Krishnagar Government College
Department of Zoology

Program Outcomes (POs), Programme Specific Outcomes (PSOs) and
Course Outcomes (COs)

For

Under Graduate Programme
Honours CBCS, Kalyani University

Green table denote UG Honours Syllabus and its Course Outcome
Blue table denote UG Programme Syllabus and its Course Outcome

	Programme Specific Outcomes (PSOs) Outlook:
Semester	PSO 01.
I	Know the taxonomic positions and characteristics, life cycles, and even the parasitic mode of important lower animals.
	Distinguish the general features and classification of phylums Annelida, Arthropoda, Mollusca and Echinodermata.
	Research topics are assigned, supervised and submitted in hard and soft copy format.
II	PSO 02.
	Conceptual knowledge of ecology and its important attributes; biodiversity and its conservation and scope tourism sector.
	Students take up a project/field study in the real-time scenario and analyze the outcome based on the data they collect.
	Comprehensive understanding of water ecosystem, types and their biomes; impact on water quality by different wastes.
	Acquaint with the structure and function of various cell organelles, cell division and cell signalling.
III	PSO 03.
	Know the origin of chordate, general descriptions of Pisces, Amphibian, Reptilia, Aves and Mammals.
	Know the types of tissues, physiology of nervous and muscles, reproduction and endocrine system.
	Comprehend the structure and functions of carbohydrates, lipids, proteins, nucleic acid and enzymes.
	Biology of bee; their diseases and enemies. Prospect in economy and entrepreneurship.
IV	PSO 04.
	Know the anatomy of vertebrates; integumentary, circulatory, digestive, respiratory. urinogenital and nervous systems; sense organs in vertebrates.
	Conceptual knowledge of the Mechanism involved in digestion, respiration, blood, renal and heart.
	Realize the broad concept of immune system; immunoglobulins, types of vaccines.
V	PSO 05.
	Understand the concept of DNA as a genetic material and their behavior.
	Understand mendelian genetics; Mutation, role of chromosomes in sex determination; recombinant bacteria and viruses.
	Comprehend the classification, morphology and physiology of fish; Inland fisheries and its sustainable aquaculture.
	Students take up a project/field studies in real time scenario and analyse the outcome based on the data they collect.
VI	PSO 06.

	Understand the concept and principles of developmental biology and know the different stages of embryonic development and its implications.
	Understand the theories of evolution of life; population genetics.
	Understand life cycle, morphology, infection and mode of control of various parasites.
	Know the anatomy of male and female reproduction; Hormones and its role in fertilization and reproductive health.

Course Outcomes (COs):

Core Courses	Content of KU Syllabus	Course Outcome (CO)
	Semester 1	
ZOOL-H-CC-T-01 (Non-chordates I: Protista to Pseudocoelomates)	Unit 1: Basics of Animal Classification 1. Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types. 2. Codes of Zoological Nomenclature; Principle of Priority; Synonymy and Homonymy.	CO 01. The students , by studying the 1st unit, will be aware of the basics of animal kingdom and its vastness on the earth; they will learn the taxonomic hierarchy, codes of zoological nomenclature, etc.
	Unit 2: Protista and Metazoa 1. Protozoa a. General characteristics and Classification up to phylum (according to Levine et. al., 1981) Locomotion in *Euglena*, *Paramoecium* and *Amoeba*; Conjugation in *Paramoecium*. b. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica* 2. Metazoa a. Evolution of symmetry and segmentation of Metazoa	CO 02. As the units cover classifications of different phyla, as mentioned in the topics, the students will find the vast diversity of invertebrates.
	Unit 3: Porifera General characteristics and Classification up to classes; Canal system in sponges.	CO 03. To gather knowledge about special structures and functions of invertebrates viz.

	Unit 4: Cnidaria 1. General characteristics and Classification up to classes 2. Metagenesis in *Obelia* 3. Polymorphism in Cnidaria 4. Corals and coral reef diversity, function & conservation	i) Protozoans' variety of locomotory structures and reproduction; ii) Canal system of Porifera (sponges); iii) Cnidarians' unique structures and polymorphism; iv) Diversity of corals and coral reefs; v) Helminths' parasitism , infective stages, prophylaxis/ treatment, etc.
	Unit 5: Ctenophora General characteristics	
	Unit 6: Platyhelminthes 1. General characteristics and Classification up to classes 2. Life cycle and pathogenicity and control measures of *Fasciola hepatica.*	
	Unit 7: Nematoda 1. General characteristics and Classification up to classes 2. Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti* 3. Parasitic adaptations in helminths	

ZOOL-H-CC-P-01 (Non-chordates I: Protista to Pseudocoelomates Lab)	1. Identification of *Amoeba*, *Euglena*, *Entamoeba*, *Opalina, Paramecium*, *Plasmodium vivax* and/or *Plasmodium falciparum* (from the prepared slides) 2. Identification of *Sycon*, Neptune's Cup, *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatula*, *Fungia*, *Meandrina*, *Madrepora* 3. Identification and significance of adult *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides* 4. Staining/mounting of any protozoa/helminth from gut of cockroach	CO 04. Students from their laboratories can have an open access to identification of invertebrates by handling and examining them. CO 05. They will be able to know the technique of staining/ mounting of protozoa/ helminth from gut of cockroach.
ZOOL-H-CC- T-02 (Non-Chordates II: Coelomates)	Unit 1: Introduction Evolution of coelom and metamerism Unit 2: Annelida 1. General characteristics and Classification up to classes Excretion in Annelida through nephridia. 2. Metamerism in Annelida. Unit 3: Arthropoda 1. General characteristics and Classification up to classes. 2. Respiration in Arthropoda 3. Metamorphosis in Lepidopteran Insects. 4. Social life in termite	The 2nd part of Non-chordates will give the students a clear picture of CO 01. Basic concept of Evolution in non- chordates like development of coelom, Study of salient identifying features and special features like metamerism, metamorphosis, eusociality and variation in physiological process in non- chordates like respiration, excretion, vision.

	Unit 4: Onychophora General characteristics and Evolutionary significance	CO 02. Concept of connecting link with evolutionary significance.
	Unit 5: Mollusca 1. General characteristics and Classification up to classes	CO 03. Study on classification and salient features of
	2. Nervous system and torsion in Gastropoda	non-chordates from Mollusca to Hemichordata.
	Unit 6: Echinodermata 1. General characteristics and Classification up to classes 2. Water-vascular system in Asteroidea 3. Larval forms in Echinodermata 4. Affinities with Chordates	CO 04. Apart from knowing the classifications of the said phyla here also, students will learn some very pertinent aspects like: i) Excretion and metamerism in annelida; ii) Respiration and metamorphosis of arthropoda; iii) Nervous system and torsion in mollusca; iv) Water vascular system and larval forms of echinodermata, etc.
	Unit 7: Hemichordata General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates	CO 05. A very interesting event of phylum hemichordata, the invertebrate chordate, has been added to boost this chapter.

ZOOL-H-CC- P-02 (Non-Chordates II: Coelomates Lab)	1. Study of following specimens: a. Annelids - *Aphrodite, Nereis, Sabella, Chaetopterus, Pheretima, Hirudinaria* b. Arthropods – *Limulus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta*, termites and honey bees *Onychophora – Peripatus* c. Molluscs - *Chiton, Pila, Unio, Sepia, Octopus*	CO 06. Students are to have practical knowledge on different specimens under the phyla from annelida to hemichordate. CO 07. Dissection of digestive system and nephridia of earthworm; T.S. through different digestive organs; mounting of mouth parts and dissection of digestive and nervous systems of cockroach are the main points the students are to deal with.
	d. Echinodermates - *Asterias, Echinus, Cucumaria* and *Antedon* 2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm 3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm (Diagram/study of mounted specimen) 4. Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta* 5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)	

Core Courses	Content of KU Syllabus	Course Outcome (CO)
	Semester 2	
ZOOL-H-CC- T-03 (Perspectives in Ecology)	Unit 1: Introduction to Ecology Autecology and synecology, Levels of organization, Laws of limiting factors.	CO 01. Keeping in mind that without proper knowledge on ecology and environment, and the interaction between biotic (microorganism to human) and abiotic communities, the students' overall idea remains incomplete, this chapter has been introduced.
	Unit 2: Population 1. Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal. 2. Geometric, exponential and logistic growth, equation, r and K strategies Population regulation - densitydependent and independent factors. 3. Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition, predator-prey cycling.	CO 02. Some unique topics under this paper like i) Relationship of population, community and ecosystem; ii) Population growth, demography, life tables, and survivorship curve; are included to input thorough ideas within the students.
	Unit 3: Community Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect. Ecological succession with one example	CO 03. This chapter deals with the concept of biodiversity and different attributes of a community, a study on the succession of a community and identification of the different seral stages.

