



**Mahishadal Raj College**  
**Department of Zoology**  
**PO, CO, & PSO Programme For Under Graduate**  
**Session: 2020-2021**

**PROGRAMME OUTCOME:**

- **PO1 - KNOWLEDGE ENRICHMENT:** Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms.
- **PO2 - FUNDAMENTAL KNOWLEDGE ABOUT ANIMAL:** Analyze complex interactions among the various animals of different phyla, their distribution and their relationship with the environment
- **PO3 - SELF AWARENESS SKILL:** Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
- **PO4 - ETHOLOGICAL PROFICIENCY:** Understands the complex evolutionary processes and behaviour of animals.
- **PO5 - PHYSIOLOGICAL LEARNING:** Correlates the physiological processes of animals and relationship of organ systems
- **PO6 - ENVIRONMENTAL KNOWLEDGE:** Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species
- **PO7 - EMPLOYABILITY OPTIONS:** Gain knowledge of Agro based Small Scale industries like sericulture, fish farming.
- Butterfly farming and vermicompost preparation.
- **PO8 - CRITICAL ANALYSIS:** Understands about various concepts of genetics and its importance in human health.
- **PO9 - ETHICAL COMPREHENSION:** Apply ethical principles and commit to professional ethics and responsibilities in delivering his duties
- **PO10 - SELF DIRECTED KNOWLEDGE:** Apply the knowledge and understanding of Zoology to one's own life and work
- **PO11 - EMPATHY DEVELOPMENT:** Develops empathy and love towards the animals
- **PO12 - CAREER DEVELOPMENT SKILL:** After completion of this course, they have the option to go for higher studies like M.Sc Integrated M.Sc., PhD and then do research work for the welfare of mankind.
- **PO13 - EXPERIMENTAL AND RESEARCH DEVELOPMENT SKILL:** Gains knowledge about research methodologies, effective communication and skills of problem solving methods

**COGNITIVE LEVELS:**

R = Remembering. U = Understanding, AP = Applying. AN = Analysing. E = Evaluating, C = Creating

## **PROGRAMME SPECIFIC OUTCOME:**

**PSO1:** Demonstrate a fundamental understanding of the academic field of Zoology, its different learning areas and applications, and its link with related disciplinary areas/subjects; provides awareness on the divisions in Animal Kingdom, their distribution, relationship among them and with the environment.

**PSO2:** Show Procedural knowledge in various professions related to the subject in different fields inclusive of research and development, teaching, government and public services with the help of practical tests in different branches; Use it to analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.

**PSO3:** Exhibit Skills in areas related to their individual specialization like genetic engineering, in relation to current developments and related fields in the domain; helps to apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.

**PSO4:** Able to communicate the concepts, constructs and techniques involved in with ease and in a clear manner based on the animal evolution, animal behaviour, animal development and animal ecology topics.

**PSO5:** Techniques and Methodologies discussed in the vital topics like Cell Biology, Genetics, Molecular Biology manifest the knowledge in research specific areas and studies by correlating the physiological processes of animals and relationship with cellular structure.

**PSO6:** Understand the environmental conservation processes and its importance, pollution control, protection of endangered species, Wildlife Management. Climatic changes and Global Management are discussed as a paper to improvise the subject knowledge for identifying any problems related and in helping the impacted environment and biodiversity.

**PSO7:** Helps advancement in job, trades, and employment with the help of knowledge about of Agro-based Small Scale industries like sericulture, fish farming, butterfly farming and vermicompost preparation and helps create various opportunities in the educational, research and developmental, social entrepreneurial sectors related to the same.

**PSO8:** Should be able to create a contextual contents and examples in the real time world based on the applications and discussions carried out in all the subjects like combining clinical laboratory techniques studied as part of Medical Parasitology and behaviours of the microbes studied as part of the Microbiology.

**PSO9:** Improve the observational, computational, and analytical ethical skills required for the research and development fields discussed for evolving trends in Genetics, molecular biology, micro-biology, cell biology, etc.

