NETAJI SUBHAS UNIVERSITY

Estd. Under Jharkhand State Private University Act, 2018

Department of Zoology

B.Sc. ZOOLOGY (Hons.)
Course Curriculum
(with CO, PO Structure)

w.e.f. 2018

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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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

COURSE	Code Of Papers	Name of Papers	Internal marks	Externa lmarks	Practical marks	Total Marks
Core Course	C-1	Systematic& Diversity of Non chordate	20	50	30	100
	C-2	Biochemistry	20	50	30	100
	P-1	Practical based in C-1 & c-2				
AECC Ability Enhancement Compulsory Course	AECC-1	Communicative English /MIL	20	30	--	50
Generic Elective	GE-1	Botany	20	50	30	100
	GE-2	Chemistry	20	50	30	100
						400

Semester–II

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-3	Diversity of chordates	20	50	30	100
	C-4	Molecular Biology	20	50	30	100
	P-2	Practical based on C-3 & C-4				
AECC Ability Enhancement Compulsory Course	AECC-2	Environmental Science	20	30	---	50
Generic Elective	GE-3	Botany	20	50	30	100
	GE-4	Chemistry	20	50	30	100
		Practical based on GE- 3 and GE-4				450

Semester–III

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-5	Endocrinology	20	50	30	100
	C-6	Immunology	20	50	30	100
	C-7	Ecology	20	50	30	100
	P-3	Practical based on C-5, C-6 & C-7				
Skill Enhancement Course	SEC-1	IT Skill	15	25	10	50
Generic Elective	GE-5	Botany	20	50	30	100
	GE-6	Chemistry	20	50	30	100
		Practical based on GE5 and GE6				550

Semester–IV

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
CoreCourse	C-8	Genetics	20	50	30	100
	C-9	Evolution	20	50	30	100
	C-10	Cell biology	20	50	30	100
	P-4	Practical based on C-8, C-9 & C-10				
Skill Enhancement Course	SEC-2	IT Skill	15	35		50
Generic Elective	GE-7	Botany	20	50	30	100
	GE-8	Chemistry	20	50	30	100
						550

Semester–V

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
CoreCourse	C-11	Animal physiology: life sustaining systems	20	50	30	100
	C-12	Biotechnology	20	50	30	100
	P-5	Practical based on C-11 & C-12				
Discipline specific Elective	DSE-1	Economic Zoology	20	50	30	100
	DSE-2	Project work	----------			100
	P-6	Practical on DSE-1				30
						400

Semester–VI

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
CoreCourse	C-13	Developmental biology	20	50	30	100
	C-14	Biostatistics	20	50	30	100
	P-7	Practical based on C-11 & C-12				
Discipline specific Elective	DSE-3	Wild Life conservation & Management	20	50	30	100
	DSE-4	Project work	----------			100
	P-8	Practical on DSE-3				30
						400

B.Sc.(Honours)Zoology

Semester I

Core Course–(C-1): Systematic &Diversity of Non chordate

Course objective:

Course Objectives of Systematic & Diversity of Non-Chordates:

1. To provide an understanding of the classification, taxonomy, and phylogenetic relationships of non-chordate animals.
2. To explore the structural, functional, and ecological diversity of non-chordates from protozoa to echinoderms.
3. To study the morphological and anatomical characteristics of major non-chordate phyla.
4. To analyze evolutionary adaptations and ecological significance of various non-chordate groups.
5. To introduce students to modern approaches in systematic, including molecular taxonomy and cladistics.

UNIT-I:

1.1 Elementary Knowledge of Zoological nomenclature and international code.
1.2 Classification of lower invertebrates. (Protozoa, Porifera, Coelenterates)
1.3 Classification of higher invertebrates (Annelida, Arthropopda, Mollusca, Echinodermata)

UNIT-II:

2.1 Protozoa — Type study of Plasmodium.
2.2 Protozoa and Diseases.
2.2 Porifera— Type study of Sycon
2.4. Corals and Coral Reef formation

UNIT-III:

3.1 Helminthes: Type study of Fasciola hepatica
3.2 Platyhelminthes and diseases
3.3 Nematodes and diseases
3.4 Annelida — Type study of earthworm, metamerism

Unit IV:

4.1 Arthropoda— Type study of Prawn
4.2 Type study of Periplanata
4.3 Insect and vectors of human diseases.
4.4 Mollusca— Type study of Pila

UNIT-V

5.1 Echinodermata—ExternalFeaturesandwatervascularsystemofStarFish
5.2 Larval forms of Echinoderms
5.3 Hemichordates: Type study of *Balanoglossus*
5.4 Affinities of ***B****alanoglossus.*

References:

1. Parker, T.J. &Haswell, W.A.A Text –book of zoology, volume 1, McMillan co.
2. Brooks, W.K. Handbook of invertebrate zoology. Kessinger Publishers

Course Outcomes (COs) of Systematic & Diversity of Non-Chordates:

After completing this course, students will be able to:

CO1.Understand Taxonomy & Classification – Demonstrate knowledge of the classification, phylogenetic relationships, and systematic position of various non-chordate phyla.

CO2.Describe Morphological & Anatomical Features – Explain the structural and functional diversity of non-chordates, including their adaptations to different environments.

CO3.Analyze Evolutionary Relationships – Interpret the evolutionary significance and lineage diversification of different non-chordate groups.

C04.Apply Identification Techniques – Utilize taxonomic keys and modern systematic methods for the identification and classification of non-chordates.

CO5. Evaluate Ecological & Economic Importance – Assess the role of non-chordates in ecosystems, their economic significance, and their impact on human health.

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

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Semester-I

Core Course (C-2): Biochemistry

Course Objective:

Course Objectives of Biochemistry:

1. To provide a fundamental understanding of the chemical basis of life and biomolecular interactions.
2. To explore the structure, function, and metabolism of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids.
3. To study enzyme kinetics, mechanisms of enzyme action, and regulatory pathways in metabolism.
4. To examine bioenergetics and the biochemical principles underlying cellular respiration and ATP synthesis.
5. To understand the role of vitamins, coenzymes, and hormones in biochemical processes.

Unit I

1.1 Carbohydrates: Classification of carbohydrates
1.2 Monosaccharide's: Structure, types and properties of monosaccharide's
1.3 Oligosaccharides: Structure, types and properties of oligosaccharides.
1.4 Polysaccharides: Structure, types and properties of Polysaccharides.

