

Syllabus
First Year

Course Code	: ZOODC101			
Course Name	: Non-Chordata			
Semester	: I Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. To provide students with an informative and engaging introduction to the animal kingdom, covering its fundamental concepts, diversity, and classification.
2. To enable students to classify and organize animals based on key biological criteria, including body plan, levels of organization, symmetry, germ layer origin, and other diagnostic features.

COURSE CONTENT

UNIT I

Salient features and outline classification (up to orders) of various Non-chordate Phyla and related type study and topics as covered under respective Phyla.

UNIT II

Protozoa: Amoeba and Paramecium with particular reference to locomotion, nutrition, osmoregulation, and reproduction.

Porifera: *Sycon* with reference to structure, reproduction, and development. Canal system and affinities of Porifera.

Coelenterates: *Aurelia* with reference to structure, reproduction, and development. Polymorphism in Coelenterates. A brief account of Corals and Coral reefs.

UNIT III

Helminthes: Taxonomy, morphology (including adaptations), life cycle, pathogenicity, and control measures of *Fasciola*. Parasitic adaptations in Helminthes.

Annelida: *Nereis*- External features, excretory organs, and reproduction. Metamerism in Annelida: Its Origin and Significance. Trochophore larva and its significance. Parasitic adaptations in Hirudinaria.

UNIT IV

Arthropoda: *Palaemon*- External features and reproduction. *Peripatus*- Its distribution and Zoological importance.

Mollusca: *Pila*- External features, Organs of Pallial complex. Reproduction. A brief account of torsion in Gastropoda.

Echinodermata: *Asterias*- External features. Water vascular system. Mode of feeding and reproduction.

Suggested books:

1. Barnes: Invertebrate Zoology (4th ed.), Holt- Saunders, 1980.
2. Hickman, Roberts & Hickman: Integrated Principles of Zoology (7th ed.)- mirror, Mosby
3. Kotpal, R.L: Modern Textbook of Zoology
4. Invertebrates. Rastogi, V.B. (2007).
5. Nigam: Biology of Non-Chordates, Nagin Chand.
6. Parker, T.J. & Haswell, WA: Textbook of Zoology Vol I & II, McMillan.
7. Hyman L: Invertebrate Series, Academic Press

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the various non-chordates and chordates based on their characteristics and body organization, as well as their classification.
CO2	Discuss the diversity and various adaptations found in vertebrates and invertebrates.
CO3	Classify the Invertebrates based on the modifications in their body plan, organization, symmetry, etc.
CO4	Investigate the structural and functional aspects of various body systems in the Invertebrates.
CO5	Conclude the various characteristics and morphological adaptations in animal diversity.
CO6	Generate the order of evolution of the Invertebrates based on adaptation and their various characteristics.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	3	2	1	1	2	2	2	2	3	2	1	3
CO2	3	1	2	2	3	2	1	2	2	2	2	2	3	2	1	3
CO3	3	1	2	2	3	2	2	1	2	3	2	3	3	3	2	3
CO4	3	2	3	2	3	2	1	1	2	2	2	2	3	2	1	3
CO5	3	3	2	2	3	2	1	3	2	2	2	2	3	2	2	3
CO6	3	3	2	2	3	2	2	1	2	2	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL102			
Course Name	: Lab Course Based on ZOODC101			
Semester	: I Semester			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objective of this course is

1. Students will be able to identify animals based on their taxonomic features
2. Students will be able to understand the significance of taxonomic keys and the diversity of nonchordates and chordates.

COURSE CONTENT

Phylum Protozoa: Amoeba, Euglena, Plasmodium, Paramecium.

Phylum Porifera: Sycon (including T.S. and L.S.), Hyalonema, and Euplectella.

Phylum Cnidaria: Obelia, Physalia, Aurelia, Tubipora, Metridium.

Phylum Platyhelminthes: Taenia solium and Study of its life history stages.

Phylum Nematelminthes: Male and female *Ascaris lumbricoides*.

Phylum Annelida: Aphrodite, Nereis, Pheretima, Hirudinaria.

Phylum Arthropoda: Palaemon, Cancer Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis.

Phylum Mollusca: Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus.

Phylum Echinodermata: Pentaceros, Ophiura, Echinus, Cucumaria, and Antedon

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the animal with its taxonomic keys and characteristics.
CO2	Illustrate the taxonomic keys as characteristics of Invertebrates.
CO3	Apply the taxonomic keys for Album creation, depicting the diversity of animals.
CO4	Compare the taxonomic keys as characteristics using a diagram.
CO5	Conclude the significance of taxonomic keys in the animal kingdom.
CO6	Discover the evolution of taxonomic keys as an adaptation tool.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	2	1	1	2	2	2	2	3	2	1	2
CO2	3	2	3	3	3	3	1	1	2	2	2	2	3	2	1	2
CO3	3	1	2	2	3	1	2	1	2	3	2	3	2	2	2	3
CO4	3	2	3	3	3	3	1	2	2	2	2	2	3	3	1	3
CO5	3	2	3	2	3	3	1	1	2	2	2	2	3	3	2	2
CO6	3	2	3	3	3	3	2	1	2	2	2	2	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester- II

Course Code : ZOODC201				
Course Name : Chordata				
Semester : II Semester				
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

COURSE OBJECTIVES: The objectives of this course are

1. To provide knowledge about chordates, their classification, structure, and functional biology.
2. To explain the evolutionary transition from simple to complex body organization, emphasizing the role of division of labour among cells, tissues, and organ systems.
3. To examine the adaptations that enable the survival and success of diverse, large, and complex life forms in different environments.

COURSE CONTENT**UNIT I**

Salient features and outline classification (up to order) of various chordate groups as covered under respective taxonomic groups.

UNIT II

Protochordata: Systematic position and salient features of body organization and affinities. Agnatha: External features and affinities of Cyclostomes.

Pisces: Systematic position. Scales and fins in fish. Parental care and Migration in fishes. Economic importance of Fish.

UNIT III

Amphibia: General characters, Classification and affinities (including Gymnophiona). Parental care in Amphibia.

Reptilia: General Characters and Classification. Poisonous and non-poisonous snakes. Snake venom & anti-venom. Adaptive radiation in reptiles. Adaptations of reptiles to desert life.

UNIT IV

Aves: Flightless birds and their distribution. Flight adaptations in birds. Modification of Beaks, Feet, and Palate in Birds.

Mammalia: General organisation, distribution, and affinities of Prototheria. Economic importance. Adaptive radiation with particular reference to aquatic mammals. Dentition in Mammals.

Suggested books:

1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford University Press.
2. Pough H. Vertebrate Life, VIII Edition, Pearson International.
3. Kotpal, R.L.: Modern Text-book of Zoology, Vertebrates. Rastogi Publication, 2007
4. Jordan, E.L. and P.S. Verma: Chordate Zoology. S. Chand & Co. Ltd., 2013
5. Hildebrand, M. Goslow, G.: Analysis of Vertebrate Structure, Wiley, 1998
6. Romer, A.S., T.S. Parsons: Vertebrate Body, Saunders (W.B.) Co Ltd; 5th Revised edition, 1977.
7. Pandey, B.N., Mathur, V. Biology of Chordates. PHI Learning Pvt. Ltd., Delhi, 2019

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the salient features and fundamentals of Chordata, including their organization, distribution, adaptive radiation, and economic importance.
CO2	Discuss the systematic position, general organization, and evolutionary affinities of Protochordata and Euchordata.
CO3	Illustrate various Amphibians and Reptiles, including Parental care in amphibians, poisonous & non-poisonous snakes.
CO4	Explain the flight adaptations, parental care, and migratory behaviors in various birds, and assess the evolutionary significance of flightless birds within Aves.
CO5	Assess the ecological & economic importance, and adaptation from protochordates to mammals.
CO6	Integrate knowledge of chordate adaptive radiation and evolutionary trends to compare morphological, ecological, and behavioral adaptations across major groups from protochordates to mammals.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2	2	1	1	2	2	2	2	1	2	1	2
CO2	1	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2
CO3	1	2	1	2	2	2	2	1	2	3	2	3	2	2	1	2
CO4	2	2	2	2	2	2	1	3	2	2	2	2	2	3	2	2
CO5	3	3	2	3	2	2	3	1	2	2	2	2	2	3	3	3
CO6	2	2	2	2	2	2	1	2	2	2	2	2	2	3	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL202			
Course Name	: Lab Course Based on ZOODC201			
Semester	: II Semester			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. To identify the diversity, distribution, and abundance of Chordata.
2. To identify the poisonous and non-poisonous snakes.

COURSE CONTENT

Protochordata: Balanoglossus, Herdmania, Branchiostoma.

Agnatha: Petromyzon.

Pisces: Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla,

Amphibia: Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla.

Reptilia: Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis

Key for Identification: poisonous and non-poisonous snakes.

Aves: Study of common birds from different orders.

Mammalia: Sorex, Bat, Funambulus, Loris, Platypus, Opossum, Kangaroo, Manis, Dolphin, Whale, Polar Bear (Photographs)

An “animal album” containing photographs and cut-outs, with an appropriate write-up about the above-mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose. These need not be repeated as drawings by the album maker.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the diversity and distribution of Chordata.
CO2	Interpret the behaviour of Pisces and Amphibians.
CO3	Carry out a taxonomic study of various specimens of Chordates.
CO4	Collection/Demonstration, identification, and classification of various specimens of Chordates.
CO5	Evaluate the permanent slides of the Chordates.
CO6	Learn and study the life cycle of various Chordates.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	2	1	1	2	2	2	2	3	2	1	2
CO2	3	2	3	3	3	3	2	1	2	2	2	2	3	2	1	2
CO3	3	1	2	2	3	1	1	2	2	3	2	3	2	2	2	3
CO4	3	2	3	3	3	3	2	1	2	2	2	2	3	3	1	3
CO5	3	2	3	2	3	3	1	2	2	2	2	2	3	3	2	2
CO6	3	2	3	3	3	3	1	1	2	2	2	2	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated.

Second Year

Course Code	: ZOODC301			
Course Name	: Molecular Biology			
Semester	: III Semester			
			P	C
			0	3

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. Students can understand the structure and function of RNA and DNA.
2. Students will come to know about several techniques by which DNA is damaged and get repaired
3. Students will learn how transcription and regulation of genes occur in eukaryotes and prokaryotes.

COURSE CONTENT**UNIT I**

DNA as genetic material: Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication.

UNIT II

DNA damage and repair: Causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanisms.

RNA structure and types of RNA: RNA and its types, t-RNA, r-RNA, m-RNA

Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, longation, and termination of RNA chains.

UNIT III

Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics. Ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. , Post-translational modifications of proteins.

Suggested books:

1. Molecular Cell Biology, Lodish et al., W.H. Freeman and Company, New York, USA.
2. Molecular Biology of the Cell, Alberts et al., Taylor and Francis Group, New York, USA.
3. De- Robertis- Cell and Molecular Biology.
4. Verma, P.S. and Agrawal, V.K. Molecular Biology
5. Tortora- Microbiology and Introduction.
6. Parija- Textbook of Microbiology.
7. Pelczar: Microbiology, Tata McGraw-Hill.
8. Davis: Microbiology Harper & Row, Publ. Inc.

Course Outcomes (COs): Upon successful completion of the course, a student will be able

CO1	Identify the structure of DNA and RNA in prokaryotes and eukaryotes.
CO2	Explain the process of DNA damage and repair.
CO3	Demonstrate the process of transcription in eukaryotes.
CO4	Create how RNA and DNA synthesis are similar and different.
CO5	Prove that DNA is the genetic material and histological studies of various organs.
CO6	Formulate a plan for how RNA is regulated in prokaryotes and eukaryotes.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	2	2	2	3	2	2	2	2	2	2	1	3
CO2	3	2	2	3	3	2	1	3	2	2	2	2	2	1	1	3
CO3	3	2	2	3	2	2	1	3	2	3	2	3	2	2	2	3
CO4	3	2	2	3	3	2	2	3	2	2	2	2	2	1	1	3
CO5	3	2	3	3	3	2	1	3	2	2	2	2	2	2	1	3
CO6	3	2	2	3	2	2	1	3	2	2	2	2	2	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOODL302				
Course Name : Lab Course Based on ZOODC301				
Semester : III Semester				
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. Students will be able to extract DNA from a given sample.
2. Students will be able to understand the DNA & RNA structures.

COURSE CONTENT

1. Demonstration of DNA/RNA structure with the help of a chart/model.
2. To study the structure and types of DNA/RNA with the help of a chart.
3. To determine the molecular size of DNA
4. Nucleic acid and protein sequence database.
5. Data mining for sequence analysis.
6. To study the normal human karyotype.
7. To study chromosomal abnormalities.
8. To study the various human pedigrees.
9. To identify different amino acids in a mixture using paper chromatography.
10. Demonstration of DNA extraction from blood or tissue samples.
11. To estimate the amount of DNA using a spectrophotometer

Suggested Readings:

1. Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001)

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Describe the structure of DNA and RNA in prokaryotes and eukaryotes.
CO2	Explain the process of DNA damage and repair, and concepts of Toxicology.
CO3	Demonstrate the process of transcription in eukaryotes by a chart/ model.
CO4	Compare the similarities and differences between RNA and DNA synthesis using a diagram/chart.
CO5	Prove that DNA is the genetic material of various organs.
CO6	Formulate a plan for how RNA is regulated in prokaryotes and eukaryotes, including a diagram.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	2	1	1	2	2	2	2	3	2	2	3
CO2	3	2	2	2	2	2	1	1	2	2	2	2	3	2	2	3
CO3	3	2	2	2	2	2	1	1	2	3	2	3	3	2	2	3
CO4	3	2	2	2	3	1	1	1	2	2	2	2	3	2	2	3
CO5	3	2	2	2	3	2	1	1	2	2	2	2	3	2	2	3
CO6	3	2	2	2	2	2	1	1	2	2	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course Code	: ZOODC401			
Course Name	: EVOLUTIONARY BIOLOGY AND SYSTEMATICS			
Semester	: IV Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

COURSE OBJECTIVES: The objectives of this course are

1. To know about the origin of life.
2. To understand the Nomenclature and Taxonomy.

UNIT I

Concepts of organic evolution and evolutionary theories. Origin of life (including aspects of prebiotic environment and molecular evolution). Micro and macroevolution. Synthetic theory of evolution, Natural selection: Concept: Types of selection and selection coefficient.

UNIT II

Role of mutation in evolution. Speciation: Isolating mechanisms; Modes of speciation (allopatric, sympatric, parapatric).

UNIT III

Fossils and fossilization. Geological distribution of animals. Geological Time Scale. Evolution of Horse and Man.

UNIT IV

Introduction, scope, and History of animal taxonomy. Species concepts (Typological, Nominalistic, Biological, and Evolutionary). Linnean hierarchy. Zoological Nomenclature: ICZN; Taxon, Rank and Categories. Preparation of keys and museum preparation techniques.

Suggested readings:

1. Mayr: Animal Species and Evolution. Belknap Press, 1966.
2. Strick Berger: Evolution, (Indian Edition). CBS Publ., 1994.
3. Richard Swann Lull: Organic Evolution Seema Publications, 1976
4. Simpson G.G.: Principles of Animal Taxonomy, Columbia Univ. Press, 1961.
5. Mayr, E. Systematics and the Origin of Species, Columbia Univ. Press, 1942.
6. Blackwelder RE: Guide to the Taxonomic Literature of Vertebrates, Iowa State Univ. Press, 1972.
7. Moody: Introduction to evolution (Indian Edition) Kalyani Publ., 1978.
8. V.B.Rastogi; Organic Evolution, Kedar Nath Ram Nath Publication, Meerut.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the detailed and conceptual understanding of evolution and systematics
CO2	Interpret the various processes of molecular evolution and systematics.
CO3	Demonstrate the evolution and evolutionary theories. Life at the molecular level, taxonomy, and its principles
CO4	Compare the evolutionary outline & theories and taxonomy.
CO5	Distinguish the role of Evolution, and learn the Geological time scale.
CO6	Develop the Scope and history of animal taxonomy, molecular biology, and evolution.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	2	3	1	2	2	2	2	2	3	2	2	3
CO2	2	2	2	3	3	3	2	2	2	2	2	2	3	2	3	3
CO3	3	2	3	3	3	3	1	2	2	3	2	3	3	2	2	3
CO4	2	2	2	3	2	3	2	2	2	2	2	2	3	2	3	3
CO5	2	2	2	3	3	3	1	2	2	2	2	2	3	2	3	3
CO6	2	2	2	3	2	3	1	2	2	2	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL402			
Course Name	: Lab Course Based on ZOODC401			
Semester	: IV Semester			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. To know about Taxonomy and Nomenclature.
2. To understand processes of evolution.
3. To know about the Origin of life.
4. To understand the theories of Evolution.
5. To understand the Geological Time Scale.

