Department of Zoology, Pragjyotish College
Programme specific outcome for B. Sc. Zoology (Honours)

The Department has clearly stated learning outcomes of the Programs and Courses by the following mechanism and is followed by the department to communicate the learning outcomes to the teachers and students.

- The Department of Zoology, Pragjyotish College maintain a hard copy of syllabi for ready reference to the teachers and students
- The students are also made aware of the same through Meetings.

Programme specific outcome (PSO)

After completion of the programme students will be able to -

- PSO1: Identify and list out animals in and around our environment. Develop respect for nature , explain the role and impact of different environmental conservation programmes and develop skills to analyze the impact of environment
- PSO2 : Understand various genetic abnormalities, identify animals beneficial to humans and explain various physiological changes in our bodies
- PSO3: Develop scientific attitude and temperament among the students, which will be beneficial for the society
- PSO4: Equip themselve to learn and know about different biological systems, their coordination and control as well as evolution, behavior and biological roles of the animals in the ecosystem.
- PSO5: Acquire skills in diagnostic testing procedures used in clinical and research laboratories will provide them scopes to work in research laboratory.
- PSO6 : Develop cognitive ability to Use tools of information technology for all activities related to higher studies.
- PSO9: Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

Course Outcome

B. Sc. In Zoology (Honours) syllabus (CBCS)

1st Semester (Honours)

Paper Name: Non-chordates I: Protista to Pseudocoelomates
Paper Code: ZOO-HC-1016

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Learn about the importance of systematics, taxonomy and structural organization of animals. ➢ Understand the diversity of non-chordates living in varied habit and habitats. ➢ Understand evolutionary history and relationships of different non-chordates through functional and structural affinities. ➢ Critically analyse the organization, complexity and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla. ➢ Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem. ➢ Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.	**Unit 1: Protista, Parazoa and Metazoa** ➢ General characteristics and Classification up to classes ➢ Study of *Euglena*, *Amoeba* and *Paramecium* Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica* ➢ Locomotion and Reproduction in Protista ➢ Evolution of symmetry and segmentation of Metazoa **Unit 2: Porifera** ➢ General characteristics ➢ Classification up to classes ➢ Canal system and spicules in sponges **Unit 3: Cnidaria** ➢ General characteristics ➢ Classification up to classes ➢ Metagenesis in *Obelia* Polymorphism in Cnidaria ➢ Corals and coral reefs **Unit 4: Ctenophora** ➢ General characteristics and Evolutionary significance **Unit 5: Platyhelminthes** ➢ General characteristics and Classification up to classes ➢ Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium* **Unit 6: Nemathelminthes** ➢ General characteristics and Classification up to classes ➢ Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti* ➢ Parasitic adaptations in helminthes **Practical** ➢ Study of whole mount of *Euglena*, *Amoeba* and *Paramecium,* Binary fission and Conjugation in *Paramecium* ➢ Examinationofpondwatercollectedfromdifferentplacesfordiversityinprotista ➢ Study of *Sycon*(T.S. and L.S.), *Hyalonema, Euplectella,Spongilla* ➢ Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina,Madrepora* ➢ One specimen/slide of anyctenophore ➢ Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles(Slides/micro-photographs) ➢ Study of adult *Ascaris lumbricoides* and its life stages(Slides/micro-photographs) ➢ To submit a Project Report on any related topic on life cycles.	Remember, Understand, Apply, Analyse, Evaluate , Create

Paper Name: Principles of Ecology

Paper Code: ZOO-HC-1026

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Understand the community characteristics, ecosystem development and climax theories. ➢ Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies. ➢ Apply the basic principles of ecology in wildlife conservation and management ➢ Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors. ➢ Comprehend the population characteristics, dynamics, growth models and interactions. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Introduction to Ecology** ➢ History of ecology, Autecology and synecology ➢ Levels of organization, Laws of limiting factors, ➢ Study of physical factors **Unit 2: Population** ➢ Unitary and Modular populations ➢ Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion ➢ Exponential and logistic growth, equation and patterns, r and K strategies ➢ Population regulation - density-dependent and independent factors ➢ Population interactions, Gause's Principle with laboratory and field examples, ➢ Lotka-Volterra equation for competition and Predation, functional and numerical responses **Unit 3: Community** ➢ Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example ➢ Theories pertaining to climax community **Unit 4: Ecosystem** ➢ Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies ➢ Nutrient and biogeochemical cycle with one example of Nitrogen cycle ➢ Human modified ecosystem **Unit 5: Applied Ecology** ➢ Ecology in Wildlife Conservation and Management **Practical** ➢ Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided ➢ Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon- Weiner diversity index for the same community ➢ Study of an aquatic ecosystem: Phytoplankton and Zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method). ➢ Report on a visit to National Park/Biodiversity Park/Wild life sanctuary	Remember, Understand, Apply, Analyse, Create

2nd Semester (Honours)