Unit II:

2.1 Amino acids and its types on the basis of solubility
2.2 Essential and Non-essential amino acids, Amino acids and formation of peptide bonds
2.3 Proteins and their classification
2.4 Functions of amino acids

Unit III:

3.1 Lipids and its structure
3.2 Lipids: Classification
3.3 Saturated and unsaturated fatty acids
3.4 Functions of lipids

Unit IV:

4.1 Enzyme: Chemical nature and properties.
4.2 Factors affecting enzyme activity
4.3 Enzyme inhibition: Reversible and Irreversible
4.4 Mechanism of Enzyme action: Lock and Key model and Induced fit theory

Unit V:

5.1 Vitamins: Classification of vitamins
5.2 Fat soluble vitamins and their functions
5.3 Water soluble vitamins and their functions
5.4 Diseases associated with the deficiency of vitamins

References:

Murray, R.K., Granner, D.K., Mayer, P.A. &Rodwell, V.W. Harper's Biochemistry. McGraw- Hill Pub
Lehninger, A.L., Nelson, D.L. & Cox, M.M. Principles of Biochemistry. CBSD Publishers & Distributors, Delhi

Course Outcomes (COs) of Biochemistry:

After completing this course, students will be able to:

CO1.Understand Biomolecular Structure & Function – Explain the structure, properties, and functions of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids.

CO2.Analyze Metabolic Pathways – Describe key metabolic pathways, including glycolysis, the TCA cycle, oxidative phosphorylation, and their regulatory mechanisms.

CO3.Demonstrate Knowledge of Enzymology – Understand enzyme kinetics, enzyme regulation, and mechanisms of enzyme action.

CO4.Explain Bioenergetics & Cellular Metabolism – Interpret energy production and utilization in biological systems, including ATP synthesis and redox reactions.

CO5.Apply Molecular Biology Concepts – Explain the biochemical basis of genetic information flow, including DNA replication, transcription, and translation.

CO PO MAPPING MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	2	2	1	1	1	0	2	2
CO2	2	0	1	1	0	2	2	2	1	1
CO3	3	4	1	2	2	1	3	1	2	2
CO4	1	2	3	1	1	2	1	2	2	1
CO5	2	1	0	3	1	1	0	3	1	1
AVR	1.8	2	1.4	1.8	1	1.4	1.4	1.6	1.6	1.4

Practical(P-1)

1. Collection of specimens, recording of : locality, co-ordinates, altitude, river basin, lake ,mountain range etc.,
2. Method of collection, name, description and characters of particular organisms.
3. Fixation and preservation techniques-wet dry, slide preparation
4. Description of a species.
1. Specimens: Sycon, Spongilla, physalis, porita, Favia Tubiform, Madrepore, Aurelia sea anemone Alcyonium, Taenia Heronries, Aphrodite, chaetotpterussabella Leech, Bonellia spider limulus millipede centipede crab, peripatus scorpion, Termite, Daphnia Cyclops Balanus chiton, Dentalium pearl Oyester, Limax, Nautilus, Octopus sepia Loligosolen Aplysia starfish Antedon ,Holothuria sea urchin, Brittle star.
2. Quantification of Carbohydrates
3. Quantification of Lipids
4. Quantification of Proteins
5. Separation of amino acid using Paper chromatography

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Semester-II

Core Course(C-3): Diversity of Chordates

Course objective:

1. To introduce the fundamental characteristics and classification of chordates.
2. To explore the structural, functional, and evolutionary diversity of different chordate groups, including Protochordates, Fishes, Amphibians, Reptiles, Birds, and Mammals.
3. To study the comparative anatomy and physiology of chordate organ systems.
4. To understand the phylogenetic relationships and evolutionary adaptations within chordates.
5. To analyze the ecological roles and behavioral adaptations of various chordate species.

UNIT-I:

1.1 General account &affinities of Hemichordates
1.2 General account & affinities of Urochordates
1.3 General account & affinities of Cephalochordates
1.4 Affinities of Prototheria & Metatheria

UNIT-II

2.1 General characters and classification of Cyclostomes
2.2 General characters and classification of Fishes
2.3 General characters and classification of Amphibians
2.4 General characters and classification of Reptiles

UNITIII:

3.1 Parental Care of Amphibia
3.2 Flight adaption in Birds
3.3 Migration in Birds
3.4 Origin and evolution of Amphibia

UNIT-IV

4.1 Retrogressive metamorphosis in Urochordates
4.2 Comparative account of Petromyzon and Myxine
4.3 Accessory Respiratory organ in fishes
4.4 Pedogenesis and neoteny with special reference to Axolotl larvae

UNIT-V:

5.1 Poisonous & Non- poisonous India, Biting &feeding mechanism of Snakes
5.2 Parental care in Fishes
5.3 Comparative anatomy of Integument :Reptiles, Birds ,Mammals
5.4 Comparative anatomy of heart, kidney invertebrates

References:

1. Sedgewicke, A. A student textbook of Zoology. Central Book Depot, Allahabad
2. KentJr.G.e.1969.ComparativeAnatomy of the vertebrates. The C.Y. Mosby Corn. Toppan, Japan.

Course Outcomes (COs) of Diversity of Chordates:

After completing this course, students will be able to:

CO1.Understand Chordate Classification & Evolution – Explain the fundamental characteristics, classification, and evolutionary relationships of chordates.

CO2.Describe Structural & Functional Adaptations – Analyze the anatomical and physiological adaptations of different chordate groups, including fishes, amphibians, reptiles, birds, and mammals.

CO3.Compare Chordate Organ Systems – Demonstrate knowledge of the comparative anatomy and physiology of chordate organ systems.

CO4.Evaluate Evolutionary Trends – Interpret the evolutionary significance and adaptive modifications seen in various chordate groups.

CO5.Analyze Ecological & Behavioral Aspects – Assess the ecological roles, behavioral patterns, and environmental adaptations of chordates.

CO PO MAPPING MATRIX

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

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Semester-II

Core Course (C-4): Molecular Biology

Course Objectives of Molecular Biology:

1. To provide a fundamental understanding of the molecular basis of life, including the structure and function of nucleic acids and proteins.
2. To explore the mechanisms of DNA replication, repair, recombination, transcription, and translation.
3. To study gene expression regulation in prokaryotic and eukaryotic systems.
4. To understand the molecular mechanisms of signal transduction, cell cycle regulation, and apoptosis.
5. To introduce students to modern molecular biology techniques such as PCR, gel electrophoresis, cloning, and sequencing.
6. To analyze the role of molecular biology in genetic engineering, biotechnology, and medicine.

Unit I

1.1 Nucleic acid: Sugars and bases.
1.2 Watson Crick model of DNA
1.3 Difference between A, B and Z type of DNA.
1.4 DenaturationofDNAstrands

Unit II:

2.1 Ribonucleic acid: Sugars and bases.
2.2 Structures of RNA
2.3 Different types of RNA
2.4 RNA as catalyst: Ribozyme

Unit III:

3.1 Double helical structure of DNA
3.2 Eukaryotic DNA packaging
3.3 Establishment of DNA as genetic material
3.4 Different types of enzymes involved in DNA replication

Unit IV:

4.1 Replication in prokaryotes
4.2 Transcription in prokaryotes
4.3 Genetic code: Wobble hypothesis
4.4 Translation in Prokaryotes

Unit V:

5.1 Concepts of Operon (Positive and Negative, Inducible and Repressible)
5.2 Lac Operon and its mechanism
5.3 Tarp Operonanditsregulation

References:

1. DeRobertis-Cell and Molecular Biology
2. Alberts Tal.: Molecular Biology of the cell .Garl andPubl. New York.

Course Outcomes (COs) of Molecular Biology:

After completing this course, students will be able to:

CO1.Understand Nucleic Acid Structure & Function – Explain the molecular structure, organization, and function of DNA, RNA, and proteins.