COURSE CONTENT

1. To study Evolutionary theories.
2. To study the origin of life.
3. To study the Evolution of Horse and Man.
4. To study the Geological Time Scale.
5. To study the rules of Nomenclature in Taxonomy.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Recall the Evolutionary theories, origin of life, Geological time scale and nomenclature.
CO2	Discuss the origin of life, Geological time scale and nomenclature. Evolutionary theories, etc.
CO3	Discuss the conceptual understanding of evolution and systematics and evolution of Horse and Man.
CO4	Examine the various Evolutionary theories, origin of life and its , Geological time scale .
CO5	Appraise the application of the conceptual understanding of evolution and systematics.
CO6	Write about the study of Evolutionary theories, origin of life, the Geological time scale and nomenclature.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	2	1	1	2	2	2	2	3	2	1	3
CO2	3	2	3	2	2	2	1	1	2	2	2	2	3	2	1	3
CO3	3	2	3	2	2	2	2	1	2	3	2	3	3	2	2	3
CO4	3	2	3	2	2	3	1	2	2	2	2	2	3	2	1	3
CO5	3	2	3	2	3	3	2	1	2	2	2	2	3	2	2	3
CO6	3	2	3	2	3	3	1	1	2	2	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Third Year (Degree in Bachelor of Science) Semester V

Course code	: ZOODC501			
Course Name	: BIOCHEMISTRY AND ANIMAL PHYSIOLOGY			
Semester	: V Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

COURSE OBJECTIVES: The objectives of this course are

1. To know about the physiology of animals.
2. To understand physiological processes (Digestion, Respiration, Excretion, Cardiovascular system, Nervous system) in animals.
3. Student will gain knowledge about enzyme, their function, mechanism and regulation.
4. To understand the metabolism of carbohydrates.

COURSE CONTENT**A. PHYSIOLOGY****Unit 1: Nutrition and digestion:**

Nutrition, Digestion in different segments of the alimentary canal; Absorption of carbohydrates, proteins, lipids.

Unit 2: Respiration and Cardiovascular System:

Pulmonary ventilation, Respiratory volumes and capacities, respiratory pigments Transport of Oxygen and carbon dioxide in blood, Structure of the Heart. Composition of Blood, blood coagulation, cardiac cycle. Cardiac Cycle.

Unit 3: Excretion, Nerve and Muscle:

Concept of ammonotelic, ureotelic, and uricotelic animals, Structure of nephron, mechanism of Urine formation in mammals. Structure of a neuron, resting and action potential of nerves. Ultrastructure of skeletal muscle, Mechanism of muscle contraction.

B. BIOCHEMISTRY**Unit 4: Carbohydrate Metabolism:**

Glycolysis, Krebs cycle, gluconeogenesis, glycogenesis, glycogenolysis.

Enzymes and Vitamins:

Naming and Classification of Enzymes, Mechanism of Enzyme Action, Inhibition & Regulation. Vitamins: Types, sources and deficiencies.

Suggested books:

1. Ganong: Review of Medical Physiology, Lang Medical Publ.
2. Guyton and Hall; Textbook of Medical Physiology WB Saunders.
3. Keel et al: Sampson Wright's Applied Physiology, Oxford Press.
4. C.C. Chatterjee: Human Physiology.
5. Nielson: Animal Physiology, Cambridge.
6. Jain A.K.: Textbook of Physiology, Avical Publishing Company.
7. Conn and Stumpf: Outlines of Biochemistry, John Wiley.
8. Pandey B.N: Zoology Series- Biochemistry, Physiology, Endocrinology, Tata McGraw Hill Edu Pvt Ltd, New Delhi.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	List the various organ systems based on their characteristics and the mechanism of absorption in the animal world.
CO2	Explain the functioning of various components of organ systems found in the animal world and its biochemical aspects.
CO3	Demonstrate the Structural morphology of biological phenomena (respiration, digestion, excretion, reproduction) and its biochemical aspects.
CO4	Compare the peculiarity of organs within the animal and its biochemical aspects.
CO5	Conclude the morphological changes among the organs.
CO6	Formulate and combine the modifications within the organ system.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	2	1	1	2	2	2	2	3	2	2	3
CO2	3	2	3	2	2	2	2	2	2	2	2	2	3	2	1	3
CO3	3	2	3	2	2	2	1	1	2	3	2	3	3	2	1	3
CO4	3	2	3	2	2	3	2	2	2	2	2	2	3	2	2	3
CO5	3	2	3	2	3	3	1	2	2	2	2	2	3	2	1	3
CO6	3	2	3	2	3	3	1	1	2	2	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 502			
Course Name	: LAB COURSE BASED ON ZOODL501			
Semester	: V Semester			
	L	T	P	C
	0	0	2	1

COURSE OBJECTIVE

1. Students will be able to perform, analyze & report experiments and observations in physiology and biochemistry.
2. Students will be able to examine various organ slides and the various histological sections of mammals.
3. Students will develop the temperament to apply and effectively communicate scientific reasoning and data analysis.

COURSE CONTENT

1. Estimation of hemoglobin using Sahli's haemoglobinometer
2. Preparation of hemin and haemochromogen crystals
3. Counting of RBCs and WBCs using a Haemocytometer
4. Recording of blood pressure using a sphygmomanometer
5. Recording of blood glucose level by using glucometer.
6. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell.
7. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
8. Qualitative analysis of carbohydrates, proteins & lipids.
9. Action of salivary amylase under optimum conditions.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	State the various histological slides of animals. Find the lipids, carbohydrates, and protein in a given solution.
CO2	Describe the given slides based on their characteristics. Blood test, Proteins, lipids, and carbohydrates estimation in a given sample.
CO3	Demonstrate the serological experiment (Hb %, RBC, WBC, etc.). Various histological slides of animals and implement various biochemical experiments.
CO4	Examine the slides of various organs. Serological experiment and biochemical experiments.
CO5	Evaluate the histological slides, serological experiment and biochemical experiments.
CO6	Formulate the salient features of the physiological slides and biochemical assay.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	2	1	2	2	2	2	2	3	3	2	3
CO2	3	2	3	2	2	2	2	2	2	2	2	2	3	3	2	3
CO3	3	2	2	2	2	1	1	2	2	3	2	3	3	3	2	3
CO4	3	3	3	2	2	2	2	1	2	2	2	2	3	3	1	3
CO5	3	2	2	2	2	1	1	2	2	2	2	2	3	3	2	3
CO6	3	2	3	2	2	2	2	1	2	2	2	2	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODC601			
Course Name	: CELL BIOLOGY			
Semester	: VI Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives

1. To understand the cell structure and its components.
2. To know about the function of cells.
3. To know about the disease of cancer.

Course Content:

UNIT-I

Theories on the Origin of Cells and the Cell as a Unit of Life. Prokaryotic and eukaryotic cells; Plasma membrane: ultrastructure, chemical composition, models of the plasma membrane; specializations and functions of the plasma membrane.

UNIT-II

Structure and Functions of Cellular Organelles: Mitochondria, ribosomes, lysosomes, centrioles, Golgi complex, endoplasmic reticulum, nucleus, nucleolus, and cytoskeleton.

UNIT-III

Molecular Aspects of Cell Division: Cell cycle and its regulation. Cancer and its types, Programmed Cell Death, Oncogenes, and Tumor Suppressor Genes.

UNIT-IV

An overview of cell transformation, Cancer and its types, Programmed Cell Death, Oncogenes, and Tumor Suppressor Genes.

Reference Books

1. Lewin, B. (1998). *Genes VII*. Oxford University Press.
2. Strachan, T., & Read, A.P. (1999). *Human Molecular Genetics*. John Wiley & Sons.
3. De Robertis, E.D.P., & De Robertis, E.M.F. (1987). *Cell and Molecular Biology*. Lea & Febiger, Philadelphia.

Textbooks

1. Rastogi, V.B. (11th Revised Edition). *Introductory Cytology*. Ram Nath & Kedar Nath Publication, Meerut.
2. Rastogi, V.B. (9th Revised Edition). *A Textbook of Genetics*. Ram Nath & Kedar Nath Publication, Meerut.
3. Gupta, P.K. *Cell & Molecular Biology*.
4. Gupta, P.K. *Cytology, Genetics and Evolution*.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the cell structure, cell organelles, and cell cycle.
CO2	Summarize structural and functional aspects of the basic unit of life, i.e. Cell concepts, their structure, and function.
CO3	Execute the structural organization of all cell organelles and cell signaling.
CO4	Examine the composition of cell organelles, oncogenes, tumors, and apoptosis, and the structure and function of the Plasma membrane.
CO5	Evaluate whether Cancer (tumor) is an act of Mitosis or Meiosis.
CO6	Formulate the Molecular aspects of cell division, structure, and function.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	2	2	1	2	2	2	2	3	2	1	3
CO2	3	2	2	2	2	2	1	2	2	2	2	2	3	2	2	3
CO3	3	3	2	2	2	2	2	1	2	3	2	3	3	2	1	3
CO4	3	3	2	2	2	2	1	2	2	2	2	2	3	2	2	3
CO5	3	3	2	2	2	2	2	1	2	2	2	2	3	2	1	3
CO6	3	3	2	2	2	2	1	1	2	2	2	2	3	2	3	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course Code	: ZOODL 602			
Course Name	: Lab course based on ZOODC601			
Semester	: VI Semester			
	L	T	P	C
	0	0	2	1

Course Objectives: The objectives of this course are

1. Students will be able to learn about cell theory and gain knowledge about.
2. Students will also identify different cell organelles.

COURSE CONTENT

1. Study of mitosis and meiosis using available material.
2. Study of permanent slides showing various stages of mitosis and meiosis.
3. Study of various cell organelles based on their structure and functions.
4. Isolation of various cell organelles (Cell fractionation).

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the stages of cell division from the given slides.
CO2	Discuss the basic stages of mitosis and meiosis.
CO3	Demonstrate the structural and functional aspects of the basic unit of life i.e. cell division
CO4	Examine the structure and function of cell organelles based on their function.
CO5	Evaluate how various cell organelles can be isolated..
CO6	Formulate the Molecular aspects of cell division along with their cell organelles.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	2	2	2	1	2	2	2	2	3	2	1	3
CO2	3	2	2	3	2	2	1	2	2	2	2	2	3	2	1	3
CO3	3	2	2	3	2	2	3	1	2	3	2	3	3	2	2	3
CO4	3	2	2	2	2	2	1	2	2	2	2	2	3	2	1	3
CO5	3	2	2	3	2	2	2	1	2	2	2	2	3	2	2	3
CO6	3	2	2	3	2	2	1	1	2	2	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODC 701			
Course Name	: GENETICS			
Semester	: VII Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To know about the Inheritance of genes.
2. To understand the Mendelian Laws.
3. To know about the sex determination and chromosomes.

COURSE CONTENT

UNIT I

Genetics, Mendel's life, Pre-Mendelian experiments, symbols and terminologies, Laws of dominance, segregation, and independent assortment. Linkage: Coupling and repulsion hypothesis, Morgan's view of linkage, kinds of linkage, chromosome theory of linkage.

UNIT II

Crossing over: Somatic and germinal crossing over, kinds of crossing over, theories of the mechanism of crossing over, and significance.

UNIT III

Eukaryotic chromosomes- Structure, chemical composition, classification, and uninematic and multinemic concepts of chromosome structure. Structure and functions of polytene and lampbrush chromosomes. Fine structure of a gene. Determination of sex: chromosome mechanism, Genic balance theory, External environment, and sex determination.

UNIT IV

Sex-linked inheritance: Inheritance of X-linked gene (Colour blindness and hemophilia in man), Sex linkage in *Drosophila*. Mutation: Historical background, chromosomal mutation (Chromosomal aberrations), gene mutations, and their interpretation. Pedigree analysis in man, genetic disorder, cytoplasmic inheritance and extrachromosomal inheritance, Operon hypothesis.

Suggested books:

1. Strick Berger: Genetics, Prentice Hall.
2. Modern Genetics Analysis: Integrating Genes and Genomes, Griffith, J.F., Gelbart, M., Lewontin, C, and Miller, W.H. Freeman and Company, New York, USA.
3. Genetics, J Russell, Benjamin-Cummings Publishing Company, San Francisco, California, USA.
4. Lodish-et al, Molecular Biology
5. P.K. Gupta, Cell Biology and Genetics.
6. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
7. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Define the Mendelian law, chromosomes, gene mutation, organization of cell signaling, sex-linked inheritance, and genetic disorders.
CO2	Summarize Mendel's law and the deviations from conventional patterns of inheritance.
CO3	Implement the structural organization of cell signalling, sex-linked inheritance, and genetic disorders.
CO4	Analyze the terms Mutations and hypotheses. Sex-linked inheritance and genetic disorders.
CO5	Conclude the genetic disorder and mutation, and argue that Cancer (tumor) is an act of Mitosis or Meiosis.
CO6	Formulate the numerical problem of gene imbalance. Mitosis and Meiosis.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	3	2	2	2	2	2	2	3	2	2	3
CO2	3	1	2	2	3	3	1	2	2	2	2	2	3	2	3	3
CO3	3	2	2	2	3	3	2	2	2	3	2	3	3	2	2	3
CO4	3	1	2	2	2	3	1	2	2	2	2	2	3	2	3	3
CO5	3	2	2	2	3	3	2	2	2	2	2	2	3	2	3	3
CO6	3	1	2	2	2	3	1	2	2	2	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL702			
Course Name	: Lab Course Based on ZOODC701			
Semester	: VII Semester			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. To understand the Mendelian Laws.
2. To know about the disease of cancer.
3. To know about the genetic disorders.

COURSE CONTENT

1. Demonstration of the law of segregation using *Drosophila* mutants.
2. Study of the law of independent assortment.
3. To solve the numerical problem related to Mendel's law.
4. Preparation of polytene chromosomes.
5. Preparation of human karyotype and study of the chromosomal aberrations concerning number, translocation, deletion, etc., from the pictures provided. (Virtual/optional)
6. To prepare family pedigrees.
7. Study of the mutant phenotype of *Drosophila* by the chart.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Observe the numerical problem related to Mendel's law.
CO2	Interpret the various phases of chromosomal aberrations.
CO3	Explain and solve the problems related to Mendelian /modern genetics principles and laws.
CO4	Describe about various genetic theories (Mendel's laws and gene interactions) through suitable examples (genetic disorders, pedigree analysis, multiple alleles, etc.) Identify the traits of homology and analogy from the given specimen.
CO5	Associate the genetic data with the statistical tools (Chi-Square, etc.) and illustrate the origins of animal traits using specimens and charts.
CO6	Apply the gained knowledge and implement the relationship within the species regarding the trait's development.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	2	1	1	2	2	2	2	3	2	1	3
CO2	3	2	3	2	2	2	1	2	2	2	2	2	3	2	2	3
CO3	3	2	3	2	2	2	2	1	2	3	2	3	3	2	1	3
CO4	3	2	3	2	2	3	1	2	2	2	2	2	3	2	2	3
CO5	3	2	3	2	3	3	2	1	2	2	2	2	3	2	1	3
CO6	3	2	3	2	3	3	1	2	2	2	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODC801			
Course Name	: DEVELOPMENTAL BIOLOGY			
Semester	: VIII Semester			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. To understand the history and basic concepts of embryology
2. To understand detailed processes of Gametogenesis and Fertilization, Early embryonic development, Embryonic Differentiation and organogenesis, etc.
3. Students will be able to understand developmental phenomena.
4. To understand the molecular basis of development.

UNIT I**History and Gametogenesis**

Definition, scope & historical perspective of development Biology, Gametogenesis: Spermatogenesis and Oogenesis, including structure, differentiation, and longevity of gametes. Chemical and metabolic events during gamete formation. Types of eggs.

UNIT II

Fertilization: Significance of fertilization, approximation of gametes, Capacitation, Acrosome reaction, formation of fertilization membrane, egg activation, and amphimixis. Block of polyspermy. Parthenogenesis.

UNIT III**Early Embryonic Development**

Cleavage: Patterns & control of cleavage patterns, totipotency. Blastulation and Gastrulation: A complete study in frog/chick. Fate maps: their formation and significance. Foetal membranes: Their formation and functions.

UNIT IV**Embryonic Differentiation**

Embryonic Induction: Origin, structure, and significance of the organizer. Development of the Vertebrate Eye. Placentation in mammals. Metamorphosis: As exhibited by Amphibians etc. Regeneration: Morphallaxis and Epimorphosis, Blastema and its significance.