	Unit 4: Ecosystem 1. Pond ecosystem 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 2. Nitrogen cycle	CO 04. Besides, topics like food chain, ecological pyramids, study of energy flow through ecosystem add to this chapter much emphasis.
	Unit 5: Applied Ecology 1. Wildlife Conservation (in-situ and ex-situ conservation). 2. Management strategies for tiger conservation; Wild life protection act (1972).	CO 05. Explain the large scale patterns of biodiversity, describe how biodiversity is measured and predict the consequences of continued species loss.
ZOOL-H-CC- P-03 (Perspectives in Ecology Lab)	1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided 2. Determination of population parameters (dominance, diversity, frequency) in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index and Importance Value Index for the same community. 3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO_2 4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary	CO 06. Study of life tables and plotting of survivorship curve; determination of population parameters by Quadrate method and calculation of diversity index are the practical topics included in this paper. CO 07. Study of aquatic ecosystem, determination of pH, dissolved oxygen, and chemical oxygen demand, the students need to learn at laboratory. CO 08. Students find much enthusiasm by preparing a Field note book after a visit to biodiversity spot/ sanctuary/ marine ecosystem, which is done every year.

ZOOL-H-CC- T-04 (Cell Biology)	Unit 1: Overview of Cells Basic structure of Prokaryotic and Eukaryotic cells, Viruses	CO 01. Without having a vivid knowledge on cell, the students' intuitive ideas would not be clear. In order to well equip the students, this chapter has been arranged in a lucid way CO 02. With basic structures of prokaryotic and eukaryotic cell, this chapter starts.
	Unit 2: Plasma Membrane 1. Ultra-structure and composition of Plasma membrane: Fluid mosaic model 2. Transport across membrane: Active and Passive transport, Facilitated transport 3. Cell junctions: Tight junctions, Gap junctions, Desmosomes	CO 03. Unique structure of plasma membrane, transport across the membrane, cell-tight and gap junctions are some of the important features of this chapter.
	Unit 3: Cytoplasmic organelles I 1. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes 2. Protein sorting and mechanisms of vesicular transport	CO 04. Concepts on Mitochondria, its origin and different biochemical processes; structure and function of

	Unit 4: Cytoplasmic organelles II Mitochondria: Structure, Semiautonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis		Peroxisome, centrosome and cytoskeleton. Brief concepts on different grades of packaging of chromatin fibre with detailed structure and function of nucleus.
	Unit 5: Cytoskeleton Type, structure and functions of cytoskeleton		
	Unit 6: Nucleus Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)		
	Unit 7: Cell Division Cell cycle and its regulation, Cancer (Concept of oncogenes and tumor suppressor genes with special reference to p53, Retinoblastoma and Ras and APC.	CO 05.	This is a very important chapter related to Cell cycle check points and cancer. Concepts of oncogenes and tumor suppressor genes are dealt with apoptosis have been added here to raise students' overall conception.
	Unit 8: Cell Signaling 1. Cell signalling transduction pathways; Types of signaling molecules and receptors 2. GPCR and Role of second messenger (cAMP) 3. Apoptosis and Necrosis	CO 06.	Various cell signalling pathways and their implications in disease states are discussed in details Concept of apoptosis and necrosis with their role in normal physiology are discussed

ZOOL-H-CC-P04 (Cell Biology Lab)	1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis 2. Study of various stages of meiosis. 3. Preparation of permanent slide to demonstrate: a. DNA by Feulgen reaction b. Cell viability study by Trypan Blue staining	CO 07. CO	Students from this practical paper are to learn some cytological squash preparations from root tip of onion or grasshopper testis, and to identify different stages of meiosis. 08. Temporary preparations to demonstrate DNA by Feulgen reaction and Trypan blue staining for cell viability, very sophisticated techniques, are also included here.

Core Courses	Content of KU Syllabus	Course Outcome (CO)
Semester 3		
ZOOL-H-CC- T-05 (Diversity of Chordata)	Unit 1: Introduction to Chordates General characteristics and outline classification of Phylum Chordata	CO 01. This chapter deals with the Classifications and characteristics of Phylum-Chordata and of different classes from Agnatha to Mammalia, as was discussed those of Invertebrates in the previous chapters.
	Unit 2: Protochordata General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. Retrogressive metamorphosis in *Ascidia*. Chordate Features and Feeding in *Branchiostoma*	CO 02. Besides learning classifications, students are able to know the specialized aspects like i) Retrogressive metamorphosis of Ascidia; ii) Feeding mechanism of Branchiostoma.

	Unit 3: Origin of Chordata Dipleurula concept and the Echinoderm theory of origin of chordates	CO 03. This unit explains about of origin of chordates.
	Unit 4: Agnatha General characteristics and classification of cyclostomes up to order	CO 04. This unit Introduces the concept of jawless vertebrates.
	Unit 5: Pisces 1. General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses 2. Accessory respiratory organ, migration and parental care in fishes 3. Swim bladder in fishes.	CO 05. Students study about identification of various fish and their practical utility through the study of their systems and migration patterns.
	Unit 6: Amphibia 1. General characteristics and classification up to living Orders. 2. Metamorphosis and parental care in Amphibia	CO 06. This chapter includes the study and identification of various amphibians and their systems. It also includes metamorphosis and parental care in Amphibia and the hormonal factors involved.
	Unit 7: Reptilia 1. General characteristics and classification up to living Orders. 2. Poison apparatus and Biting mechanism in Snake	CO 07. Describing unique characters of reptiles, aves and mammals upto subclass/order. CO 08. To understand the special features of some

	Unit 8: Aves 1. General characteristics and classification up to Sub-Classes 2. Migration in Birds 3. Principles and aerodynamics of flight	chordates like metamorphosis, paedomorphosis, parental care in Amphibia, biting mechanism and poison apparatus in poisonous snake, migration and aerodynamics principle of bird flight, exoskeletal derivative and echolocation in Mammals.
	Unit 9: Mammals 1. General characters and classification up to living orders 2. Affinities of Prototheria 3. Echolocation in Micro chiropterans.	
	Unit 10: Zoogeography Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of birds and mammals in different realms	CO 09. Over and above, the students must get enriched by Zoogeographical realms and distribution of birds and mammals there; plate tectonic, etc.
ZOOL-H-CC- P-05 (Diversity of Chordata Lab)	1. Protochordata: *Balanoglossus*, *Branchiostoma* 2. Agnatha: *Petromyzon* or *Myxine* 3. Fishes: *Scoliodon*, *Sphyrna*, *Torpedo*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon*/ *Diodon*, *Anabas*, Flat fish 4. Amphibia: *Bufo, Hyla, Axolotl, Tylototriton* 5. Reptilia: *Chelone*, *Trionyx*, *Hemidactylus, Varanus,*	CO 10. Like the invertebrate specimens, identifying features and systematic positions of some important chordate specimens viz. *Petromyzon* from Agnatha; *Exocetus*, Hippocampus from fish; Amphibians like *Tylototryton*, Axolotl; 10 reptilians like *Chelone*, *Naja*, *Chameleon*, etc. and bat from mammalia. CO 11. How to dissect pectin

	Chamaeleon, Ophiosaurus, Draco, Vipera, Naja, Crocodylus. Key for Identification of poisonous and non-poisonous snakes 6. Mammalia: Bat (Insectivorous and Frugivorous) 7. Pecten from Fowl head 8. Dissection of brain and pituitary of Rohu/Catla/Mrigal 9. Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)	from fowl head and pituitary gland from rohu, are also included here. CO 12. Moreover, by power point presentation, students study some animals.
ZOOL-H-CC-T06 (Animal Physiology: Controlling & Coordinating Systems)	Unit 1: Tissues Structure, location, classification and functions of epithelial tissue. Unit 2: Bone and Cartilage Structure and types of bones and cartilages, Ossification Unit 3: Nervous System Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types	Students will be able to gain concept on CO 01. Learning principles and concepts of basic physiological processes to relate the various levels of organization and interaction amongst them to ensure proper functionality of an individual. CO 02. Understanding brief physiological processes like chemical digestion and absorption of food,

	Unit 4: Muscular system Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre	mechanism of respiration, respiratory pigments, CO poisoning, haematopoesis, blood clotting, blood grouping, Rh factor, working principle of myocardial fibres, conduction of cardiac impulse, cycle and output. CO 03. Besides knowing all the above topics, students learn how such physiological systems operate in a coordinated way.
	Unit 5: Reproductive System Histology of testis and ovary Physiology of Reproduction	CO 04. Histology of testis and ovary and Physiology of Reproduction is reviewed here
	Unit 6: Endocrine System 1. Histology and function of pituitary, thyroid, pancreas and adrenal 2. Classification of hormones; Mechanism of Hormone action 3. Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system.	CO 05. This chapter deals with the endocrine glands and the hormones and their roles

ZOOL-H-CC-P06 (Animal Physiology: Controlling & Coordinating Systems Lab)	1. Preparation of temporary mounts: Squamous epithelium or Striated muscle fibres or nerve cells 2. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid 3. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues	CO 06. Knowledge of different histological structures through the methodology of microtomy is the main subject here. CO 07. Besides preparation of histological slides the students learn how to identify the T.S. of tissues like bones, spinal cord, nerves and endocrine glands.
ZOOL-H-CC-T-07 (Fundamentals of Biochemistry)	Unit 1: Carbohydrates Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis Unit 2: Lipids Lipid metabolism: β-oxidation of fatty acids; Fatty acid biosynthesis Unit 3: Proteins 1. Amino acids Structure, Classification, General and Electro chemical properties of α-amino acids; Physiological importance of essential and nonessential amino acids 2. Proteins Bonds stabilizing protein structure; Levels of organization Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids	CO 01. As knowledge on basics of life is never completed without this important paper of biochemistry, the students must gain knowledge on different biochemical molecules like Carbohydrates, lipids, proteins, nucleic acids and enzymes. CO 02. Metabolisms of such biochemicals are also included here. Carbohydrates - citric acid cycle, gluconeogenesis, etc., lipids - beta oxidation, fatty acid biosynthesis. CO 03. Students will be able to gain concept on Proteins include electrochemical properties of alpha amino acid, physiological importance of essential amino acids, transamination, deamination, urea cycle, ketogenic amino acids, etc .

