal systems.
4. **Neurophysiology and Sensory Mechanisms** – Examine the functioning of the nervous system, nerve conduction, reflexes, and sensory perception.
5. **Cardiovascular and Respiratory Functions** – Analyze the mechanisms of blood circulation, heart function, gas exchange, and regulation of breathing.

Unit- I:

Introduction to physiology: Cell and general physiology. Functional organization of human body. Internal environment and homeostasis. Cell and its function.

Unit-II:

Blood circulation: Arteries, veins and capillaries. Blood flow and blood pressure. Regulation of blood circulation. Composition of blood, blood groups, blood transfusion and artificial blood.

Unit-III:

Membrane physiology: Molecular organization of membrane; transport across membrane. Anatomy and physiology of cardiac muscles.ECG, myocardial infarction and cardiac arrest. Physiology of digestion and absorption: Nutrition and balanced diet and vitamins. Malnutrition, over-nutrition and obesity.

Unit-IV:

Respiratory organs and physiology of respiration: Transport of gases in high altitude and diving physiology. Regulation of respiration. Respiratory distress and asthma. The kidneys: Physiology of excretion. Urine formation. Micturition and diuretics. Renal failure and dialysis.

Unit-V General organization of the nervous system: peripheral and central nervous system. Structure of neuron and conduction of nerve impulse,Sensory and motor systems.Hormonestypes and their physiological actions.

References:

1. Text book of medical physiology: Guyton AC and Hall JE, Xth edition Saunders , Philadelphia, 2004.
2. Concise medical physiology: Chaudhuri SK, 4th edition, Central Book Agency, 2002, Kolkata.
3. Biological sciences: Taylor DJ, Green, NPO and Stout GW edited by Soper R, Cambridge University Press, 3rd edition 1997, Cambridge UK.
4. Animal physiology: Schmidt-Nielson K, 5th edition, Cambridge University Press, Cambridge UK.

Course Outcomes of Human Physiology:

CO1.Understanding Human Body Functions – Demonstrate knowledge of the physiological mechanisms governing different organ systems.

CO2.Homeostasis and System Integration – Explain how various physiological systems interact to maintain homeostasis and overall body function.

CO3. Neurophysiology and Sensory Functions – Describe the working of the nervous system, reflexes, and sensory organs.

CO4.Cardiovascular and Respiratory Physiology – Analyze heart function, blood circulation, and gas exchange mechanisms.

CO5.Digestive and Metabolic Processes – Understand nutrient absorption, metabolism, and energy production in the human body.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	3	1	0	1	0	2	2
CO2	3	3	3	1	0	2	2	2	2	2
CO3	1	1	2	3	2	1	2	1	1	1
CO4	1	1	1	2	1	2	1	2	1	1
CO5	2	1	0	1	2	1	0	3	1	1
AVR	2	1.6	1.4	2	1.2	1.2	1.2	1.6	1.4	1.4

203- BIOLOGY OF CHORDATES

Course Objectives of Biology of Chordates:

1. **Understanding Chordate Diversity** – Explore the classification, characteristics, and evolutionary relationships of chordates.
2. **Taxonomic Classification** – Learn the hierarchical classification and distinguishing features of major chordate groups, including Protochordates, Fishes, Amphibians, Reptiles, Birds, and Mammals.
3. **Morphology and Anatomy** – Study the structural organization of chordates, including their skeletal, muscular, nervous, circulatory, respiratory, and reproductive systems.
4. **Comparative Physiology** – Understand physiological adaptations and functional similarities/differences among chordate groups.
5. **Evolutionary Relationships** – Analyze the evolutionary trends, origin, and adaptive radiation of different chordate groups.

Unit-I:

Origin and systematic position: Origin of chordate in the light of recent theories, Protochordata: Life cycles of Doliolium and Amphioxus, Significance of retrogressive metamorphosis

Unit-II:

Origin and evolution of vertebrate groups: Agnatha, Placoderms and Chondrichthyes.Osteichthyes: Lateral line system, Migration in fishes

Unit-III:

Amphibian: Origin and evolution, Breeding behavior and parental care of living Amphibia, Neoteny, Adaptive radiation

Unit-IV:

Reptilia: Origin and Evolution of temporal arcades and fossae, extinct reptiles, Adaptive radiation in living reptiles, Poisonous and non-poisonous snakes in India.

Unit-V:

Aves: Aerial adaptations and mechanism of flight, behavior, migration and Aquatic Birds. Mammalia: Origin and evolution of mammals. Adaptive radiation in Marsupials.Aquatic mammals.

References:

1. Marshall, A.J and Williams. W.D (Ed). Textbook of Zoology: Vertebrates-VII Ed. Vol. II. AITBS Publishers and distributors, 1995.
2. Young, J.Z. The Life of Vertebrates, III rd Ed Clarendon Press Oxford, 1981.
3. William N McFarland, F and Harvey PoughTom.J.C and Heiser, J.B. Vertebrate Life. CollierMacmillan Publishers, London, 1979.
4. Romer, W.B. The Vertebrate Body. Saunders, Philadelphia, 1956.

Course Outcomes of Biology of Chordates:

CO1.Understanding Chordate Classification – Demonstrate knowledge of the classification, characteristics, and evolutionary relationships of chordates.

CO2.Comparative Anatomy and Physiology – Describe and compare the anatomical structures and physiological functions of different chordate groups.

CO3.Evolutionary Adaptations – Analyse the evolutionary trends, adaptations, and transitions from primitive to advanced chordates.

CO4.Life Cycles and Development – Explain the reproductive strategies, embryonic development, and metamorphosis in chordates.

CO5.Ecological Roles and Behaviour – Evaluate the ecological significance and behavioural adaptations of chordates in various habitats.

CO PO MAPPING MATIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	3	1	0	1	0	2	2
CO2	3	3	3	1	0	2	2	2	2	2
CO3	1	1	2	3	2	1	2	1	1	1
CO4	1	1	1	2	1	2	1	2	1	1
CO5	2	1	0	1	2	1	0	3	1	1
AVR	2	1.6	1.4	2	1.2	1.2	1.2	1.6	1.4	1.4

204- DEVELOPMENTAL BIOLOGY

Course Objectives of Developmental Biology:

1. **Understanding Developmental Processes** – Explore the fundamental principles of growth, differentiation, and morphogenesis in living organisms.
2. **Gametogenesis and Fertilization** – Study the formation of gametes, fertilization mechanisms, and zygote formation.
3. **Early Embryonic Development** – Examine cleavage, blastulation, gastrulation, and neurulation in different organisms.
4. **Organogenesis and Tissue Differentiation** – Understand how different organs and tissues develop from germ layers.
5. **Genetic and Molecular Regulation** – Analyze the role of genes, signaling pathways, and transcription factors in development.