Paper Name: Non Chordates- II: Coelomate
Paper Code: ZOO-HC-2016

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Learn about the importance of systematics, taxonomy and structural organization of animals. ➢ Appreciate the diversity of non-chordates living in diverse habit and habitats. ➢ Understand evolutionary history and relationships of different non-chordates through functional and structural affinities. ➢ Critically think about the organization, complexity and characteristic features of non-chordates. ➢ Getting familiarized with the morphology and anatomy of representatives of various animal phyla. ➢ Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Introduction to Coelomates** ➢ Evolution of coelom and metamerism **Unit 2: Annelida** ➢ General characteristics and Classification up to classes ➢ Excretion in Annelida **Unit 3: Arthropoda** ➢ General characteristics and Classification up to classes ➢ Vision and Respiration in Arthropoda ➢ Metamorphosis in Insects Social life in bees and termites **Unit 4: Onychophora** ➢ General characteristics and Evolutionary significance **Unit 5: Mollusca** ➢ General characteristics and Classification up to classes ➢ Respiration in Mollusca Torsion and detorsion in Gastropoda ➢ Pearl formation in bivalves ➢ Evolutionary significance of trochophore larva **Unit 6: Echinodermata** ➢ General characteristics and Classification up to classes ➢ Water-vascular system in Asteroidea ➢ Larval forms in Echinodermata ➢ Affinities with Chordates **Practical** ➢ Study of following specimens: ➢ Annelids- *Aphrodite, Nereis, Heteronereis ,Sabella, Serpula, Chaetopterus,Pheretima, Hirudinaria* ➢ Arthropods - *Limulus*, *Palamnaeus, Palaemon, Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta,* termites and honey bees Onychophora - *Peripatus* ➢ Molluscs - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus* ➢ Echinodermates - *Pentaceros*/*Asterias, Ophiura, Clypeaster, Echinus, Cucumaria* and *Antedon* ➢ Studyofdigestivesystem,septalnephridiaandpharyngealnephridiaofearthworm ➢ T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm ➢ Mount of mouth parts and dissection of digestive system and nervous system of ➢ *Periplaneta** ➢ To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)	Remember, Understand, Apply, Analyse, Create

Paper Name: Cell Biology
Paper Code: ZOO-HC-2026

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Understand fundamental principles of cell biology. ➢ Understand defects in functioning of cell organelles and regulation of cellular processes can develop into diseases. ➢ Explain structure and functions of cell organelles involved in diverse cellular processes. ➢ Appreciate how cells grow, divide, survive, die and regulate these important processes. ➢ Comprehend the process of cell signalling and its role in cellular functions. ➢ Learn the advances made in the field of cell biology and their applications. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Over view of Cells** ➢ Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions **Unit 2: Plasma Membrane** ➢ Various models of plasma membrane structure ➢ Transport across membranes: Active and Passive transport, Facilitated transport ➢ Cell junctions: Tight junctions, Desmosomes, Gap junctions **Unit 3: Endomembrane System** ➢ Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes **Unit 4: Mitochondria and Peroxisomes** ➢ Mitochondria: Structure, Semi-autonomous nature ➢ Endosymbiotic hypothesis ➢ MitochondrialRespiratory Chain ➢ Chemi-osmotic hypothesis ➢ Peroxisomes **Unit5: Cytoskeleton** ➢ Structure and Functions: Microtubules ➢ Microfilaments and Intermediate filaments **Unit6: Nucleus** ➢ Structure of Nucleus: Nuclear envelope, Nuclear pore complex ➢ Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging(nucleosome) **Unit 7: Cell Division** ➢ Mitosis, Meiosis, Cell cycle and its regulation **Unit 8: Cell Signaling** ➢ GPCR and Role of second messenger (cAMP) **Practical** ➢ Preparation of temporary stained squash of onion root tip to study various stages of mitosis ➢ Study of various stages of meiosis. ➢ Preparation of permanent slide to show the presence of Barrbody in human female blood cells/cheek cells. ➢ Preparation of permanent slide to demonstrate: iDNA by Feulgen reaction ➢ Mucopolysaccharides by PAS reaction ➢ Proteins by Mercuro bromophenol blue/FastGreen	Remember, Understand, Apply, Analyse, Create

3rd Semester (Honours)

Paper Name: Diversity of Chordata

Paper Code: ZOO-HC-3016

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Understand different classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum. ➢ Know about the habit and habitat of chordates in marine, freshwater and terrestrial ecosystems ➢ Study about diversity in animals making students understand about their distinguishing features. ➢ Contrast the similarities and differences in life functions among various groups of animals in Phylum Chordata. ➢ Comprehend the circulatory, nervous and skeletal system of chordates. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Introduction to Chordates** ➢ General characteristics and outline classification **Unit2: Protochordata** ➢ General characteristics of Hemichordata, Urochordata and Cephalochordata ➢ Study of larval forms in protochordates; ➢ Retrogressive metamorphosis in Urochordata **Unit 3: Origin of Chordata** ➢ Dipleurula concept and the Echinoderm theory of origin of chordates ➢ Advanced features of vertebrates over Protochordata **Unit4: Agnatha** ➢ General characteristics and classification of cyclostomes up to class **Unit5: Pisces** ➢ General characteristics of Chondrichthyes and Osteichthyes, ➢ Classification up to order ➢ Migration, Osmoregulation and Parental care in fishes **Unit6: Amphibia** ➢ Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); ➢ General characteristics andclassification up to order ➢ Parental care in Amphibians **Unit7: Reptilia** ➢ General characteristics and classification up to order ➢ Affinities of *Sphenodon* ➢ Poison apparatus and Biting mechanism in snakes **Unit8: Aves** ➢ General characteristics and classification up to order ➢ *Archaeopteryx*-- a connecting link; ➢ Principles and aerodynamics of flight, ➢ Flight adaptations and Migration in birds **Unit9: Mammals** ➢ General characters and classification up to order ➢ Affinities of Prototheria ➢ Adaptive radiation with reference to locomotory appendages **Unit10: Zoogeography** ➢ Zoo geographical realms, ➢ Theories pertaining to distribution of animals, ➢ Plate tectonic and Continental drift theory, ➢ Distribution of vertebrates in different realms **Practical** ➢ Protochordata: *Balanoglossus, Herdmania, Branchiostoma,* Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchio genital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slide of *Herdmania* spicules ➢ Agnatha: *Petromyzon, Myxine* ➢ Fishes: *Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas,* Flat fish ➢ Amphibia: *Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra* ➢ Reptilia: *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus.* Key for Identification of poisonous and non-poisonous snakes ➢ Aves: Study of six common birds from different orders. Types of beaks and claws ➢ Mammalia: *Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus, Loris,Herpestes, Erinaceous.* ➢ Mount of weberian ossicles of *fish* ➢ Power point presentation on study of any two animals from two different classes by students (may be included if dissections not givenpermission)	Remember, Understand, Apply, Analyse