	Unit 4: Nucleic Acids 1. Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids 2. Types of DNA and RNA, Complementarity of DNA, Hpyo- and Hyperchromaticity of DNA 3. Basic concept of nucleotide metabolism	CO 04. Students will be able to gain concept on types of DNA and RNA, bases like purine and pyrimidine, nucleotide metabolism.
	Unit 5: Enzymes Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzymecatalyzed reactions; Enzyme inhibition; Allosteric enzymes and their kinetics.	CO 05. Students will be able to gain concept on Enzymes- types, action and kinetics, Michaelis-Menten equation, Lineweaver-Burk plot, etc.
	Unit 6: Oxidative Phosphorylation Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System	CO 06. Students will be able to gain concept on Oxidative phosphorylation – Redox systems, ETS, etc.
ZOOL-H-CC- P-07 (Fundamentals of Biochemistry Lab)	1. Qualitative tests of functional groups in carbohydrates, proteins and lipids. 2. Demonstration/Virtual lab/Dry lab of paper chromatography of amino	CO 07. From this paper students will be able to gain practical knowledge of: Qualitative tests of carbohydrates, proteins, and lipids; demonstration

	acids. 3. Quantitative estimation of proteins by Lowry Method. 4. Demonstration/Virtual lab/Dry lab of proteins separation by SDSPAGE. 5. Wet lab: to study the enzymatic activity of Trypsin or Lipase. 6. Wet lab: To perform the Acid and Alkaline phosphatase assay from serum/ tissue/soil.	of paper chromatography, estimation of protein, SDS-page separation of protein, etc. CO 08. Besides, wet lab study of enzymatic activity, phosphatase assays are to be done in this paper.

Core Courses	Content of KU Syllabus	Course Outcome (CO)
Semester 4		
ZOOL-H-CC-T08 (Comparative Anatomy of Vertebrates)	Unit 1: Integumentary System Structure, function and derivatives of integument in amphibian, birds and mammals.	CO 01. From this paper students will be able to grasp knowledge on the comparative anatomical structures of different organ systems like: Integumentary, sketetal, digestive, circulatory, respiratory, urinogenital, nervous, etc. CO 02. By the study of such comparative organs/systems viz. skin, aortic arches, stomach, respiratory organs, kidney and cranial nerves students will learn as to how such organs evolve from lower to higher vertebrates. CO 03. A study of sense organs like classification of receptors, auditory receptors of vertebrates, etc. is to be made also.
	Unit 2: Skeletal System Jaw suspension; structure of branchial and visceral arches.	
	Unit 3: Digestive System Comparative anatomy of stomach; dentition in mammals.	
	Unit 4: Circulatory System Comparative account of heart and aortic arches.	
	Unit 5: Respiratory System Respiratory organs in Pisces, Aves and Mammalia.	
	Unit 6: Urinogenital System Succession of kidney, Types of mammalian uteri.	
	Unit 7: Nervous System Cranial nerves in mammals.	
	Unit 8: Sense Organs Classification of receptors, Brief account of auditory receptors in vertebrate.	

ZOOL-H-CC-P08 (Comparative Anatomy of Vertebrates Lab)	1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs 2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig. 3. Demonstration of Carapace and plastron of turtle OR 4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal	CO 04. The practical paper deals with study of scales of fishes, like placoid, cycloid and ctenoid; skeletons of toad, pigeon and guineapig, etc. CO 05. Students are to demonstrate carapace and plastron of turtle and to identify dog and guineapig skulls.
	5. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system.	CO 06. In addition, students are to dissect out some systems like circulatory, brain, pituitary, and urinogenital of tilapia/carp.
ZOOL-H-CC-T09 (Animal Physiology: Life Sustaining Systems)	Unit 1: Physiology of Digestion Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food	CO 01. If any zoologist does not know the basics of his systems, his physiology as to how he or she feeds, respires; how heart and kidney work, the overall knowledge would be completed. CO 02. In order to have clear ideas, digestive systems and physiology of digestion; respiratory system and related physiology like transport of oxygen and carbon
	Unit 2: Physiology of Respiration Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments; Carbon monoxide poisoning	

	Unit 3: Physiology of Circulation 1. Components of Blood and their functions; Structure and functions of haemoglobin 2. Haemostasis; Blood clotting system, Fibrinolytic system 3. Haemopoiesis; Basic steps and its regulation 4. Blood groups; ABO and Rh factor	dioxide, dissociation curves; circulatory system associated with blood components, blood group types, blood clotting system, structure of hemoglobin, etc. have been incorporated here. CO 03. Ideas on physiology of heart with the knowledge of its structure, cardiac output, cardiac cycle, blood pressure, etc. are to perceive. CO 04. Other important topics are Thermoregulation and osmoregulation of different vertebrates, and Renal physiology with the understanding of kidney structure and function, mechanism.
	Unit 4: Physiology of Heart 1. Structure of mammalian heart, Coronary Circulation, Origin and conduction of cardiac impulses 2. Cardiac Cycle and cardiac output 3. Blood pressure and its regulation	
	Unit 5: Thermoregulation & Osmoregulation 1. Physiological classification based on thermal biology. 2. Thermal biology of endotherms 3. Osmoregulation in aquatic vertebrates 4. Extrarenal osmoregulatory organs in vertebrate	
	Unit 6: Renal Physiology Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance	

ZOOL-H-CC-P09 (Animal Physiology: Life Sustaining Systems Lab)	1. Determination of ABO Blood group 2. Enumeration of red blood cells and white blood cells using haemocytometer 3. Estimation of haemoglobin using Sahli's haemoglobinometer 4. Preparation of haemin and haemochromogen crystals from mammal/fish blood. 5. Recording of blood pressure using a sphygmomanometer	CO 05. The students in this practical paper will learn know how of blood count i.e. TC and DC, hemoglobin estimation, measurement of blood pressure, etc., which he may practice in future in a pathology/biochemistry lab.
ZOOL-H-CC-T10 (Immunology)	Unit 1: Overview of Immune System Basic concepts of health and diseases, Cells and organs of the Immune system	CO 01. Another very unique topic that the students of Zoology would never refuse to rely is immune system. CO 02. Without the knowledge of health and diseases, immunity related with antigen and antibody, vaccines, etc., understanding of such a topic is incomplete.
	Unit 2: Innate and Adaptive Immunity Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).	Students will be able to gain knowledge on CO 03. Identification the cellular and molecular basis of immune responsiveness.
	Unit 3: Antigens Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity	CO 04. Understand the fundamental concepts of immunity, contributions of the organs and cells in immune responses.

	Unit 4: Immunoglobulins Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production.	CO 05. Conceptualize how the innate and adaptive immune responses coordinate to fight invading pathogens. CO 06. Realize how the MHC molecules function and conceptualize.
	Unit 5: Major Histocompatibility Complex Structure and functions of MHC molecules. Structure of T cell Receptor and its signaling.	
	Unit 6: Cytokines Types, properties and functions of cytokines.	CO 07. The students will be able to describe cytokines.
	Unit 7: Complement System Components and pathways of complement activation.	CO 08. The students will be able to describe immunological response and how it is triggered and regulated.
	Unit 8: Hypersensitivity Gell and Coombs' classification and brief description of various types of hypersensitivities.	CO 09. Comprehend the overreaction by our immune system leading to hypersensitive conditions and its consequences.
	Unit 9: Immunology of diseases Malaria, Filariasis, Dengue.	CO 10. Students will be able to gain knowledge on immunology of diseases like malaria, dengue, filarial.
	Unit 10: Vaccines Various types of vaccines. Active & passive immunization (Artificial and natural).	CO 11. Different vaccines and their mode of action are the important aspects students are to know.

ZOOL-H-CC-P10 (Immunology lab)	1. Demonstration/virtual lab/dry lab of lymphoid organs. 2. Histological study of spleen, thymus and lymph nodes through slides/ photographs.	CO 12. The practical paper of immunology consists of demonstration of lymphoid organs; determination of ABO blood group; histological study of spleen, thymus, lymph nodes, etc. through permanent slides.
	3. Preparation of stained blood film to study various types of blood cells. 4. ABO blood group determination. 5. Demonstration/virtual lab/dry lab of ELISA.	CO 13. Preparation of stained blood film to study the blood cell types; and demonstrations of ELISA are some unique aspects, the students perform at lab.
ZOOL-H-SEC-T-02 (Sericulture)	Unit 1: Introduction Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture	Students will be able to understand basic concept of CO 01. History, development and organization of sericulture industry.
	Unit 2: Biology of Silkworm Life cycle of *Bombyx mori* Structure of silk gland and secretion of silk	CO 02. Understanding biology of silkworm, rearing of silkworm. CO 03. Gaining knowledge of Techniques of Mulberry garden establishment, cultivation, pruning and management.
	Unit 3: Rearing of Silkworms Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder Silkworm rearing technology: Early age and Late age rearing Types of mountages. Spinning, harvesting and storage of cocoons	CO 04. Harvesting and storage of silk.