CO2.Describe Genetic Mechanisms – Demonstrate knowledge of DNA replication, repair, recombination, transcription, and translation processes in prokaryotic and eukaryotic cells.

CO3.Analyze Gene Expression & Regulation – Explain the regulatory mechanisms of gene expression and their role in cellular function and development.

CO4.Interpret Molecular Signaling & Cell Regulation – Evaluate the molecular basis of signal transduction, cell cycle regulation, and programmed cell death (apoptosis).

CO5.Apply Molecular Biology Techniques – Utilize key laboratory techniques such as PCR, gel electrophoresis, cloning, blotting techniques, and sequencing.

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	2	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	0	1	0	2	1	0	1	1
	1.8	2.0	1.2	1	1.5	1.6	1.6	1.2	2	1.4

Practical(P-2)

1. Study of specimens : Amphioxus, Balanoglossus, Ascidian, Petromyzon, Myxine, Electric ray, Sea horse,Sawfish,Sucker fish, Hammer headed shark, Salamander,Hyla,Hemidactylus,Mabuia, Varanus, Turtle, Tortoise, Chameleon, Draco, Cobra, Viper, sea-snake, Krait, Parrot, Cuckoo, Kite, Myna, Flying fox, Duck-billed Platypus, Echidna.
2. Study of bones: 1. Toad or Frog-skull, lower jaw, pectoral & pelvic girdles, vertebrae 2.Calotes- skull, lower jaw, pectoral & pelvic girdles, atlas and axis. 3. Pigeon -lower jaw, cervical vertebrae, rib, pectoral and pelvic girdles and pygostyle. Rabbit -skull, lower jaw, pectoral and pelvic girdles.
3. IdentificationofDNAusingUV-VisibleSpectroscopy
4. Identification of RNA using UV- Visible Spectroscopy
5. Identification of Protein using UV-Visible Spectroscopy
6. Quantification of DNA using DPA methods
7. Quantification of RNA using Orcinol methods

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Semester-III

Core Course(C-5): Endocrinology

Course Objectives of Endocrinology:

1. To provide a fundamental understanding of the endocrine system, including the structure and function of endocrine glands.
2. To explore the biosynthesis, secretion, and mechanism of action of hormones.
3. To study the regulation of physiological processes by hormones, including growth, metabolism, reproduction, and homeostasis.
4. To analyze the interactions between the endocrine system and other physiological systems in maintaining body functions.
5. To understand hormone signaling pathways and their role in cellular communication.

Unit I:

1.1 Endocrine glands: Definition of endocrine, Paracrine and Autocrine system.
1.2 Neurosecretory cells
1.3 Significance of endocrine and neuro-endocrine system.
1.4 Classification of hormone

Unit II:

2.1 Structure of Hypothalamus
2.2 Structure of pituitary gland
2.3 Hormones of pituitary glands and their functions
2.4 Disorders of pituitary gland hormones

Unit III

3.1 Structure of Thyroid Gland–Biosynthesis of Thyroid Hormones
3.2 Biological functions of Thyroxin
3.3 Regulation of Thyroid Secretion
3.4 Thyroid Dysfunction-parathyroid Glands

Unit IV:

4.1 Biological Action of parathyroid Hormones–parathyroid Dysfunction.
4.2 Structural features–Hormones of Adrenal Cortex
4.3 Biological Action of Adrenaline and Noradrenaline–Emergency Hormones.
4.4 Islets of Langerhans: Insulin and their functions

Unit V:

5.1 Male Reproductive system–Hormonal control of Testes
5.2 Chemistry of Testosterone–Functions of Testosterone
5.3 Female Reproductive system-Role of Hormones in Female Sexual cycle
5.4 Placental Hormones– parturition-Lactation.

References:

1. Rastogi, S.C. Essentials of Animal Physiology. Wiley Eastend
2. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. 9th Edn., Elsevier, a division of Reed Elsevier India Pvt., Ltd.

Course Outcomes (COs) of Endocrinology:

After completing this course, students will be able to:

CO1.Understand Endocrine Gland Functions – Explain the structure, function, and regulation of endocrine glands and their hormones.

CO2.Describe Hormone Biosynthesis & Mechanisms – Demonstrate knowledge of hormone synthesis, secretion, transport, and mechanisms of action.

CO3.Analyze Hormonal Regulation of Physiology – Explain the role of hormones in metabolism, growth, reproduction, and homeostasis.

CO4.Interpret Hormone Signaling Pathways – Evaluate the molecular mechanisms of hormone-receptor interactions and intracellular signaling.

CO5.Assess Endocrine Disorders – Identify major endocrine disorders, their pathophysiology, symptoms, diagnostic approaches, and treatment strategies.

CO PO MAPPING MATRIX

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

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Semester-III

Core Course (C-6): Immunology

Course Objectives of Immunology:

1. To provide a fundamental understanding of the immune system, including its organs, cells, and molecules.
2. To explore the mechanisms of innate and adaptive immunity and their roles in host defense.
3. To study the structure, function, and interactions of antigens, antibodies, and immune receptors.
4. To analyze immune responses, including humoral and cell-mediated immunity.
5. To understand the molecular basis of immune signaling pathways and immune regulation.

Unit I:

1.1 Immunity :Introduction
1.2 Cells of immune system
1.3 Cells and organs of Immune system (Primary and Secondary Lymphoid organs)
1.4 Hematopoiesis.

Unit II:

2.1 Types of Immunity –Innate and acquired.
2.2 Basic properties of antigens
2.3 Band T cell epitopes, haptens, and adjuvants.
2.4 Structure, function and types of an antibody.

Unit III:

3.1 Monoclonal antibodies and their production
3.2 Antigen-antibody interactions as tools for research and diagnosis.
3.3 T- Cell and B-Cell activation.
3.4 Humoral and Cell mediated immunity.

Unit IV:

4.1 Structure and functions of major histocompatibility complex.
4.2 Basic properties and functions of Cytokines
4.3 Elementary idea of Complement system
4.4 Interferon: Definition and uses

Unit V:

5.1 Basic idea of Hypersentivity
5.2 Concept of Autoimmunity
5.3 Immuno deficiency :AIIDS
5.4 Introduction to Vaccines and types of Vaccines.

References:

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
2. Delves,P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.
3. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
4. Delves,P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.

Course Outcomes (COs) of Immunology:

After completing this course, students will be able to:

CO1.Understand the Components of the Immune System – Explain the structure and function of immune organs, cells, and molecules.

CO2.Describe Innate & Adaptive Immunity – Differentiate between innate and adaptive immune responses and their roles in host defense.

CO3.Analyze Antigen-Antibody Interactions – Explain the structure, function, and significance of antigens, antibodies, and immune receptors.