Unit-I: Introduction: Overview of animal development. The issues of Developmental Biology. Anatomical approach to Developmental Biology. Experimental approach to Developmental biology.

Unit-II: Early embryonic development: Fertilization- structure of gametes, cellular and biochemical processes during early fertilization .Acrosome reaction and egg activation .Cleavage and blastulation in Drosophila and chick (till blastocyst).Gastrulation in frog and chick.

Unit-III: Early development in Drosophila: Origin of anterior & posterior polarity, maternal effects of genes. Segmental genes, homeotic selector genes .Generation of dorso-ventral polarity. Early development in sea urchin egg: Experimental analysis of early development, biochemical and physiological gradients.

Unit-IV: Axis formation in Amphibians: The progressive determination of amphibian axis, primary embryonic induction. Regional specificity of induction. Organogenesis: Differentiation of neural tube - anterior posterior axis, dorsoventral axis, Differentiation of vertebrate lens.

Unit-V: Post-embryonic and abnormal development: Regeneration in animals with reference to Hydra, Planarian and Salamander limb. Metamorphosis in Amphibians- morphological, biochemical changes and hormonal control of metamorphosis .Ageing-consequences and causes of ageing. Control of ageing by genes.

References:

1. Gilbert, S.F. Developmental Biology IV ED. Sinauer Associates Inc. Publishers, Massachusetts, 2000.
2. Kalthoff. K. Analysis of Biological Development. McGraw Hill Inc. New York, 1996.
3. Rao, K. V. Developmental Biology: A Modern Synthesis. Oxford & IBH Publishing co. Pvt. Ltd, 1993.
4. Subramanian, T. Developmental Biology, Narosa Publishing House, 2002.
5. Twyman, R .M. Instant Notes. Developmental Biology. Bios Scientific Publishers Ltd, 2001.
6. Wolpert, L., Beddington, R., Brocks, J., Jessel, T., Lawrence, P and Meyerwitz, E. Principles of Development. Oxford University Press, 1998.

Course Outcomes of Developmental Biology:

CO1.Understanding Developmental Stages – Demonstrate knowledge of key stages of development, from gametogenesis to organogenesis.

CO2.Explaining Fertilization and Early Embryonic Development – Describe the processes of fertilization, cleavage, blastulation, gastrulation, and neurulation.

CO3.Analyzing Organogenesis and Differentiation – Explain how organs and tissues develop from germ layers and the factors influencing cell differentiation.

CO4.Understanding Molecular and Genetic Regulation – Interpret the roles of genes, transcription factors, and signaling pathways in development.

CO5.Comparing Development Across Species – Analyze similarities and differences in developmental processes among various organisms.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	1	2	2	2	1	0	2	1	1	1
CO3	0	1	1	2	2	2	2	2	2	2
CO4	1	1	3	1	0	2	1	2	1	1
CO5	1	1	0	3	2	1	0	2	1	1
AVR	1.2	1.2	1.4	1.8	1.2	1.2	1.2	1.4	1.4	1.4

Practical of 201 and 202

1. Study of ultra-structure of Animal cell.

2. Study of Compound and binocular Microscope.

3.Overview of organ systems and its accessory parts a) Human digestive system and salivary glands b) Human liver and pancreas c) Human respiratory and excretory system d) Human heart, kidney and brain.

4. Differential staining of blood smear.

5. Biochemical test: Carbohydrates and Proteins.

7. Study of instruments used in human physiology. a) Accu-chek blood glucose meters and the corresponding strips. b) Sphygmomanometer c) ECG-Electro Cardio Gram. d) Stethoscope.

Practical of 203 and 204

I. TYPES OF Eggs: Eggs of Frog, Fish, Chick and Mammalian egg.

II. Development of frog

1. Early and late cleavage in Frog
2. Blastula and Gastrula in Frog
3. Tadpole larva of frog

III. Metamorphosis of frog

IV. Preparation of whole mount of chick embryo

V. Observation of permanent slides of chick embryo based on hours of incubation. 1. 18, 24, 33, 48 and 72 hours

VI. DEVELOPMENT OF INSECT

1. Life cycle of honey bee and Silk moth

VII Study of Migration of fishes

VIII Study of culturable freshwater fishes.

IX. Study of poisonous and nonpoisonous snakes in India

X Study of migratory birds.

301- BIOMOLECULE AND STRUCTURAL BIOLOGY

Course Objectives of Biomolecules and Structural Biology:

1. **Understanding Biomolecular Structure and Function** – Explain the structure, properties, and functions of key biomolecules, including proteins, nucleic acids, carbohydrates, and lipids.
2. **Chemical and Physical Properties of Biomolecules** – Explore the chemical composition, bonding, and interactions that determine biomolecular stability and function.
3. **Protein Structure and Folding** – Analyze the primary, secondary, tertiary, and quaternary structures of proteins and their role in biological functions.
4. **Enzyme Structure and Mechanism** – Understand enzyme kinetics, catalytic mechanisms, and regulation of enzymatic activity.
5. **Nucleic Acid Structure and Dynamics** – Study DNA and RNA structures, base pairing, and the principles of molecular recognition.

Unit I:

Chemical foundation of Biology: pH, pK, acid and bases, buffers, weak bonds. Structure and classification of Amino acids, Zweitter ion

Unit-II:

Carbohydrates: Structures, classification and functions of carbohydrates. D and L form of carbohydrates, Reducing and None reducing sugars.

Unit-III:

Proteins: Structures, classification and functions of proteins. Sequencing of proteins Properties of Proteins and functions of Proteins.

Unit- IV:

Lipids: Lipids definition, Properties of Lipids, Structure of Lipids, Classification (Types) of Lipids and functions of lipids.

Unit-V:

Enzymes: Terminologies, Classification and basics of enzyme kinetics. Mechanism of enzyme catalysis .Regulation of enzyme action. Derivation of Michaelis- Menton equation and its significance in enzyme action.

References:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman& Company, 2006.(link is external)
2. Voet&Voet, Fundamentals of Biochemistry, 4th Edition, Wiley, 2012.(link is external)
3. Garret and Grisham, Biochemistry - 4th Edition, Mary Finch, 2012

Course Outcomes of Biomolecules and Structural Biology:

CO1.Understanding Biomolecular Composition and Function – Demonstrate knowledge of the structure, properties, and functions of proteins, nucleic acids, carbohydrates, and lipids.