	Unit 4: Pests and Diseases Pests of silkworm: Uzi fly, dermestid beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases	CO 05. Pests & disease, future and prospects of silk industry in India with regard to Mulberry and non- Mulberry sericulture. CO 06. Visiting sericulture centres to gain an insight of the concepts learned in theory and familiarity with various sericulture practices.
	Unit 5: Entrepreneurship in Sericulture Report on a visit to a sericulture center.	

Core Courses	Content of KU Syllabus	Course Outcome (CO)
Semester 5		
ZOOL-H-CC-T11 (Molecular Biology)	Unit 1: Nucleic Acids Salient features of DNA and DNA Watson and Crick Model of DNA	CO 01. If one is to learn Zoology and seeks to have understandings on biotechnology, biochemistry and molecular biology, this paper should not remain unstudied. CO 02. The students will develop a clear concept of explaining the basic structuire of nucleic acid and molecular mechanisms of DNA replication in prokaryotes and eukaryotes.

	Unit 2: DNA Replication Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres	CO 03. The students will develop a clear concept on the Transcription in prokaryotes and eukaryotes, mRNA processing and modifications and concept of genetic code, mechanism of protein synthesis and post translational modification.
	Unit 3: Transcription Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors. Difference between prokaryotic and eukaryotic transcription.	
	Unit 4: Translation Mechanism 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; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation	
	Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, and RNA editing.	
	Unit 6: Gene Regulation Regulation of Transcription in prokaryotes: *lac* operon and *trp* operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing.	CO 04. This unit describes how gene expression is regulated at the transcriptional and post-transcriptional level.

	Unit 7: DNA Repair Mechanisms Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair	CO 05	. Different types of DNA repairing mechanism and biotechnological estimation of DNA, RNA and protein different types of DNA repairing mechanism and biotechnological estimation of DNA, RNA and protein.
	Unit 8: Molecular Techniques PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing	CO	06. Molecular techniques like PCR, Southern and Northern blots, Sanger DNA sequencing are the most important topics a student must know.
ZOOL-H-CC-T-12 (Principles of Genetics)	Unit 1: Mendelian Genetics and its Extension 1. Principles of inheritance, Incomplete dominance and co-dominance, Epistasis Multiple alleles, Lethal alleles, Pleiotropy, 2. Sex-linked, sex- influenced and sex- limited inheritance, Polygenic Inheritance.	CO 01.	Genetics, the science of heredity, is the subject a student of Zoology must learn as it is related with the father of genetics, Mendel. So, invariably this paper starts with the Mendelian genetics and ends with the modern theme of genetics.

	Unit 2: Linkage, Crossing Over and Chromosomal Mapping Linkage and Crossing Over, molecular basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence	CO 02. This paper deals with topics like Linkage and crossing over concepts, estimation of recombination frequency, linkage map construction using three factor cross, sex linkage in Drosophila and human.
	Unit 3: Mutations Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens	CO 03. Some very pertinent topics like Mutations and its molecular basis, chromosomal aberrations are to be studied to have a clear idea on genetics.
	Unit 4: Sex Determination 1. Mechanisms of sex determination in *Drosophila* 2. Sex determination in mammals 3. Dosage compensation in *Drosophila* & Human	CO 04. Students can compare the mechanisms of sex determination and Dosage compensation in Drosophila and human.
	Unit 5: Extra-chromosomal Inheritance 1. Criteria for extra chromosomal inheritance 2. Kappa particle in *Paramoecium*	CO 05. Extra chromosomal inheritance with example of Kappa particle in Paramoecium can be studied in this unit.
	Unit 6: Recombination in Bacteria and Viruses Conjugation, Transformation, Transduction, Complementation test in Bacteriophage	CO 06. The students will learn about the Complementation test in bacteriophage, and

	Unit 7: Transposable Genetic Elements Transposons in bacteria, P elements in *Drosophila,* LINE, SINE, Alu elements in humans	different types of transposable genetic elements and their functions.
ZOOL-H-CC-P-12 (Principles of Genetics Lab)	1. Chi-square analyses 2. Linkage maps based on conjugation 3. Identification of chromosomal aberration in *Drosophila* and man from photograph 4. Pedigree analysis of some human inherited traits	CO 07. The practical topics students are to cover are comprised of i) Chi-square analysis; ii) Preparation of linkage maps; iii) Identification of chromosomal aberrations in *Drosophila*, etc. CO 08. If the students do not go for pedigree analysis in practical lab, the idea of genetics would be incomplete; so to accomplish knowing pedigree is a must.
ZOOL-H-DSE-T01 (Fish and Fisheries)	Unit 1: Introduction and Classification 1. Feeding habit, habitat and manner of reproduction 2. Classification of fish (up to Subclasses)	CO 01. Course provides them comprehensive understanding about aquatic ecosystem and various economical important fishes.

	Unit 2: Morphology and Physiology Types of fins and their modifications; 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 in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ.	
	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.	CO 03. Understanding of fishes habits and habitats and their functional anatomy and also the practical application parts like preparation of fish diet, preservation, processing of fish, fishery by products etc CO 04. The students will be well equipped to become very competent in research or teaching fields of fisheries. CO 05. It is one of the small scale industry which can provide the student employment opportunity.
	Unit 4: Aquaculture Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Induced breeding of fish; Management of finfish hatcheries; 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 byproducts	
	Unit 5: Fish in research Transgenic fish. Zebrafish as a model organism in research	

ZOOL-H-DSE-P01 (Fish and Fisheries Lab)	1. Morphometric and meristic characters of fishes. 2. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas, Echeneis,* exotic carps – Identification with characters. 3. Study of different types of scales (through permanent slides/ photographs). 4. Study of crafts and gears used in Fisheries (Pictures/models). Characters. 5. Water quality criteria for Aquaculture: Assessment of pH, DO, free CO_2, productivity, alkalinity, hardness, chloride (by titration/refractometer). 6. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*. Drawing with characters. 7. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab. 8.	CO 06. Students gain knowledge in the areas of responses characterization and classification of Ostracoderms, placoderms, acanthodians, holocephali, elasmobranchs. CO 07. Students gain knowledge about different water quality testing.
ZOOL-H-DSE-T02 (Wildlife conservation and Management)	Unit 1: Introduction to Wild Life Brief introduction to Conservation: Importance of conservation; Causes of depletion.	CO 01. Students will gain a solid foundation in the fundamental principles and concepts of wildlife conservation, including biodiversity, ecosystem dynamics, habitat management, and the role of human activities in shaping wildlife populations.

	Unit 2: Evaluation and management of wild life Habitat analysis: Physical parameters – Topography, soil and water; Biological Parameters – food and cover estimation; Brief idea on remote sensing and GIS in wildlife status estimation.	CO 02. Understand basic ecological principles (the interconnectedness of organisms to each other and their environment) to environmental problems and sustainability issues.
	Unit 3: Management of habitats Setting back succession; Advancing the successional process; Cover construction; Restoration of degraded habitats.	
	Unit 4: Population estimation Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores; Pug marks and census method.	CO 03. Explain the large scale patterns of biodiversity, describe how biodiversity is measured and predict the consequences of species loss.
	Unit 5: Aims and objectives of wildlife conservation Necessity for wildlife conservation; modes of conservation – in-situ conservation and ex-situ conservation.	CO 04. To understand importance of wildlife and conservation measures, National parks and Sanctuaries.
	Unit 6: Management planning of wild life in protected areas Estimation of carrying capacity; Eco tourism / wild life tourism in forests.	CO 05. Make informed decisions about wildlife conservation and management by critically evaluating information sources.
	Unit 7: Man and Wildlife Causes and consequences of humanwildlife conflicts.	CO 06. Appreciate current threats to biodiversity in relation to protected areas and nonprotected areas

	Unit 8: Protected areas National parks & sanctuaries. Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.	CO 07. Be capable of assessing status of wildlife and biodiversity
ZOOL-H-DSE-P02 (Wildlife conservation and Management Lab)	1. Identification (at least 5 each) of flora, mammalian fauna, avian fauna, herpetofauna of locality; field notebook with pictures/sketches and brief description. 2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses); note book with pictures/sketches and short description. 3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc. Descriptions to be noted in field notebook. 4. Monitoring for estimation of faunal abundance and diversity in locality (direct and indirect evidences): setting pitfall, spring and light traps and recording results from collections therein; pellet collection, dissection and recording; bird counts, migratory bird	CO 08. The practical course outcomes aim to provide students with hands-on experience and skills required for conducting wildlife conservation and management activities in realworld situations. By combining theoretical knowledge with practical training, students are better prepared to address the challenges and complexities of wildlife conservation and management. CO 09. Students will learn and practice various field survey techniques used in wildlife conservation, such as transect surveys, camera
	counts.	trapping, radio telemetry, and bird point count methods. They will develop skills in data collection, identification of wildlife species, and recording accurate field observations.