CO4.Explain Immune Response Mechanisms – Describe humoral and cell-mediated immunity and their roles in protecting the body from infections.

CO5. Interpret Immune Signaling & Regulation – Evaluate immune signaling pathways and their role in immune activation and regulation.

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	0	2	0	0	1	1
CO4	1	1	1	2	1	2	1	2	1	1
CO5	2	0	0	1	2	1	0	0	1	1
AVR	1.8	1.4	1.4	2.2	1.2	1.4	1.2	1.6	1.4	1.4

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Semester-III

Course Objectives of Principle of Ecology:

1. To provide a fundamental understanding of ecological principles, including interactions between organisms and their environment.
2. To study the structure and function of ecosystems, including energy flow, nutrient cycles, and ecological succession.
3. To explore population ecology, community ecology, and species interactions such as competition, predation, and symbiosis.
4. To analyze the impact of environmental factors on biodiversity, species distribution, and ecological balance.
5. To understand the principles of conservation biology and sustainable resource management.

Core Course (C-7): Principle of Ecology

Unit I:

1.1 Basic concepts of Ecology: Definition, significance, Concepts of habitat and ecological niche.
1.2 Factors affecting Environment: Abiotic factors (light-intensity, quality and duration), temperature, humidity, topography; edaphic factors; biotic factors.
1.3 Population Growth Kinetics :Growth models
1.4 Population Interactions: Neutralism, Mutualism, Commensalism, Competition, Amensalism, Predation, Parasitism.

Unit II:

2.1 Ecosystem: Types structure and function
2.2 Factors affecting ecosystem: Biotic and Abiotic factors
2.3 Energy flow in Ecosystem
2.4 Ecological Pyramids: Pyramid of number, Pyramid of Biomass and Pyramid of energy

Unit III:

3.1 Fresh water habitat
3.2 Marine habitat
3.3 Terrestrial habitat
3.4 Biodiversity: Natural resources and their conservation with special reference to forests

Unit IV:

4.1 Air pollution and its control.
4.2 Water pollution and its control
4.3 Domestic and industrial sewage treatment plants, BOD and COD of water
4.4 Greenhouse effect and global warming, Ozone depletion, Causes of deforestation and reforestation

Unit V:

5.1 Wild life conservation and Wild life protection act
5.2 Endangered species of India
5.3 National parks and Sanctuaries of India
5.4 Urbanization and effect of human population on environment.

References:

1. Elements of Ecology–T.H .Smith and R.L.Smith
2. Ecology: Principles and Applications–J.L. Chapman &M.J.Reiss (CambridgeUniv.Pr.)

Course Outcomes (COs) of Principle of Ecology:

After completing this course, students will be able to:

CO1.Understand Ecological Principles – Explain fundamental ecological concepts, including ecosystem structure, energy flow, and biogeochemical cycles.

CO2.Analyze Population & Community Dynamics – Interpret population growth models, species interactions, and community structure.

CO3.Evaluate Ecosystem Functioning – Assess ecological succession, food webs, trophic levels, and nutrient cycling.

CO4.Examine Biodiversity & Conservation – Identify factors affecting biodiversity and apply conservation strategies for ecosystem sustainability.

CO5.Assess Human Impact on the Environment – Analyze issues such as pollution, climate change, habitat destruction, and their ecological consequences.

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	0
CO3	1	1	1	0	2	2	0	1	0	1
CO4	0	1	1	2	1	2	1	2	1	1
CO5	2	1	0	1	2	1	0	0	1	1
AVR	1.8	1.4	1.4	2.2	1.2	1.4	1.1	1.4	1.4	1.2

Practical(P-3)

1. Determination of Blood group and Rh factor of Blood.
2. Separation of Plasma from RBC
3. Effects of isotonic, hypotonic and hypertonic solutions on erythrocytes
4. Counting of RBC using Hemocytometer
5. Counting of WBC using Hemocytometer
6. Estimation of hemoglobin percentage of a blood sample
7. Coagulation of blood timing
8. Recording of frog's heartbeat
9. Antigen–Antibody interaction (ELISA methods)
10. Demonstration of immune-electrophoresis
11. Study of ecosystem of a pond.
12. Identificationofbioticandabioticcomponentsaffectingthepondecosystem
13. Estimation of turbidity, temperature and pH of pond water.
14. Estimation of air pollution on local flora and fauna of heavily populated area.

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Semester-IV

Core Course (C-8):Genetics

Course Objectives of Genetics:

1. To provide a fundamental understanding of the principles of heredity and variation.
2. To study the structure, function, and organization of genes, chromosomes, and genomes.
3. To explore the molecular mechanisms of DNA replication, transcription, translation, and gene regulation.
4. To analyze patterns of inheritance and genetic interactions in classical and modern genetics.
5. To understand the role of mutations, genetic recombination, and chromosomal aberrations in evolution and diseases.

Unit I:

1.1 Elements of heredity & variation
1.2 Mendel's laws of inheritance, Monohybrid and dihybrid cross, their significance and current status
1.3 Gene interaction: Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy
1.4 Pedigree analysis

Unit II:

2.1 Environmental effects on phenotypic expression of the organisms
2.2 Multiple Alleles: Coat Colour in mice, ABO Blood group in man, Rh factor
2.3 Linkage and crossing over: Cytological basis of crossing over, Molecular mechanism of crossing over
2.4 Recombination: Types and significance

Unit III:

3.1 Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy
3.2 Gene mutations: Induced versus Spontaneous mutations
3.3 Molecular basis of Mutations
3.4 Mutagens and its types

Unit IV:

4.1 Chromosome theory in sex determination
4.2 Genic balance theory of sex determination, X/A ratio in Drosophila
4.3 Chromosomal mechanisms of sex determination in mammals, Grasshoppers, birds and Man
4.4 Variation in chromosomal number: haploidy, diploidy, polyploidy, aneuploidy

Unit V

5.1 Genetic disorder in Human beings (Down's, Turner's, Klinefelter's)
5.2 Transposons in bacteria
5.3 Ac-Ds elements in maize and P-elements in Drosophila
5.4 Transposons in humans

References:

1. Principles of Genetics–R.H. Tamarin (McGraw Hill)
2. Genetics –M.W. Strickberger (Macmillam)

Course Outcomes (COs) of Genetics:

After completing this course, students will be able to:

CO1.Understand Genetic Principles – Explain the fundamental concepts of heredity, variation, and Mendelian and non-Mendelian inheritance patterns.

CO2.Describe Gene Structure & Function – Analyze the organization, structure, and function of genes, chromosomes, and genomes.

CO3.Explain Molecular Mechanisms – Demonstrate knowledge of DNA replication, transcription, translation, and gene regulation processes.

CO4. Interpret Genetic Mutations & Variations – Assess the role of mutations, recombination, and chromosomal aberrations in genetic diversity and diseases.

CO5. Apply Genetic Techniques – Utilize molecular and classical genetics techniques, including PCR, DNA sequencing, gene editing, and genetic mapping.