Paper Name: Animal Physiology: Controlling And CoordinatingSystems
Paper Code: ZOO-HC-3026

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Know the basic fundamentals and understand advanced concepts so as to develop a strong foundation that will help them to acquire skills and knowledge to pursue advanced degree courses. ➢ Know the role of regulatory systems viz. endocrine and nervous systems and their amalgamation in maintaining various physiological processes. ➢ Recognize and explain how all physiological systems work in unison to maintain homeostasis in the body and use of feedback loops to control the same ➢ Learn an integrative approach to understand the interactions of various organ systems resulting in the complex overall functioning of the body. Synthesize ideas to make connection between knowledge of physiology and real world situations, including healthy life style decisions and homeostatic imbalances ➢ Comprehend and analyze problem-based questions ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Tissues** ➢ Structure, location, classification and functions of epithelial tissue,connective tissue, muscular tissue and nervous tissue **Unit 2: Bone and Cartilage** ➢ Structure and types of bones and cartilages, Ossification, bonegrowth and resorption **Unit 3: Nervous System** ➢ Structure of neuron, resting membrane potential, ➢ Origin of action potential and its propagation across the myelinated and unmyelinatednerve fibers; ➢ Types of synapse, Synaptic transmission and, Neuromuscular junction; ➢ Reflex action and its types - reflex arc; ➢ Physiology of hearing and vision. **Unit 4: Muscle** ➢ Histology of different types of muscle; ➢ Ultra structure of skeletal muscle; ➢ Molecular and chemical basis of muscle contraction ➢ Characteristics of muscle twitch; Motor unit, summation and tetanus **Unit 5: Reproductive System** ➢ Histology of testis and ovary ➢ Physiology of male and female reproduction; ➢ Puberty, Methods of contraception in male and female **Unit 6: Endocrine System** ➢ Histology of endocrine glands- pineal, pituitary, thyroid,parathyroid, pancreas, adrenal ➢ Hormones secreted by them and their mechanism of action ➢ Classification of hormones; Regulation of theirsecretion; ➢ Mode of hormone action, ➢ Signal transduction pathways for steroidal and non- steroidal hormones; ➢ Hypothalamus (neuroendocrine gland)-principal nuclei involved in neuro endocrine control of anterior pituitary and endocrines system; ➢ Placental hormones **Practical** ➢ Demonstration of the unconditioned reflex action (Deep tendon reflex such as kneejerk reflex) ➢ Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells ➢ Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nervecell,Pituitary,Pancreas,Testis,Ovary, Adrenal,ThyroidandParathyroid ➢ Microtomy: Preparation of permanent slide of any five mammalian (Goat/ rat/mice) tissues	Remember, Understand, Apply, Analyse

Paper Name: Fundamentals of Biochemistry
Paper Code: ZOO-HC-3036

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Gain knowledge and skill in the fundamentals of biochemical sciences, interactions and interdependence of physiological and biochemical processes. ➢ Know about classical laboratory techniques, use modern instrumentation, design and conduct scientific experiments, and analyze the resulting data. ➢ Get exposed to various processes used in industries and gain skills in techniques of chromatography and spectroscopy. ➢ Demonstrate foundation knowledge in biochemistry; synthesis of proteins, lipids, nucleic acids, and carbohydrates; and their role in metabolic pathways along with their regulation. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit1: Carbohydrates** ➢ Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates **Unit2: Lipids** ➢ Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids **Unit3: Proteins** ➢ **Amino acids:** Structure, Classification and General properties of α- amino acids; Physiological importance of essential and non-essential α-amino acids ➢ **Proteins:** Bonds stabilizing protein structure; Levels of organizationin proteins; Denaturation; Introduction to simple and conjugate proteins ➢ **Immunoglobulins:** Basic Structure, Classes and Function, AntigenicDeterminants **Unit 4: Nucleic Acids** ➢ Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids ➢ Cot Curves ➢ Basepairing ➢ De-naturation and Re-naturation of DNA ➢ Types of DNA and RNA ➢ Complementarily of DNA ➢ Hpyo- Hyper-chromaticity of DNA **Unit5: Enzymes** ➢ Nomenclature and classification; Cofactors; ➢ Specificity of enzyme action; ➢ Isozymes ➢ Mechanism of enzyme action; ➢ Enzyme kinetics; ➢ Factors affecting rate of enzyme-catalyzed reactions; ➢ Derivation of Michaelis-Menten equation, ➢ Concept of Km and V-max, Line weaver-Burk plot ➢ Multi-substrate reactions; ➢ Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action **Practical** ➢ Qualitative tests of functional groups in carbohydrates, proteins and lipids. ➢ Paper chromatography of amino acids. ➢ Action of salivary amylase under optimum conditions. ➢ Effect of pH, temperature on the action of salivary amylase. ➢ Demonstration of proteins separation by SDS-PAGE.	Remember, Understand, Apply