Suggested books:

1. Gilbert: Development Biology Sinauers Ass. Publ. Massachusetts.
2. Wolpert: Analysis of Biological development, Oxford.
3. Kolthoff, Analysis of Biological development, McGraw-Hill Science, New Delhi, India.
4. Balinsky: Introduction to Embryology Saunders Co. Philadelphia and London.
5. Berill: Development Biology Tata McGraw Hill.
6. PC Jain: Elements of Developmental Biology, Vishal Publication.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the basic concepts of developmental biology and organogenesis. Cellular differentiation, organizer and embryonic inductions, and eye morphogenesis.
CO2	Explain the basic concept of development and gamete formation.
CO3	Construct the various aspects concerning the early development.
CO4	Examine the concept of cellular differentiation, organizer and embryonic inductions, and eye morphogenesis.
CO5	Conclude the various stages of development in Drosophila and Sex determination in vertebrates and flies.
CO6	Develop the processes of metaplasia, transdifferentiation, and Metamorphosis.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	2	2	1	1	2	2	2	2	3	3	1	3
CO2	3	2	2	3	2	2	2	2	2	2	2	2	3	3	2	3
CO3	3	2	2	2	2	2	1	1	2	3	2	3	3	3	1	3
CO4	3	2	2	2	2	2	2	1	2	2	2	2	3	3	3	3
CO5	3	2	2	2	3	3	1	2	2	2	2	2	3	3	1	3
CO6	3	2	2	2	3	2	2	2	2	2	2	2	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 802			
Course Name	: Lab course based on ZOODC801			
Semester	: VIII Semester			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. Students will be able to learn and know about the developmental stages of the embryo of Vertebrates.
2. Students will be able to study the general patterns and sequential developmental stages during embryogenesis.

COURSE CONTENT:

1. **Study of developmental stages** (Insects/Amphibians/Mammals, etc.) - Whole mounts and sections (TS/LS) through permanent Slides, cleavage stages, blastula, gastrula, tail bud stage, tadpole external and internal Gill stages, etc.
2. **Study of the different types of placentae-** Histological sections through permanent slides or photomicrographs.
3. **Study of placental development:** Humans by ultrasound scans or photomicrographs.
4. **Examination of Gonads and gametes** (Amphibians/Mammals) Testis, Ovary, sperm, etc., through permanent slides or photomicrographs.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the various serological and biochemical tests.
CO2	Interpret the various toxicological tests.
CO3	Illustrate the permanent slides/ whole mount of the various developmental stages of chicks, Amphibians, Mammals, etc.
CO4	Examine the various permanent slides/Mounts.
CO5	Evaluate the biochemical test and serological test.
CO6	Construct new toxicological techniques.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	3	1	1	2	2	2	2	3	3	1	3
CO2	2	3	3	2	3	2	2	2	2	2	2	2	2	3	1	3
CO3	2	3	3	2	3	2	1	1	2	3	2	3	3	3	2	3
CO4	3	2	3	2	3	2	2	2	2	2	2	2	3	3	1	3
CO5	3	2	3	2	3	2	2	1	2	2	2	2	3	3	2	3
CO6	3	2	3	2	3	2	1	2	2	2	2	2	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODC801			
Course Name	: Endocrinology and Animal Behavior			
Semester	: VIII Semester			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES: The objectives of this course are

1. To know about the endocrine gland.
2. To understand the physiological actions of various hormones.
3. To understand the metabolic pathway of various hormones.
4. To understand the concept and fundamentals of animal behavior.

COURSE CONTENT

UNIT I

Hormones and Physiological actions of the following endocrine glands in vertebrates:

Pituitary, Thyroid, Parathyroid, Pancreas, Gastro-intestinal tract, Adrenal and Medulla,(Adrenal gland), Thymus & Pineal gland.

UNIT II

Hypo and Hypersecretion of Endocrine Glands:

Elementary knowledge of Dwarfism, Gigantism, Acromegaly, Diabetes insipidus, Goitre, Cretinism, Myxoedema, Diabetes mellitus, and Addison's disease.

UNIT III

Biosynthesis of Hormones:

Biosynthesis of protein hormones. Biosynthesis of steroid hormones.

Biosynthesis of Catecholamines. Biosynthesis of amino acid-derived hormones (Thyroid).

Mechanism of action of hormones.

UNIT IV

Behaviour and Communication:

Patterns of behavior: Innate behavior. Learned behavior: Hormonal control of Behavior.

Biological Communication: Chemical, Visual, Auditory, Electric and tactile, Dance language of honeybees,

Suggested Books:

1. Krebs & Davies : An introduction to behavioural ecology (3rd ed.) Blackwell 1993.
2. Mac E. Hadley: Endocrinology, Prentice-Hall International ed.1988/1992.
3. G J Goldsworthy et al: Endocrinology, Blackie, 1981.
4. Maurice Goodman: Basic and Medical Endocrinology, Raven Press.
5. ME Hadley: Endocrinology

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Define the hormones and their physiological actions, biosynthesis, and the concept and fundamentals of animal behavior.
CO2	Explain the concepts of endocrine systems, homeostasis, and their physiological actions of various hormones.
CO3	Illustrate the metabolic pathways of hormone biosynthesis and the mechanism of action.
CO4	Discover the various diseases from hormonal imbalance.
CO5	Evaluate the metabolic pathway of various hormones.
CO6	Construct the concept and fundamentals of animal behavior.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	1	1	2	3	2	2	2	2	3	2
CO2	3	3	2	3	2	2	2	2	2	3	3	3	2	2	3	2
CO3	2	2	2	2	2	2	1	1	2	3	2	2	2	2	3	2
CO4	2	1	1	2	2	2	2	2	1	2	1	2	2	1	1	2
CO5	1	2	1	2	2	2	2	1	2	2	1	2	1	1	1	2
CO6	1	2	1	2	2	2	1	2	2	2	1	2	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOOML 802			
Course Name	: Lab course based on ZOODC801			
Semester	: VIII SEMESTER			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. To know about the endocrine gland.
2. To understand the animal hormones

COURSE CONTENT

1. To identify different endocrine glands with the help of charts.
2. To study the histology of endocrine glands of animals with the help of slides.
3. To determine the concentration of glucose in the diabetic samples.
4. Isolation of hormones from different endocrine glands.
5. Study on various behavioral patterns of the animals.

Course Outcomes: Upon successful completion of the course, a student will be able to

CO1	Observe the localization of different endocrine glands in the animals, including humans.
CO2	Discover various diseases caused by the malfunctioning of different endocrine glands in human beings.
CO3	Examine the various permanent slides of different endocrine glands.
CO4	Conclude the identification of different endocrine glands by the Charts/ Model.
CO5	Case study based on diseases caused by endocrine glands.
CO6	Construct and study permanent slides of the different endocrine glands of the animals.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	3	2	3	2	2	3	1	1	3
CO2	2	2	2	2	2	2	2	3	2	3	3	3	2	2	1	3
CO3	3	2	3	2	2	3	2	3	2	3	2	2	2	2	2	3
CO4	2	2	2	2	2	3	1	2	1	2	1	2	2	2	1	3
CO5	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	3
CO6	2	3	2	2	2	2	2	2	2	2	1	2	2	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Discipline-Specific Elective Courses

Course code	: ZOODE 303			
Course Name	: Animal Ecology			
Semester	: III Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To know about Ecology and Environment.
2. To understand ecological principles

UNIT-I

Ecology: Definition, Scope, Importance, Application. Limiting Factors: Liebig's law of the minimum and Shelford's law of tolerance. Combined concept of limiting factor, Factor interaction. Homeostasis. Biogeochemical cycle: Concept & Types of biogeochemical cycle (nitrogen, phosphorus, carbon & water cycle).

UNIT-II

Ecosystem Concept: Abiotic and Biotic factors and their interdependence. Energy flow; Food chains & Ecological pyramids. Habitat Ecology: Concept of habitats & ecological niche.

UNIT III

Population: Concept & attributes: Biotic potential, Density, Natality, Mortality; Population growth forms; Carrying capacity; Community: Concept & characteristics: Density, Dominance, Diversity & Stratification. Environmental pollution (Air, water, solid waste, Radioactive); Environmental Impact Assessment.

UNIT IV

Population Ecology: Characteristics of a Population; Population Growth Curves; Population Regulation; Life History Strategies (r and k Selection); Concept of MetaPopulation – Demes and Dispersal, Interdemic Extinctions, Age Structured. Altruism (Hamilton's Rule).

Suggested Books:

1. Krebs: Ecology (4th ed.) Harper Collins College Publisher
2. Odum: Fundamentals of ecology, Saunders Co. Publ., 1993 Indian ed.
3. Odum: Basic ecology, Saunders Co. Publ., 1993 Indian ed.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Enumerate ecological laws, the Biogeochemical cycle, the Ecosystem, Food chains and food web, pollution, population, and biodiversity
CO2	Observe the concept of population, Community, and succession.
CO3	Applying knowledge about biodiversity & its importance
CO4	Analyze the economic valuation of biodiversity, environmental pollution, and wildlife conservation.
CO5	Evaluate the techniques in wildlife and population estimation.

CO6	Generate knowledge about pollution, population, and biodiversity.
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CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	2	2	2	3	2	2	2	2	3	2	1	3
CO2	3	2	2	3	2	2	2	3	2	2	2	2	3	3	2	3
CO3	3	3	2	3	3	3	2	3	2	3	2	3	3	2	1	3
CO4	3	3	3	3	2	3	1	2	2	2	2	2	3	3	2	3
CO5	3	3	2	1	2	2	2	2	2	2	2	2	3	2	1	3
CO6	3	3	2	1	2	2	2	2	2	2	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 304			
Course Name	: Lab course based on ZOODE303			
Semester	: III Semester			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. Students will learn various techniques used to count the animal's population in a community.
2. The student will learn how to perform various physicochemical parameters on soil and water.

COURSE CONTENT

1. Models based on different aspects of animal ecology.
2. Population study of available terrestrial and aquatic animals
3. Physicochemical study of soil and water

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Define the Biogeochemical cycle, Ecosystem, Food chains and food web, and biodiversity by chart.
CO2	Associate various biogeochemical cycles, pollution, and population estimation.
CO3	Apply the effect of the biochemical cycle on terrestrial and aquatic animals.
CO4	Examine with a diagram how biochemical cycles affect Soil and water physico-chemical parameters.
CO5	Evaluate various techniques used to count the animal's population in a community and prove which habitat is most prone to which biochemical cycle.
CO6	Formulate and put a plan by rewriting the soil and water physicochemical parameters with respect to various biogeochemical cycles.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	2	2	1	2	2	1	2	2	2	1	2	2
CO2	2	2	1	1	2	2	1	2	2	1	2	2	2	1	2	2
CO3	2	2	1	1	2	2	1	2	2	1	-	2	2	1	2	2
CO4	1	2	2	2	1	2	2	1	1	2	1	1	2	2	2	1
CO5	2	1	2	2	1	1	2	2	2	2	1	2	-	1	1	2
CO6	2	2	1	1	2	2	2	1	1	2	1	2	1	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE403			
Course Name	: Aquatic Biology			
Semester	: IV Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students will be able to learn about various water bodies, their origin and their management for better managing their resources.
2. Students will also be learning about freshwater bodies and marine water bodies.

COURSE CONTENT:

UNIT I

Aquatic Biomes: Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, marine benthic zone and coral reefs.

UNIT II

Freshwater Biology: Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physicochemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

UNIT III

Marine Biology: Salinity and density of Sea water, Continental shelf, Adaptations of deep-sea organisms, Coral reefs, Seaweeds.

UNIT IV

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

Suggested Books:

1. Sakhare V.B Aquatic Biology and Aquaculture (2008) Arjun Publication House.
2. Christopher Frid , Ecology of Aquatic Management (2013), Oxford Press.
3. Biology and Ecology of Aquatic Animals; Frost John SyraWood Publication House.
4. Ichthyology and Aquatic Biology; Curtis Rory SyraWood Publication House.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify and compare freshwater bodies with marine bodies of water.
CO2	Express the process of the creation of a lake and stream.
CO3	Demonstrate how marine animals have adapted themselves to survive in saline water.
CO4	Categorize the various challenges facing the water bodies.
CO5	Evaluate the Physicochemical characteristics of river, stream and Marine habitats
CO6	Generate the threats to aquatic biology and their management.

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	2	2	3	2	2	2	2	3	1	1	3
CO2	3	3	2	2	2	2	2	3	2	2	2	2	3	2	1	3
CO3	3	3	2	2	2	2	2	3	2	3	2	3	3	2	2	3
CO4	3	3	2	2	2	2	1	2	2	2	2	2	3	2	1	3
CO5	3	3	2	2	2	2	2	2	2	2	2	2	3	2	2	3
CO6	3	3	2	2	2	3	2	2	2	2	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOODL 404				
Course Name: Lab course based on ZOODE403				
Semester : IV Semester				
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVE: The objectives of this course are

1. Students can learn about the basics of creating and managing aquatic animals.
2. Students will come to know about several biomes.
3. Students will come to know about natural resources.

COURSE CONTENT

1. Population study of Terrestrial & aquatic animals
2. Study of Physicochemical parameters of water.
3. Study of several biomes by chart/model.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify Biosphere reserves, biodiversity and national parks by chart.
CO2	Associate various natural resources of water bodies.
CO3	Apply the effect of the biochemical cycle on the aquatic animal.
CO4	Examine with a diagram how biochemical cycles effect on water and physico-chemical parameters.
CO5	Evaluate various techniques used to manage biomes and aquatic animals.
CO6	Formulate and put a plan for the threats to water treatment & wastewater management.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	2	2	1	2	2	1	2	2	2	1	2	2
CO2	2	2	1	1	2	2	1	2	2	1	2	2	2	1	2	2
CO3	2	2	1	1	2	2	1	2	2	1	1	2	2	1	2	2
CO4	1	2	2	2	1	2	2	1	1	2	1	1	2	2	2	1
CO5	2	1	2	2	1	1	2	2	2	2	2	2	1	1	1	2
CO6	2	2	1	1	2	2	2	1	1	2	1	2	1	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE503			
Course Name	: Instrumentation, Computer Application, and Biostatistics			
Semester	: V Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3 Credits)

Course Objectives: The objectives of this course are

1. To provide scientific and computational knowledge related to various techniques associated with biology.
2. To impart laboratory skills for handling analytical tools in industry and research institutions.

COURSE CONTENT

UNIT I

Laboratory Safety Guidelines. Principles and applications of different types of Microscopy (Light microscope, Fluorescent microscope, Phase Contrast microscope, Scanning, and Transmission Electron Microscopy). Microtomy. Centrifugation: Principles, Types of Centrifuges. Principles & Applications of pH Meter and Spectrophotometer. Chromatographic Techniques: Paper Chromatography and Thin Layer Chromatography. Electrophoresis: Principles, types, and applications PAGE and Agarose gel electrophoresis.

UNIT II

Introduction to Computers: Computer Fundamentals (Hardware & Software), Input-Output Devices, Storage Devices, Memory Concepts, Web Browsers & Search Engines, Introduction to MS Office.

UNIT III

Introduction to Biostatistics, Applications of Statistics in Biological Research, Data Collection and Representation of Data (Pie Chart, Bar Diagram, Histogram, etc.).

UNIT IV

Measures of Central Tendency (Mean, Median, Mode), Standard Deviation, and Standard Error. Tests of Significance ('T' Test, & Chi-Square Test). Probability, Correlation and Regression Analysis, Introduction to Statistical Software and Handling (Excel Data Sheets).

Suggested Books:

1. Bioinformatics Basics: Applications in Biological Science and Medicine Lukas K. Buehler, Hooman H. Rashidi (2019) CRC Press
2. Fundamentals of Computers 2nd Edition Reema Thareja (2019) 2nd Edition Oxford Higher Education.
3. An Introduction to Biostatistics, Banerjee, P. (2007) S. Chand.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	State the scope of Computer and Biostatistics.
CO2	Associate the various computer toolkits needed to support biostatistics.
CO3	Apply the importance of Biostatistics as a tool in research.
CO4	Organise and outline the relation of Life science with computer and maths.
CO5	Conclude the various tools used for Data Analysis.
CO6	Integrate the use of various biostatistical tools with the software kit.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	2	2	3	2	1	2	2	3	2	1	3
CO2	3	2	2	1	2	2	2	3	2	1	2	2	3	1	1	3
CO3	3	2	2	1	2	2	2	3	2	1	1	2	3	2	1	3
CO4	3	2	2	1	2	2	1	2	1	2	1	1	3	2	1	3
CO5	3	2	2	1	2	2	2	2	2	2	1	2	3	2	1	3
CO6	3	2	2	1	2	2	2	2	1	2	1	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 504			
Course Name	: Lab course based on ZOODE503			
Semester	: V SEMESTER			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. Student will learn various instruments.
2. Students will learn how to use a computer in various fields of biostatistics.