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	3	2	1	2	2	2	2	2	2	2
CO4	1	1	3	1	0	2	1	2	2	1
CO5	1	1	0	3	2	1	0	3	1	1
AVR	1.6	1.4	1.4	1.6	1.2	1.4	1.2	1.6	1.6	1.4

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Semester-IV

Core Course(C-9): Evolution

Course Objectives of Evolution:

1. To provide a fundamental understanding of evolutionary theories and the mechanisms driving evolution.
2. To explore the historical development of evolutionary thought from Darwinism to modern evolutionary synthesis.
3. To analyze the role of genetic variation, natural selection, mutation, genetic drift, and gene flow in evolution.
4. To study patterns of evolution, including speciation, adaptive radiation, and co-evolution.
5. To understand the molecular basis of evolution through comparative genomics and phylogenetics.

Unit I:

1.1 Origin of Life: Introduction
1.2 Theories of origin of life
1.3 Biological evolution
1.4 Experimental proof of biological evolution

Unit II:

2.1 Theories of Evolution: Lamarckism
2.2 Objections of Lamarckism's theory and Neo-Lamarckism
2.3 Theories of Evolution: Darwinism
2.4 Objections of Darwinian Theory

Unit III:

3.1 Natural selection: Stabilizing selection, Directional selection
3.2 Mutation theory: Hugo De Vries theory
3.3 Biological species concept: Advantages and Limitations
3.4 Modes of speciation (Allopatric, Sympatric)

Unit IV:

4.1 Geneflow/Gene Migration, Genepool: Effect on population
4.2 Extinction: Mass extinction (Causes, Names of five major extinct species)
4.3 Role of extinction in evolution
4.4 Hardy-Weinberg Law

Unit V:

5.1 Significance of Hardy-Weinberg Law in evolution
5.2 Definition and scope: Founder effect, Genetic drift
5.3 Evidences of evolution: Divergent and Convergent evolution
5.4 Origin and Evolution of man

References:

1. Introduction to Evolution–P.A. Moody (Kalyani Pub.)
2. Life: Origin, Evolution and Adaptation–S. Chattopadhyay (Books&AlliedPub.)

Course Outcomes (COs) of Evolution:

After completing this course, students will be able to:

CO1.Understand Evolutionary Theories – Explain the principles of evolution, including Darwinism, Neo-Darwinism, and modern evolutionary synthesis.

CO2.Analyze Mechanisms of Evolution – Describe the role of natural selection, genetic drift, gene flow, and mutation in shaping genetic diversity.

CO3.Interpret Patterns of Evolution – Explain processes such as speciation, adaptive radiation, convergent and divergent evolution.

CO4.Examine Molecular & Genetic Basis of Evolution – Analyze evolutionary relationships using molecular genetics, phylogenetics, and comparative genomics.

CO5. Evaluate Fossil & Biogeographical Evidence – Assess the fossil record, biogeographical patterns, and anatomical evidence supporting evolution.

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	3	2	1	2	0	2	2	2	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	1.6	1.4	1.4	1.6	1.1	1.4	1.2	1.6	1.4	1.4

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Semester-IV

Core Course (C-10): Cell Biology

Course Objectives of Cell Biology:

1. To provide a fundamental understanding of the structure and function of cells as the basic unit of life.
2. To explore the organization of prokaryotic and eukaryotic cells, including cellular organelles and their functions.
3. To study the molecular mechanisms of cellular processes such as cell division, cell signaling, and transport across membranes.
4. To understand the principles of cellular metabolism, including energy production and enzyme function.
5. To analyze the regulation of gene expression and the role of the nucleus in cellular activities.

UNIT-I:

1.1 History of cell biology, Different types of cells
1.2 Introduction to cell theory
1.3 Prokaryotic cells (Bacteria, Viruses, Viroids, Mycoplasma, Prions)
1.4 Eukaryotic cells, Difference between Prokaryotic and Eukaryotic cell

UNIT-II:

2.1 Structure and function of plasma membrane
2.2 Structure and function of Golgi body, ER, Lysosomes.
2.3 Structure and function of mitochondria, Ribosome, Centriole.
2.4 Structure and function of Nucleus and Nucleolus.

UNIT-III:

3.1 Structure and functions of typical chromosomes
3.2 Basic concept of Chromatin and Heterochromatin
3.3 Structure and functions of Lampbrush and polytene Chromosome
3.4 Satellite DNA and its significance.

UNIT-IV:

4.1 Basic feature of Cell cycle
4.2 Cell cycle and its control
4.3 Mitosis and its significance
4.4 Meiosis and its significance.

UNIT-V:

5.1 Introduction to Apoptosis
5.2 Introduction to Necrosis
5.3 Difference between Apoptosis and Necrosis with example
5.4 Elementary idea of cancer

References:

1. Cell Biology –G.M. Cooper (Sinauer)
2. The World of Cell–W.M. Becker, L.J. Kleinsmith, J. Hard

Course Outcomes (COs) of Cell Biology:

After completing this course, students will be able to:

CO1.Understand Cell Structure & Function – Explain the organization and functions of prokaryotic and eukaryotic cells, including cellular organelles.

CO2.Analyze Cellular Processes – Describe fundamental cellular mechanisms such as membrane transport, cell signaling, and cell division.

CO3.Interpret Cellular Metabolism – Explain the biochemical pathways involved in energy production, enzymatic activity, and metabolic regulation.

CO4.Evaluate Gene Expression & Regulation – Analyze the role of the nucleus, chromatin organization, and gene regulation in cellular function.

CO5.Examine the Cytoskeleton & Cell Motility – Assess the role of cytoskeletal components in cell shape, movement, and intracellular transport.

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	3	2	1	2	2	2	2	2	2	2
CO4	0	1	3	1	0	2	1	0	0	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	1.6	1.4

Practical(P-4)

1. Study of mimicry in insects and animals: stick insect, leaf insect, moth, cicada, sea horse, flat fish, remora, flying lizard, bat etc.
2. Study of different types of nests of animals.
3. Study of parental care
4. Study of migrating bird
5. Study of new variety of organisms in your locality
6. Comparative study between Convergent and Divergent evolution
7. Study of sex-linked disorders in mammals
8. Demonstration of sex chromatin (Barr body)
9. Study of life cycle of fruit fly
10. Temporary preparation of the salivary gland chromosomes of Drosophila
11. Study of slides of Bacterial cell
12. Study of slides of unicellular cell-Amoeba, Paramecium
13. Study of various stages of cell division through permanent slides Mitosis and Meiosis
14. Preparation of Mitotic Slides from onion root tips.
15. Study of Blood cells through slides preparations
16. Study of barr body through slide preparation from hair follicle/cheek cells of female.