Paper Name: Ornamental Fish and Fisheries (SEC)
Paper Code: ZOO-SE-3014

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Define, comprehend, scope and significance of aquaculture ➢ Acquire knowledge on taxonomy and morphology of fishes. ➢ Understand food, feeding, growth, digestion and respiration in fishes. ➢ Examine the types and practices of Aquaculture. ➢ Construct aquariums and plankton cultures ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1:** ➢ Ornamental Fish Diversity of North East India. **Unit 2:** ➢ Aquarium plant diversity in the wetland of Assam. **Unit 3:** ➢ Construction and management of Home Aquarium. **Unit 4:** ➢ Natural feed of Ornamental Fish **Unit 5:** ➢ Strategies for maintenance of natural colour of Ornamental Fish **Unit 6:** ➢ Natural Breeding of Tricogaster species **Unit 7:** ➢ Health management of Ornamental Fish **Unit 8:** ➢ Feed formulation of Ornamental Fish **Unit 9:** ➢ Development of Biological filtration in Aquarium **Unit 10:** ➢ Pure culture of planktons **Practical** ➢ Identification of Ornamental Fish ➢ Culture of Indigenous ornamental fish in Aquarium ➢ Estimation of Physico-chemical characteristics of Aquarium water ➢ Biological filter for removal of Ammonia from Aquarium ➢ Culture of Plankton	**Remember, Understand, Apply, Analyze, Create**

4th Semester (Honours)

Paper Name: ComparativeAnatomy of Vertebrates

Paper Code: ZOO-HC-4016

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Understand the pattern of vertebrate evolution, organization and functions of various systems. ➢ Learn the comparative account of integument, skeletal components, their functions and modifications in different vertebrates. ➢ Understand the evolution of heart, modification in aortic arches, structure of respiratory organs used in aquatic, terrestrial, aerial vertebrates; and digestive system and its anatomical specializations with respect to different diets and feeding habits. ➢ Learn the evolution of brain, sense organs and excretory organsto a complex, highly evolved form in mammals ➢ Analyze and critically evaluate the structure and functions of vertebrate systems, which helps them to discern the developmental, functional and evolutionary history of vertebrate species. ➢ Understand the importance of comparative vertebrate anatomy to discriminate human biology ➢ Explain comparative account of the different vertebrate systems. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Integumentary System** ➢ Structure, functions and derivatives of integument **Unit 2: Skeletal System** ➢ Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches **Unit 3: Digestive System** ➢ Alimentary canal and associated glands, dentition **Unit 4:Respiratory System** ➢ Skin, gills, lungs and air sacs; ➢ Accessory respiratory organs **Unit 5: Circulatory System** ➢ General plan of circulation ➢ Evolution of heart and aortic arches **Unit 6: Urinogenital System** ➢ Succession of kidney, ➢ Evolution of urinogenital ducts, ➢ Types of mammalian uteri **Unit 7:Nervous System** ➢ Comparative account of brain ➢ Autonomic nervous system, ➢ Spinal cord, ➢ Cranial nerves in mammals **Unit 8:Sense Organs** ➢ Classification of receptors ➢ Brief account of visual and auditory receptors in man **Practical** ➢ Study of placoid, cycloid and ➢ Disarticulated skeleton of Frog, Fowl, Rabbit ➢ Carapace and plastron of turtle/tortoise ➢ Mammalian skulls: One herbivorous and one carnivorous animal ➢ Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted) ➢ Project on skeletal modifications in vertebrates (may be included if dissection not permitted)	Remember, Understand, Analyze,

Paper Name: Animal Physiology: Life Sustaining Systems
Paper Code: ZOO-HC-4026

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Understand basic fundamentals and understanding of advanced concepts of physiology. ➢ Learn interactions of various organ systems resulting in the complex overall functioning of the body. ➢ Comprehend and analyse problem-based questions on physiological aspects. ➢ Recognize and explain how all physiological systems maintain homeostasis in the body; and use of feedback loops to control the same. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Physiology of Digestion** ➢ Structural organization and functions of gastrointestinal tract and associated glands; ➢ Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; ➢ Hormonal control of secretion of enzymes in Gastrointestinaltract. **Unit 2: Physiology of Respiration** ➢ Histology of trachea and lung; ➢ Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; ➢ Transport of oxygen and carbon dioxide in blood; Respiratory pigments, ➢ Dissociation curves and the factors influencing it; ➢ Carbon monoxide poisoning; ➢ Control of respiration **Unit 3: Renal Physiology** ➢ Structure of kidney and its functional unit ➢ Mechanism of urine formation; ➢ Regulation of water balance; ➢ Regulation of acid-base balance **Unit4: Blood** ➢ Components of blood and their functions ➢ Structure andfunctions of haemoglobin ➢ Haemostasis: Blood clotting system, Kallikrein- Kinninogen system, ➢ Complement system & Fibrinolytic system, Haemopoiesis ➢ Blood groups: Rh factor, ABO and MN **Unit 5: Physiology of Heart** ➢ Structure of mammalian heart; Coronary circulation; ➢ Structure and working of conducting myocardial fibers. ➢ Origin and conduction of cardiac impulses ➢ Cardiac cycle; Cardiac output and its regulation, ➢ Frank-Starling Law of the heart, nervous and chemical regulation ofheart rate. ➢ Electrocardiogram, Blood pressure and its regulation **Practical** ➢ Determination of ABO Blood group ➢ Enumeration of red blood cells and white blood cells using haemocytometer ➢ Estimation of haemoglobin using Sahli's haemoglobinometer ➢ Preparation of haemin crystals ➢ Recording of blood pressure using a sphygmomanometer ➢ Examination of sections of mammalian oesophagus, stomach, duodeum, ileum, rectum liver, trachea, lung, kidney	Remember, Understand, Analyze