Core Courses	Content of KU Syllabus	Course Outcome (CO)
	Semester 6	
ZOOL-H-CC- T-13 (Developmental Biology)	Unit 1: Early Embryonic Development 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); Embryonic induction and organizers Unit 2: 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 3: Post Embryonic Development Development of brain and Eye in Vertebrate Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each) Unit 4: Implications of Developmental Biology Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell (ESC), Amniocentesis	parts. They will explore the cellular and molecular mechanisms involved in regeneration and the factors that influence the regenerative potential of different organisms.

ZOOL-H-CC- P-13 (Developmental Biology Lab)	1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 24, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages) 2. Study of the developmental stages and life cycle of *Drosophila* from stock culture 3. Study of different sections of placenta (photomicrograph/ slides) 4. Project report on *Drosophila* culture/aspects of chick embryo development under normal or stressed condition	CO 09. Practical items of embryology offered to the students are much relevant with its theoretical aspects. CO 10. Here, the students will learn the developmental stages of chick embryo at different hours of incubation; developmental stages and life cycle of Drosophila from stock culture; study of sections of placenta, etc. CO 11. In addition, a project report on drosophila culture, much important for future research on drosophila genetics, students are to produce before exam

ZOOL-H-CC- T-14 (Evolutionary Biology)	Unit 1 1. Geological time scale; evolution of horse 2. Neutral theory of molecular evolution, Molecular clock	CO 01. Evolution, the subject which tells about not only our own origin, it uncovers the mystery of the origin of our earth. So a student without knowing evolution would definitely lose the essence of science. CO 02. Students will gain a comprehensive understanding of the geological time scale, including the major divisions of time (eons, eras, periods, and epochs) and the events and life forms associated with each time period. CO 03. Students will study the evolutionary history of horses, from their early ancestors to modernday species. They will learn about the key transitional forms and important evolutionary milestones in the development of the horse lineage.
	Unit 2 1. Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to biallelic Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, types of selection, selection coefficient, mode of	CO 04. Students will learn about the HardyWeinberg equilibrium and its significance in population genetics. They will understand the conditions required for

	selection heterozygous superiority). 2. Genetic Drift mechanism (founder's effect, bottleneck phenomenon) 1.	a population to be in equilibrium and the role of various evolutionary forces (such as selection, mutation, migration, and genetic drift) in disrupting this equilibrium.
	Unit 3 Species concept, Isolating mechanisms, modes of speciation Adaptive radiation/macroevolution (exemplified by Galapagos finches)	CO 05. Students will gain a comprehensive understanding of the concept of speciation and its significance in evolutionary biology. They will explore the criteria for defining a species and the different species concepts, such as biological, morphological, and phylogenetic concepts.

	Unit 4 Origin and Evolution of Man (from *Sahelanthropus* to *Homo sapiens*), Unique Hominid characteristics contrasted with primate characteristics.	CO 06	. As mentioned at 1st point, origin and evolution of man, a student must know with the unique hominid characteristics as contrast with the primates.
	Unit 5 Phylogenetic trees, Construction & interpretation of Phylogenetic tree using parsimony, distance methods, Convergent & Divergent evolution.	CO	07. Moreover, phylogenetic tree construction using parsimony, and convergent and divergent evolution have made this paper much unique.
ZOOL-H-CC- P-14 (Evolutionary Biology Lab)	1. Study of fossils from models/ pictures 2. Study of homology and analogy from suitable specimens 3. Study and verification of HardyWeinberg Law by chi square analysis	CO	08. As drawing a phylogenetic tree must need fossil evidences, a student must study the fossils of different
	4. Graphical representation and interpretation of data of height/ weight of a sample of 20 humans in relation to their age and sex.		categories. CO 09. Study of homology and analogy of specimens; and Hardy-Weinberg law, a student should know. CO 10. In addition, from the practical viewpoint, a student is to construct graphical representation and interpretation of data of height and weight of some samples of human in relation to age and sex.

ZOOL-H-DSE-T-03 (Parasitology)	Unit 1: Introduction to Parasitology Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship	CO 01. Introductory unit in parasitology focuses on the study of parasites and their interactions with their hosts.
	Unit 2: Parasitic Protists Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Trypanosoma gambiense*, *Leishmania donovani*	CO 02. Students will study the life cycles of parasitic protists, including the different stages of development, modes of transmission, and the roles of intermediate hosts or vectors. They will learn about the various strategies that protozoan parasites employ to survive and replicate within their hosts. CO 03. Students will learn about the major diseases caused by parasitic protists. They will explore the symptoms, epidemiology, diagnosis, and treatment of these diseases, as well as their impact on human and animal health.

	Unit 3: Parasitic Platyhelminthes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*.	CO 04. Students will learn about the major diseases caused by parasitic Platyhelminthes. They will explore the symptoms, epidemiology, diagnosis, and treatment of these diseases, as well as their impact on human and animal health.
	Unit 4: Parasitic Nematodes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti.*	CO 05. This unit aims to provide students with a comprehensive understanding of the biology, diversity, and impact of parasitic Nematodes. It prepares students for further studies or careers in fields such as medical parasitology, veterinary parasitology, public health, and parasitological research.
	Unit 5: Parasitic Arthropods Biology, importance and control of ticks (Soft tick *Ornithodoros,* Hard tick *Ixodes*), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*).	CO 06. Students will gain a comprehensive understanding of the diversity of parasitic arthropods. They will learn about different groups of arthropod parasites, such as ticks, mites, lice,

		fleas, and mosquitoes. They will study their morphology, life cycles, and the types of diseases they cause in humans and animals.
	Unit 6: Parasite Vertebrates Brief account of Vampire bat	CO 07. This unit on parasitic vertebrates with a focus on bats would delve into the study of behaviour of bat.

ZOOL-H-DSE-P03 (Parasitology Lab)	1. Study of life stages of any one: *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* through permanent slides/micro photographs 2. Study of adult and life stages of any one: *Schistosoma haematobium*, *Taenia saginata* through permanent slides/micro photographs 3. Study of adult and life stages of any one: *Ancylostoma duodenale*, *Brugia malayi* and *Trichinella spiralis* through permanent slides/micro photographs 4. through permanent slides/micro photographs 5. Study of any one: *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs 6. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry] 7. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by-product	CO 08 CO	. A practical course in parasitology aims to provide students with hands-on experience and practical skills related to the study of parasites. 09. Students will develop skills in the identification and classification of parasites. They will learn to recognize different parasite species based on their morphology, life cycle stages, and key diagnostic features. This includes both macroscopic examination of parasites and microscopic examination of diagnostic specimens.
ZOOL-H-DSE-T-04 (Endocrinology)	Unit 1: Introduction to Endocrinology General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones.	CO 01. Students will be able	to acquire knowledge about the general idea of classification, characteristics, different modes of transport of endocrine hormones and their function.

	Unit 2: Epiphysis, Hypothalamohypophysial Axis 1. Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction. 2. Regulation of neuroendocrine glands, Feedback mechanisms 3. Structure of pituitary gland, Hormones and their functions, Hypothalamohypophysial portal system, Disorders of pituitary gland.	CO 02. Students will gain a comprehensive understanding of the structure, anatomy, and function of the epiphysis (pineal gland). They will learn about its location within the brain, its developmental origin, and the hormones it produces, such as melatonin. CO 03. Students will learn about the different hormones produced by the anterior and posterior pituitary glands. They will study the synthesis, secretion, and physiological effects of hormones such as adrenocorticotropic hormone (ACTH), thyroid-stimulating hormone (TSH), growth hormone (GH), prolactin (PRL), luteinizing hormone (LH), and follicle-stimulating hormone (FSH). CO 04. Students will explore the feedback mechanisms involved in the regulation of

		the hypothalamohypophysial axis. They will learn about negative and positive feedback loops that control hormone secretion and maintain hormonal balance in the body.
	Unit 3: Peripheral Endocrine Glands 1. Structure, Hormones, Functions and Regulation of Thyroid gland, Pancreas, Ovary and Testis 2. Hormones in homeostasis, Disorders of endocrine glands	CO 05. Students will gain a comprehensive understanding of the peripheral endocrine glands, including the thyroid gland, pancreas and gonads (testes and ovaries). They will learn about the anatomy, histology, and functional aspects of these glands. CO 06. Students will study the hormones produced by peripheral endocrine glands and their regulation. They will learn about the synthesis, secretion, and transport of hormones, as well as the factors that influence hormone production and release, including neural, hormonal, and environmental stimuli.
	Unit 4: Regulation of Hormone Action 1. Bioassays of hormones using RIA & ELISA 2. Estrous cycle in rat and menstrual cycle in human	CO 07. Students will gain a comprehensive understanding of the principles underlying RIA and ELISA. They will learn about the immunological reactions that form the basis of

	Multifaceted role of Vasopressin & Oxytocin.	these assays, including antigen-antibody interactions and the use of labeled tracers or enzymes for detection. CO 08. Students will gain a comprehensive understanding of the estrous cycle in non-primate mammals and the menstrual cycle in primates, including humans. They will learn about the phases and duration of these cycles, as well as the key events and hormonal changes that occur during each phase. CO 09. Students will gain a comprehensive understanding of vasopressin and oxytocin, including their chemical structure, synthesis, and release. They will learn about the physiological processes and systems regulated by these hormones.
ZOOL-H-DSE-P-05 (Endocrinology Lab)	1. Dissect and display of Endocrine glands in laboratory bred rat. 2. Study of the permanent slides of all the endocrine glands 3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland 4. Estimation of plasma level of any hormone using ELISA (either on	CO 10. A practical course in endocrinology aims to provide students with hands-on experience in conducting experiments and techniques related to the study of endocrine system function.