COURSE CONTENT

1. To solve numerical problems related to biostatistics.
2. To study various instruments/tools in biological science.
3. Demonstrate and discuss the computer and its accessories.
4. Use of excel sheet for data processing.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Describe the structure and components of a computer and the field of biostatistics.
CO2	Interpret the use of Biostatistics to resolve various research problems.
CO3	Apply and discuss the computer and its accessories.
CO4	Categorize the various equipment and their use in biology.
CO5	Evaluate the application of various statistical methods/tools in biological Sciences.
CO6	Revise the study of various instruments/tools in biological science

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	2	1	2	2	2	2	3	3	3	2	3	2
CO2	3	3	2	2	2	2	2	2	2	2	3	3	3	3	3	2
CO3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2	2
CO4	3	3	2	2	2	2	2	3	2	2	3	3	2	2	3	2
CO5	3	3	2	2	2	2	2	2	2	3	3	3	3	2	3	2
CO6	3	3	2	2	2	2	2	3	3	2	3	3	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOODE 603				
Course Name : Reproductive Biology				
Semester : VI Semester				
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

Course Objectives: The objectives of this course are

1. Students can learn about basic of Reproductive endocrinology.
2. Students will come to know about the anatomy and physiology of male and female reproductive organs.
3. To develop an understanding about various Reproductive health issue, new scientific and latest techniques available in assisting and their contraceptive issues.

COURSE CONTENT:

UNIT I

Reproductive Endocrinology: Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

UNIT II

Functional anatomy of male reproduction: Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions: Sperm transportation in male tract.

UNIT III

Functional anatomy of female reproduction: Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation.

UNIT IV

Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET,

EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic

terminology used in family planning.

Suggested Books:

1. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
3. Austin, C.R. and Short, R.V. Reproduction in Mammals. Cambridge University Press.
4. Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Describe the Gonadal Hormone and their action mechanism and regulation of hormones.
CO2	Interpret the kinetics and hormonal regulation involved in spermatogenesis and oogenesis.
CO3	Demonstrate the role of Hormonal control during Male and female reproduction
CO4	Analyse the different Assisted Reproductive Technologies.
CO5	Evaluate the functional anatomy of the Gonadal hormone.
CO6	Generate and formulate the various issues concerning reproductive health and their remedies.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	3	3	2	3	2	2	3	3	3	3	1	1
CO2	2	3	2	3	3	3	2	3	2	2	3	3	3	3	1	1
CO3	2	3	2	3	3	3	2	3	2	2	2	3	3	2	1	1
CO4	2	3	3	3	3	3	1	2	2	2	3	3	3	3	2	3
CO5	3	3	2	2	3	2	2	2	2	3	3	3	3	2	2	2
CO6	3	3	2	2	3	3	2	2	3	2	3	3	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 604			
Course Name	: Lab course based on ZOODE603			
Semester	: VI Semester			
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVE: The objectives of this course are

1. Students can learn about the basics of creating and managing animal houses.
2. Students will come to know about several surgical techniques.
3. To develop a scientific attitude among student towards the endocrinology issues involved in their life.

COURSE CONTENT:

1. **Study of the animal house:** set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. **Examination of vaginal smear in rats from live animals.**
3. **Surgical techniques: principles of surgery in endocrinology:** Vasectomy, hysterectomy, castration and vasectomy in rats.
4. **Examination of histological sections from photomicrographs/ permanent slides of rat/human:** testis, epididymis and accessory glands of male reproductive systems; Sections of the ovary, fallopian tube, uterus (proliferative and secretory stages), cervix, and vagina.
5. **Human vaginal exfoliate cytology.**
6. **Sperm count and sperm motility in rat**
7. **Study of modern contraceptive device**

COURSE OUTCOMES (COs) : Upon successful completion of the course, a student will be able to

CO1	Find out the various operating processes involved in the maintenance of animal houses.
CO2	Discuss various histological sections of reproductive organs and Surgical techniques.
CO3	Apply the gained knowledge in demonstrating how animal houses can be managed.
CO4	Examine and comment on various histological sections from the given slide.
CO5	Evaluate Sperm count and sperm motility in rat and conclude and critique various slides of rat/humans.
CO6	Formulate all modern contraceptive devices with their pro and cons.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	3	2	2	3	3	3	1	1	3
CO2	2	2	2	2	2	2	2	3	2	2	3	3	2	2	1	3
CO3	3	2	3	2	2	3	2	3	2	2	2	3	2	2	1	3
CO4	2	2	2	2	2	3	1	2	2	2	3	3	2	2	1	3
CO5	2	2	2	2	2	2	2	2	2	3	3	3	2	2	1	3
CO6	2	3	2	2	2	2	2	2	3	2	3	3	2	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOODE 703				
Course Name : Basic Immunology				
Semester : VII Semester				
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

Course Objectives: The objectives of this course are

1. To know about the Immune system.
2. To understand Immunological principles and their role in Human Physiology.

UNIT I

Introduction and Historical Background: Cells and Organs of the Immune System

Immune System- Anatomical, Physiological, and Inflammatory Barriers. Hematopoiesis – Formation of B-Lymphocytes and T-Lymphocytes and Its Regulation. Cells of The Immune System- NK Cells, B Lymphocytes, Lymphoid Organs.

UNIT II

Antigen and Immunogen, Structure and Function of Immunoglobulins, Structure and Function of MHC

Antigen- Definition and Its Properties. Immunogen-Definition and Its Properties. Antigenicity Vs. Immunogenicity and Factors Affecting It. Basic Structure of Immunoglobulin. Classes of Immunoglobulin and Its Biological Activities. Major Histocompatibility Complex [MHC] - Structure, Types and Function. Regulation of MHC Expression.

UNIT III

Primary and Secondary Line of Defense [Innate and Acquired Immunity], Antigen-Antibody Interactions

Innate Immunity- Phagocytic Barriers. Antigen Presenting Cells. Antigen Processing and Presentation. Acquired Immunity- B-Cell Mediated Immunity, T-Cell Mediated Immunity, Its Mechanism and Regulation. Immune Memory of B-Lymphocytes. Structure of Antibody. Interaction of Antigen-Antibody-Antibody Affinity.

UNIT IV

Immune Effector Mechanism, Allergy, and Hypersensitivity

Cytokines- Properties and Its Receptors. The Complement System: Its Components, Functions, Activation and Regulation. Complement Deficiencies. Allergy and Hypersensitivity, [Type I, Type II, Type III].

Suggested readings

1. Roitt, Male & Brostoff: Immunology (3rd ed).
2. Elgert & Elgert: Immunology.
3. Kubly: Immunology (6th ed.).
4. SS Lal : Immunology: Rastogi Publication

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Knowledge of Cells and Organs of the Immune System.
CO2	Interpret Primary and Secondary Lines of Defence [Innate and Acquired Immunity] and antigen-antibody Interactions.
CO3	Execute Antigen and Immunogen, Structure and Function of Immunoglobulins, and Structure and Function of MHC.
CO4	Analyze Immune Effector Mechanism, Allergy, and Hypersensitivity.
CO5	Evaluating cells and organs of the Immune system.
CO6	Design the components of MHC and the complement system.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	2	2	3	2	2	3	3	3	2	1	2
CO2	3	3	2	2	3	2	2	3	2	2	3	3	3	2	1	3
CO3	3	3	2	2	3	3	2	3	2	2	2	3	3	2	1	3
CO4	3	3	2	2	3	3	1	2	2	2	3	3	3	2	1	3
CO5	3	3	2	2	3	2	2	2	2	3	3	3	3	2	1	3
CO6	3	3	3	2	3	3	2	2	3	2	3	3	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL704			
Course Name	: Lab Course Based on ZOODE703			
Semester	: VII Semester			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVE:

1. Students can identify their blood groups.
2. Students will learn various techniques to study lymphoid organs.
3. Students will learn how to perform Immune Effector Mechanisms, Allergy, and Hypersensitivity

COURSE CONTENT

1. Study of lymphoid organs (by slides or micrographs).
2. ABO blood group determination.
3. Antibody-antigen structures and types.
4. Antigen-antibody interaction (Reaction types)
5. Preparation, cell count, and percentage viability of spleenocytes.
6. Enzyme-linked immunosorbent assay (DOT-ELISA).
7. Demonstration of immune-electrophoresis.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Knowledge of Blood group determination.
CO2	Understand Primary and Secondary Line of Defence [Innate and Acquired Immunity] and antigen-antibody Interactions by chart.
CO3	Applying the Structure and Function of Immunoglobulins, Structure and Function of MHC.
CO4	Analyze Immune Effector Mechanism, Allergy and Hypersensitivity.
CO5	Evaluating cells and organs of the Immune system
CO6	Create/ design components of MHC and complement system.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	2	3	2	2	3	3	3	2	1	3
CO2	2	2	2	3	2	2	2	3	2	2	3	3	3	2	1	3
CO3	2	2	2	2	2	2	2	3	2	2	2	3	3	2	1	3
CO4	3	2	2	2	3	2	1	2	2	2	3	3	3	2	1	3
CO5	3	2	2	3	2	2	2	2	2	3	3	3	3	2	1	3
CO6	3	2	2	3	3	2	2	2	3	2	3	3	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE 705			
Course Name	: General Ichthyology			
Semester	: VII Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

Course Objectives: The objectives of this course are

1. To know about the evolution and phylogeny of fishes.
2. To understand the physiology of the fish.
3. To know about the behaviour of the fish.

UNIT I

Classification of Fishes, Systematic Position, Habit and Habitat, Morphology, Distribution, Significance and Affinities of Holocephali and Dipnoi. Histomorphology and Elementary Physiology (A) Digestive System (With Particular Reference to Food And Feeding Habits of Freshwater Fishes) (B) Excretory System (C) Accessory Respiratory Organs in Fishes.

UNIT II

General Survey of the Marine, Estuarine and Inland Capture Fisheries of India with Particular Reference to Fishery Resources of Uttaranchal. Methods of Fishing: Fishing Gears and Crafts. Cold Water Fishery. , Chemical Composition of Fish Flesh, Length –Weight Relationship, Natural Food and Artificial Feed and Their Role in Fish Culture.

UNIT III

Electric Organs in Fishes. Brief Knowledge of Sexual Dimorphism, Courtship and Parental Care. Migratory Instincts, Hill Stream Adaptations. Endocrine Glands: Pituitary, Thyroid, Pancreas, Adrenal, Corpuscles of Stannins, Ultimobranchial Glands, Caudal Neurosecretory System and Sex Hormones.

UNIT IV

Brief Knowledge of Sense Organs: Eyes, Hearing, Bioluminescence, Sound Production and Lateral Line System. Parental Care in Fishes. Venomous and Non-Venomous Fishes. Fish Pheromones. Coloration in Fishes.

Suggested Books

1. C.B.L. Srivastava: Fish Biology, Narendra Publication House, 2008.
2. Kyle: The Biology of Fishes, 2007.
3. H.R. Singh: Advances in Fish Biology, Hindustan Publishing Corp., 1994.
4. J.D. Munshi & J.S.D. Munsli: Fundamentals of Freshwater Biology, Narendra Publ. House, 1995.
5. Carlander: Handbook of Freshwater Fishery Biology, vol. 2, Iowa State Univ. Press, 1977.
6. SS Khanna & H.R. Singh: Fish & Fisheries.
7. Dr. J. Ojha: Biology of Hill Stream Fish, Narendra Publication House, 2002.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Recall the phylogeny, physiology, metamorphosis, water resources and hormonal changes by the endocrine gland and fish behaviour.
CO2	Interpret the systematics, Phylogeny, and general organization of fishes.
CO3	Compile the general organization and affinities of Agnatha, Holocephali, and Dipnoi.
CO4	Analyze the comparative Morphology and metamorphosis of teleosts and Elasmobranchs.
CO5	Conclude the knowledge of the physiology of the alimentary canal and associated glands in fishes.
CO6	Develop the knowledge of the physiology of respiration, sense organs, parental care and reproduction in fishes

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	3	2	3	2	2	2	2	3	2
CO2	3	3	2	3	2	2	2	3	2	3	3	3	2	2	3	2
CO3	2	2	2	2	2	2	2	3	2	3	2	2	2	2	3	2
CO4	2	1	1	2	2	2	1	2	1	2	1	2	2	1	1	2
CO5	1	2	1	2	2	2	2	2	2	2	1	2	1	1	1	2
CO6	1	2	1	2	2	2	2	2	2	2	1	2	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 706			
Course Name	: Lab course based on ZOODE 705			
Semester	: VII Semester			
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students can learn about fish.
2. Students will learn various techniques for making an aquarium.

COURSE CONTENT

1. To study the specimens of fishes for classification and general studies.
2. To study the permanent slides of fishes for histological studies.
3. To study of feeding habits of fishes by gut content analysis.
4. Aquarium design and maintenance.
5. Estimation of ovarian egg counts.
6. Estimation of hydrological parameters- temperature, pH, conductivity, salinity, dissolved oxygen, COD of nursery, rearing, stocking and breeding points.
7. Demonstration of breeding pools and hatcheries.
8. Induced breeding of Indian major carps and catfishes.
9. Identification of eggs, spawn, fry, and fingerlings of cultivable fishes of India.
10. Visit to freshwater/marine fish farm.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identification, Collection, classification, and preparation of a systematic record of freshwater Ichthyofauna.
CO2	Interpret classification and general study of the various specimens of Agnatha, Chondrichthyes, Osteichthyes, etc.
CO3	Demonstrate the different types of scales, vertebrae, Girdles, Opercular bones, Pharyngeal bones, etc., in fishes.
CO4	Analyze the various permanent slides of different tissues/organs/ developmental stages, etc., in fishes.
CO5	Evaluate the various accessory respiratory organs/ Weberian ossicles, Electric organs, etc. in fishes.
CO6	Construct the diversity and distribution, Behavioral aspects, and economic importance of freshwater Ichthyofauna through field trips/case study/experimental setup, etc.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	2	3	2	2	3	3	3	2	1	3
CO2	2	2	2	3	2	2	2	3	2	2	3	3	3	2	1	3
CO3	2	2	2	2	2	2	2	3	2	2	2	3	3	2	2	3
CO4	3	2	2	2	3	2	1	2	2	2	3	3	3	2	1	3
CO5	3	2	2	3	2	2	2	2	2	3	3	3	3	2	2	3
CO6	3	2	2	3	3	2	2	2	3	2	3	3	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE 707			
Course Name	: Medical Laboratory Techniques			
Semester	: VII Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Knowledge about Laboratory Techniques and equipment.
2. To understand the biological wastes and sample collection techniques.

UNIT I

Basic Laboratory Principles - Code of Conduct of Medical Laboratory Personnel. Organization and Functioning of Clinical Laboratory. Safety Measures - Safety Equipment's, Safety Symbols.

Hazards in the Laboratory (Chemical Hazards, Clinical Hazards, Electrical Hazards, Biological Hazards. Waste Disposal.

UNIT II

Introduction of Common Laboratory Equipment's: Hot Air Oven, Incubator, Autoclave, Water Bath and Centrifuges Microscope - Fundamentals of Microscopy, Resolution and Magnification, Light Microscopy, Electron Microscopy, PCR Machine (Thermal Cycler), Electrophoresis Unit and UV Trans Illuminator Etc.

UNIT III

Specimen Collection, Processing and Analytical Techniques Collection and Preservation of Blood, Urine, Stool, Sputum, Pus, Body Fluids and Swab. Preparation of Blood Smears. Sources of Biological Variations and Pre-Analytical Variables.

UNIT IV

Preparation of Reagents: Buffers and pH, Normal, Percent and Molar Solution, Normal Saline -Methods of Measuring Liquids. Clinical Laboratory Records - Modern Laboratory Set Up - Quality Control: Accuracy, Precision, and Reference Values. Disposal of Biomedical Waste. Laboratory Safety Protocols and Guidelines.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the Basic Laboratory Principles - Code of Conduct of Medical Laboratory Personnel
CO2	Interpret the Hazards in the Laboratory (Chemical Hazards, Clinical Hazards, Electrical Hazards, Biological Hazards. Waste Disposal
CO3	Compile the sources of Biological Variations and Pre-Analytical Variables.
CO4	Analyze the knowledge about Laboratory equipment.
CO5	Conclude the Specimen Collection, Processing and Analytical Techniques
CO6	Develop the knowledge of Laboratory Safety Protocols and Guidelines

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	3	2	3	2	2	2	2	3	2
CO2	3	3	2	3	2	2	2	3	2	3	3	3	2	2	3	2
CO3	2	2	2	2	2	2	2	3	2	3	2	2	2	2	3	2
CO4	2	1	1	2	2	2	1	2	1	2	1	2	2	1	1	2
CO5	1	2	1	2	2	2	2	2	2	2	1	2	1	1	1	2
CO6	1	2	1	2	2	2	2	2	2	2	1	2	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 708			
Course Name	: Lab course based on ZOODE 707			
Semester	: VII Semester			
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students can learn about different Laboratory equipment
2. Students will learn various techniques used to collect the population sample.