Paper Name: Biochemistry of Metabolic Processes
Paper Code: ZOO-HC-4036

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Gain knowledge and skill in the interactions and interdependence of physiological and bio-molecules ➢ Understand essentials of the metabolic pathways along with their regulation. ➢ Apply knowledge to the scientific understanding of metabolism ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Overview of Metabolism** ➢ Catabolism *vs* Anabolism ➢ Stages of catabolism ➢ Compartmentalization of metabolic pathways ➢ Shuttle systems and membrane transporters ➢ ATP as "Energy Currency of cell"; coupled reactions ➢ Use of reducing equivalents and cofactors ➢ Intermediary metabolism and regulatory mechanisms	Remember, Understand, Apply
	Unit 2: Carbohydrate Metabolism ➢ Sequence of reactions and regulation of glycolysis ➢ Citric acidcycle ➢ Phosphate pentose pathway ➢ Gluconeogenesis, Glycogenolysis and Glycogenesis	
	Unit 3: Lipid Metabolism ➢ β-oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms ➢ Biosynthesis of palmitic acid ➢ Ketogenesis	
	U**nit 4: Protein Metabolism** ➢ Catabolism of amino acids: Transamination, Deamination, Urea cycle ➢ Fate of C-skeleton of Glucogenic and Ketogenic amino acids	
	Unit 5: Oxidative Phosphorylation ➢ Redox systems ➢ Review of mitochondrial respiratory chain ➢ Inhibitors and un-couplers of Electron Transport System	
	Practical ➢ Estimation of total protein in given solutions by Lowry's method. ➢ Detection of SGOT and SGPT in serum/tissue ➢ To study the enzymatic activity of Trypsin and Lipase. ➢ Study of biological oxidation (SDH) [goat liver] ➢ To perform the Acid and Alkaline phosphatase assay from serum/tissue.	

Paper Name: Non-Mulbery Sericulture (SEC)
Paper Code: ZOO-SE-4014

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Understand overall aspects of Sericulture, namely, Mulberry and non-mulberry silkworms and their food plants, ➢ Learn various technologies involved in Sericulture. ➢ Apply knowledge to rearing of the silkworm, Silkworm pathology, Process of silkworm seed production and silk technology. ➢ Apply knowledge learnt for Mulberry nursery management, Silkworm rearing, and Silk reeling. ➢ Evaluate quality of silkworms and their products ➢ Create awareness on economic importance and suitability of Sericulture in Indian conditions. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and field projects	**Unit 1: Introduction** ➢ Sericulture: Definition, history and present status of Mulberry and Non-Mulberry Sericulture ➢ Silk routeVarieties of Silk ➢ Types and distribution of non-mulberry or wild or vanya sericigenous insects in N-E India **Unit 2: Biology of Non-mulberry Silkworm:** ➢ Life cycle of silkworm- Eri and Muga Structure of silk gland and Nature of Silk **Unit 3: Rearing of Silkworms** ➢ Eri and Muga Silkworm ➢ Food plants of Eri and Muga Silkworm **Rearing Operation:** ➢ Rearing house/Site and rearing appliances ➢ Disinfectants: Formalin, bleaching powder ➢ Rearing technology: Early age and Late age rearing ➢ Environmental conditions in rearing-Temperature, Humidity, Light and Air ➢ Types of mountages ➢ Harvesting and storage of cocoons ➢ Spinning and Reeling of silk **Unit 4: Pests and Diseases:** ➢ Pests of eri and muga silkworm ➢ Pathogenesis of eri and muga silkworm diseases: Protozoan, viral, fungal and bacterial ➢ Prevention and control measures of pests and diseases **Unit 5: Entrepreneurship in Non-Mulberry Sericulture:** ➢ Varieties of Non-Mulberry Silk products and economics in India ➢ Prospectus of Non-Mulberry Sericulture in India: Non-Mulberry Sericulture industry in different states, employment generation and potential **Practical** ➢ Visit to various sericulture Govt. /Private Farm/ Centers.	**Remember, Understand, Apply, Analyze, Create**

5th Semester (Honours)