	Instrument or by demonstration/virtual lab). 5. Designing of primers of any hormone.	CO 11. Students will gain proficiency in laboratory techniques commonly used in endocrinology research. This may include hormone quantification assays (such as ELISA or RIA) and various microscopy techniques.

Krishnagar Government College
Department of Zoology

Program Outcomes (POs), Programme Specific Outcome (PSOs) and Course Outcomes (COs)

For

Under Graduate Programme
Programme CBCS, Kalyani University

Programme Outcomes (POs) outlook:

PO 01. Studying this very subject Zoology, the students will not only learn the diversity of animals, their structural and functional organizations, classification, etc., its outcome and benefit will remain eternal and everlasting.

PO 02. The chapters incorporated in different papers of the syllabus are designed to meet the students' academic and job oriented avenues.

PO 03. After successful completion of the courses at U.G. level, students may pursue higher studies; may seek for jobs elsewhere; or may find administrative assignments.

PO 04. Some unique chapters, which make the syllabus more realistic and much versatile comprise: Biodiversity and wildlife management; Ecology and environment;

Economic Zoology in the fields of fisheries, sericulture, apiculture, etc.; and Medical biology with special knowledge on microorganisms, parasites and helminthes.

PO 05. Moreover, some very pertinent and multifaceted topics, viz. Cell biology, Genetics, Developmental biology, Biotechnology, Molecular biology, Evolution, etc. have been incorporated in order to inculcate conceptual and cognitive ideas in the learners.

PO 06. Last but not the least, the essence of studying Zoology delimits no boundary of knowledge for which Ambrose Bierce rightly pointed out "The study of zoology is full of surprises".

	Programme Specific Outcomes (PSOs):
Semester	PSO 01.
I	Know the taxonomic positions and characteristics, life cycles, and even the parasitic mode of important lower animals.
	Distinguish the general features and classification of phylums Annelida, Arthropoda, Mollusca and Echinodermata.
	Know the origin of chordate, general descriptions of Pisces, Amphibian, Reptilia, Aves and Mammals.
II	PSO 02.
	Know the anatomy of vertebrates; integumentary, circulatory, digestive, respiratory. urinogenital and nervous systems; sense organs in vertebrates.
	Understand the concept and principles of developmental biology and know the different stages of embryonic development and its implications.
	Conceptual knowledge of ecology and its important attributes; biodiversity and its conservation and scope tourism sector.
	Students take up a project/field studies in real time scenario and analyse the outcome based on the data they collect.
	Comprehensive understanding of water ecosystem, types and their biomes; impact on water quality by different wastes.
III	PSO 03.
	Acquaint with the structure and function of various cell organelles, cell division
	and cell signalling.
	Understand mendelian genetics; Mutation, role of chromosomes in sex determination; recombinant bacteria and viruses.
	Understand the theories of evolution of life; population genetics.
IV	PSO 04.
	Conceptual knowledge of the Mechanism involved in digestion, respiration, blood, renal and heart.
	Comprehend the structure and functions of carbohydrates, lipids, proteins, nucleic acid and enzymes.
V	PSO 05.

	Comprehend the classification, morphology and physiology of fish; Inland fisheries and its sustainable aquaculture.
	Students take up a project/field studies in real time scenario and analyse the outcome based on the data they collect.
VI	PSO 06.
	Understand life cycle, morphology, infection and mode of control of various parasites.

Course Outcomes (COs)

Core Courses	Content of KU Syllabus	Course Outcome (CO)
	Semester 1	
ZOOL-G-CC-T-01 (Animal Diversity and Taxonomy)	Unit 1: Basics of Animal Classification Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy.	CO 01. The students , by studying the 1st unit, will be aware of the basics of animal kingdom and its vastness on the earth; they will learn the taxonomic hierarchy, codes of zoological nomenclature, etc.
	Unit 2: Protista Protozoa. Outline of classification (salient features and classification scheme upto subphylum only). a. Locomotion in *Amoeba*; Conjugation in *Paramoecium*. b. Life cycle and pathogenicity of *Entamoeba histolytica.*	CO 02. As the units cover classifications of different phyla, as mentioned in the topics, the students will find the vast diversity of invertebrates.
	Unit 3: Porifera Outline of classification (salient features and classification scheme upto subclass only). Canal system in sponges.	CO 03. To gather knowledge about special structures and functions of invertebrates viz.

	Unit 4:Cnidaria Outline of classification (salient features and classification scheme upto subclass only). Metagenesis in *Obelia.*	i) Protozoans' variety of locomotory structures and reproduction; ii) Canal system of Porifera (sponges); iii) Cnidarians' unique structures and polymorphism; iv) Diversity of corals and coral reefs; v) Helminths' parasitism , infective stages, prophylaxis/ treatment, etc.
	Unit 5: Platyhelminthes Outline of classification (salient features and classification scheme upto subclass only). Life cycle and pathogenicity and controlmeasures of *Fasciola hepatica.*	
	Unit 6: Nematoda Outline of classification (salient features and classification scheme upto subclass only). Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides.*	
	Unit 7:Annelida Outline of classification (salient features and classification scheme upto subclass only). Excretion in Annelida through nephridia.	This part of Non-chordates will give the students a clear picture of CO 04. Basic concept of Evolution in non- chordates like development of coelom, Study of salient identifying features and special features like metamerism, metamorphosis, eusociality and variation in physiological process in non- chordates like respiration, excretion, vision. CO 05. Concept of connecting link with evolutionary significance.
	Unit 8: Arthropoda Outline of classification (salient features and classification scheme upto class only). Social life in termite.	

	Unit 9: Mollusca Outline of classification (salient features and classification scheme upto subclass only). Respiration in *Pila.*		CO 06. Study on classification and salient features of non chordates from Mollusca to Hemichordata.
			CO 07 . Apart from knowing the classifications of the said phyla here also, students will learn some very pertinent aspects like: i) Excretion and metamerism in annelida; ii) Respiration and metamorphosis of arthropoda; iii) Nervous system and torsion in mollusca; iv) Water vascular system and larval forms of echinodermata, etc.
	Unit 10: Echinodermata Outline of classification (salien features and classification schem upto subclass only). Water vascular system in Asteroidea		
	Unit 11: Protochordata Retrogressive metamorphosis *Ascidia*.	in	CO 08. This unit on Protochordata, also known as the chordate subphylum Protochordata or Urochordata, focuses on the study of primitive chordates, including tunicates or sea squirts.

	Unit 12: Pisces Outline of classification (salient features and classification scheme upto subclass only). Swim bladder in fishes.	CO 09. Students study about identification of various fish and their practical utility through the study of their systems and migration patterns.
	Unit 13:Amphibia Outline of classification (salient features and classification scheme upto order only). Parental care in Amphibia.	CO 10. This chapter includes the study and identification of various amphibians
		and their systems. It also includes metamorphosis and parental care in Amphibia and the hormonal factors involved.
	Unit 14: Reptilia Outline of classification (salient features and classification scheme upto order only). Poison apparatus and Biting mechanism in Snake.	CO 11. Describing unique characters of reptiles, aves and mammals upto subclass/order. CO 12. To understand the special features of some chordates like metamorphosis, paedomorphosis, parental care in Amphibia, biting mechanism and poison apparatus in poisonous snake, migration and aerodynamics principle of bird flight, exoskeletal derivative and echolocation in Mammals.
	Unit 15: Aves Outline of classification (salient features and classification scheme upto subclass only). Exoskeleton and Migration in Birds.	
	Unit 16: Mammalia Outline of classification (salient features and classification scheme upto infraclass only). Exoskeletal derivatives of mammals.	

ZOOL-G-CC-P-01 (Animal Diversity, Taxonomy Lab)	1. Identification of: a. Porifera - *Sycon*, *Obelia*, *Physalia*, *Corallium*, *Metridium*, *Pennatula*. b. Annelids - *Nereis, Pheretima,Hirudinaria.* c. Arthropods – *Limulus, Palaemon, Eupagurus, Scolopendra, Bombyx, Periplaneta*, termites and honey bees. d. Onychophora – *Peripatus.* e. Molluscs - *Pila, Sepia.* f. Echinodermata - *Asterias, Echinus.*	CO 13. Students from their laboratories can have an open access to identification of invertebrates by handling and examining them. CO 14. Students are to have practical knowledge on different specimens under the phyla from Porifera to hemichordate. CO 15. Like the invertebrate specimens, identifying features and systematic positions of
	g. Protochordata – *Balanoglossus.* h. Fishes - *Sphyrna*, *Torpedo*, *Labeo*, *Exocoetus*, *Echeneis*, *Hippocampus.* i. Amphibia - *Hyla, Tylototriton.* j. Reptilia - *Trionyx*, *Hemidactylus,Chamaeleon,Draco, Naja.* k. Mammalia: Bat 2. Pecten from Fowl head 3. Dissection of brain and pituitary of Rohu/Catla/Mrigal 4. Identification and significance of adult *Fasciola hepatica*, and *Ascaris lumbricoides*	some important chordate specimens viz. *Petromyzon* from Agnatha; *Exocetus*, Hippocampus from fish; Amphibians like *Tylototryton*, Axolotl; 10 reptilians like *Chelone*, *Naja*, *Chameleon*, etc. and bat from mammalia. CO 16. How to dissect pectin from fowl head and pituitary gland from rohu, are also included here.