**Abbreviation Used****CC = Core Course****GE = Generic Elective****SEC = Skill Enhancement Course****AECC = Ability Enhancement Compulsory Course****DSE = Disciplinary Specific Elective**

<b>Core Course</b>	<b>List of Core Course</b>	<b>Semester</b>
UGZOOCC 01	Non Chordate I	<b>I</b>
UGZOOCC 02	Ecology	
UGZOOCC 03	Non Chordate II	<b>II</b>
UGZOOCC 04	Cell Biology	
UGZOOCC 05	Chordates	<b>III</b>
UGZOOCC 06	Animal Physiology	
UGZOOCC 07	Fundamental of Biochemistry	
UGZOOCC 08	Comparative anatomy of Vertebrates	<b>IV</b>
UGZOOCC 09	Animal Physiology	
UGZOOCC 10	Immunology	
UGZOOCC 11	Molecular Biology	<b>V</b>
UGZOOCC 12	Genetics	
UGZOOCC 13	Developmental Biology	<b>VI</b>
UGZOOCC 14	Evolutionary Biology	
	<b>GE</b>	
UGZOOGE 3	Aquatic Biology	<b>III</b>
UGZOOGE 4	Insect, Vector & Disease	<b>IV</b>
	<b>SEC</b>	
UGZOOSEC 1	Aquarium & Fish Keeping	<b>III</b>
UGZOOSEC 2	Sericulture	<b>IV</b>
	<b>DSE</b>	
UGZOODSE 1	Animal Behaviour	<b>V</b>
UGZOODSE 2	Animal Biotechnology	
UGZOODSE 3	Parasitology	<b>VI</b>
UGZOODSE 4	Biology of Insects	

## Core Course

### SEMESTER I

**Course Name:** Non-Chordates I

**Course Code:** UGZOOCC 01

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO1.1	Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Six kingdom concept of classification (Card woese).	PO1, PO2, PO11, PO12, PO13	PSO1, PSO2	R
CO1.2	Protozoa General characteristics and Classification up to phylum (according to Levine et. al., 1981) Locomotion in Euglena, Paramecium and Amoeba; Conjugation in Paramecium. Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica.	PO1, PO2, PO11	PSO1, PSO2	AP
CO1.3	Evolution of symmetry and segmentation of Metazoa. General characteristics and Classification up to classes; Canal system and spicules in sponges. General characteristics and Classification up to classes Metagenesis in Obelia & Aurelia Metagenesis in Obelia Polymorphism in Cnidaria Corals and coral reef diversity, function & conservation. Ctenophora General characteristics.	PO1, PO5	PSO1, PSO2	R,U
CO1.4	General characteristics and Classification up to Classes, Life cycle and pathogenicity and control measures of Fasciola hepatica and Taenia solium. Nematoda General characteristics and Classification up to classes Life cycle, and pathogenicity and control measures of Ascaris lumbricoides and Wuchereria bancrofti. Parasitic adaptations in helminthes.	PO10	PSO1, PSO2	U, AP
CO1.5	Study of whole mount of Euglena, Amoeba and Paramecium Identification of Amoeba, Euglena, Entamoeba, Opalina, Paramecium, Plasmodium vivax and Plasmodium falciparum (from the prepared slides) Identification of Sycon, Neptune's Cup, Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatulula, Fungia, Meandrina, Madrepora..Identification and significance of adult Fasciola hepatica, Taenia solium and Ascaris lumbricoides. Staining/mounting of any protozoa/helminth from gut of cockroach.	PO1, PO10, PO13	PSO1, PSO2	AN, AP