Paper Name: Molecular Biology
Paper Code: ZOO-HC-5016

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Describe the basic structure and chemistry of nucleic acids, DNA and RNA; molecular machinery and mechanism of information transfer processes, transcription and translation-in prokaryotes and eukaryotes, modification mechanisms for the processing of eukaryotic RNAs; ➢ Understand gene expression regulation in eukaryotes ➢ Explain the significance of DNA repair mechanisms in controlling DNA damage, role of RNAs (riboswitches, siRNA and miRNA) in gene expression regulation. ➢ Compare and contrast DNA replication machinery and mechanisms in prokaryotes and eukaryotes. ➢ Estimate concentration of DNA and RNA by colorimetric methods. ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Nucleic Acids** ➢ Salient features of DNA and RNA Watson and Crick modelof DNA **Unit 2: DNA Replication** ➢ DNA Replication in prokaryotes and eukaryotes ➢ Mechanism of DNA replication ➢ Semi-conservative, bidirectional and semi-discontinuous replication ➢ RNA priming, Replication of circular and linear *ds*-DNA, replication of telomeres **Unit3: Transcription** ➢ RNA polymerase and transcription unit ➢ Mechanism of transcription in prokaryotes and eukaryotes ➢ Synthesis of rRNA and mRNA, transcription factors **Unit4: Translation** ➢ Genetic code, Degeneracy of the genetic code Wobble Hypothesis ➢ Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, *aminoacyl tRNA synthetases*and charging of tRNA; ➢ Proteins involved in initiation, elongation and termination of Polypeptide chain; Inhibitors of protein synthesis; ➢ Difference between prokaryotic and eukaryotic translation **Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA** ➢ Structure of globin mRNA ➢ Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, ➢ Processing of tRNA **Unit 6: Gene Regulation** ➢ Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trpoperon*, Transcription. ➢ Regulation in eukaryotes: Activators, Repressor. Gene Silencing and Genetic importing **Unit 7: DNA Repair Mechanism** ➢ Pyrimidine dimerization and mismatch repair **Unit 8: Regulatory RNAs** ➢ Ribo-switches, RNA interference, miRNA,siRNA **Practical:** ➢ Study of Polytene chromosomes from Chironomous/ Drosophila larvae ➢ Preparation of liquid culture medium (LB) and raise culture of *E.coli* ➢ Estimation of the growth kinetics of *E. coli* by turbidity method ➢ Quantitative estimation DNA using colorimeter (Diphenylamine reagent) ➢ Quantitative estimation of RNA using Orcinol reaction ➢ Study and interpretation of electron micrographs/ photograph showing (a) DNA replication (b) Transcription (c) Split genes	**Remember, Understand, Apply, Analyze**

Paper Name: Principles of Genetics
Paper Code: ZOO-HC-5026

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Have a deeper understanding of the varied branches of the biological sciences like microbiology, evolutionary biology, genomics and metagenomics. ➢ Gain knowledge of the basic principles of inheritance. ➢ Analyse pedigree leading to development of analytical skills and critical thinking enabling the students to present the conclusion of their findings in a scientific manner. ➢ Know the mechanisms of mutations, the causative agents and the harmful impact of various chemicals and drugs being used in day to day life. ➢ Find out the effects of indiscriminate use of various chemicals, drugs or insecticides in nature by studying their effect on various bacterial species in soil and water samples from different industrial or polluted areas ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Mendelian Genetics and its Extension** ➢ Principles of inheritance, Incomplete dominance and co- dominance ➢ Multiple alleles, Lethal alleles, Epistasis, Pleiotropy ➢ Sex-linked, sex- influenced and sex-limited characters inheritance. **Unit 2: Linkage, Crossing Over and Chromosomal Mapping** ➢ Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination ➢ Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses ➢ Interference and coincidence ➢ Somatic cell hybridization. **Unit3: Mutations** ➢ Types of gene mutations (Classification) Types of chromosomal aberrations (Classification, figures and with one suitable example of each) ➢ Molecular basis of mutations inrelation to UV light and chemical mutagens ➢ Detection of mutations: CLB methods attached *X* method. **Unit 4: Sex Determination** ➢ Chromosomal mechanisms of sex determination in Drosophila and Man **Unit 5: Extra-chromosomal Inheritance** ➢ Criteria for extra-chromosomal inheritance ➢ Antibiotic resistancein *Chlamydomonas* ➢ Mitochondrial mutations in *Saccharomyces* ➢ Infective heredity in *Paramecium* and Maternal effects **Unit 6: Polygenic Inheritance** ➢ Polygenic inheritance with suitable examples; simple numerical based on it. **Unit 7: Recombination in Bacteria and Viruses** ➢ Conjugation, Transformation, Transduction, Complementation testin Bacteriophage **Unit 8: Transposable Genetic Elements** ➢ Transposons in bacteria, Ac-Ds elements in maize and P elements in *Drosophila* ➢ Transposons in humans **Practical** ➢ To study the Mendelian laws and gene interactions. ➢ Chi-square analyses using seeds/ beads/ *Drosophila*. ➢ Linkage maps based on data from conjugation, transformation and transduction. ➢ Linkage maps based on data from *Drosophila* crosses. ➢ Study of human karyotype (normal and abnormal). ➢ Pedigree analysis of some human inherited traits.	Remember, Understand, Apply, Analyze

Paper Name: Computational Biology and Biostatistics (DSE)
Paper Code: ZOO-HE-5016

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Gain knowledge on history, definition, overview and scopes of Bioinformatics. ➢ Understand different types of Biological Databases: NCBI, EMBL, PIR, SWISS-Prot, PubChem, and phylogenetic trees ➢ Gain concepts on sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues, Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series ➢ Apply and Evaluate sequence-based database searches, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA ➢ Create Phylogenetic trees ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Introduction to Bioinformatics** ➢ Importance, Goal, Scope ➢ Genomics, Transcriptomics, Systems Biology ➢ Functional Genomics, Metabolomics, ➢ Molecular Phylogeny ➢ Applications and Limitations of Bioinformatics **Unit 2: Biological Databases** ➢ Introduction to biological databases; Primary, secondary and compositedatabases; ➢ Nucleic acid databases (GenBank, DDBJ, EMBL and NDB) ➢ Protein databases (PIR, SWISS-PROT, TrEMBL, PDB) ➢ Metabolic pathway database (KEGG, EcoCyc, and MetaCyc) ➢ Small molecule databases (PubChem, Drug Bank, ZINC, CSD) **Unit 3: Data Generation and Data Retrieval** ➢ Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray) ➢ Sequence submission tools (BankIt, Sequin, Webin) ➢ Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot) ➢ Sequence annotation; Data retrieval systems (SRS, Entrez) **Unit 3: Basic Concepts of Sequence Alignment** ➢ Scoring Matrices (PAM, BLOSUM) ➢ Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA) ➢ Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences. **Unit 4: Applications of Bioinformatics** ➢ Structural Bioinformatics (3-D protein, PDB) ➢ Functional genomics(genome- wide and high throughput approaches to gene and protein function) ➢ Drug discovery method (Basic concepts) **Unit 5: Biostatistics** ➢ Introduction ➢ Calculation of standard deviation, standard error, Co-efficient of Variance, Chi-square test, Z test, t-Test **Practical** ➢ Accessing biological databases ➢ Retrieval of nucleotide and protein sequences from the databases. ➢ To perform pair-wise alignment of sequences (BLAST) and interpret the output ➢ Predict the structure of protein from its amino acid sequence. ➢ To perform a ―two-sample t- testǁ for a given set of data ➢ To learn graphical representations of statistical data with the help of computers (e.g. MS Excel)	Remember, Understand, Apply, Analyze, Evaluate, Create