COURSE CONTENT

1. Determine the various blood groups.
2. Study of Laboratory equipment.
3. Collection of Samples from various organisms.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Determine the various blood groups & collection of samples from other organisms.
CO2	Associate various laboratory techniques & equipments.
CO3	Apply the Laboratory safety protocol and guidelines.
CO4	Examine the various samples from collections.
CO5	Evaluate various techniques about medical waste.
CO6	Formulate and put a plan in about clinical hazards.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	2	3	2	2	3	3	3	2	1	3
CO2	2	2	2	3	2	2	2	3	2	2	3	3	3	2	1	3
CO3	2	2	2	2	2	2	2	3	2	2	2	3	3	2	2	3
CO4	3	2	2	2	3	2	1	2	2	2	3	3	3	2	1	3
CO5	3	2	2	3	2	2	2	2	2	3	3	3	3	2	2	3
CO6	3	2	2	3	3	2	2	2	3	2	3	3	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE 709			
Course Name	: Endocrinology and Animal Behavior			
Semester	: VII Semester			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES: The objectives of this course are

1. To know about the endocrine gland.
2. To understand the physiological actions of various hormones.
3. To understand the metabolic pathway of various hormones.
4. To understand the concept and fundamentals of animal behavior.

COURSE CONTENT

UNIT I

Hormones and Physiological actions of the following endocrine glands in vertebrates:

Pituitary, Thyroid, Parathyroid, Pancreas, Gastro-intestinal tract, Adrenal and Medulla,(Adrenal gland), Thymus & Pineal gland.

UNIT II

Hypo and Hypersecretion of Endocrine Glands:

Elementary knowledge of Dwarfism, Gigantism, Acromegaly, Diabetes insipidus, Goitre, Cretinism, Myxoedema, Diabetes mellitus, and Addison's disease.

UNIT III

Biosynthesis of Hormones:

Biosynthesis of protein hormones. Biosynthesis of steroid hormones. Biosynthesis of Catecholamines. Biosynthesis of amino acid derived hormones (Thyroid). Mechanism of action of hormones.

UNIT IV

Behaviour and Communication:

Patterns of behavior: Innate behavior. Learned behavior: Hormonal control of Behavior.

Biological Communication: Chemical, Visual, Auditory, Electric and tactile, Dance language of honeybees,

Suggested Books:

1. Krebs & Davies : An introduction to behavioural ecology (3rd ed.) Blackwell 1993.
2. Mac E. Hadley: Endocrinology, Prentice-Hall International ed.1988/1992.
3. G J Goldsworthy et al: Endocrinology, Blackie, 1981.
4. Maurice Goodman: Basic and Medical Endocrinology, Raven Press.
5. ME Hadley: Endocrinology

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the hormones and their physiological actions, biosynthesis, and the concept and fundamentals of animal behavior.
CO2	Explain the concepts of endocrine systems, homeostasis, and their physiological actions of various hormones.
CO3	Illustrate the metabolic pathways of hormone biosynthesis and the mechanism of action.
CO4	Discover the various diseases from hormonal imbalance.
CO5	Evaluate the metabolic pathway of various hormones.
CO6	Construct the concept and fundamentals of animal behavior.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	1	1	2	3	2	2	2	2	3	2
CO2	3	3	2	3	2	2	2	2	2	3	3	3	2	2	3	2
CO3	2	2	2	2	2	2	1	1	2	3	2	2	2	2	3	2
CO4	2	1	1	2	2	2	2	2	1	2	1	2	2	1	1	2
CO5	1	2	1	2	2	2	2	1	2	2	1	2	1	1	1	2
CO6	1	2	1	2	2	2	1	2	2	2	1	2	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 710			
Course Name	: Lab course based on ZOODE709			
Semester	: VII SEMESTER			
	L	T	P	C
	0	0	2	1

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. To know about the endocrine gland.
2. To understand the animal hormones

COURSE CONTENT

1. To identify different endocrine glands with the help of charts.
2. To study the histology of endocrine glands of animals with the help of slides.
3. To determine the concentration of glucose in the diabetic samples.
4. Isolation of hormones from different endocrine glands.
5. Study on various behavioral patterns of the animals.

Course Outcomes: Upon successful completion of the course, a student will be able to

CO1	Observe the localization of different endocrine glands in the animals, including humans.
CO2	Discover various diseases caused by the malfunctioning of different endocrine glands in human beings.
CO3	Examine the various permanent slides of different endocrine glands.
CO4	Conclude the identification of different endocrine glands by the Charts/ Model.
CO5	Case study based on diseases caused by endocrine glands.
CO6	Construct and study permanent slides of the different endocrine glands of the animals.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	3	2	3	2	2	3	1	1	3
CO2	2	2	2	2	2	2	2	3	2	3	3	3	2	2	1	3
CO3	3	2	3	2	2	3	2	3	2	3	2	2	2	2	2	3
CO4	2	2	2	2	2	3	1	2	1	2	1	2	2	2	1	3
CO5	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	3
CO6	2	3	2	2	2	2	2	2	2	2	1	2	2	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE711			
Course Name	: Research Methodology			
Semester	: VII Semester			
	L	T	P	C
	3	1	0	4

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To introduce with meaning, functions of research and the research process.
2. To highlight the various postulates of research problems, research Design, interpretation and report writing.
3. To expose the student to concepts of measure of central tendency and variation and their application to analyze the statistical data.
4. To acquire the knowledge of correlation, regression, data analysis and hypothesis testing using suitable test of statistical significance.

UNIT I

Meaning & Functions of Research

Meaning of Research, Characteristics of Research, Steps involved in Research, Research in Pure and Applied Sciences, Interdisciplinary Research, Trans disciplinary Research, Significance of Research, Research and Scientific Methods, Research Process, Criteria of Good Research, Problems Encountered by Researchers, Literature Review.

UNIT II

Research Problem and Research Design

Selecting the Research problem, Necessity of defining the problem, Goals and Criteria for identifying problems for research, Perception of the Research problem, Formulation of the Research design, Need for the Research design, Features of good design, Basic principles of experimental designs, Computer and internet in designs.

UNIT III

Interpretation and Report Writing

Meaning and Technique of interpretation, Precautions in interpretation, Significance of report writing, Different steps in writing a report, Layout of a Research report, Types of report, Mechanics of writing a research report, Precautions for writing a research report

UNIT IV

Statistical Techniques and Tools -I

Introduction of statistics, frequency distribution, Graphical representation of data, Measures of central tendency, Mean, Median, Mode, Standard deviation, Co-efficient of variation, Probability & distribution.

Statistical Techniques and Tools –II: Correlation, coefficient of correlation, Scatter diagram, Regression, Sampling distribution, Standard error, Hypothesis testing, Level of significance, Degree of freedom, Chi Square, T-test, Analysis of variance (ANOVA).

Suggested readings:

1. Kothari C.R., Research Methodology Methods & Techniques, New Age International Publishers.
2. Gupta G. and Gupta M., Research Methodology, PHI Learning Private Ltd.
3. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultana Chand & Sons, New Delhi.

Course Outcome (COs): Upon successful completion of the course, a student will be able to

CO1	Identification of various kinds of research, objectives of doing research, research process and research design.
CO2	Demonstrate the ability to choose methods appropriate to research aims and objectives.
CO3	Obtain skills to analyze data and draw reasonable interpretations as well as communicate research findings in a clear and well-organized way.
CO4	Analyzing a detailed and comprehensive study related to Statistical tools and techniques for carrying out data analysis and hypothesis testing using a suitable test of statistical significance.
CO5	Evaluating the properties of the mechanism of research methodology.
CO6	Constructing the research methodology and mechanism.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	1	2	1	2	2	2	1	2	2	1
CO2	1	2	1	2	2	1	2	2	2	2	2	2	2	2	1	2
CO3	1	2	2	1	2	1	2	2	1	2	1	1	2	1	2	2
CO4	1	3	1	2	2	1	2	2	2	2	1	1	2	2	1	1
CO5	2	1	2	2	2	2	1	1	2	2	1	2	1	2	1	2
CO6	2	2	1	1	1	-	2	1	1	2	2	1	2	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE803			
Course Name	: Applied Immunology			
Semester	: VIII Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To know about the Immune system.
2. To understand Immunological principles and their role in Human Physiology.
3. To know about Immunological diseases.

UNIT I

Immune Response to Infectious Diseases: Mechanism of Immune Response During: Viral Infections [Influenza, HIV], Bacterial Infections [*Corynebacteria* and *Mycobacterium*] Protozoan Infections [*Plasmodium*, *Trypanosoma* and *Leishmania*], Helminth Infections [*Ascaris* and *Schistosoma*].

UNIT II

Disease of Immune System and Vaccines: Mechanism of Autoimmune Diseases-Rheumatoid Arthritis, Celiac Disease. Cancer of Blood Cells-Lymphoma and Leukemia.

Vaccines- Historical Background, Routine Vaccines, DNA Vaccines, Snake-Antidotes. Production of Monoclonal Antibodies and Its Mechanism.

UNIT III

Immunotechnological: Separation of Immune Cells by Flow Cytometry. Principle and Application of Immunoprecipitation. Functioning and Application of Microscopes: Immunofluorescence and Confocal. Principle and Application of *in-Situ* Hybridization Technology-FISH and GISH Principle, Methodology and Application of Following Techniques, ELISA, RIA, Western Blotting.

UNIT IV

Transplantation Immunology: Transplantation- History, Graft Vs. Host Rejection Studies for Specific Transplantation I.E Skin Graft, Kidney, Liver. Immunosuppression- Definition, Drugs Used for Immunosuppression and Its Mechanism of Action. Xenotransplantation- Definition and Its Application. HLA Phenotyping. Blood Groups- MN, ABO Blood Group and Blood Transfusion.

Suggested readings

1. Roitt, Male & Brostoff: Immunology (3rd ed).
2. Elgert & Elgert: Immunology.
3. Kuby : Immunology (6th ed.).
4. SS Lal: Immunology: Rastogi Publication

Course Outcomes (COs) : Upon successful completion of the course, a student will be able to

CO1	Knowledge of Cells and Organs of the Immune System.
CO2	Demonstrate Immune Response to Infectious Diseases. Blood Group and Blood Transfusion
CO3	Explain Antigen and Immunogen, Immunosuppression, and its mechanism.
CO4	Analyze the Mechanism of Autoimmune Diseases.
CO5	Evaluating hybridization technology, blotting, and other immunotechnological methods.
CO6	Create transplantation of immunology. Immune Response to Infectious Diseases.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	2	2	1	2	2	1	2	2	2	1	2	2
CO2	2	2	1	1	2	2	1	-	2	1	2	2	2	1	2	2
CO3	2	2	1	1	2	2	1	2	2	1	2	2	2	1	2	2
CO4	1	2	2	2	1	2	2	1	1	2	1	1	2	2	2	1
CO5	2	1	2	2	1	-	2	2	2	2	1	2	2	1	1	2
CO6	2	2	1	1	2	2	2	1	1	2	1	2	1	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOODL804				
Course Name : Lab course based on ZOODE803				
Semester : VIII Semester				
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students are able to know about blood groups.
2. Student will learn various techniques to study lymphoid organs.
3. Student will learn how to perform Immune Effector Mechanism, Allergy, and Hypersensitivity

COURSE CONTENT

1. Study of lymphoid organs (by slides or micrographs).
2. ABO blood group determination.
3. Antibody-antigen structures and types.
4. Antigen-antibody interaction (Reaction types)
5. Preparation, cell count and percentage viability of splenocytes.
6. Enzyme-linked immunosorbent assay (DOT-ELISA).
7. Demonstration of immune-electrophoresis.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Recall the process of Blood group determination.
CO2	Interpret Primary and Secondary Line of defence [Innate and Acquired Immunity], Antigen-Antibody Interactions by chart.
CO3	Explain the Structure and Function of Immunoglobulins, Structure and Function of MHC.
CO4	Analyze Immune Effector Mechanism, Allergy and Hypersensitivity.
CO5	Evaluating cells and organs of the Immune system
CO6	Design components of MHC and the complement system.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	1	2	1	2	2	2	1	2	2	1
CO2	1	2	1	2	2	1	2	2	2	2	2	2	2	2	1	2
CO3	1	2	2	1	2	1	2	2	1	2	1	1	2	1	2	2
CO4	1	3	1	2	2	1	2	2	2	2	1	1	2	2	1	1
CO5	2	1	2	2	2	2	1	1	2	2	1	2	1	2	1	2
CO6	2	2	1	1	1	-	2	1	1	2	2	1	2	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE 805			
Course Name	: Applied Ichthyology			
Semester	: VIII Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To know the physiology of fish.
2. To understand the behaviour of fish.
3. To know the endocrine system of fish.

COURSE CONTENT

UNIT I

Important Cultivable Fishes (Teleost fishes) & Important Cultivable Shellfish.

Physicochemical characteristics of water essential for fishes, Preparation and maintenance of Fish farm

UNIT II

Carp Culture: Monoculture, Poly Culture and Composite Fish Culture. Live Fish Culture,

Ecology of Fishponds and their types. Pollution in Relation to Fisheries

UNIT III

Induced Breeding, Hatching Techniques and Hatcheries, Nursery Management, Packing and Transport of Fish. Fish Preservation. Ornamental Fishes setting and maintenance of Aquarium.

UNIT IV

Integrated Aquaculture: Fish-Cum Poultry, Fish-Cum Piggery, Paddy-Cum Fish Culture and Dairy-Cum Fish Culture. Induced Spawning and Hybridization. Factors Responsive for Induced Breeding, Hypophysation. Use of Different Synthetic and Natural Hormones. Larvivores Fishes and Public Health. Fish Diseases and Their Management. Exotic Fishes and Their Merits and Demerits, Cryopreservation of Gametes and Embryos.

Suggested Books

1. C.B.L. Srivastava: Fish Biology, Narendra Publication House, 2008.
2. Kyle: The Biology of Fishes, 2007.
3. H.R. Singh: Advances in Fish Biology, Hindustan Publishing Corp., 1994.
4. J.D. Munshi & J.S.D. Muni: Fundamental of Freshwater Biology, Narendra Publ. House, 1995.
5. Carlander: Handbook of Freshwater Fishery Biology, vol. 2, Iowa State Univ. Press, 1977.
6. Dr. J. Ojha: Biology of Hill Stream Fish, Narendra Publication House, 2002.
7. SS Khanna & H.R. Singh: Fish & Fisheries

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Recall about fish culture, poultry culture, fish behaviour and disease.
CO2	Interpret the specialized characters and endocrine system of fish.
CO3	Illustrate the knowledge about the development of fish.
CO4	Determine the Fish behaviour, fish breeding and hormonal control.
CO5	Create knowledge about Fish embryology
CO6	Assemble the Endocrine system of fishes & Cryopreservation.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1	1	1	2	1	2	2	2	1	-	2	1
CO2	1	2	1	2	2	1	2	2	2	2	2	2	2	2	1	2
CO3	1	2	2	1	2	1	2	2	1	2	1	1	2	1	2	2
CO4	1	3	1	2	2	1	2	2	2	2	1	1	2	2	1	1
CO5	2	1	-	2	2	2	1	1	2	2	1	2	1	2	2	2
CO6	2	2	1	1	1	-	2	1	1	2	2	1	2	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL806			
Course Name	: Lab course based ZOODE 805			
Semester	: VIII Semester			
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students can learn about fish.
2. Student will learn various techniques for making aquarium.
3. The student will learn how to perform various Physicochemical parameters of water and histological slides.

COURSE CONTENT

1. To study the specimens of fish for classification and general studies.
2. To study the permanent slides of fish for histological studies.
3. To study of feeding habits of fish by gut content analysis.
4. Aquarium design and maintenance.
5. Estimation of ovarian egg counts.
6. Estimation of hydrological parameters- temperature, pH, conductivity, salinity, dissolved oxygen, COD of the nursery, rearing, stocking, and breeding points.
7. Demonstration of breeding pools and hatcheries.
8. Induced breeding of Indian major carp and catfishes.
9. Identification of eggs, spawn, fry, and fingerlings of cultivable fishes of India.
10. Visit to freshwater/marine fish farm.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Recall the Identification, Collection, classification, and preparation of a systematic record of freshwater Ichthyofauna.
CO2	Interpret the classification and general study of the various specimens of Agnatha, Chondrichthyes, Osteichthyes, etc.
CO3	Demonstrate the different types of scales, Vertebrae, Girdles, Opercular bones, Pharyngeal bones, etc., in fishes.
CO4	Examine the various permanent slides of different tissues/organs/ developmental stages, etc. in fishes.
CO5	Explain the various accessory respiratory organs/ Weberian ossicle, Electric organs, etc, in fishes.
CO6	Construct the diversity and distribution, as well as the Behavioral aspects and economic importance of freshwater ichthyofauna, through field trips/case studies, and experimental setups, etc.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1	1	1	2	1	2	2	2	1	-	2	1
CO2	1	2	1	2	2	1	2	2	2	2	2	2	2	2	1	2
CO3	1	2	2	1	2	1	2	2	1	2	1	1	2	1	2	2
CO4	1	3	1	2	2	1	2	2	2	2	1	1	2	2	1	1
CO5	2	1	-	2	2	2	1	1	2	2	1	2	1	2	2	2
CO6	2	2	1	1	1	-	2	1	1	2	2	1	2	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE807			
Course Name	: Basic Limnology			
Semester	: VIII Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

Course Objectives: The objectives of this course are

1. To know about aquatic biodiversity.
2. To understand about Physicochemical characteristics.
3. To know the impact of different parameters on biological activity and organisms.