CO2Analyzing Protein Structure and Folding – Explain the levels of protein structure and the importance of folding, stability, and misfolding in diseases.

CO3.Interpreting Enzyme Kinetics and Mechanisms – Apply concepts of enzyme kinetics, catalytic mechanisms, and enzyme regulation in biological systems.

CO4.Exploring Nucleic Acid Structure and Function – Describe DNA and RNA structures,their interactions, and their role in molecular recognition and gene expression.

CO5. Membrane and Lipid Dynamics – Understand the structure and function of biological membranes, lipid bilayers, and membrane proteins.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	3	1	0	1	0	2	2
CO2	2	3	3	1	0	2	2	2	2	2
CO3	1	1	2	3	2	1	2	1	1	1
CO4	0	1	1	2	1	0	1	0	1	1
CO5	2	1	0	1	2	1	0	2	1	1
AVR	1.6	1.6	1.4	2	1.2	1.1	1.2	1.4	1.4	1.4

302- QUANTITIVE BIOLOGY, BIODIVERSITY AND WILD LIFE

Course Objectives of Quantitative Biology, Biodiversity, and Wildlife:

1. **Understanding Quantitative Approaches in Biology** – Introduce mathematical and statistical methods used in biological research and data analysis.
2. **Principles of Biodiversity** – Explore the concepts of biodiversity, including species richness, genetic diversity, and ecosystem diversity.
3. **Ecological and Evolutionary Dynamics** – Understand population ecology, species interactions, and evolutionary principles that shape biodiversity.
4. **Conservation Biology and Wildlife Management** – Learn about conservation strategies, habitat management, and policies for wildlife protection.
5. **Quantitative Methods in Ecology and Evolution** – Apply statistical models, population dynamics, and ecological modeling to study biodiversity.

Unit-I:

Biostatistics: Mean- Definition and Calculation, Median- Definition and Calculation, Mode- Definition and Calculation, Standard Deviation- Definition and Calculation, Graphs and Histogram including applications and Bar diagram and Pictogram including applications

Unit-II:

Sampling theory, Experimental designing, Variance and its analysis, Co- relation and its types, t-test, Chi-Square test.

Unit-III:

Biodiversity: Concept and principal of biodiversity, Causes for the loss of biodiversity, Biodiversity conservation method, National biodiversity status of India

Unit-IV:

Wild life of India: Values of Wildlife (Positive and Negative values), Wild life protection act, Causes for the extinction of Wild life, Conservation of Wild lifein India, Endangered and threatened Indian species.

Unit-V:

Wild life Conservation: National parks and Sanctuaries, Project tiger and project Gir lions, Crocodile- Conservation. Biospheres reserves and Safari park, Wild life crossing.

References:

1. Dasmann F Raymond.Wildlife Biology. Wiley eastern Ltd. India. 1982
2. Burnie,D.(Ed).Animal : The Deginitive Visual Guide to the World Wildlife. D.K Publications.2001
3. . Anderson,S Managing Wildlife Resources. Prentice-Hall ,EnglwoodCliffs,New Jersey.1991
4. Gee,E.p The Wildlife of India. E.P.Dutton Co.N.Y.1964. 5. Nair, S.M.Endangered animal of India and their Conservation. National Book Trust, India 1992.
5. Dutta, N. K. (2004). Fundamentals of Biostatistics, Kanishka Publishers.
6. Gurumani N. (2005). An Introduction to Biostatistics, MJP Publishers.

Course Outcomes of Quantitative Biology, Biodiversity, and Wildlife:

CO1.Application of Quantitative Methods in Biology – Demonstrate proficiency in mathematical and statistical approaches for biological data analysis.

CO2.Understanding Biodiversity Concepts – Explain species diversity, genetic variation, and ecosystem dynamics in different habitats.

CO3.Ecological and Evolutionary Analysis – Analyze population dynamics, species interactions, and evolutionary trends affecting biodiversity.

CO4.Wildlife Conservation Strategies – Evaluate conservation techniques, habitat restoration, and wildlife management practices.

CO5.Data Collection and Analysis in Ecology – Apply biodiversity assessment techniques such as species sampling, ecological indices, and GIS mapping.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	3	1	0	1	0	2	2
CO2	3	2	3	2	0	2	2	2	2	2
CO3	1	1	1	3	2	2	2	1	1	1
CO4	1	1	1	2	1	2	1	2	1	1
CO5	2	1	0	1	2	1	0	3	1	1
AVR	1.8	1.4	1.4	2.2	1.2	1.4	1.2	1.6	1.4	1.4

301 &302 - PRACTICALS

1. Quantification of Carbohydrates
2. Quantification of Lipids
3. Quantification of Proteins
4. Separation of amino acid using Paper chromatography
5. Separation of amino acid using Thin Layer chromatography
6. Estimation of protein using Folin-Lowry method
7. Estimation of amino acid by Ninhydrin method
8. Estimation of vitamin – C by 2,6- dichlorophenol indophenols method
9. The effect of pH and temperature (α-amylase) activity
10. Study of Threatened, Endangered, Endemic, Extinct animals in India
11. Study of wetland fauna
12. Field technics in wildlife studies: Transect, Camera trapping, pug marks, scat analysis, Census techniques, sampling, GPS coordinates.
13. Visit to wildlife sanctuaries, museums, zoo, and national parks

Elective-1:- AQUATIC BIOLOGY

Course Objectives of Aquatic Biology:

1. **Understanding Aquatic Ecosystems** – Explore the structure, function, and dynamics of freshwater, marine, and estuarine ecosystems.
2. **Biodiversity of Aquatic Organisms** – Study the classification, adaptations, and ecological roles of aquatic flora and fauna.
3. **Water Chemistry and Environmental Factors** – Analyze the physical and chemical properties of water and their impact on aquatic life.
4. **Human Impact on Aquatic Systems** – Assess the effects of pollution, climate change, and habitat destruction on aquatic biodiversity.
5. **Conservation and Sustainable Management** – Learn about strategies for the conservation, restoration, and sustainable use of aquatic resources.

Unit-I:

Introduction to Aquatic Biology and Concepts: Physical Characteristics of Water: light, temperature, Electrical Conductivity, turbidity, density, pressure.

Unit-II:

Chemical properties of water: Hydrogen-ion-concentration Dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chloride, sulphate, nitrate-nitrite, phosphate- phosphorus, BOD, COD

Unit-III:

Rivers and Lakes: origins and morphometry, thermal stratification.Biological communities of lakes and rivers: Phytoplankton, periphyton,
Zooplankton, benthos, microphytes, insects, mollusca, amphibians, fish and birds.