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Semester-V

Core Course (C-11): Animal physiology: life sustaining systems

Course Objectives of Animal Physiology:

1. To provide a fundamental understanding of the physiological processes in animals, including humans.
2. To study the structure and function of various organ systems, such as the nervous, circulatory, respiratory, digestive, excretory, and endocrine systems.
3. To explore the mechanisms of homeostasis and physiological regulation in different environmental conditions.
4. To analyze the neurophysiological basis of sensory perception, movement, and behavior.
5. To understand metabolic pathways, energy balance, and thermoregulation in animals.

Unit I:

1.1 Components of blood and their functions
1.2 Structure and functions of hemoglobin
1.3 Haemostasis: Blood clotting system
1.4 Blood groups: Rh factor, ABO

Unit II:

2.1 Structural organization and functions of gastrointestinal tract and associated glands
2.2 Mechanical and chemical digestion of food: Absorptions of carbohydrates and lipids.
2.3 Digestion and absorption of proteins, water, minerals and vitamins
2.4 Hormonal control of secretion of enzymes in gastrointestinal tract

Unit III:

3.1 Histology of trachea and lung: Mechanism of respiration, pulmonary ventilation; Respiratory volumes and capacities.
3.2 Transport of oxygen and carbon dioxide in blood.
3.3 Carbon monoxide poisoning, respiratory pigments, dissociation curves and the factors influencing it.
3.4 Control of respiration.

Unit IV:

4.1 Structure of kidney and its functional unit
4.2 Mechanism of urine formation
4.3 Regulation of water balance
4.4 Regulation of acid-base balance

Unit V:

5.1 Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers
5.2 Cardiac cycle, Cardiac output and its regulation
5.3 Electrocardiogram
5.4 Blood pressure and its regulation

References:

1. Comparative Animal Physiology –C.L. Prosser and F.A. Brown (Saunders)
2. General and Comparative Physiology–W.S. Hoar (PHI)

Course Outcomes (COs) of Animal Physiology:

After completing this course, students will be able to:

CO1.Understand Organ System Functions – Explain the structure and function of major physiological systems, including nervous, circulatory, respiratory, digestive, excretory, and endocrine systems.

CO2.Analyze Homeostasis & Regulation – Describe the mechanisms of homeostasis and how physiological processes are regulated under different conditions.

CO3.Interpret Neurophysiological Processes – Explain the functioning of the nervous system, sensory perception, and motor control in animals.

CO4.Evaluate Metabolism & Energy Balance – Analyze metabolic pathways, thermoregulation, and energy production in animals.

CO5.Examine Hormonal Regulation – Assess the role of hormones in coordinating physiological functions and maintaining internal stability.

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

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Semester-V

Core Course (C-12):Biotechnology

Course Objectives of Biotechnology:

1. To provide a fundamental understanding of the principles and applications of biotechnology.
2. To study the structure, function, and manipulation of genetic material in various organisms.
3. To explore modern biotechnological techniques such as genetic engineering, recombinant DNA technology, and genome editing.
4. To understand microbial, plant, and animal biotechnology and their industrial applications.
5. To analyze bioprocess engineering, fermentation technology, and the production of biopharmaceuticals.

Unit I:

1.1 Introduction to Genetic engineering
1.2 History of Genetic engineering
1.3 Scope of Genetic engineering
1.4 Importance of Genetic Engineering in modern era of Biotechnology

Unit II:

2.1 Methods used in Genetic Engineering
2.2 Tools Used in Genetic engineering
2.3 Different enzymes used in Genetic engineering
2.4 Gel Electrophoresis methods used in Genetic Engineering

Unit III:

3.1 DNA isolation from bacteria
3.2 Plasmid isolation from bacteria
3.3 Vectors: Plamids, Cosmids, Phagemids: Application as a vector Asavector
3.4 *E.coli:* A good host

Unit IV:

4.1 Techniques employed to insert the gene of interest into the host,
4.2 Agrobacterium mediated Gene Transfer in Plants
4.3 Identification and Selection of rDNA.
4.4 Construction of cDNA.

Unit V:

5.1 PCR: Introduction and application in Biotechnology
5.2 PCR: Types
5.3 Expression of cloned genes in host and purification of expressed proteins from host (Insulin).
5.4 Genetically modified organisms (Dolly).

References:

1. Genetic Engineering –P.S. Verma & V.K. Agarwal (S.Chand)
2. Introduction to Biotechnology- W.J. Thieman and M.A. Palladino(Pearson)
3. Introduction to Biotechnology- W.J. Thieman and M.A. Palladino (Pearson)

Course Outcomes (COs) of Biotechnology:

After completing this course, students will be able to:

CO1.Understand the Fundamentals of Biotechnology – Explain the core principles and interdisciplinary nature of biotechnology.

CO2.Analyze Genetic Engineering Techniques – Demonstrate knowledge of recombinant DNA technology, gene cloning, and genome editing tools like CRISPR.

CO3.Apply Biotechnology in Healthcare – Assess the role of biotechnology in producing vaccines, biopharmaceuticals, and gene therapy.

CO4.Evaluate Agricultural Biotechnology – Explain the applications of genetically modified organisms (GMOs), biofertilizers, and pest-resistant crops.

CO5. Examine Industrial & Environmental Biotechnology – Analyze the use of microbes in bioprocessing, waste management, biofuels, and bioremediation.

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	0	0	2
CO4	1	2	3	1	3	0	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.4	1.4	1.2	1.6	1.4

Practical(P-5)

1. Extraction of DNA from bacteria
2. Extraction of DNA from plants
3. Extraction of plasmid DNA from bacteria
4. Separation of DNA using Gel-Electrophoresis
5. Extraction of proteins from legumes
6. Protein separation using SDS-PAGE
7. Determination of blood pressure using sphygmomanometer
8. Determination of blood group.

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Semester-V

Discipline Specific Effective (DSE-1): Economic Zoology

Course Objectives of Economic Zoology:

1. To provide an understanding of the economic significance of various animal species in human welfare.
2. To study beneficial animals such as bees, silkworms, fishes, and their role in industries like apiculture, sericulture, and aquaculture.
3. To explore the impact of harmful animals, including pests and parasites, on agriculture, livestock, and human health.
4. To analyze the role of animal husbandry, poultry farming, and dairy farming in economic development.
5. To understand fisheries and aquaculture practices and their contributions to food security and the economy.

Unit I:

1.1 Classification and Biology of Honey Bees
1.2 Social Organization of Bee Colony
1.3 Selection of Bee Species for Apiculture
1.4 Methods of Extraction of Honey (Indigenous and Modern)

Unit II:

2.1 Exotic and Endemic species of Aquarium Fishes
2.2 Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish
2.3 Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator
2.4 General Aquarium maintenance - budget for setting up an Aquarium Fish Farm as a Cottage Industry

Unit III:

3.1 Types of silk worms, Distribution and Races
3.2 Exotic and indigenous races
3.3 Mulberry and non-mulberry Sericulture
3.4 Life cycle of *Bombyx mori*

Unit IV:

4.1 Selection of mulberry variety and establishment of mulberry garden Pests of silkworm
4.2 Rearing house and rearing appliances used in silkworm
4.3 Disinfectants: Formalin, bleaching powder, RKO
4.4 Silkworm rearing technology: Early age and Late age rearing

Unit V:

5.1 Pests of silkworm
5.2 Diseases: Protozoan, viral, fungal and bacterial
5.3 Control and prevention of pests and diseases
5.4 Prospectus of Sericulture in India

References:

1. B. Vasanth raj David and T. Kumaraswami 1982. Elements of Economic Entomology, Popular book depot, Chennai.
2. Nayar, K.K., Ananthakrishnan, T.N. and B.V. David, V 1992. General and Applied Entomology Tata McGraw, New Delhi

Course Outcomes (COs) of Economic Zoology:

After completing this course, students will be able to:

CO1.Understand the Scope of Economic Zoology – Explain the importance of zoological resources in human welfare and economic development.