Paper Name: Endocrinology (DSE)
Paper Code: ZOO-HE-5036

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Gain knowledge and Understand endocrine systems their functions and endocrine disorders ➢ Understand Regulation of Hormone Action. ➢ Apply knowledge to gain a general understanding of the approaches used to study endocrinology. ➢ Classify and contrast different endocrine glands and their functions ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit 1: Introduction to Endocrinology** ➢ History of endocrinology ➢ Classification, Characteristic and Transport of Hormones, Neuro secretions and Neuro hormones **Unit 2: Epiphysis, Hypothalamo-hypophysial Axis** ➢ Structure of pineal gland, Secretions and their functions in biologicalrhythm sand reproduction. ➢ Structure of hypothalamus, Hypothalamic nuclei and their functions, ➢ Regulation of neuro endocrine glands, Feedback mechanisms ➢ Structure of pituitary gland, Hormones and their functions, ➢ Hypothalamo- hypophysial portal system, ➢ Disorders of pituitarygland. **Unit3:Peripheral Endocrine Glands** ➢ Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis ➢ Hormones in homeostasis, Disorders of endocrine glands **Unit4: Regulation of Hormone Action** ➢ Hormone action at Cellular level: Hormone receptors, transduction and regulation ➢ Hormone action at Molecular level: Molecular mediators ➢ Genetic control of hormone action **Practical** ➢ Dissect and display of Endocrine glands in laboratory bred rat* ➢ Study of the permanent slides of all the endocrine glands ➢ Demonstration of Castration/ovariectomy in laboratory bred rat* ➢ Designing of primers of any hormone	**Remember, Understand, Apply, Analyze**

6th Semester (Honours)

Paper Name: Developmental Biology

Paper Code: ZOO-HC-6016

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Understand the events that lead to formation of a multicellular organism from a single cell ➢ Understand the impact of Teratogenic agents and their effects on embryonic development ➢ Understand stem cells, and Amniocentesis and their implications in real life situtaions ➢ Acquire basic knowledge of developmental process in frog, chick and mammals, the cellular processes of development and the molecular mechanisms underlying these. ➢ Describe the general patterns developmental stages during embryogenesis. ➢ Elucidate the process of embryonic development ➢ Contrast and compare between- types of blastula, cleavage, and placenta ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit1: Introduction** ➢ Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differentialgene expression, Cytoplasmic determinants and asymmetric cell division **Unit 2: Early Embryonic Development** ➢ Gametogenesis, Spermatogenesis, Oogenesis ➢ Types of eggs, Egg membranes ➢ Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; ➢ Types of Blastula; Fate maps (including Techniques); ➢ Early development of frog and chick up to gastrulation; Embryonic induction and organizers **Unit 3: Late Embryonic Development** ➢ Fate of Germ Layers; Extra-embryonic membranes in birds ➢ Implantation of embryo in humans, ➢ Placenta (Structure, types and functions of placenta) **Unit 4: Post Embryonic Development** ➢ Metamorphosis: Changes, hormonal regulations in amphibians and insects ➢ Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each) ➢ Ageing: Concepts and Theories **Unit 5: Implications of Developmental Biology** ➢ Teratogenesis: Teratogenic agents and their effects on embryonic development ➢ *In vitro* fertilization ➢ Stem cell (ESC) ➢ Amniocentesis **Practical** ➢ Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages) ➢ Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages) ➢ Study of the developmental stages and life cycle of *Drosophila* from stock culture ➢ Study of different sections of placenta (photo micropgraph/slides) ➢ Project report on *Drosophila* culture/chick embryo development	Remember, Understand, Apply, Analyze, Evaluate