Unit-IV:

The Dynamics of ecosystem: The components, abiotic substances, producers, consumers, decomposers, transformers, productions rates, energy flow structure and ecological pyramids.

Unit-V:

Aquatic pollution monitoring and control .Lowland rivers, flood plains and wetlands .Conservation and management of aquatic ecosystem.

References:

1. Tonapi, G.T. (1980): Freshwater animals of India. Oxford and IBH Publishing Company, New Delhi, India.
2. Blakey, D.R.andHrusa, D.C. (1989): Inland Aquaculture development handbook. Fishing News Books Great Britain.
3. Jhingran.V.G. (1985): Fish and Fisheries of Indian Hindustan Publishing Co, New Delhi.
4. Pillay, T.V.R. (1990): Aquaculture Principles and Practices, Fishing News Books, Oxford

Course Outcomes of Aquatic Biology:

CO1.Understanding Aquatic Ecosystem Functioning – Explain the ecological processes, energy flow, and nutrient cycles in freshwater and marine environments.

CO2.Identification of Aquatic Biodiversity – Demonstrate knowledge of the diversity, adaptations, and ecological significance of aquatic organisms.

CO3.Analysis of Water Quality and Environmental Factors – Assess the physical, chemical, and biological parameters influencing aquatic ecosystems.

CO4.Evaluation of Human Impacts on Aquatic Systems – Analyze the effects of pollution, climate change, and habitat destruction on aquatic life and ecosystem health.

CO5.Application of Conservation and Management Strategies – Develop sustainable approaches for aquatic resource conservation, habitat restoration, and biodiversity protection.

PRACTICAL

AQUATIC BIOLOGY

1. Estimation of physical and chemical characteristics of water (pH, Density, DO, BOD, COD)
2. Identification of phytoplankton, zooplankton in the water samples
3. Morphometric features of fishes
4. Study of Molluscs, benthos, microphytes, aquatic insects, mollusca, amphibians, fish and birds
5. Visit to aquatic ecosystems.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	3	1	0	1	0	2	2
CO2	3	2	3	2	0	2	2	2	2	2
CO3	1	1	1	3	2	2	2	1	1	1
CO4	1	1	1	2	1	2	1	2	1	1
CO5	2	1	0	1	2	1	0	3	1	1
AVR	1.8	1.4	1.4	2.2	1.2	1.4	1.2	1.6	1.4	1.4

Elective -1:-COMPUTER APPLICATION

Course Objectives of Computer Applications:

1. **Understanding Basic Computer Concepts** – Introduce fundamental principles of computer systems, including hardware, software, and operating systems.
2. **Developing Software and Programming Skills** – Provide knowledge of programming languages, algorithms, and problem-solving techniques.
3. **Enhancing Data Management and Analysis Skills** – Teach the use of databases, spreadsheets, and data analysis tools for efficient information processing.
4. **Improving Digital Literacy and Productivity** – Enable students to use office applications, internet tools, and multimedia software for academic and professional tasks.
5. **Applying Computer Applications in Real-World Scenarios** – Explore the role of computing in various fields such as business, education, healthcare, and research.

Unit 1:

Basics of Computer, Characteristics of Computers, Evolution of computers, computer memory, computer generations, Basic computer organization; System software, Application software, introduction to operating system.

Unit 2:

Data Communication and Networks Data communication concepts, local area network, wide area network, internet, intranet, extranet, website. E-mail, search engine

Unit 3:

Using Internet for Research. The Internet: quick look, what is internet, Use of Internet, major internet services, electronic mail, www, downloading super tools for better computing Internet and the society.

Unit 4:

Data processing and plotting, Excel, presentations and drawings.Power point and word processors.

Unit 5

MS-Office and its application, File handing in window, various versions of MSOffice, Research publishing tool- MS-Word, Adobe acrobat, Graphics.

References:

1. Young, S. S. Computerized data acquisition & Analysis for life Sciences: A Hands-on guide. Cambridge University Press, 2001.
2. Snedecor ,G.W and Cochran, W.G. Statistical Methods. Ed VI. Oxford and IBH Publishing co, New Delhi, 1967.
3. Higgins, D & Taylor, W (Eds). Bioinformatics Sequence, Structure. Chapman & Hall, 1995.

Course Outcomes of Computer Applications:

CO1.Understanding Fundamental Computer Concepts – Demonstrate knowledge of computer hardware, software, operating systems, and basic programming principles.

CO2.Proficiency in Office and Productivity Tools – Apply skills in word processing, spreadsheets, databases, and presentation software for professional and academic tasks.

CO3.Programming and Problem-Solving Skills – Develop and implement basic algorithms using programming languages like Python, Java, or C++.

CO4.Data Management and Analysis – Utilize database management systems and data analysis tools for organizing, retrieving, and processing information efficiently.

CO5.Application of Computer Technology in Various Fields – Apply computing skills in diverse domains such as business, research, education, and multimedia applications.

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PRACTICAL

COMPUTER APPLICATION

1. Study of different parts of Computers and associated devices Computer Hardware: CPU, Mother Board, Hard disc, Floppy disc, Compact disc, USB, Pen drive, Scanner Input devices: Keyboard, Mouse, Joy stick, Touch screen monitor Output devices: Monitor, Printer Microsoft Office: MS word, MS Excel and MS Power Point Access to internet and Computer interfacing with Equipment

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	1	1	1	3	2	3	2	2	2	2
CO4	1	2	3	1	3	2	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.6	1.4	1.4	1.6	1.4

Elective-2:-LIMNOLOGY

Course Objectives of Limnology:

1. **Understanding Freshwater Ecosystems** – Study the physical, chemical, and biological characteristics of inland water bodies, including lakes, rivers, and wetlands.
2. **Examining Aquatic Biodiversity** – Explore the diversity, adaptations, and ecological roles of organisms in freshwater ecosystems.
3. **Analyzing Water Quality and Environmental Factors** – Investigate factors such as temperature, pH, dissolved oxygen, and nutrient dynamics that influence aquatic life.
4. **Assessing Human Impacts on Freshwater Systems** – Evaluate the effects of pollution, climate change, eutrophication, and habitat destruction on freshwater environments.
5. **Developing Conservation and Management Strategies** – Learn sustainable approaches for freshwater resource management, ecosystem restoration, and biodiversity conservation.

Unit 1:

Limnology: Definition, historical scope.
Fresh water resources of India and their management
Lotic ecosystem of freshwater and their fishery a) Rivers b) Springs.