CO2.Analyze Beneficial & Harmful Animals – Identify economically significant animals, including beneficial species (e.g., bees, silkworms, fishes) and harmful species (e.g., pests, parasites).

CO3.Evaluate Apiculture & Sericulture – Demonstrate knowledge of beekeeping and silk production, their economic importance, and management practices.

CO4.Explain Aquaculture & Fisheries – Assess the principles of fish farming, pearl culture, and their role in the economy and food security.

CO5.Understand Poultry & Dairy Farming – Describe the management and economic significance of

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	0	0	2
CO4	1	2	3	1	3	0	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.4	1.4	1.2	1.6	1.4

Practical:5

1. Identification and comment on the economic importance of the following: *Millepora sp*., *Pinctadasp, Schistocercasp* .,*Penaeussp*. ,*Pheretimasp*., *Sepiasp.,Schizothoraxsp.,Paasp*.,*Ithaginiscruentus* and *Bosgrunniens*.
2. Field trip to studyApiculture/Sericulture/Pisciculture/CropfieldsofCardamom/Rice/Maize.

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Semester-VI

Core Course(C-13): Developmental Biology

Course Objectives of Developmental Biology:

1. To provide a fundamental understanding of the principles and processes of embryonic and post-embryonic development.
2. To explore the cellular and molecular mechanisms involved in gametogenesis, fertilization, and early embryogenesis.
3. To study the stages of organogenesis, morphogenesis, and differentiation in various organisms.
4. To analyze the role of genes and signaling pathways in development, including pattern formation and axis specification.
5. To examine the influence of environmental factors and maternal effects on development.

Unit I:

1.1 Basics of embryology: Historical review and types of embryology
1.2 General idea of asexual and sexual reproduction
1.3 An introduction to animal development in sexually reproducing animals (Reproductive system)
1.4 Neuroendocrine regulation of reproductive organs: estrous and menstrual cycles

Unit II:

2.1 Gametogenesis: spermatogenesis and oogenesis
2.2 Ultrastructure of sperm and Ovum
2.3 Eggs: Structures and Types
2.4 Fertilization: In-vitro fertilization and parthenogenesis

Unit III:

3.1 Fertilization in mammals
3.2 Fertilization in Chick
3.3 Fertilization in Seaurchin
3.4 Polyspermy

Unit IV:

4.1 Types and pattern of cleavage
4.2 Cleavage pattern in animals: Blastulation and Gastrulation, development of three germinal layers in animals
4.3 Metamorphosis: Tadpole larvae
4.4 Regeneration

Unit V:

5.1 Fate of Germ Layers;
5.2 Vitellogenesis
5.3 Extra-embryonic membrane in chick
5.4 Placenta: Structure, type and function

References:

1. Developmental Biology–S. Gilbert (Sinauer)

2. Developmental Biology–R.M. Twyman

Course Outcomes (COs) of Developmental Biology:

After completing this course, students will be able to:

CO1.Understand the Principles of Development – Explain key concepts of embryonic and post-embryonic development in various organisms.

CO2.Describe Gametogenesis & Fertilization – Analyze the processes of sperm and egg formation, fertilization, and zygote formation.

CO3.Explain Embryonic Development Stages – Interpret the stages of cleavage, gastrulation, neurulation, and organogenesis.

CO4. Analyze Genetic & Molecular Regulation – Evaluate the role of genes, transcription factors, and signaling pathways in development.

CO5. Examine Morphogenesis & Differentiation – Understand how cells acquire specialized functions and contribute to tissue and organ formation.

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	1	1	1	1
CO3	1	1	1	3	2	3	2	0	0	2
CO4	1	2	0	1	0	0	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.2	2	2	1.2	1.2	1.2	1.6	1.4

B.Sc. (Honours.) Zoology
Semester-VI

Core Course (C-14): Biostatistics

Course Objectives of Biostatistics:

1. To provide a fundamental understanding of statistical concepts and their applications in biological sciences.
2. To introduce methods of data collection, organization, and presentation in biological research.
3. To explore various statistical measures such as central tendency, dispersion, probability distributions, and hypothesis testing.
4. To analyze different statistical techniques used in experimental design and data interpretation.
5. To understand the application of correlation, regression, and analysis of variance (ANOVA) in biological studies.

Unit I:

1.1 Biostatistics- Definition and Scope
1.2 Collection, Classification and Tabulation of data
1.3 Presentation of Data: Diagrams and graphs: bar, pie Histogram, linegraph.
1.4 Frequency curves-Ogives.

Unit II:

2.1 Calculation of Mean
2.2 Calculation of Mode
2.3 Calculation of Median
2.4 Calculation of Range

Unit III:

3.1 Standard deviation
3.2 Calculation of Variance
3.3 Standard error and its calculation
3.4 Test of Significance: Basic concept, Levels of significance, test of significance,

Unit IV:

4.1 Correlation: Definition, Types of correlation
4.2 Regression: Definition, Types of correlation
4.3 Correlation and Regression analysis
4.4 Karl Pearson's coefficient to correlation

Unit V:

5.1 Types of hypothesis- Null hypothesis and Alternate hypothesis
5.2 Probability: Definition and scope
5.3 Probability theorem
5.4 Chi-square test

References:

1. Statistics–N.G. Das (Central)
2. Basic Statistics–A.M. Goon, M.K. Gupta & B. Dasgupta (WorldPr.)

Course Outcomes (COs) of Biostatistics:

After completing this course, students will be able to:

CO1. Understand Fundamental Statistical Concepts – Explain the principles of biostatistics and their applications in biological sciences.

CO2. Collect & Organize Data – Demonstrate methods for data collection, classification, and presentation using tables, graphs, and charts.

CO3. Apply Descriptive Statistics – Calculate and interpret measures of central tendency (mean, median, mode) and dispersion (variance, standard deviation).

CO4. Use Probability & Distributions – Analyze biological data using probability concepts and probability distributions (normal, binomial, Poisson).

CO5.Perform Hypothesis Testing – Conduct statistical tests such as t-tests, chi-square tests, and ANOVA to make data-driven conclusions.