**Course Name:** Ecology

**Course Code:** UGZOOCC 02

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO2.1	History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere. Population, Unitary and Modular populations Unique and group attributes of population: Demographic factors, life tables, fecundity tables.	PO1, PO6	PSO5	R,U
CO2.2	Survivorship curves, dispersal and dispersion. Geometric, exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors. Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect. Ecological succession with one example.	PO4, PO6	PSO2	U
CO2.3	Ecosystem. Types of ecosystem with an example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with an example of Nitrogen cycle Human modified ecosystem Applied Ecology, Wildlife Conservation (in-situ and ex-situ conservation). Management strategies for tiger conservation; Wild life protection act (1972).	PO6, PO9	PSO2, PSO6	U, AP
CO 2.4	Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided .Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO <sub>2</sub> , Report on a visit to National Park/Biodiversity Park/Wild life sanctuary Note: In field report costal area to be included.	PO6	PSO5, PSO6	AN, AP, E

## SEMESTER II

**Course Name:** Non-Chordates II

**Course Code:** UGZOOCC 03

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO3.1	Evolution of coelom and metamerism. General characteristics and Classification up to classes .Excretion in Annelida through nephridia. Metamerism in Annelida. General characteristics and Classification up to classes Vision in Insecta only. Respiration in Arthropoda (Gills in prawn and trachea in cockroach) Metamorphosis in Lepidopteran Insects.Social life in termite. General characteristics and Evolutionary significance of onychophora.	PO2	PSO1,PSO2	U
CO3.2	General characteristics and Classification up to Classes.Nervous system and torsion in Gastropoda Feeding and respiration in Pila sp. General characteristics and Classification up to classes.Water-vascular system in Asteroidea .Larval forms in Echinodermata .Affinities with Chordates. General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates.	PO5	PSO1	R
CO3.3	Study of following specimens: Annelids - Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria,Arthropods - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta, termites and honey bees Onychophora – Peripatus, Molluscs - Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus, Echinodermates - Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and, Antedon. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm, T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta.To submit a Project Report on any related topic to larval forms ( crustacean, mollusc and echinoderm)	PO1, PO2, PO5	PSO1,PSO2	R, U, AP

**Course Name:** Cell Biology

**Course Code:** UGZOOCC 04

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO4.1	Basic structure of Prokaryotic and Eukaryotic cells, Viruses, Viroid, Prion and Mycoplasma. Ultra structure and composition of Plasma membrane: Fluid mosaic model. Transport across membrane: Active and Passive transport, Facilitated transport. Cell junctions: Tight junctions, Gap junctions, Desmosomes. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes. Protein sorting and mechanisms of vesicular transport. Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis. Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis. Peroxisomes: Structure and Functions. Centrosome: Structure and Functions. Type, structure and functions of cytoskeleton. Accessory proteins of microfilament & microtubule. A brief idea about molecular motors.	PO3, PO8	PSO3, PSO8	R, U
CO4.2	Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus. Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome). Cell cycle and its regulation, Cancer (Concept of oncogenes and tumor suppressor genes with special reference to p53, Retinoblastoma and Ras and APC. Mitosis and Meiosis: Basic process and their significance. Cell signalling transduction pathways; Types of signaling molecules and receptors GPCR and Role of second messenger (cAMP). Extracellular matrix-Cell interactions Apoptosis and Necrosis.	PO3, PO8	PSO3, PSO9	U
CO4.3	Preparation of temporary stained squash of onion root tip to study various stages of mitosis. Study of various stages of meiosis. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells. Preparation of permanent slide to demonstrate: DNA by Feulgen reaction, Cell viability study by Trypan Blue staining, Mitochondria identification through vital staining	PO8	PSO3	AP, AN