Unit II:

Physical characteristics of fresh water fishery resources- Depth, light, temperature and turbidity.

Chemical characteristics of fresh water fishery resources.

Estimation and role of BOD and COD of the river water

Unit III

Phytoplankton--- Definition, types

Zooplankton--- Definitn, types

Aquatic insects and their importance.

Unit IV

Aquatic pollution: Its causes effect on fishes and remedy

Pollution status of River Ganga and their remedy

Pollution status of River Yamuna and their remedy

Unit V

Sewage- Definition, composition treatment and use in pisciculture.

Hydrophytes and their role in fish culture.

Uses and Misuses of various inland water resources

References:

1. Anathakrishnan Bioresources Ecology
2. Goldman : Limnology
3. Odum: Ecology
4. Pawlosuske :Physico- chemical methods for water
5. Wetzel: Limnology
6. Trivedi& Goyal : Chemical and biological methods for water pollution studies

Course Outcomes of Limnology:

CO1.Understanding Freshwater Ecosystem Dynamics – Explain the physical, chemical, and biological processes governing lakes, rivers, wetlands, and other freshwater bodies.

CO2. Identification of Aquatic Biodiversity – Demonstrate knowledge of freshwater organisms, their adaptations, and ecological roles in aquatic food webs.

CO3. Assessment of Water Quality and Environmental Factors – Analyze key parameters such as pH, dissolved oxygen, nutrient levels, and pollutant impacts on freshwater ecosystems.

CO4.Evaluation of Human Impacts on Aquatic Systems – Assess the consequences of pollution, climate change, eutrophication, and habitat degradation on freshwater biodiversity.

CO5. Application of Conservation and Management Practices – Develop and apply strategies for freshwater resource conservation, ecosystem restoration, and sustainable water management.

PRACTICAL : LIMNOLOGY

1. Determination of temperature, pH and salinity in the pond water sample.
2. Estimation of total alkalinity and total hardness of pond sample and water reservoir present in particular area
3. Estimation of dissolved oxygen and free carbon dioxide.
4. Estimation of phosphates and nitrites.
5. Estimation of COD and BOD

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	1	1	1	3	2	3	2	2	2	2
CO4	1	2	3	1	3	2	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.6	1.4	1.4	1.6	1.4

Elective-2:-ECO- TOXICOLOGY

Course Objectives of Ecotoxicology:

1. **Understanding Pollutants and Their Effects** – Study the sources, types, and mechanisms of environmental pollutants and their impact on ecosystems.
2. **Exploring Toxicological Principles** – Learn the fundamental concepts of toxicity, dose-response relationships, and bioaccumulation in living organisms.
3. **Assessing Environmental Risk** – Develop skills to evaluate pollutant distribution, persistence, and ecological risks using scientific methods.
4. **Analyzing Biochemical and Physiological Effects** – Examine how contaminants affect cellular, physiological, and behavioral functions in organisms.
5. **Developing Pollution Mitigation and Management Strategies** – Understand regulatory frameworks and remediation approaches for reducing environmental contamination.

Unit-1

General principles of EnvironmentalBiology with emphasis on ecosystems.

Abiotic and biotic factors of ecosystems.

Communities of the environment, their structure & significance.

Energy flow in environment: Ecological Energetics.

Unit-2

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-3

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-4.

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-5

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

References:

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

Course Outcomes of Ecotoxicology:

CO1.Understanding the Impact of Pollutants on Ecosystems – Explain how environmental contaminants affect organisms, populations, and ecosystems.

CO2.Applying Toxicological Principles – Analyze dose-response relationships, bioaccumulation, and biomagnification of toxic substances.

CO3.Assessing Environmental Risks and Toxicity – Evaluate the persistence, movement, and ecological risks of pollutants using scientific techniques.

CO4.Examining Physiological and Biochemical Effects – Interpret how toxicants alter cellular processes, metabolism, and overall health in living organisms.

CO5.Developing Pollution Management and Remediation Strategies – Apply knowledge of environmental laws, risk assessment, and pollution control measures for ecosystem protection.

PRACTICAL

ECO-TOXICOLOGY

1. Determination of heavy metals (Fe/Cu) by spectrophotometric methods
2. Removal of suspended solids by sand filter method.
3. Detection/estimation of Cr (VI) in presence of Cr (III)
4. Estimation of mixed liquor suspended solids (MLSS)and Sludge Volume Index (SVI) in activated sludge
5. Waste water analysis for pH, conductivity, TDS, DO, COD, BOD, alkalinity, chloride and hardness.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	1	1	1	3	2	3	2	2	2	2
CO4	1	2	3	1	3	2	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.6	1.4	1.4	1.6	1.4

401 – EVOLUTIONARY BIOLOGY

SEMESTER IV

Course Objectives of Evolutionary Biology:

1. **Understanding the Principles of Evolution** – Explore the fundamental concepts of evolution, including natural selection, genetic drift, and speciation.
2. **Examining the Genetic Basis of Evolution** – Analyze how genetic variation, mutations, and inheritance contribute to evolutionary change.
3. **Tracing the History of Life** – Study the fossil record, phylogenetics, and major evolutionary transitions in the history of life on Earth.
4. **Exploring Adaptations and Speciation** – Investigate how environmental pressures drive adaptation, divergence, and the formation of new species.
5. **Applying Evolutionary Concepts to Modern Science** – Understand the role of evolution in medicine, biotechnology, conservation, and ecological studies.

Unit I:

Introduction: An overview of landmarks in Evolutionary Biology.

Unit II

Concept of organic evolution: Origin of life. Evolution through ages - Geological time scales. Evidences of organic evolution.Evolution of man through ages.

Unit III

Darwinism: Contributions of Charles Darwin, Alfred Russell Wallace and Thomas Malthus. Postulates of Darwinism - objectives and evidences, limitation of Darwinism, Neodarwinism – Hardyweinberg – genetic equilibrium.

Unit IV

Recent developments on Lamarckian concepts. Postulates of Lamarckism- Objectives and evidences, limitation of Lamarckism. Speciation: Biological and phylogenetic concepts of species. Pattern and mechanisms of reproductive isolation. Models of speciation - Allopatric, Sympatric and Strasipatric.

Unit V

The evolution of life histories: Basic questions in the evolution of life history. Evolutionary age and size at maturation. Evolutionary life span and ageing.