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		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

B.Sc. (Honours.) Zoology

Semester-VI

Discipline Specific Effective (DSE-3): Wild Life Conservation and Management

Course Objectives of Wildlife Conservation:

1. To provide an understanding of the principles and importance of wildlife conservation and biodiversity management.
2. To study the ecological roles of wildlife and their interactions with ecosystems.
3. To analyze the causes of wildlife depletion, including habitat destruction, climate change, and human activities.
4. To explore conservation strategies such as protected areas, wildlife corridors, and sustainable management practices.
5. To understand the legal and policy frameworks related to wildlife protection at national and international levels

Unit I:

1.1 Values of wildlife- positive and negative
1.2 Importance of conservation of Wildlife
1.3 Study of causes of depletion of Wildlife
1.4 World conservation strategies

Unit II:

2.1 Habitat analysis: Topography, Geology, Soil and water
2.2 Biological Parameters: food, cover, forage, browses and covers estimation
2.3 Advancing the successional process
2.4 Standard evaluation procedures: remote sensing and GIS

Unit III:

3.1 Preservation of general genetic diversity
3.2 Restoration of degraded habitats
3.3 Estimation of carrying capacity; Ecotourism/wild life tourism in forests
3.4 Wild life conservation in India: (In-situ conservation and ex-situ conservation)

Unit IV:

4.1 Management planning of wild life in protected areas
4.2 Care of injured and diseased animal
4.3 Important features of protected areas in India
4.4 Protected areas National parks & sanctuaries

Unit V:

5.1 Population estimation: Natality, Birthrate, Mortality, fertility schedules and sexratio
5.2 National Organizations involved in wildlife conservation
5.3 Tiger reserves in India
5.4 Management and challenges in Tiger reserve.

Reference Books:

1. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The Wildlife Society, Allen Press.
2. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences

Course Outcomes (COs) of Wildlife Conservation:

After completing this course, students will be able to:

CO1. Understand the Principles of Wildlife Conservation – Explain the significance of wildlife conservation and its role in maintaining biodiversity and ecosystem balance.

CO2 Analyze Ecological Interactions – Assess the ecological roles of wildlife species and their interactions within ecosystems.

CO3.Identify Threats to Wildlife – Evaluate the impact of habitat destruction, climate change, poaching, and human activities on wildlife populations.

CO4 Explore Conservation Strategies – Describe various conservation approaches, including protected areas, national parks, wildlife corridors, and sustainable management.

CO5 Examine Legal & Policy Frameworks – Understand national and international laws, conventions, and policies related to wildlife conservation (e.g., CITES, Wildlife Protection Act).

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

Practical(P-6)

1. Identification of mammalian fauna/avian fauna of any protected area
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field: Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for fauna
5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

GENERIC ELECTIVE COURSES (GE1)

ANIMAL CELL BIOTECHNOLOGY

UNIT1: Introduction: Concept and Scope of Biotechnology

Unit II: Techniques in Gene manipulation: Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes.

Unit III: Transformation techniques: microbial, plants and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium Phosphate Precipitation method.

UNIT IV: Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting

Unit V: Biosafety: Physical and Biological containment.

References:

1. B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint2001).
2. T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science(2001).

Practical

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E.coli.*
4. Plasmid DNA isolation (pUC18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and HindIII.

GENERIC ELECTIVE COURSES (GE2)

ANIMAL DIVERSITY

Unit I: Protista: General characters of Protozoa; Life cycle of Plasmodium

Unit II: Porifera: General characters and canal system in Porifera

Unit III: Aceolomates: General characters of Helminthes; Life cycle of *Taeniasolium*.

Unit IV: Pseudocoelomates: General characters of Nemethehelminthes; Parasitic adaptations

Unit V: Arthropoda: General characters. Social life in insects.

References:

1. Barnes, R.D.(1992).Invertebrate Zoology. Saunders College Pub. USA
2. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt.Ltd.

Practical:

1. Study of following specimens: Non Chordates: Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, , Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Antedon. Chordates: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds-(Crow, duck, Owl), Squirrel and Bat.
2. Study of following Permanent Slides: Cross section of Sycon, Sea anemone and Ascaris (male and female).T.S. of Earthworm passing through pharynx, gizzard, and t\intestine.Bipinnaria and Pluteus larva

GENERIC ELECTIVE COURSES (GE3)

AQUATIC BIOLOGY

Unit I: Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

Unit II: Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes- Nitrogen, Sulphur and Phosphorous.

Unit III: Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

Unit IV: Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

Unit V: Different stages of stream development, Physico-chemical environment, Adaptation of hill-streamfishes.

References:

1. Trivedi and Goyal: Chemical and biological methods for water pollution studies
2. Goldman: Limnology, 2nd Edition

Practical:

1. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
2. Determine the amount of Turbidity/transparency, Dissolved Oxygen, and Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake / water body.
3. A Project Report on a visit to a Sewage treatment plant/Marine bio-reserve/Fisheries Institutes

GENERIC ELECTIVE COURSES (GE 4)

ENVIRONMENT AND PUBLIC HEALTH

Unit I: Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

Unit II: Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health.

Unit III: Air, water, noise pollution sources and effects, Pollution control.

Unit IV: Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, biomedical waste handling and disposal, nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy.

Unit V: Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid.

References:

1. Cutter, S.L., Environmental Risk and Hazards, Prentice – Hall of India Pvt. Ltd., NewDelhi, 1999.
2. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V.N.University Press, New York, 2003.

Practical:

1. To determine pH, turbidity, fluoride and Cl, in soil and water samples from different locations.

Ability Enhancement Compulsory Course

(AECC– Environment Studies)

Unit 1: Ecosystems

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession.

Unit 2: Natural Resources: Renewable and Non-renewable Resources

- Deforestation: Causes and impacts due to mining, dam building on environment.
- Water: Use and over---exploitation of surface and ground water, floods, drought.
- Energy resources: Renewable and non-renewable energy sources.

Unit 3: Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; biodiversity hot spots
- Threats to biodiversity, Conservation of biodiversity: In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 4: Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.

Unit 5: Environmental Policies & Practices

- Global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air(Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Hought on Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.

AbilityEnhancementCompulsoryCourse

(AECC–EnvironmentStudies)

Unit1: Ecosystems

Whatisanecosystem?Structureandfunctionofecosystem; Energyflowinanecosystem: food chains, food webs and ecologicalsuccession.

Unit2:NaturalResources:RenewableandNon---renewableResources

- Deforestation:Causesandimpactsduetomining,dambuildingonenvironment.
- Water:Useandover---exploitationofsurfaceandgroundwater,floods,drought.
- Energyresources:Renewableandnonrenewableenergy sources.

Unit3:Biodiversityand Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; biodiversity hot spots
- Threats to biodiversity, Conservation of biodiversity: In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit4:EnvironmentalPollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclearhazardsandhumanhealthrisks
- Solidwastemanagement:Controlmeasuresofurbanandindustrialwaste.

Unit5:EnvironmentalPolicies&Practices

- Global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- EnvironmentLaws:Environment Protection Act; Air(Prevention& Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. Internationalagreements: Montreal and Kyoto protocols and Convention onBiologicalDiversity(CBD).

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