Core Courses	Content of KU Syllabus	Course Outcome (CO)	
Semester 2			
ZOOL-G-CC-T02 (Comparative Anatomy, Developmental Biology of Vertebrates and Ecology)	Unit 1: Integumentary System Structure, function and derivatives of integument in mammals	CO 01	. From this paper students will be able to grasp knowledge on the comparative anatomical structures of different organ systems like: Integumentary, sketetal, digestive, circulatory, respiratory, urinogenital, nervous, etc.
	Unit 2: Skeletal System Jaw suspensions.		
	Unit 3: Digestive System Teeth.		
	Unit 4: Circulatory System Comparative account of heart and aortic arches		
	Unit 5: Urinogenital System Succession of kidney, Types of mammalian uteri.	CO 02	. By the study of such comparative organs/systems viz. skin, aortic arches, stomach, respiratory organs, kidney and cranial nerves students will learn as to how such organs evolve from lower to higher vertebrates.
	Unit 6: Nervous System Cranial nerves in mammals.		
	Unit 7: Early Embryonic Development Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Planes and patterns of cleavage; Embryonic induction and organizers	CO	03. The paper, developmental biology or embryology, offers immense relevance, because without having a clear understanding over this subject, a student of Zoology would never know how he or she comes into existence from the mother's womb, how he develops and grows into a baby.

		CO 04. Students will gain a comprehensive understanding of the processes and events that occur during early embryonic development. This includes fertilization, cleavage, gastrulation, and the establishment of germ layers. CO 05. Students will learn about the formation of the three primary germ layers (ectoderm, mesoderm, and endoderm) and their subsequent differentiation into various tissues and organs. They will explore the processes of organogenesis, including neural tube formation, somitogenesis, and organ primordium development.

	Unit 8: Late Embryonic Development Fate of Germ Layers; Extra-embryonic membranes in birds.	CO 06. Students will gain a comprehensive understanding of the processes and events that occur during late embryonic development. This includes organogenesis, tissue differentiation, cell migration, and the establishment of organ systems. CO 07. Students will learn about the processes of cell differentiation and specialization that occur during late embryonic development. They will explore how cells acquire specific identities and functions through gene expression and cellular interactions.

	Unit 9: Post Embryonic Development Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)	CO 08. Students will gain a comprehensive understanding of the processes and events that occur during postembryonic development. This includes growth, metamorphosis, and maturation, leading to the formation of adult structures and functions. CO 09. Students will learn about the regenerative capacity of organisms and their ability to repair damaged tissues or regenerate lost body parts. They will explore the cellular and molecular mechanisms involved in regeneration and the factors that influence the regenerative potential of different organisms.
	Unit 10: Introduction to Ecology Autecology and synecology, Levels of organization.	CO 10. Keeping in mind that without proper knowledge on ecology and environment, and the interaction between biotic (microorganism to human) and abiotic communities, the students' overall idea remains incomplete, this chapter has been introduced.
	Unit 11: Population and Community	CO 11. Some unique topics

	Geometric, exponential growth, equation, Gause with laboratory and field Community characteristics: diversity, abundance, richness. Vertical Ecological succession example	species dominance, stratification. with one under this paper like i) Relationship of population, community and ecosystem; ii) Population growth, demography, life tables, and survivorship curve; are included to input thorough ideas within the students. CO 12. This chapter also deals with the concept of biodiversity and different attributes of a community, a study on the succession of a community and identification of the different seral stages.
	Unit 12: Ecosystem Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids.	CO 13. Besides, topics like food chain, ecological pyramids, study of energy flow through ecosystem add to this chapter much emphasis.
	Unit 13: Applied Ecology Wildlife Conservation (in-situ and exsitu conservation). Management strategies for tiger conservation; Wild life protection act (1972)	CO 14. Explain the large scale patterns of biodiversity, describe how biodiversity is measured and predict the consequences of continued species loss.

ZOOL-G-CC-P02 (Comparative Anatomy and Developmental Biology of Vertebrates Lab)	1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs 2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig. 3. Demonstration of Carapace and plastron of turtle OR	CO 15. The practical paper deals with study of scales of fishes, like placoid, cycloid and ctenoid; skeletons of toad, pigeon and guineapig, etc. CO 16. Students are to demonstrate carapace
	4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal a. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system. b. Study of whole mounts of developmental stages of chick through permanent slides: 24, 48, 72, and 96 hours of incubation. 5. Study of an aquatic ecosystem: Phytoplankton and zooplankton, determination of pH, and Dissolved Oxygen content (Winkler's method) and free CO2. 6. Report on a one-day visit to Sanctuary / Zoo / Sericulture station / Fishery / apiculture station / pond ecosystem / agroecosystem.	and plastron of turtle and to identify dog and guineapig skulls. CO 17. In addition, students are to dissect out some systems like circulatory, brain, pituitary, and urinogenital of tilapia/carp. CO 18. Students find much enthusiasm by preparing a Field note book after a visit to biodiversity spot/ Zoo / Sericulture station / Fishery / apiculture station / pond ecosystem / agroecosystem, which is done every year.

Core Courses	Content of KU Syllabus	Course Outcome (CO)
Semester 3		
ZOOL-G-CC-T-03 (Cell Biology, Genetics and Evolutionary Biology)	Unit 1: Overview of Cells Basic structure of Prokaryotic and Eukaryotic cells	CO 01. Without having a vivid knowledge on cell, the students' intuitive ideas would not be clear. In order to well equip the students, this chapter has been arranged in a lucid way CO 02. With basic structures of prokaryotic and eukaryotic cell, this chapter starts.
	Unit 2: Plasma Membrane Ultrastructure and composition of Plasma membrane: Fluid mosaic model. Transport across membrane: Active and Passive transport, Facilitated transport. Cell junctions: Tight junctions, Gap junctions, Desmosomes.	CO 03. Unique structure of plasma membrane, transport across the membrane, cell-tight and gap junctions are some of the important features of this chapter.
	Unit 3: Cytoplasmic organelles I 1. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes.	CO 04. Concepts on Mitochondria, its origin and different biochemical processes; structure and function of Peroxisome, centrosome and cytoskeleton. Brief concepts on different grades of packaging of chromatin fibre with detailed structure and function of nucleus.
	Unit 4: Cytoplasmic organelles II Mitochondria: Structure, Mitochondrial Respiratory Chain.	
	Unit 5: Nucleus Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome).	

	Unit 6: Cell Division Cell cycle and its regulation.	CO 05. This is a very important chapter related to Cell cycle check points and cancer. Concepts of oncogenes and tumor suppressor genes are dealt with apoptosis have been added here to raise students' overall

		conception.
	Unit 7: Cell Signaling Cell signaling transduction pathways; Types of signaling molecules and receptors	CO 06. Various cell signalling pathways and their implications in disease states are discussed in details Concept of apoptosis and necrosis with their role in normal physiology are discussed.
	Unit 8: Mendelian Genetics and its Extension Principles of inheritance. Sex-linked, sex- influenced and sex-limited inheritance.	CO 07. Genetics, the science of heredity, is the subject a student of Zoology must learn as it is related with the father of genetics, Mendel. So, invariably this paper starts with the Mendelian genetics and ends with the modern theme of genetics.
	Unit 9: Linkage, Crossing Over and Chromosomal Mapping Linkage and Crossing Over	CO 08. This paper deals with topics like Linkage and crossing over concepts, estimation of recombination frequency, linkage map construction using three factor cross, sex linkage in Drosophila and human.

	Unit 10: Mutations Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each)	CO 09. Some very pertinent topics like Mutations and its molecular basis, chromosomal aberrations are to be studied to have a clear idea on genetics.
	Unit 11: Sex Determination Mechanisms of sex determination in *Drosophila*	CO 10. Students can compare the mechanisms of sex determination and Dosage compensation in Drosophila and human.
	Unit 12: Evolution – 1: Idea Geological time scale	CO 11. Evolution, the subject which tells about not only our own origin, it uncovers the mystery of the origin of our earth. So a student without knowing evolution would definitely lose the essence of science.
	Unit 13: Evolution - 2: Mechanism Natural selection (concept of fitness, types of selection, selection coefficient, mode of selection heterozygous superiority).	CO 12. Students will study the mechanisms and processes involved in natural selection. They will learn about the differential survival and reproduction of individuals based on their heritable traits, leading to changes in allele frequencies within populations. They will explore concepts such as variation, heritability, fitness, selection pressures, and the role of genetic drift and gene flow in shaping populations.