References:

1. Futuyama, D.J. Evolutionary Biology- III Ed. Sinauer Associates Inc. Massachusetts, 1998.
2. Gerhart, J and Kirchner, M. Cell, Embryos & Evolution. Blackwell Science Publishers, 1997.
3. Keynes, R. Charles Darwin's Zoology Notes & Specimen List from H.M.S Beagle. Cambridge University Press, 2000.
4. Price, P.W. Biological Evolution. Saunders College Publishing, 1995.

Five Course Outcomes of Evolutionary Biology:

1. **Understanding Evolutionary Mechanisms** – Explain key processes such as natural selection, genetic drift, mutation, and gene flow that drive evolution.
2. **Analyzing Genetic Variation and Adaptation** – Evaluate how genetic changes contribute to species adaptation and survival in different environments.
3. **Interpreting the Fossil Record and Phylogenetics** – Use fossils and phylogenetic trees to trace evolutionary relationships and the history of life on Earth.
4. **Exploring Speciation and Biodiversity** – Explain the processes of speciation, extinction, and the factors influencing biodiversity over time.
5. **Applying Evolutionary Principles to Real-World Issues** – Demonstrate the relevance of evolution in areas such as medicine, conservation, and biotechnology.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	1	1	1	3	2	3	2	2	2	2
CO4	1	2	2	1	1	2	2	2	0	0
CO5	0	1	2	3	2	2	0	2	1	1
AVR	1.2	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.2

402- ENDOCRINOLOGY

Course Objectives of Endocrinology:

1. **Understanding Hormonal Regulation** – Explore the role of hormones in regulating physiological processes, including growth, metabolism, and reproduction.
2. **Examining Endocrine Glands and Their Functions** – Study the structure, function, and interactions of major endocrine glands such as the pituitary, thyroid, adrenal, and pancreas.
3. **Analyzing Hormone Signaling Mechanisms** – Understand hormone synthesis, secretion, transport, and receptor-mediated signaling pathways.
4. **Exploring Hormonal Control in Health and Disease** – Investigate endocrine disorders such as diabetes, thyroid dysfunction, and hormonal imbalances.
5. **Applying Endocrinology in Medicine and Research** – Learn about diagnostic techniques, hormone therapies, and recent advances in endocrine research.

Unit I

Evolution of endocrine function. Hormones as biological signals. Classification of hormones. The concept of neuroendocrine system. Methods in endocrine research.

Unit II

Nature of hormone action: Hormone receptors- Membrane, cytosolic and nuclear receptors. Mechanism of signal transduction - role of G-proteins .Cyclic AMP and the second messenger concept .Prostaglandins and Calmodulin in hormone action.

Unit III

The pituitary gland: Comparative morphology, chemistry and biological actions of anterior and posterior pituitary hormones, their functions and diseases associated with them

Unit IV

Thyroid and parathyroid glands: Evolution of thyroid function in vertebrates. Biosynthesis and biological actions of thyroid hormones. Parathyroid hormones and calcium homeostasis: parathormone, calcitonin, vitamin D and their interaction. Diseases associated with the dysfunction of these hormones.

Unit V

Adrenal glands: Comparative morphology. Biosynthesis and biological actions of corticosteroid hormones. The adrenal catecholamines their biosynthesis, physiological actions and metabolism. Hormones and metabolism: Regulation of carbohydrate, lipid and protein metabolism.

References:

1. Mandal, A. Handbook of Neuroendocrinology. EMKAY Publications, 1994.
2. Nelson, R.J. An introduction to Behavioural Endocrinology. Sinauer Associates Inc, 1995.
3. Turner, C.D and Bagnara, J.T. General and Comparative Endocrinology, 1998.
4. Williams, R.H. Textbook of Endocrinology. W.B. Saunders.
5. Martin.C.R. Endocrine Physiology. Oxford University Press.

Course Outcomes of Endocrinology:

CO1.Understanding the Role of Hormones in Physiological Regulation – Explain how hormones control metabolism, growth, reproduction, and homeostasis in the body.

CO2.Identifying Functions of Endocrine Glands – Demonstrate knowledge of the structure, function, and hormone secretion of major endocrine glands.

CO3.Analyzing Hormonal Signaling Pathways – Interpret the mechanisms of hormone synthesis, transport, receptor interactions, and signal transduction.

CO4.Evaluating Endocrine Disorders and Their Implications – Assess the causes, symptoms, and treatments of hormonal imbalances and endocrine diseases such as diabetes and thyroid disorders.

CO5.Applying Endocrinological Concepts in Medicine and Research – Utilize knowledge of endocrinology in clinical diagnostics, therapeutic interventions, and biomedical research.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	1	1	1	3	2	3	2	2	2	2
CO4	1	2	3	1	3	2	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.6	1.4	1.4	1.6	1.4

ELECTIVE-1:-APPLIED ZOOLOGY

Course Objectives of Applied Zoology:

1. **Understanding the Practical Applications of Zoology** – Explore how zoological knowledge is applied in fields such as agriculture, medicine, industry, and environmental conservation.
2. **Studying Animal Husbandry and Fisheries** – Learn about the breeding, management, and economic importance of livestock, poultry, and aquaculture.
3. **Exploring Medical and Veterinary Zoology** – Understand the role of animals in disease transmission, vector biology, and the development of pharmaceuticals.
4. **Applying Biotechnology in Zoology** – Investigate the use of genetic engineering, bioinformatics, and biotechnological advancements in animal sciences.
5. **Developing Conservation and Wildlife Management Strategies** – Learn about biodiversity conservation, sustainable resource utilization, and habitat restoration.

Unit I:

Lac culture: Lac insect (Scientific name), composition of Lac, strains of Lac insect, cultivation of Lac host plants (in brief) processing of Lac and uses of Lac.

Unit II

Apiculture: Importance, history and development of bee keeping. Different species of honeybees and their distribution.Management of bees, product and by product of apiculture and their use.

Unit III

Vermiculture: Introduction and importance of vermiculture, Uses of earthworms for biodegradation of organic waste materials, Earthworms as protein source, Vermiculture technique.

Unit IV

Dairy: History, Importance and scope of Dairy a) Dairy breeds and Management: Cattle breeds: Milk breeds, Draught breeds, Exotic breeds Buffalo breeds: Swap buffaloes and Riverine Buffaloes b) Principles and methods of breeding: Inbreeding, out breeding and cross breeding. Fertility and breeding efficiency, artificial insemination c) Dairy products: Physico-chemical properties of cow and buffalo milk, Processing, preservation and marketing of milk and milk products.