COURSE CONTENT

UNIT I

Introduction and Development of Limnology in India, Inland, Waters Distribution of Inland waters: Ponds, Lakes, Streams, River

UNIT II

Lakes: Thermal classification of Lakes, Famous Lakes of India and the World, Nature of Inland Water environment. Physical characteristics: Pressure, compressibility, density, mobility, Buoyancy, Movement of water thermal stratification, Light, color, and turbidity.

UNIT III

Chemical characteristics: Dissolved gases – Oxygen, Carbon dioxide, and other dissolved gases dissolved solids, and dissolved organic matter influence of Physical and Chemical Conditions of Living organisms in Inland water bodies. Planktonic organisms: Classifications of organisms in water distribution of plankton food for Plankton organisms.

UNIT IV

Biological productivity, Circulation of food material, Classification of Lakes based on productivity, Laws of minimum, Biotic potential and Environmental resistance, Quantitative relations in a standing crop. Water pollution, Eutrophication, Algal blooms, Water borne diseases and drinking, Water parameters, Bioremediation of polluted water bodies.

Suggested Books:

1. KJ Gaston & JI Spicer: Biodiversity: An Introduction
2. WT Edmondson: Freshwater Biology
3. HBN Hynes: Freshwater Ecology
4. WK Dodds: Freshwater Ecology
5. Rivers for Life: Managing water for people and nature, Sandra Postel, Brain D. Richter.

Course Outcomes (COs) : Upon successful completion of the course, a student will be able to

CO1	Recall the scope and concept of aquatic biodiversity and aquatic ecosystem and reservoirs.
CO2	Describe the Biodiversity definition, species concept, community & environmental activity.
CO3	Execute the Biodiversity scope and Bioremediation, and their impact on organisms.
CO4	Explain the type of ecosystem, the Community and its characteristics.
CO5	Measure the threats to habitats and biological diversity in Freshwater and marine ecosystems
CO6	Formulate the impact of different parameters on aquatic biodiversity.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	2	1	1	1	2	2	2	3	1	1	3
CO2	3	3	2	2	2	2	1	1	2	2	2	2	3	2	1	3
CO3	3	3	2	2	2	2	1	1	1	2	1	1	3	2	1	3
CO4	3	3	2	2	2	2	1	1	2	2	1	1	3	2	1	3
CO5	3	3	2	2	2	2	1	1	2	2	1	2	3	2	1	3
CO6	3	3	2	2	2	3	1	1	1	2	2	1	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL808			
Course Name	: Lab course based on ZOODE807			
Semester	: VIII Semester			
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students are able to learn about fishes.
2. Students will learn various techniques for making aquarium.
3. Students will learn how to perform various Physicochemical parameters of water.

COURSE CONTENT

1. To study the specimens of fishes for classification and general studies.
2. To study the permanent slides of fishes for histological studies.
3. To study of feeding habits of fishes by gut content analysis.
4. Aquarium design and maintenance.
5. Estimation of ovarian egg counts.
6. Estimation of hydrological parameters- temperature, pH, conductivity, salinity, dissolved oxygen, COD of nursery, rearing, stocking and breeding points.
7. Demonstration of breeding pools and hatcheries.
8. Induced breeding of Indian major carps and catfishes.
9. Identification of eggs, spawn, fry, and fingerlings of cultivable fishes of India.
10. Visit to freshwater/marine fish farm.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Study the Identification, Collection, classification and preparation of a systematic record of freshwater Ichthyofauna.
CO2	Discuss classification, and general study of the various specimens of Agnatha, Chondrichthyes, Osteichthyes, etc.
CO3	Demonstrate the different types of scales, Vertebrae, Girdles, Opercular bones, Pharyngeal bones, etc. in fishes.
CO4	Analyze the various permanent slides of different tissues/organs/ developmental stages, etc. in fishes.
CO5	Examine the threats to habitats and biological diversity in Freshwater and marine ecosystems
CO6	Construct the diversity and distribution, Behavioral aspects, and economic importance of freshwater Ichthyofauna through field trips/case study/experimental setup, etc.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1	1	1	2	1	2	2	2	1	-	2	1
CO2	1	2	1	2	2	1	2	2	2	2	2	2	2	2	1	2
CO3	1	2	2	1	2	1	2	2	1	2	1	1	2	1	2	2
CO4	1	3	1	2	2	1	2	2	2	2	1	1	2	2	1	1
CO5	2	1	-	2	2	2	1	1	2	2	1	2	1	2	2	2
CO6	2	2	1	1	1	-	2	1	1	2	2	1	2	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODE809			
Course Name	: Biodiversity and Wildlife Conservation			
Semester	: VII Semester			
	L	T	P	C
	3	0	0	3

L- Lecture T – Tutorial P – Practical C – Credit

(3+1 Credits) = 4 Credits

Course Objectives: The objectives of this course are

1. To know about Ecology and wildlife
2. To understand ecological principles.
3. To understand concepts of wildlife and different conservation measures

COURSE CONTENT

UNIT I

Biodiversity: Definition, Concept, Scope. Types of Biodiversity: Species, Genetic, Community, Ecosystem. Measurement of biodiversity. Factors governing biodiversity. Endemic species: Definition, Concept, and Scope. Biodiversity Hotspots.

UNIT II

Concept of threatened categories. Red Data Book. Threats to habitats and biological diversity. Endangered species. Environmental Impact Assessment. Cumulative Impact Assessment of hydropower development; Environmental flows: need, methodologies, DRIFT, BBM.

UNIT III

Biodiversity Protection: Steps Taken by Indian Government, Important Indian Acts and Policies related to Environment and Biodiversity. Biodiversity Action Plans. Biodiversity conservation and management strategies: In-situ and Ex-situ Conservation of Animals.

UNIT IV

General introduction to Sanctuaries, National Parks and Biosphere Reserves of India, Endangered species: endangered fauna of Himalaya. Brief Account of Wildlife Acts and Their Amendments in India and the World. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Tiger conservation: Tiger reserves in India; Management challenges in Tiger reserve.

Recommended Book

1. Krebs: Ecology (4th ed.) Harper Collins College Publisher
2. Negi: An Introduction to Wildlife Management, 1983.
3. Majumuria T C: Wildlife Wealth of India, Tecprress Service, Bangkok, 1986.
4. Saharia: Wildlife of India, Nataraj Publishers, Dehradun.

5. Negi: Handbook of National Parks, Sanctuaries and Biosphere Reserves in India, 1995.
6. Negi: Himalayan Wildlife: Habitat and Conservation, 1992. Indus Publishing Company, New Delhi.
7. Sharma: High Altitude Wildlife of India Oxford & IBH Publishing Co. Pvt. Ltd. 1994.
8. Odum: Fundamentals of ecology, Saunders Co. Publ., 1993 Indian ed.
9. Odum: Basic ecology, Saunders Co. Publ., 1993 Indian ed.

Course Outcomes (COs): Upon successful completion of the course, students will be able to

CO1	Recall the global and regional patterns of biodiversity. Sustainable use of resources and conservation of biodiversity effectively and scientifically
CO2	Interpret the concept, principle, threats, and conservation of biological diversity.
CO3	Learn about the use and significance of various tools used for the measurement of biodiversity.
CO4	Realize the significance of the sustainable use of resources and conservation of biodiversity effectively and scientifically
CO5	Learn the scope of restoration ecology, and methods to restore the degraded lands with special reference to Doon Valley
CO6	Generate information about the legal frameworks and international programs and agreements related to biodiversity conservation and restoration ecology

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	2	1	1	2	2	2	2	3	3	2	3
CO2	3	3	2	2	2	2	1	1	2	2	2	2	3	2	2	3
CO3	3	3	2	1	2	3	1	2	2	3	2	3	3	3	2	3
CO4	3	3	2	2	2	2	1	2	2	2	2	2	3	2	2	3
CO5	3	3	2	1	2	2	1	1	2	2	2	2	3	2	2	3
CO6	3	3	2	2	2	2	1	1	2	2	2	2	3	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOODL 810			
Course Name	: Lab Course Based on ZOODE809			
Semester	: VIII Semester			
	L	T	P	C
	0	0	2	1

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objectives of this course are

1. To know about Ecology and wildlife
2. To understand ecological principles.
3. To understand concepts of wildlife and different conservation measures

Course content

1. To study different laws of Ecology (law of the minimum, Shelford's law of tolerance)
2. To study the different ecosystems and differentiation of various ecosystem biota.
3. To study pond ecosystem and thermal stratification in water body.
4. To study the biogeochemical cycle and different food chains and their trophic levels.
5. To study community, species and its types.
6. To study the population ecology, Natality mortality and different curves.
7. Study of Biodiversity, pollution type, National parks, biosphere reserve etc.

Course Outcomes (COs): Upon successful completion of the course, a student will be able to

CO1	Define or identify the ecological laws, Biogeochemical cycle, Ecosystem, Food chains and food web Biosphere reserves, population, biodiversity and national park.
CO2	Interpret the concept of population, Community, and succession
CO3	Execute the knowledge about biodiversity & its importance
CO4	Analyze the economic valuation of biodiversity, environmental pollution, wild life conservation.
CO5	Evaluate the techniques used in wildlife, Population estimation.
CO6	Generate knowledge about Sanctuaries, National Parks, and Biosphere Reserves

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	2	1	1	2	2	2	2	3	2	1	3
CO2	3	3	2	2	2	2	1	1	2	2	2	2	1	2	1	3
CO3	3	3	2	2	2	2	1	1	2	3	2	3	1	1	1	2
CO4	2	2	2	3	3	3	1	1	2	2	2	2	2	2	2	3
CO5	2	2	3	2	2	2	1	1	2	2	2	2	2	1	1	3
CO6	3	2	2	2	2	2	1	1	2	2	2	2	2	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOODE 811				
Course Name : Research Publication and Ethics				
Semester : VIII Semester				
	L	T	P	C
	3	1	0	4

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

Its objectives to provide knowledge about quality and ethics publication with the concept of plagiarism.

Course Content

UNIT I Meaning & Functions of Research

Philosophy: Definition, introduction of concept, branches of Philosophy, Introduction of Metaphysics, Epistemology, Ethics/ Moral, Political and Aesthetics Philosophy Moral philosophy, nature of moral judgments and reactions.

UNIT II

Research Problem and Research Design

Ethics: Definition of science and research, Intellectual honesty, and research integrity

Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data

UNIT III

Interpretation and Report Writing

Publication ethics: Definition, introduction, and importance, Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc., Conflicts of interest, Publication misconduct: Definition, concept, Introduction about authorship and contributorship, Violation of Publication Ethics, Identification of publication, complaints and appeals

UNIT IV

Statistical Techniques and Tools -I

Introduction about Journals & Publishers, Predatory publishers and journals, Quality of Journals & Publication, Introduction about Scopus/SCI, eSCI/Web of Science Indexing (Scopus.com) etc., Software tool to identify predatory publications developed by SPPU Plagiarism tools , Journal finder/ Journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal Suggester, etc.

Suggested readings:

1. Dutta, Sumanta, Research and Publication Ethics, Bharti Publications.
2. Yadav S.K., Research and Publication Ethics, Anne Publications.

Course Outcome (COs): Upon successful completion of the course, a student will be able to

CO1	Recognize the basics of the philosophy of science with research ethics.
CO2	Familiarize with important issues in research ethics, integrity & scientific misconduct.
CO3	Determine the best practices for publications, publication ethics and identify the predatory publishers and Journals'
CO4	Analyzing, Publisher, and Journals' Applying, remembering, and understanding the detailed and complete study related to the use of plagiarism software tools, citation databases, and research metrics.
CO5	Evaluating the properties of the mechanism of Research Publication and Ethics.
CO6	Constructing the Research Publication and Ethics.

Generic Elective Courses

Course Code : ZOOGE103				
Course Name : ANIMAL DIVERSITY -I				
Semester : I Semester				
	L	T	P	C
	4	0	0	4

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objective of this course are:

1. This paper is quite informative and interesting and will be covering the basics of the whole animal kingdom.
2. Students will be able to organize animals according to the level of the body plan, organization, symmetry, germ layers, etc.

COURSE CONTENT**UNIT I**

Kingdom Protista: General characters and classification up to classes; Locomotory organelles and locomotion in Protozoa.

Porifera, General characters and classification up to classes; Canal System in *Sycon*.

UNIT II

Phylum Cnidaria: General characters and classification up to classes; Polymorphism in Hydrozoa.

Platyhelminthes, General characters and classification up to classes; Life history of *Taenia solium*.

Nemathelminthes, General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations.

UNIT III

Phylum Annelida: General characters and classification up to classes; Metamerism in Annelida.

Arthropoda: General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects.

UNIT IV

Phylum Mollusca: General characters and classification up to classes; Torsion in gastropods.

Echinodermata: General characters and classification up to classes, Water vascular system in Asteroidea.

Suggested Books:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
2. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson.
3. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
4. Pough H. Vertebrate life, VIII Edition, Pearson International.
5. Kotpal, Agrawal & Khetrpal: Modern Textbook of Zoology, Invertebrates. Rastogi, 1976.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the various non-chordates and chordates based on their characteristics and body organization, as well as their classification.
CO2	Discuss the diversity and various adaptations found in vertebrates and invertebrates.
CO3	Classify the Invertebrates based on the modifications in their body plan, organization, symmetry, etc.
CO4	Investigate the structural and functional aspects of various body systems in the Invertebrates.
CO5	Conclude the various characteristics and morphological adaptations in animal diversity.
CO6	Generate the order of evolution of the Invertebrates based on adaptation and their various characteristics.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	3	2	2	3	1	2	2	2	3	2	1	3
CO2	3	1	2	2	3	2	2	3	2	2	2	2	3	2	1	3
CO3	3	1	2	2	3	2	2	3	1	2	1	1	3	3	1	3
CO4	3	2	3	2	3	2	1	2	2	2	1	1	3	2	1	3
CO5	3	3	2	2	3	2	2	2	2	2	1	2	3	2	1	3
CO6	3	3	2	2	3	2	2	2	1	2	2	1	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course Code : ZOOGE203				
Course Name : ANIMAL DIVERSITY-II				
Semester : II Semester				
	L	T	P	C
	4	0	0	4

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES: The objective of this course are:

1. This paper is quite informative and interesting and will be covering the basics of the whole animal kingdom.
2. Students will be able to organize animals according to the level of the body plan, organization, symmetry, germ layers, etc.

COURSE CONTENT

UNIT I

Protochordates: General features and Phylogeny of Protochordata.

Agnatha: General features of Agnatha and classification of cyclostomes up to classes.

UNIT II

Pisces: General features and Classification up to orders; Osmoregulation.

Amphibia: General features and Classification up to orders; Parental care.

UNIT III

Reptiles: General features and Classification up to orders; Poisonous and nonpoisonous snakes, Biting mechanism in snakes

UNIT IV

Aves: General features and Classification up to orders; Flight adaptations.

Mammals: Classification up to orders; Origin of mammals.

Suggested Books:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
2. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson.
5. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
6. Pough H. Vertebrate life, VIII Edition, Pearson International.
6. Kotpal, Agrawal & Khetrapal: Modern Textbook of Zoology, Invertebrates. Rastogi, 1976.

COURSE OUTCOMES (COs)**Upon successful completion of the course, a student will be able to:**

CO1	Identify the various non-chordates and chordates based on characteristics.
CO2	Discuss the diversity and various adaptation found in vertebrates and invertebrates.
CO3	Classify the animal world based on their modification in their body plan, organization, symmetry etc.
CO4	Investigate the structural and functional aspects of various body systems in animals.
CO5	Conclude the various morphological adaptation in animals.
CO6	Generate the order of evolution of animal world based on adaptation and their various characteristics.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2	2	2	3	1	2	1	2	2	1	1	2
CO2	1	2	1	2	2	2	2	3	2	2	1	2	1	1	1	2
CO3	1	2	1	2	2	2	2	3	2	2	1	2	1	1	1	2
CO4	2	2	2	2	2	2	1	2	2	3	2	2	2	2	3	2
CO5	3	3	2	3	2	2	2	2	2	3	3	3	2	2	3	2
CO6	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course Code : ZOOGE303				
Course Name : Economic Zoology				
Semester : III Semester				
	L	T	P	C
	4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To know about apiculture, sericulture and lac culture.
2. To know about parasites and their causing diseases.
3. To understand the process of integrated pest management.

COURSE CONTENT

UNIT I

Elementary knowledge of sericulture, Life cycle of Silk worm, Apiculture, Life cycle of Honey bee, Honey bee culture and tool used in honey bee culture, lac culture.

UNIT II

Fish culture System in India, Major Fresh water Fishes, Poultry keeping. Elementary knowledge of Animal Husbandry. Integrated Pest Management (IPM).