Paper Name: Evolutionary Biology

Paper Code: ZOO-HC-6026

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Remember origin and evolution of life, Historical review of evolutionary concept, Geological time scale, ➢ Gain knowledge evidences of evolution ➢ Understand the variations, genetic drift to ensure that conservation for small threatened populations, origin and evolution of man, products of evolution and extinction ➢ Use various software to generate interest towards the field of bioinformatics and coding used in programming language ➢ Apply knowledge gained, on populations in real time, while studying speciation, behaviour and susceptibility to diseases. ➢ Acquire problem solving and high order analytical skills by attempting numerical problems ➢ Predict the practical implication of various evolutionary forces acting on the human population in the field of human health, agriculture and wildlife conservation. ➢ Create and interpret phylogenetic trees ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**Unit1:** ➢ Life's Beginnings: Chemogeny, RNA world, Biogeny, ➢ Origin ofphotosynthesis ➢ Evolution of eukaryotes **Unit2:** ➢ Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism **Unit3:** ➢ Evidences of Evolution: Fossil record (types of fossils) ➢ Transitional forms, ➢ Geological time scale, ➢ Evolution of horse, ➢ Molecular (universality of genetic code and protein synthesising machinery) three domains of life, neutral theory of molecular evolution, molecular clock, example of globin gene family, rRNA/cyt-c **Unit4:** ➢ Sources of variations: Heritable variations and their role in evolution **Unit5:** ➢ Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population) ➢ Evolutionary forces upsetting H-W equilibrium ➢ Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load) ➢ Mechanism of working,types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. ➢ Genetic Drift (mechanism, founder's effect, bottle neckphenomenon ➢ Role of Migration and Mutation in changing allele frequencies **Unit 6:** ➢ Product of evolution: Micro evolutionary changes (inter-population variations, clines, races) ➢ Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, ➢ Adaptive radiation / macroevolution (exemplified by Galapagos finches **Unit7:** ➢ Extinctions, Background and mass extinctions (causes and effects),detailed example of K-T extinction **Unit 8:** ➢ Origin and evolution of man ➢ Unique hominin characteristics contrasted with primate characteristics ➢ Primate phylogeny from *Dryopithecus* leading to *Homo sapiens* ➢ Molecular analysis of human origin **Unit 9:** ➢ Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees **Practical** ➢ Study of fossils from models/pictures ➢ Study of homology and analogy from suitable specimens ➢ Study and verification of Hardy-Weinberg Law by chi square analysis ➢ Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex. ➢ Construction of phylogenetic trees with the help of bioinformatics tools(Clustal X, Phylip, NJ) and its interpretation.	**Remember, Understand, Apply, Analyze, Evaluate, Create**

Paper Name: Fish and Fisheries

Paper Code: ZOO-HE-6026

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Gain knowledge on basics of classification of fish ➢ Identify fish based on their morphological feature. ➢ Understand fish breeding and toxicology, fish morphology and physiology, aquaculture, fish diseases and fish preservation and processing of harvested fish ➢ Elaborate the concept of fishery resources and need of their conservation. ➢ Make use of survey and identification tools and techniques for fish identification, conservation, processing and technology. ➢ Gain knowledge on integrated fish forming to support income growth. ➢ Compare and contrast different fishing gears ➢ Apply remote sensing and GIS in fisheries ➢ Analyze and evaluate Fisheries law and regulations ➢ Design fishery management plans and gain knowledge on how to create brood stock management ➢ Enhance collaborative learning, communication and technical skills through practical sessions, team work, group discussions, assignments and projects	**UNIT 1: Introduction and Classification** ➢ General description of fish ➢ Account of systematic classification of fishes (up to classes) ➢ Classification based on feeding habit, habitat and manner of reproduction. **UNIT 2: Morphology and Physiology**: ➢ Types of fins and their modifications ➢ Locomotion in fishes ➢ Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish ➢ Gills and gas exchange ➢ Swim Bladder: Types and role in Respiration, buoyancy ➢ Osmoregulation inElasmobranchs ➢ Reproductive strategies (special reference to Indian fishes) ➢ Electric organs ➢ Bioluminiscience; Mechanoreceptors; Schooling;Parental care; Migration **UNIT 3: Fisheries** ➢ Inland Fisheries; Marine Fisheries ➢ Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal ➢ Fishing crafts and Gears ➢ Depletion of fisheries resources ➢ Application of remote sensing and GIS in fisheries ➢ Fisheries law and regulations **Unit 4: Aquaculture** ➢ Sustainable Aquaculture ➢ Extensive, semi-intensive and intensiveculture of fish ➢ Pen and cage culture, Poly culture, Composite fish culture ➢ Brood stock management ➢ Induced breeding of fish ➢ Management of finfish hatcheries ➢ Preparation and maintenance of fish aquarium; Preparation of compound diets for fish ➢ Role of water quality in aquaculture ➢ Fish diseases: Bacterial,viral and parasitic ➢ Preservation and processing of harvested fish, Fishery by-products **UNIT 5: Fish in research** ➢ Transgenic fish ➢ Zebra fish as a model organism in research **Practical** ➢ Morphometric and meristic characters of fishes ➢ Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera, Exocoetus*, *Hippocampus*, *Gambusia, Labeo, Heteropneustes ,Anabas* ➢ Study of different types of scales (through permanent slides/photographs). ➢ Study of crafts and gears used in Fisheries ➢ Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids ➢ Study of air breathing organs in *Channa, Heteropneustes, Anabas* and *Clarias* ➢ Demonstration of induced breeding in Fishes(video) ➢ Demonstration of parental care in fishes (video) ➢ Project Report on a visit to any fish farm /pisciculture unit/ Zebra fish rearing Lab.	**Remember, Understand, Apply, Analyze, Evaluate, Create**

Paper Name: Dissertation

Paper Code: ZOO-HE-6056

Course Outcome	Unit/ Topic	Bloom's Taxonomy Level
After the completion of this course, the students will be able to: ➢ Gather, form and critique knowledge from research studies ➢ Identify and investigate a research problem ➢ Apply an appropriate research design and associated methods rigorously ➢ Conduct the research project in an ethical fashion ➢ Draw appropriate conclusions and indicate the significance of the findings for educational practice and research ➢ Report the research in a scholarly fashion appropriate to the disciplinary area	**Dissertation**	**Remember, Understand, Apply, Analyze, Evaluate, Create**