Unit-V

Poultry: History and Importance and Scope of poultry. a) Poultry Breeds b) Principles and techniques and methods of breeding c) Poultry products: Egg, Meat, feather, excreta, nutritive value of egg and meat. d)Poultry pathology: Viral, Bacterial, fungal and protozoan diseases and their control, vaccines and for infections.

References:

1. Economic Zoology, G.S. Shukla& V.B. Upadhyay, Rastogi publications, Meerut, India
2. Fish and Fishries, KamaleshwarPandey& J.P. Shukla., RastogipublicationsMeerut, India
3. A handbook on Economic Zoology, JawidAhsan&Subhas Prasad Sinha, S. Chand & company Ltd. Ramnagar.

Course Outcomes of Applied Zoology:

CO1. Understanding the Economic and Scientific Importance of Animals – Explain the role of zoology in industries such as agriculture, medicine, and biotechnology.

CO2.Applying Zoological Knowledge in Animal Husbandry and Fisheries – Demonstrate expertise in livestock management, aquaculture, and sustainable animal production.

CO3.Analyzing the Role of Animals in Human Health – Assess the impact of zoonotic diseases, parasites, and vector biology on public health and veterinary sciences.

CO4.Utilizing Biotechnology in Zoological Research – Apply genetic engineering, bioinformatics, and molecular techniques in animal sciences for improved productivity and disease control.

CO5. Implementing Conservation and Wildlife Management Strategies – Develop sustainable approaches for biodiversity conservation, habitat restoration, and wildlife protection.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	3	2	0	3	2	3	2	2	2	2
CO4	1	2	3	2	2	2	1	3	2	1
CO5	1	1	2	1	2	2	0	2	1	1
AVR	2	1.6	1.4	1.8	1.8	1.6	1.2	1.6	1.6	1.4

PRACTICAL

APPLIED ZOOLOGY

1. Identification of Different Species of Honeybees-Apisdorsata/ Apisindica/ Apisflorea/ Apismellifera.
2. Identification of Honey Comb, Honey, Bee Hive, Drone Bee, Queen Bee, Worker Bee and Honey Bee Wax.
3. Identification of Fresh Water Fish.
4. Food adulteration detection in Dairy and its By-Products: Milk, Cheese, Curd, Ghee.

ELECTIVE-1:- ICTHYOLOGY

Course Objectives of Ichthyology:

1. **Understanding Fish Biology and Classification** – Study the taxonomy, anatomy, physiology, and evolutionary relationships of different fish species.
2. **Exploring Fish Ecology and Behavior** – Analyze the interactions of fish with their environment, including feeding habits, reproduction, and migration patterns.
3. **Examining Fisheries and Aquaculture Practices** – Learn about sustainable fishing, fish farming techniques, and the economic importance of fish resources.
4. **Assessing the Impact of Environmental Factors on Fish** – Investigate the effects of pollution, climate change, and habitat destruction on fish populations and aquatic ecosystems.
5. **Applying Conservation Strategies for Fish Biodiversity** – Develop approaches for the protection and management of endangered fish species and their habitats

Unit-1 Origin and evolution of fishes .Classification of fishes. Fish locomotion

Unit-2 Alimentary canal and digestion of fishes. Accessary respiratory organs. Air bladder and its functions. Weberian ossicles their homologies and functions.

Unit-3 Excretion and osmoregulation. Acoustic -lateral line system Luminous organs. Coloration in fishes.

Unit-4 Sound producing organs. Deep sea adaptions. Hill stream adaptions. Migration in fishes.

Unit-5 Sexual cycle and fecundity. Parental care in fishes. Early development and hatching. Poisonous and venomous fishes.

References:

1. JR. Norman - The History of fishes.
2. NagarajaRao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones: Fish migration.
5. Marshal: The life of fishes.
6. Thomas - Diseases of fish.

Course Outcomes of Ichthyology:

CO1.Identifying and Classifying Fish Species – Demonstrate the ability to recognize and classify fish based on their morphological and genetic characteristics.

CO2.Understanding Fish Physiology and Adaptations – Explain how fish have adapted to various aquatic environments through physiological and behavioral mechanisms.

CO3.Applying Fisheries and Aquaculture Techniques – Utilize scientific knowledge in sustainable fisheries management and aquaculture production.

CO4.Assessing Human and Environmental Impacts on Fish Populations – Evaluate threats such as overfishing, habitat destruction, and pollution, and propose mitigation strategies.

CO5.Developing Conservation and Management Plans for Fish Biodiversity – Apply ecological principles to promote sustainable fishery practices and conservation efforts.

PRACTICAL

ICTHYOLOGY

1. Visit to local Fresh water bodies to study their Ecology.
2. Collection, Identification and Screening of fish for Ecto and Endo parasites
3. Estimation of Productivity of local Fresh water bodies.
5. Collection and preservation of Water and Soil from water bodies.
6. Collection, Preservation and Identification of plankton.
7. Estimation of PH, Temperature, Chlorides, Dissolved Oxygen from water samples.
8. Estimation of Organic matter of bottom soil.
9. Visit to local fish seed production

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	3	2	0	3	2	3	2	2	2	2
CO4	1	2	3	2	2	2	1	3	2	1
CO5	1	1	2	1	2	2	0	2	1	1
AVR	2	1.6	1.4	1.8	1.8	1.6	1.2	1.6	1.6	1.4

ELECTIVE-2:- ENTOMOLOGY

Course Objectives of Entomology:

1. **Understanding Insect Diversity and Classification** – Study the taxonomy, morphology, and evolutionary relationships of different insect groups.
2. **Exploring Insect Anatomy and Physiology** – Learn about the structure, function, and biological processes of insect systems, including reproduction, digestion, and sensory mechanisms.
3. **Analyzing Insect Ecology and Behavior** – Investigate insect interactions with the environment, including pollination, predation, and symbiotic relationships.
4. **Examining the Role of Insects in Agriculture and Human Health** – Understand the economic importance of insects, including beneficial species (pollinators, predators) and harmful species (pests, disease vectors).
5. **Applying Insect Pest Management and Conservation Strategies** – Learn about integrated pest management (IPM), biological control, and the conservation of beneficial insect species.

Unit-1

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

Unit-2

Structure of cuticle and pigment. Sclerotization and tanning of the cuticle. Structure of alimentary canal and Physiology of digestion. Malpighian tubules – anatomical organization, Transport mechanism

Unit-3

Structure of circulatory system. Cellular elements in the haemolymph.Cell mediated and humoral immunity. Structure of compound eye and Physiology of Vision.

Unit-4

Sound Production in insect. Structure and function of endocrine glands.Pheromones.Embryonic membranous up to the formation of blastoderm.