Parasitology

UNIT III

Parasitism and evolution of parasitism. Protozoan parasites: Biology, life cycle and diseases caused by selected pathogenic protozoans of man their preventive and control measures (*Entamoeba histolytica*, *Trypanosomes*, *Leishmania donovani*, *Trichomonas vaginalis*, *Giardia intestinalis* & *Plasmodium*).

UNIT IV

Parasitic adaptations in Platyhelminthes and Aschelminthes. Common trematode, cestode and nematode parasites. Biology, life history and preventive measures of economically important helminth parasites of man and domesticated animals (*Ascaris*, *Schistosoma*, *Fasciola*, *Wuchereria*) *Taenia*. Introduction to arthropods and vectors of human diseases (mosquitoes, lice, flies & ticks). Parasitism in Crustacea.

Reference Books:

1. A general text book of entomology, Imms, A.D., Chapman & Hall, UK
2. Sobti, R.C.: Medical Zoology. Sobhan Lal Nagin Chand & Co. Jallendhar.
3. Kotpal, Agrawal & Khetrpal: Modern Text-book of Zoology, Invertebrates. Rastogi, 1976.
4. Foundation of Parasitology, Roberts L.S. and Janovy j., McGraw-Hill Publishers, New York, USA.

Course Outcomes (COs): Upon successful completion of the course a student will be able to

CO1	Remember about culture techniques, animal husbandry, IPM, parasitic protozoans and helminthes.
CO2	To understand the behaviour of fishes, insects and other parasitic protozoans and helminths.
CO3	To analyze about the sericulture and life cycle of silk worms, Apiculture, and fish culture systems in India
CO4	Analyzing poultry keeping & IPM
CO5	Evaluate parasitism and evolution of parasitism, protozoan parasite.
CO6	Generate knowledge about parasitic adaptation in Platyhelminthes and Aschelminthes.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	2
CO2	3	3	2	3	2	2	3	3	2	3	3	3	2	2	3	2
CO3	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	2
CO4	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	2
CO5	3	3	2	3	2	2	3	3	2	3	3	3	2	2	3	2
CO6	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOOGE403			
Course Name	: Apiculture			
Semester	: IV Semester			
	L	T	P	C
	4	0	0	4

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To impart basic knowledge about honey bee species and their habitat.
2. Understanding the handling of honey beekeeping equipment and management of diseases and pests of honey bees.
3. Development of skills in the collection of bees and honey by scientific methods.
4. Knowledge about the process of beekeeping management and their valuable products.

COURSE CONTENT

UNIT I

Introduction to Beekeeping, History, present status & scope, selection of bee species & races, identification of bee flora, and location of the site.

UNIT II

Honey beekeeping equipment, Building & division of comb and colony, Management of insects and diseases, and nuisance in bee hives.

UNIT III

Scientific methods of Beekeeping, Bee box maintenance, collection, and preservation of honey and wax.

UNIT IV

Month-wise calendar of operations in beekeeping, seasonal management of honey bees.

Suggested Books

1. Kumar and Corton. Pathological Basis of Diseases.
2. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
3. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
4. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.

COURSE OUTCOMES (COs) : Upon successful completion of the course, a student will be able to

CO1	Describe the scope of entomology and its threats.
CO2	Illustrate the economic scope and its threats (Diseases, Parasites, etc.) to various livestock and Insects.
CO3	Apply how scientific methods can be done to increase the sustainability of bee flora.
CO4	Investigate the various epidemiological threats to the various form of insects.
CO5	Evaluate how beekeeping can be made more profitable and induced a job opportunity.
CO6	Formulate a plan for various form of entomology to mitigate the threats.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	1	2	2	2	2	2	3	2	2	3	2	2	3
CO2	2	2	2	1	2	3	3	3	2	3	3	3	3	2	2	3
CO3	2	2	2	2	2	2	2	2	2	3	2	2	3	2	2	3
CO4	2	3	2	1	2	2	2	2	2	3	2	2	3	2	2	3
CO5	2	2	2	1	2	3	3	3	2	3	3	3	3	2	2	3
CO6	2	2	2	1	2	2	2	2	2	3	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOOGE503				
Course Name : Pisciculture				
Semester : V Semester				
	L	T	P	C
	4	0	0	4

L- Lecture T – Tutorial P – Practical C – Credit

Course objectives: The objectives of this course are

1. Student will be able to learn how to manage the water bodies to for the production of fish.
2. Student can apply the knowledge in managing the fish culture, nutrition requirement and prevention of disease.

COURSE CONTENT

UNIT I

Scope of Aquaculture.: Importance of cultivable fresh water, marine ornamental species.

UNIT II

Fish farm Maintenance: Farm management technique, water quality, temperature and accessories in Farm management viz Aerator, Filter, paddler.

UNIT III

Fish culture technique: Monoculture, Polyculture and mono sex culture, Induced fish breeding, Integrated fish farming.

UNIT IV

Fish nutrition and fish formulations: live fish live fish transport. Prevention and control of fish diseases.

Suggested Books:

- 1 Textbook of Pisciculture and Aquarium Keeping Jagtap VK (2009) Daya Publishing House
2. Textbook of Fish Biology and Fisheries Khanna SS (2014) 3rd edition Narendra Publishing House.
3. Disease Management in Freshwater Pisciculture Mishra BK (2006) Agrotech Publishing Academy
4. Aquaculture: Farming Aquatic Animals and Plants, John S. Lucas (2019) 3rd Edition Wiley Publication.
5. Handbook of Fisheries and Aquaculture

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the various fresh and marine fish species.
CO2	Discuss the various techniques to manage the fish farm.
CO3	Demonstrate the various fish culture techniques.
CO4	Organise the fish culture techniques associated with the various fish species.
CO5	Conclude the various culture activities along with their maintenance parameters.
CO6	Integrate a plan for the different fish species living in different habitats.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	2	2	2	2	3	2	2	3	2	2	3
CO2	3	2	3	2	3	2	3	3	2	3	3	3	3	2	3	3
CO3	2	2	3	2	2	2	2	2	2	3	2	2	3	2	2	3
CO4	3	2	3	2	3	2	2	2	2	3	2	2	3	2	2	3
CO5	3	2	3	2	3	2	3	3	2	3	3	3	3	2	2	3
CO6	3	2	3	2	2	2	2	2	2	3	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOOGE603			
Course name	: WILDLIFE CONSERVATION AND MANAGEMENT			
Semester	: VI Semester			
	L	T	P	C
	4	0	0	4

L- Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVE: The objective of this course are

1. Students are able to learn about need to conserve wildlife, how to manage and use them in a sustainable manner.
2. Student will come to known about several techniques used in managing the wildlife.
3. To develop a scientific attitude among students towards wildlife conservation and make them aware with the future avenue in them.

COURSE CONTENT

UNIT I

Wildlife - Values of wildlife - positive and negative; our conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

UNIT II

Habitat analysis, Evaluation and management of wildlife - Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

UNIT III

Management of habitats - Setting back succession; Grazing logging, Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity. Population estimation, Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

UNIT IV

National Organizations involved in wildlife conservation: Wildlife Legislation –Wild Protection act - 1972, its amendments and implementation. Management planning of wildlife in protected areas; Estimation of carrying capacity; Ecotourism/wildlife tourism in forests; Concept of climax persistence. Management of excess population & translocation; Bio-telemetry; Care of injured and diseased animals; Quarantine; Common diseases of wild animals.

Protected areas, National parks & sanctuaries: Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

Suggested Books:

1. Sharma, High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.
2. Negi: Himalayan Wildlife: Habitat and Conservation. 1992. Indus Publ. Company, New Delhi.
3. Pullin: Conservation Biology, Cambridge, 2002.

COURSE OUTCOMES (COs) : Upon successful completion of the course, a student will be able to

CO1	Arrange and list the various physical and biological Parameters involved in managing wildlife.
CO2	Illustrate the various methods used for calculating the species population and richness in the stated community.
CO3	Relate the significance of various biological factors in protecting the Protected Area.
CO4	Investigate and organise the various challenges involved in managing the protected Area.
CO5	Evaluate and conclude the various approaches to estimate the populations in a habitat.
CO6	Integrate and combine a plan approach to conserve wildlife and manage them.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	2	2	2	2	3	2	2	3	3	2	3
CO2	3	3	2	2	2	2	3	3	2	3	3	3	3	2	2	3
CO3	3	3	2	1	2	3	2	2	2	3	2	2	3	3	2	3
CO4	3	3	2	2	2	2	2	2	2	3	2	2	3	2	2	3
CO5	3	3	2	1	2	2	3	3	2	3	3	3	3	2	2	3
CO6	3	3	2	2	2	2	2	2	2	3	2	2	3	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOOGE 703			
Course name	: ANIMAL BEHAVIOUR			
Semester	: VII Semester			
	L	T	P	C
	4	0	0	4

Course Objective: The objective of this course are

1. Students are able to understand the need to the science of behaviour.
2. Student will come to known about several techniques, which animals used in learning, how they use their hormonal control and chemicals in their communication.
3. To develop an insight knowledge about the various concepts and theory used in ecology, further how the biogeochemical cycle affect and alter the species of fauna.

COURSE CONTENT

UNIT I

Animal Behaviour: The science of behaviour: History, scope and terminology. Proximate and ultimate causes of behaviour. Instinct: Definition and characteristics (sign stimuli and Fixed Action Pattern).

UNIT II

Learning behaviour: Definition. Spatial learning. Associative learning, classical conditioning, operant conditioning, language learning. Imprinting. Kin recognition. Instinct versus learning behaviour.

UNIT III

Biological rhythms. The Biological Clock. Circadian rhythms and their synchronisation seasonal rhythms. Photoperiodism. Dance language of honey bees, Biological clocks. Bird migration with particular reference to the mechanisms of navigation. Introduction to Socio-biology: Social structure in primates.

UNIT IV

Communication: Visual, olfactory, accoustic. Chemoreception: Chemicals (pheromones) are used as signals in insects, fish, and mammals. Hormonal Control of Behaviour. Cooperation and conflict: Evolution of altruism.

Suggested readings:

1. Alcock : Animal behaviour Sinaur Associates, Inc. 1989.
2. Goodenough et al.: Perspectives on animal behaviour. Wiley & Sons, New Youk. 1993.
3. Grier : Biology of animal behaviour, Mosby 1984.
4. Krebs & Davies : An introduction to behavioural ecology (3rd ed.) Blackwell 1993.
5. Halliday, T.R.: Animal Behaviour Vol. 1 & 2 Communication, 1983.
- 6.M P Arora. Anilam behaviour. Himalayan Publishing house

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Describe how animal behaviour has evolved and learn new information.
CO2	Illustrate how chemicals and hormones control communication within the animal kingdom.
CO3	Demonstrate how it affects the fauna of the animal living in a community.
CO4	Analyze the role of photoperiodism and the biological clock of a community.
CO5	Evaluate and conclude the learning behaviour of animals.
CO6	Rewrite a plan for Imprinting and learning behaviour.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	1	1	2	3	2	2	2	2	3	2
CO2	3	3	2	3	2	2	1	1	2	3	3	3	2	2	3	2
CO3	2	2	2	2	2	2	1	1	2	3	2	2	2	2	3	2
CO4	2	1	1	2	2	2	1	1	1	2	1	2	2	1	1	2
CO5	1	2	1	2	2	2	1	1	2	2	1	2	1	1	1	2
CO6	1	2	1	2	2	2	1	1	2	2	1	2	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOOGE803			
Course name	: AQUARIUM FISH KEEPING			
Semester	: IV Semester			
	L	T	P	C
	4	0	0	4

COURSE OBJECTIVE:**The objective of this course are**

1. The student will be able to gain experience in managing the aquarium on their own.
2. The student will also be able to recognise a variety of aquarium fish and ornamental fish.

COURSE CONTENT**UNIT I**

The potential scope of Aquarium Fish Industry as a Cottage Industry: Exotic and endemic species of Aquarium fishes. General Aquarium maintenance – Budget for setting up an aquarium fish farm as a Cottage Industry.

UNIT II

Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes: Guppy, Molly, Gold fish, Angelfish, Blue morph, *Puntius conchonius* and *Barilius bendelisis*.

UNIT III

Food and feeding of Aquarium fishes – Use of live fish feed organisms. Preparation and composition of formulated fish feeds.

UNIT IV

Live fish transport: Fish handling, packing and forwarding techniques.

Suggested readings:

1. Aquarium Fishes Alappat Harishanker J.(2011) BR Publishing Corporation.
2. The Aquarium Fish Handbook David Goodwin (2008) KB Publication.
3. Aquarium Fish, Bailey Mary (2002) Anness Publishing.
4. An Introduction to Fish Biology and Fisheries. Khanna SS (2019) Surjeet Publication.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the scope of fish rearing in aquarium as a potential venture.
CO2	Discuss the characters and sexual dimorphism in respect to fresh and marine fishes.
CO3	Demonstrate how the various species can be groomed in aquarium.
CO4	Investigate the various process involved in making fish rearing in aquarium.
CO5	Conclude the various rearing techniques used for the fish species individually.
CO6	Formulate a plan schedule with various fish species for their high survivability and profitability.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	2	1	1	2	2	2	2	3	1	1	3
CO2	3	3	2	2	2	2	1	1	2	2	2	2	3	2	1	3
CO3	3	3	2	2	2	2	1	1	2	3	2	3	3	2	1	3
CO4	3	3	2	2	2	2	1	1	2	2	2	2	3	2	1	3
CO5	3	3	2	2	2	2	1	1	2	2	2	2	3	2	1	3
CO6	3	3	2	2	2	3	1	1	2	2	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COMPULSORY/ABILITY ENHANCEMENT COURSES**AEC104 Environment Science- I****Credit 2****Course Outcome**

1. Discover knowledge in an ecological perspective and value of the environment.
2. Understand the significance of various natural resources and its management.
3. Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation.
4. Categorize different types of pollution and their control measures. Discover effective methods of waste Management.
5. Evaluate global environmental problems and come out with the best possible solutions.
6. Create environmental laws and sustainable development.

Unit I

Environment: Definition, scope and importance of environment, need for public awareness; Ecosystem: Definition, scope and importance of ecosystem, classification, structure, and function of an ecosystem, food chains, food web and ecological pyramids, flow of energy; Biogeochemical cycles: Hydrological cycle, Phosphorous cycle, Nitrogen cycle.

Unit II

Natural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; Mineral resources: Use and exploitation; Land resources; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

Unit III

Biodiversity and biotic resources: Introduction, definition, genetic, species and ecosystem diversity; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values; India as a mega diversity nation.

Unit IV

Endangered and Endemic species, Hot spots of biodiversity. Threats to biodiversity: Habitat loss, poaching of wildlife, human-wildlife conflicts; Conservation of biodiversity: In situ and ex situ conservation; National Biodiversity Act.

Suggested Readings

1. Benny Joseph, "Environmental Studies", Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 1st Edition, 2006.
2. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", Orient Black Swan, 2nd Edition, 2013.
3. Dr. P. D Sharma, "Ecology and Environment", Rastogi Publications, New Delhi, 12th Edition, 201

AEC204 Environment Science- II**Credit-2****Course Outcome**

1. Discover knowledge in ecological perspective and value of environment.
2. Understand the significance of various natural resources and its management
3. Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation.
4. Categorize different types of pollution and their control measures. Discover effective methods of waste Management
5. Evaluate global environmental problems and come out with best possible solutions.
6. Create environmental laws and sustainable development.

Unit I

Environmental pollution: Definition, causes and effects of air pollution, water pollution, soil pollution, noise pollution; Solid waste: Municipal solid waste management, composition and characteristics of e-waste and its management; Pollution control technologies: Waste water treatment methods, primary, secondary and tertiary.

Unit II

Concepts of bioremediation; Global environmental problems and global efforts: Global Warming, Climate change, Sea level rise, ozone depletion, ozone depleting substances, deforestation and desertification; International conventions/protocols: Earth summit, Kyoto protocol and Montreal protocol

Unit III

Environmental legislations: Environmental protection act, air act1981, water act, forest act. Municipal solid waste management and handling rules, biomedical waste management and handling rules2016, hazardous waste management and handling rule.

Unit IV

Environmental impact assessment(EIA); Towards sustainable future: Concept of sustainable development, population and its explosion, crazy consumerism, environmental education, urban sprawl, concept of green building

Suggested Readings

4. Benny Joseph, "Environmental Studies", Tata Mc Graw Hill Publishing Co. Ltd, New Delhi, 1 st Edition, 2006.
5. Erach Bharucha, "Textbook of Environmental Studies for Under Graduate Courses", Orient Black Swan, 2nd Edition, 2013.
6. Dr. P. D Sharma, "Ecology and Environment", Rastogi Publications, New Delhi, 12th Edition, 201

Course Outcomes

1. Remember the different techniques of word formation; and demonstrate knowledge of synonyms, antonyms and skills of sensible writing.
2. Understand and remember the principle, mechanism of Communication skills, essential techniques and features of effective writing and make use of them in written communication.
3. Applying, understanding and remembering the detailed processes of essential techniques and features of effective writing and make use of them in written communication. Knowledge of synonyms, antonyms and skills of sensible writing.
4. Analyzing, applying, remembering, understanding the detailed study related common errors in English and solve exercises based on them; apply acquired knowledge and skills of oral and written communication in personal and professional life.
5. Evaluating, analyzing, applying, remembering, and understanding the principle, methods, properties and functions of plant physiology.
6. Constructing (Creating), Evaluating, Analyzing, demonstrating, remembering, and understanding the Take part in individual and group communication activities; and determine and invent new forms and methods of communication to as per the situation.