	Unit 14: Evolution - 3: Effect Species concept, Isolating mechanisms, modes of speciation	CO 13. Students will gain a comprehensive understanding of the concept of speciation and its significance in evolutionary biology. They will explore the criteria for defining a species and the different species concepts, such as biological, morphological, and phylogenetic concepts.
	Unit 15: Evolution - 4: Humans Unique Hominid characteristics contrasted with primate characteristics.	CO 14. A student will know with the unique hominid characteristics as contrast with the primates.
ZOOL-G-CC-P-03 (Cell Biology, Genetics and Evolutionary Biology Lab)	1. Study of various stages of meiosis. 2. Study of fossils from models/ pictures. 3. Chi-square analyses.	CO 15. Students from this practical paper are to learn some cytological squash preparations from root tip of onion or grasshopper testis, and to identify different stages of meiosis. CO 16. As drawing a phylogenetic tree must need fossil evidences, a student must study the fossils of different categories. CO 17. The practical topics students are to cover are also comprised of Chisquare analysis

Core Courses	Content of KU Syllabus	Course Outcome (CO)
Semester 4		
ZOOL-G-CC-T04 (Physiology and Biochemistry)	Unit 1: Digestion and Absorption of Food Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins.	CO 01. If any zoologist does not know the basics of his systems, his physiology as to how he or she feeds, respires; how heart and kidney work, the overall knowledge would be completed. CO 02. In order to have clear ideas, digestive systems and physiology of digestion; respiratory system and related physiology like transport of oxygen and carbon dioxide, dissociation curves; circulatory system associated with blood components, blood group types, blood clotting system, structure of hemoglobin, etc. have been incorporated here. CO 03. Ideas on physiology of heart with the knowledge of its structure, cardiac output, cardiac cycle, blood pressure, etc. are to perceive.
	Unit 2: Functioning of Excitable Tissue (Nerve and Muscle) Structure of neuron, Propagation of nerve impulse (myelinated and nonmyelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory.	
	Unit 3: Respiratory Physiology Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.	
	Unit 4: Renal Physiology Functional anatomy of kidney, Mechanism and regulation of urine formation	
	Unit 5: Cardiovascular Physiology Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG	

	Unit 6: Endocrine and Reproductive Physiology Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of Menstrual cycle.	CO 04. Students will gain a comprehensive understanding of the peripheral endocrine glands, including the pituitary, thyroid gland, pancreas and gonads (testes and ovaries). They will learn about the anatomy, histology, and functional aspects of these glands.
	Unit 7: Carbohydrates Glycolysis, Citric acid cycle Unit 8: Lipids Fatty acid biosynthesis Unit 9: Proteins Amino acids: Structure, Classification Proteins: Levels of organization; Protein metabolism: Urea cycle	CO 05. As knowledge on basics of life is never completed without this important paper of biochemistry, the students must gain knowledge on different biochemical molecules like Carbohydrates, lipids, proteins, nucleic acids and enzymes. CO 06. Metabolisms of such biochemicals are also included here. Carbohydrates - citric acid cycle, gluconeogenesis, etc., lipids - beta oxidation, fatty acid biosynthesis. CO 07. Students will be able to gain concept on Proteins include electrochemical properties of alpha amino acid, physiological importance of essential amino acids, transamination, deamination, urea cycle, ketogenic amino acids, etc .

	Unit 10: Nucleic Acids Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids	CO 08. Students will be able to gain concept on types of DNA and RNA, bases like purine and pyrimidine, nucleotide metabolism.
	Unit 11: Enzymes Classification; Cofactors; Specificity; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzymecatalyzed reactions.	CO 05. Students will be able to gain concept on Enzymes- types, action and kinetics, Michaelis-Menten equation, Lineweaver-Burk plot, etc.
ZOOL-G-CC-P04 (Physiology and Biochemistry Lab)	1. Preparation of temporary mounts: Blood film.	CO 06. Preparation of stained blood film to study the blood cell types are some unique aspects, the students perform at lab. CO 07. Knowledge of different histological structures through the methodology of microtomy is the main subject here. CO 08. Besides preparation of histological slides the students learn how to identify the T.S. of tissues like bones, spinal cord, nerves and endocrine glands. CO 09. From this paper students will be able to gain practical knowledge of: Qualitative tests of carbohydrates, proteins, and lipids.
	2. Estimation of haemoglobin using Sahli's haemoglobinometer. 3. Examination of permanent histological sections of mammalian duodenum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary. 4. Qualitative tests of functional groups in carbohydrates, proteins and lipids.	

Core Courses	Content of KU Syllabus	Course Outcome (CO)
	Semester 5	
ZOOL-G-DSE-T01 (Fish and Fisheries)	Unit 1: Introduction and Classification 1. Feeding habit, habitat and manner of reproduction 2. Classification of fish (up to Subclasses)	CO 01. Course provides them comprehensive understanding about aquatic ecosystem and various economical important fishes. CO 02. Students get to learn not only about physiology of fish.
	Unit 2: Morphology and Physiology Types of fins and their modifications; 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 in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ.	
	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.	CO 03. Understanding of fishes habits and habitats and their functional anatomy and also the practical application parts like preparation of fish diet, preservation, processing of fish, fishery by products etc CO 04. The students will be well equipped to become very competent in research or teaching fields of fisheries. CO 05. It is one of the small scale industry which can provide the student
	Unit 4: Aquaculture Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Induced breeding of fish; Management of finfish hatcheries; 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 byproducts	
	Unit 5: Fish in research Transgenic fish. Zebrafish as a model organism in research	

			employment opportunity.
ZOOL-G-DSE-P-01 (Fish and Fisheries Lab)	1. Morphometric and meristic characters of fishes. 2. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas, Echeneis,* exotic carps. 3. Study of different types of scales (through permanent slides/ photographs). 4. Study of crafts and gears used in Fisheries (Pictures/models). Characters. 5. Water quality criteria for Aquaculture: Assessment of pH, DO, free CO_2, productivity, alkalinity, hardness, chloride (by titration/refractometer). 6. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias.* Drawing with characters. 7. Project Report on a visit to any fish farm/ pisciculture unit / Zebrafish rearing Lab.	CO	06. Students gain knowledge in the areas of responses characterization and classification of Ostracoderms, placoderms, acanthodians, holocephali, elasmobranchs. 07. Students gain knowledge about different water quality testing.

Core Courses	Content of KU Syllabus	Course Outcome (CO)
Semester 6		
ZOOL-G-DSE-T-03 (Parasitology)	Unit 1: Introduction to Parasitology Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship	CO 01. Introductory unit in parasitology focuses on the study of parasites and their interactions with their hosts.
	Unit 2: Parasitic Protists Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Trypanosoma gambiense*, *Leishmania donovani*	CO 02. Students will study the life cycles of parasitic protists, including the different stages of development, modes of transmission, and the roles of intermediate hosts or vectors. They will learn about the various strategies that protozoan parasites employ to survive and replicate within their hosts. CO 03. Students will learn about the major diseases caused by parasitic protists. They will explore the symptoms, epidemiology, diagnosis, and treatment of these diseases, as well as their impact on human and animal health.

	Unit 3: Parasitic Platyhelminthes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*.	CO 04. Students will learn about the major diseases caused by parasitic Platyhelminthes. They will explore the symptoms, epidemiology, diagnosis, and treatment of these diseases, as well as their impact on human and animal health.
	Unit 4: Parasitic Nematodes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti.*	CO 05. This unit aims to provide students with a comprehensive understanding of the biology, diversity, and impact of parasitic Nematodes. It prepares students for further studies or careers in fields such as medical parasitology, veterinary parasitology, public health, and parasitological research.

	Unit 5: Parasitic Arthropods Biology, importance and control of ticks (Soft tick *Ornithodoros,* Hard tick *Ixodes*), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*).	CO 06. Students will gain a comprehensive understanding of the diversity of parasitic arthropods. They will learn about different groups of arthropod parasites, such as ticks, mites, lice, fleas, and mosquitoes. They will study their morphology, life cycles, and the types of diseases they cause in humans and animals.
	Unit 6: Parasite Vertebrates Brief account of Vampire bat	CO 07. This unit on parasitic vertebrates with a focus on bats would delve into the study of behaviour of bat.
ZOOL-G-DSE-P-03 (Parasitology Lab)	1. Study of life stages of any one: *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* through permanent slides/micro photographs 2. Study of adult and life stages of any one: *Schistosoma haematobium*, *Taenia saginata* through permanent slides/micro photographs 3. Study of adult and life stages of any one: *Ancylostoma duodenale*, *Brugia malayi* and *Trichinella spiralis* through permanent slides/micro photographs 4. through permanent slides/micro photographs 5. Study of any one: *Pediculus humanus*,	CO 08. A practical course in parasitology aims to provide students with hands-on experience and practical skills related to the study of parasites. CO 09. Students will develop skills in the identification and classification of parasites. They will learn to recognize different parasite species based on their morphology, life cycle stages, and key diagnostic features. This includes both macroscopic examination of parasites and microscopic examination of diagnostic specimens.

	Xenopsylla cheopis and *Cimex lectularius* through permanent slides/ photographs 6. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry] 7. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by-product	