Unit-5

Metamorphosis. Insecticide effects on CNS. Important pest of Soybean. Modern concept of pest management.

References:

1. Entomophagous Insect by Clausen.
2. Entomology by Gilbert.
3. Principles of Insect Physiology by Wigglesworth.
4. Fundamentals of Entomology by Elzinga
5. Hand book of economic Entomology for South India by Ayyar.

Course Outcomes of Entomology:

CO1. Identifying and Classifying Insects – Demonstrate knowledge of insect taxonomy, morphology, and evolutionary traits.

CO2. Understanding Insect Physiology and Adaptations – Explain the anatomical and physiological adaptations that allow insects to survive in diverse environments.

CO3.Applying Insect Ecology in Agriculture and Conservation – Evaluate the ecological roles of insects, including their impact on crop production and ecosystem balance.

CO4.Developing Pest Management Strategies – Utilize integrated pest management (IPM) techniques to control harmful insect populations while minimizing environmental impact.

CO5.Assessing the Role of Insects in Human Health and Disease Transmission – Analyze how insects act as vectors for diseases and develop strategies for controlling insect-borne illnesses.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	3	2	0	3	2	3	2	2	2	2
CO4	1	2	3	2	2	2	1	3	2	1
CO5	1	1	2	1	2	2	0	2	1	1
AVR	2	1.6	1.4	1.8	1.8	1.6	1.2	1.6	1.6	1.4

PRACTICAL

ENTOMOLOGY

1. Study of morphology of an insect (local insects to be used).
2. Dissection of digestive, nervous, excretory, reproductive systems of any two insects of different orders.
3. Mounting of different types of mouthparts.
4. a. Field study to collect insect species
   b. Identification of at least 10 insects belonging to different orders.
5. a. Field study for various methods of pest management.
   b. Field visit to warehouses and Plant protection centres.

ELECTIVE-2:- IMMUNE SYSTEM

Course Objectives of Immunology:

1. **Understanding the Fundamentals of the Immune System** – Study the structure, function, and components of the immune system, including innate and adaptive immunity.
2. **Exploring Immune Responses and Mechanisms** – Learn how the body defends against pathogens through humoral and cell-mediated immune responses.
3. **Examining Immunological Disorders and Diseases** – Investigate autoimmune diseases, hypersensitivity reactions, immunodeficiencies, and transplantation immunology.
4. **Applying Immunological Techniques in Research and Medicine** – Understand diagnostic and therapeutic approaches, including vaccines, monoclonal antibodies, and immunotherapies.
5. **Analyzing the Role of Immunology in Health and Disease** – Study how the immune system interacts with infections, cancer, and environmental factors.

Unit-1

Tissues of Immune system- Primary lymphoid organs, structure and functions (Thymus and Bursa of Fabricius). Tissues of Immune system- Secondary lymphoid organs, structure and functions (Spleen, lymph node and Payers patches).

Unit-2

Antigen processing.Antigenpresentation.T-cell lineage and receptors.T-cell activation.B-cell lineage and receptors.B-cell activation.

Unit-3

Immunoglobulin structure and physical properties of immunoglobulin.Generation of antibody diversity (Light and heavy chain) 4. Immunization

Unit-4

Immediate type of hypersensitivity reaction of anaphylactic type-1.Antibody dependent cytotoxic type II reaction. Complex mediated type III reaction. Delayed type cell mediated hypersensitivity type IV reaction.

Unit-5

Enzyme linked immunosorbent assay (ELISA) technique and its applications. Immunofluorescence technique (Direct& Indirect and Sandwich antibody labelling

techniques. Immune diffusion techniques .Monoclonal antibody technology (Hybridoma technology).

References:

1. Immunology, Kuby, by Kindt, Goldsby, Osborne, Sixth Edition.
2. Immunobiology, The Immune system in Health and Disease, Seventh Edition by Janeway, Travers et al, Garland Publishing, 2008.
3. Research articles and reviews from scientific publications.

Course Outcomes of Immunology:

CO1.Demonstrating Knowledge of Immune System Components – Explain the roles of immune cells, organs, and molecules in maintaining immunity.

CO2.Understanding the Mechanisms of Immune Responses – Describe how innate and adaptive immune responses function in protecting against pathogens.

CO3.Identifying and Analyzing Immune Disorders – Assess the causes and mechanisms of diseases such as autoimmunity, allergies, and immunodeficiency disorders.

CO4.Applying Immunological Techniques in Disease Diagnosis and Treatment – Utilize immunological tools such as ELISA, PCR, and flow cytometry in medical and research settings.

CO5.Evaluating Immunotherapy and Vaccine Development – Analyze the principles of vaccine design, immunotherapy strategies, and emerging treatments for immune-related diseases.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	3	2	0	3	2	3	2	2	2	2
CO4	1	2	3	2	2	2	1	3	2	1
CO5	1	1	2	1	2	2	0	2	1	1
AVR	2	1.6	1.4	1.8	1.8	1.6	1.2	1.6	1.6	1.4

PRACTICALS

IMMUNE SYSTEM

1. Agglutination Reaction: Slide Agglutination Reaction
2. Precipitation Reaction a) Double Diffusion Reaction b) Single Diffusion Reaction
3. Enzyme-Linked Immunosorbent Assay
4. Antigen Antibody interaction
5. Separation of Plasma from Blood
6. Separation of different component of Blood cells
7. Determination of blood grouping

Practical of 401 & 402

1. Study of Fossil evidences – Homology, Analogy and Vestigial structures.
2. Study of Evolution of vertebrate skull.
3. Study of Evolution of vertebrate heart chambers.
4. Study of Phylogeny of horse related to limbs and teeth.
5. Study of Darwin's finches related to beaks of different species.
6. Construction of Cladogram based on morphological characteristics and construction of character table a) Vertebrate Cladogram b) Primate Cladogram
7. Study and verification of Hardy-Weinberg law by chi-square analysis.
8. Study of Phylogenetic trees.
9. Visit to Natural History Museum.
10. Observation of Permanent slides.
    a) T.S of Fish Pituitary, Testis and Ovary
    b) T.S of Frog Pituitary, Pancreas, Testis and Ovary
    c) T.S of Reptilian Testis and Ovary
    d) T.S of Pituitary of Mammals
    e) V.L.S of anterior Pituitary gland of Mammals
    f) V.S of Thyroid gland of Mammals
    g) T.S of Adrenal gland, Pancreas and Hypothalamus of Mammals
    h) T.S of Testis and Ovary of Mammals.