Unit I

Theory of Communication, Types and Modes of Communication: Introduction, Definitions and Function of Communication, Needs for Effective Communication, Process of Communication, Barrier to Communication, Kinds of Communication; Intrapersonal, Personal, Group and Mass, Verbal and Nonverbal Communication

Unit II

Listening and Speaking Skills: Types of Listening, Developing Effective Listening Skills, Academic Listening (Lectures), Listening to Talks and Presentation, Monologue, Dialogue, Group Discussion, Miscommunication, Interview, Public Speech, Pronunciation, Accent and Intonation and Rhythm.

Unit III

Reading Skills: Skimming, Scanning, Summary, Paraphrasing, Comprehension.

Suggested Readings

1. Fluency in English- Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (Forthcoming) ed. Dr. Gauri Mishra, Dr. RanjhanaKaul, Dr. Brati Biswas.

Course Outcomes

1. Remember the different techniques of word formation; and demonstrate knowledge of synonyms, antonyms and skills of sensible writing.
2. Understand and remember the principle, mechanism of Communication skills, essential techniques and features of effective writing and make use of them in written communication.
3. Applying, understanding and remembering the detailed processes of essential techniques and features of effective writing and make use of them in written communication. Knowledge of synonyms, antonyms and skills of sensible writing.
4. Analyzing, applying, remembering, understanding the detailed study related common errors in English and solve exercises based on them; apply acquired knowledge and skills of oral and written communication in personal and professional life.
5. Evaluating, analyzing, applying, remembering, and understanding the principle, methods, properties and functions of plant physiology.
6. Constructing (Creating), Evaluating, Analyzing, demonstrating, remembering, and understanding the Take part in individual and group communication activities; and determine and invent new forms and methods of communication to as per the situation.

Unit I

Introductory English Grammar: Parts of Speech, Tenses, Punctuation, Common Errors in English.

Unit II

Writing Skills; Social and Official Correspondence: Enquiries, Complaints and Replies, Letters to the Editor.

Unit III

Social Appeals in the Form of Letter/ Pamphlets, Standard Business Letter, Email Drafting and Etiquettes, Preparing Agenda and Writing Minutes for Meetings.

Unit IV

Career Skills: Job Application, Cover Letter, Bio-data, CV and Resume and Effective Profiling, Mock Interviews, Group Discussions

Suggested Readings

1. Fluency in English- Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (Forthcoming) ed. Dr. Gauri Mishra, Dr. RanjhanaKaul, Dr. Brati Biswas.

SKILL ENHANCEMENT COURSES IN ZOOLOGY

Course code	: ZOOSC105			
Course Name	: Public Health and Hygiene			
Semester	: I Semester			
	L	T	P	C
	2	0	0	2

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students will be able to understand the significance of public health and hygiene in our daily life.
2. Students will also be able to learn about the environmental challenges, and Diseases spread due to a lack of hygiene.

COURSE CONT**UNIT I**

Scope of Public health and Hygiene: Nutrition and health – classification of foods –Nutritional deficiencies - Vitamin deficiencies.

UNIT II

Environment and Health Hazards: Environmental degradation – Pollution and associated health hazards.

UNIT III

Communicable diseases and their control measures: Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS. Non-communicable diseases and their preventive measures, Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.

UNIT IV

Health Education in India: WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on sporadic diseases.

Suggested Books:

1. Public Health and Hygiene Dass K , (2021) Om Book International.
2. Public Health and Hygiene. Sudhar R. Wagh Vinod B. Kakade (2015) Success Publication.
3. Principles of Public Health: A Simple Text Book on Hygiene Presenting. The Principles Fundamental To The Conservation Of Individual And Community Health Thomas Dyer Turtle (2020) Lector House LLP.
4. Principles of Occupational Health and Hygiene: An introduction Sue Reed (2020) 3rd Edition Taylor and Francis .

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the importance of public health in our life.
CO2	Illustrate how environmental degradation affects human health.
CO3	Construct and implement a plan to summarize the list of communicable and noncommunicable diseases along with their prevention mechanism.
CO4	Investigate and organize the impact of non-communicable diseases in our society and its possible preventive measures.
CO5	Evaluate and conclude the challenges affecting public health, along with their possible remedial action.
CO6	Integrate and generate a report of the WHO-run program and its effects on our public health.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	2	1	1	2	2	2	2	2	1	3	2
CO2	3	3	3	2	3	3	1	1	2	2	2	2	3	1	3	3
CO3	3	3	2	3	2	2	1	1	2	3	2	3	2	1	3	3
CO4	3	3	2	2	3	2	1	1	2	2	2	2	2	1	3	3
CO5	2	3	3	2	3	3	1	1	2	2	2	2	3	1	3	2
CO6	2	3	3	2	3	3	1	1	2	2	2	2	3	1	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOOSC205			
Course name	: AQUARIUM FISH KEEPING			
Semester	: II Semester			
	L	T	P	C
	2	0	0	2

COURSE OBJECTIVE: The objective of this course are

1. The student will be able to gain experience in managing the aquarium on their own.
2. The student will also be able to recognise a variety of aquarium fish and ornamental fish.

COURSE CONTENT

UNIT I

The potential scope of Aquarium Fish Industry as a Cottage Industry: Exotic and endemic species of Aquarium fishes. General Aquarium maintenance – Budget for setting up an aquarium fish farm as a Cottage Industry.

UNIT II

Common characters and sexual dimorphism of freshwater and Marine Aquarium fishes: Guppy, Molly, Gold fish, Angelfish, Blue morph, *Puntius conchonus* and *Barilius bendelisis*.

UNIT III

Food and feeding of Aquarium fishes – Use of live fish feed organisms. Preparation and composition of formulated fish feeds.

UNIT IV

Live fish transport: Fish handling, packing and forwarding techniques.

Suggested Books:

1. Aquarium Fishes Alappat Harishanker J.(2011) BR Publishing Corporation.
2. The Aquarium Fish Handbook David Goodwin (2008) KB Publication.
3. Aquarium Fish, Bailey Mary (2002) Anness Publishing.
4. An Introduction to Fish Biology and Fisheries Khanna SS (2019) Surjeet Publication.

COURSE OUTCOMES (COs) : Upon successful completion of the course, a student will be able to

CO1	Identify the scope of fish rearing in aquarium as a potential venture.
CO2	Discuss the characters and sexual dimorphism in respect to fresh and marine fishes.
CO3	Demonstrate how the various species can be groomed in aquarium.
CO4	Investigate the various processes involved in making fish rearing in aquarium
CO5	Conclude the various rearing techniques used for the fish species individually .

CO6	Formulate a plan schedule with various fish species for their high survivability and profitability.			
Course code	: ZOOSC305 a			
Course Name	: Apiculture			
Semester	: III Semester			
	L	T	P	C
	2	0	0	2

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students will be able to learn how to manage apiculture as a self-employment venture.
2. Student will also be able to identify bee selection, the method for its upkeep, the extraction of honey and the prevention of diseases

COURSE CONTENT

UNIT I

History: Biology and classification of Honeybees, species of honey bees, social organization of the honey bee colony.

UNIT II

Beehive: Flora for Apiculture – Selection of bees for apiculture, Method of bee Keeping
Indigenous method of Extraction of honey.

UNIT III

Modern method of apiculture: Appliances for modern method. Diseases of Honey bee and control measures. Products of beekeeping, Honey – Bee wax– Honey: Production, Chemical composition, Economic importance of Honeybee wax.

UNIT IV

Bee enemies: Beekeeping industry – Recent efforts – Modern method in employing honey bees for cross-pollination in horticultural gardens.

Suggested Books

1. Understanding Apiculture Kumar Ashok (2011) Discovery Publication House.
2. Text Book of Sericulture, Apiculture and Entomology Sehgal PK (2018), Kalyani Publication
3. Economic Zoology Apiculture, Sericulture and Aquaculture Kamal Jaiswal (2014) PHI Publication.
4. Apiary Apiculture Payasi Y.K (2022) . OrangeBooks Publication.

COURSE OUTCOMES (COs) : Upon successful completion of the course, a student will be able to

CO1	Identify the scope of apiculture as a potential venture.
CO2	Discuss the characters of honey bee species and various maintenance process to be done in upkeeping their hive.
CO3	Demonstrate how the various species can be groomed.
CO4	Investigate the various process involved in making bee keeping with respect to various bee species.
CO5	Conclude the various rearing techniques used for the beekeeping with respect to their species.
CO6	Formulate a plan schedule with various bee species for their high survivability and profitability.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	1	1	2	2	2	2	2	3	2	2	3
CO2	2	2	2	1	2	2	2	2	2	2	2	2	3	2	2	3
CO3	2	2	2	2	2	1	1	2	2	3	2	3	3	2	2	3
CO4	2	3	2	1	2	2	1	2	2	2	2	2	3	2	2	3
CO5	2	2	2	2	2	1	2	2	2	2	2	2	3	2	2	3
CO6	2	2	2	1	2	1	1	2	2	2	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: ZOOSC305 b			
Course Name	: Disaster Management			
Semester	: III			
	L	T	P	C
	2	0	0	2

L - Lecture T – Tutorial P – Practical C – Credit

Objective of the Course

1. To provide basic conceptual understanding of disasters.
2. To understand approaches to Disaster Management
3. To build skills to respond to disasters

Course Content

Unit I.

Hazards and Disaster- Concepts, Vulnerability, and risks, Hazard and disaster types- Natural and Man-made disasters, earthquakes, floods, drought, landside, land subsidence, cyclones, and volcanoes. Man-made disasters: gas and radiation leaks, toxic waste disposal, oil spills, forest fires.

Unit II:

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of the Indian plate, flood types and its management, drought types and its management, landslides and its types.

Unit III:

GIS and Remote Sensing, Disaster management Cycle- Rescue, Relief, Rehabilitation, Reconstruction, prevention, mitigation.

Unit IV:

Preparedness, awareness generation strategies for the community on safe practices in disasters, and Early Warning Systems.

Text Books:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster Management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
3. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the key concepts of hazards, disasters, vulnerability, and risks, including the various types of natural and manmade disasters.
CO2	Describe the characteristics, causes, and effects of major natural disasters (earthquakes, floods, droughts, landslides, cyclones, volcanoes) and manmade disasters (gas leaks, radiations leaks, toxic waste, disposal, oil spills, forest fires).
CO3	Use knowledge of disaster types, hazard mapping, and risk assessment tools (including GIS and Remote Sensing) to analyze real life disaster scenarios.
CO4	Differentiate between types of disasters, their management strategies, and the roles of various stages in the disaster management cycle (rescue, relief, rehabilitation, reconstruction, prevention, mitigation, preparedness).

CO5	Predict the potential impacts of specific hazards on vulnerable communities using seismic zone data, flood/drought patterns, and environmental indicators.
CO6	Prepare disaster management and community awareness plans incorporating early warning systems, mitigation measures, and safe practices for disaster resilience.

Course code	: ZOOSC405			
Course Name	: Poultry Farming			
Semester	: IV Semester			
	L	T	P	C
	2	0	0	2

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students will be able to learn how to manage the poultry as a self-employment venture.
2. Student will also be able to identify several fowls based on their use, and the prevention of disease.

COURSE CONTENT

UNIT I

External morphology of a variety of Fowls: Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn.

UNIT II

Classification of Fowls based on their use: Meat type, such as Broilers, Egg type such as White Leghorn and Commercial layers, Dual purpose varieties, Game and Ornamental purpose varieties.

UNIT III

Feeding Poultry: Management of Egg Layers – Management of Broilers in large scale farms.

Poultry diseases: Viral, Bacterial, Fungal, Protozoan and Parasitic Lice etc., Prevention and precautions during vaccination.

UNIT IV

Management of modern Poultry Farms: Progressive plans to promote Poultry as a Self-Employment venture.

Suggested books:

1. Handbook of Poultry Farming And Feed Formulations A Practical Guide for Basic Bioinformatics and Biostatistics Tiwari Pooja, Pandey Pallavi, Notion Press.
2. Poultry Farming, Sasadhar Dash (2020) Namya Press .
3. Handbook of Poultry Farming and Feed Formulation, Nandan Ramesh Engineers India Research Institute.
4. Modern Poultry Farming Louis M Hurd (2003) Macmillan Publication Oxford Higher Education.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the fowl species based on their uses.
CO2	Associate the various fowl species' morphology used in selecting their purpose of breeding.
CO3	Demonstrate the various management approaches used in managing the poultry farms.
CO4	Examine how the management approach changes for fowl after separating according to their uses.
CO5	Evaluate the various diseases affecting the fowl and their management.
CO6	Formulate a progressive plan to manage the poultry farm.

CO-PO Mapping

course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	1	1	2	2	2	2	2	3	2	2	3
CO2	2	2	2	1	2	2	2	2	2	2	2	2	3	2	2	3
CO3	2	2	2	2	2	1	1	2	2	3	2	3	3	2	2	3
CO4	2	3	2	1	2	2	1	2	2	2	2	2	3	2	2	3
CO5	2	2	2	2	2	1	2	2	2	2	2	2	3	2	2	3
CO6	2	2	2	1	2	1	1	2	2	2	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : ZOOSC507				
Course Name : Sericulture				
Semester : V Semester				
	L	T	P	C
	2	0	0	2

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Students will be able to learn how to produce silk as a self-employment venture.
2. Students will also be able to identify several species found in India.

Course Content

UNIT I

Agencies, History of Sericulture in India; Financial Assistance from Government, Types of Silkworms and Distribution, Systematic Position and Propagation of Mulberry, Nutritive Value of Mulberry.

UNIT II

Mulberry Breeding, Diseases, and The Factors Influencing the Growth of Mulberry.

UNIT III

Systematic Position – Morphology and Life History of *Bombyx mori* Digestive, Circulatory, Respiratory, Excretory Systems, Reproduction, and Development

UNIT IV

Silkworm Nutrition; Silk Gland, Pests and Diseases of Silkworm

UNIT V

Egg Production, Grainage Activity, Moulting, Growth Studies, Cocoon Production. Raw Materials and Conditioning: Reeling Methods and Operation. Raw Silk Production and Weaving – Sericulture By-Product.

Suggested books:

1. Sericulture Johnson, M. and Kesary, M. (2020). Sericulture. (Ed. 1). Saras Publication.
2. Comprehensive Sericulture: Silkworm Rearing and Silk Rearing. Chawala, N. K., (2017) Indian Books and Periodicals.
3. An Introduction to Sericulture. (Ed. 2). Madan Mohan Rao, M. (2019) B S Publications.
4. Textbook of Soil Science. (Ed. 12). Biswas, T. D. and Mukherjee, S. K. (2004) Mc Graw. Hill Company Ltd., New Delhi.
5. Introductory Soil Science. (Ed. 4). Das, Dilip Kumar (2020). Kalyani Publishers.

COURSE OUTCOMES (COs): Upon successful completion of the course, a student will be able to

CO1	Identify the factors affecting the silkworm.
CO2	Describe the various systems of <i>Bombyx mori</i> .
CO3	Demonstrate the various management approaches used in managing the sericulture farms.
CO4	Examine how the various activities are used in sericulture.
CO5	Critique various diseases affecting the silkworm and their management.
CO6	Formulate a progressive plan to manage the sericulture farm.

CO-PO Mapping

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2	2	1	1	1	2	1	2	2	1	1	2
CO2	1	2	1	2	2	2	1	1	2	2	1	2	1	1	1	2
CO3	1	1	2	2	2	1	2	1	1	2	1	1	1	2	1	1
CO4	1	2	1	2	2	1	2	2	1	2	1	1	2	1	2	1
CO5	1	1	2	2	1	2	2	1	2	2	2	2	2	1	2	2
CO6	1	1	2	2	1	1	2	1	1	2	2	1	1	2	2	1

Seminar/Dissertation
Semester VII & VIII**Course contents:**

Under the direct mentorship of a faculty member, the student will review and critically analyze existing literature in their chosen area of Zoology/biological sciences and actively participate in relevant research activities.

Course Outcome (COs):

Upon successful completion of this course, the student will be able to:

CO1	To outline the research ideas & objectives.
CO2	To review the subject-specific scientific literature.
CO3	To acquire skills for writing a thesis and scientific papers.
CO4	To correlate the fundamentals of research methodology.
CO5	To appraise the knowledge gained during the coursework.
CO6	To develop a scientific temperament.