### SEMESTER III

**Course Name:** Chordates

**Course Code:** UGZOOCC 05

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO5.1	General characteristics and outline classification of Phylum Chordate. General characteristics and classification of sub-phylum Urochordata and Cephalochordate up to Classes. Retrogressive metamorphosis in Ascidia. Chordate Features and Feeding in Branchiostoma.	PO2	PSO1,P SO2	R
CO5.2	Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata. General characteristics and classification of cyclostomes up to order. General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses. Accessory respiratory organ, migration and parental care in fishes Swim bladder in fishes. Classification up to Sub-Classes. General characteristics and classification up to living Orders. Metamorphosis and parental care in Amphibia. General characteristics and classification up to living Orders. Poison apparatus and Biting mechanism in Snake. General characteristics and classification up to Sub-Classes Exoskeleton and migration in Birds. Principles and aerodynamics of flight. General characters and classification up to living orders Affinities of Prototheria. Exoskeleton derivatives of mammals. Adaptive radiation in mammals with reference to locomotory appendages Echolocation in Micro chiropterans and Cetaceans.	PO1, PO5, PO6	PSO1,P SO2	R, U
CO5.3	Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of birds and mammals in different realms.	PO6	PSO6	U
CO5.4	Protochordata, Balanoglossus, Herdmania, Branchiostoma, Agnatha, Petromyzon, Myxine Fishes, Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas, Flat fish, Amphibia, Necturus, Bufo, Hyla, Alytes, Axolotl, Tylotriton, Reptilia, Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus. Key for Identification of poisonous and non-poisonous snakes, Mammalia: Bat (Insectivorous and Frugivorous), Funambulus, Pecten from Fowl head, Dissection of brain and pituitary of Tilapia. Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission).	PO2		AN, AP



**Course Name:** Animal Physiology: Controlling & Coordinating Systems

**Course Code:** UGZOOCC 06

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO6.1	Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue and, fixation and staining of tissues.	PO10	PSO3	U
CO6.2	Structure and types of bones and cartilages, Ossification. 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. Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre. Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre. Histology of testis and ovary Physiology of Reproduction. Histology and function of pituitary, thyroid, pancreas and adrenal Classification of hormones; Mechanism of Hormone action. Signal transduction pathways for Steroidal and Non steroidal hormones. Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system. Placental hormones.	PO3, PO12	PSO3, PSO9	U, R
CO6.3	Recording of simple muscle twitch with electrical stimulation (or Virtual). Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex), Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells, Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid, Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues.	PO3	PSO3	AP, AN

**Course Name:** Fundamentals of Biochemistry

**Course Code:** UGZOOCC 07

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO7.1	Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosachharides .Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis. Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpinoids. Lipid metabolism: $\beta$ -oxidation of fatty acids; Fatty acid biosynthesis. Amino acids Structure, Classification, General and Electro chemical properties of $\alpha$ -amino acids; Physiological importance of essential and non-essential amino acids Proteins. Bonds stabilizing protein structure; Levels of organization.Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids. Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids.Types of DNA and RNA, Complementarity of DNA, Hpyo- Hyperchromaticity of DNA Basic concept of nucleotide metabolism.	PO1, PO2, PO5, PO8	PSO3,PSO9	R,U
CO7.2	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 enzyme-catalyzed reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Strategy of enzyme action- Catalytic and Regulatory (Basic concept with one example each) Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System.	PO12, PO13	PSO5,PSO9	U,R
CO7.3	Qualitative tests of functional groups in carbohydrates, proteins and lipids.Paper chromatography of amino acids. Quantitative estimation of Lowry Methods.Demonstration of proteins separation by SDS-PAGE.To study the enzymatic activity of Trypsin and Lipase.To perform the Acid and Alkaline phosphatase assay from serum/ tissue.	PO13	PSO5,PSO9	AP,AN,E,C

## SEMESTER IV

**Course Name:** Comparative Anatomy of Vertebrates

**Course Code:** UGZOOCC 08

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO9.1	Structure, function and derivatives of integument in amphibian, birds and mammals. Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches. Comparative anatomy of stomach; dentition in mammals. Respiratory organs in fish, amphibian, birds and mammals. General plan of circulation, Comparative account of heart and aortic arches. General plan of circulation, Comparative account of heart and aortic arches. Comparative account of brain, Cranial nerves in mammals. Classification of receptors, Brief account of olfactory and auditory receptors in vertebrate.	PO1,PO2,PO5	PSO1	R,U
CO9.2	Study of placoid, cycloid and ctenoid scales through permanent slides/photographs. Study of disarticulated skeleton of Toad, Pigeon and Guineapig. Demonstration of Carapace and plastron of turtle. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system.	PO2, PO6	PSO1	R,U

**Course Name:** Animal Physiology: Life Sustaining Systems

**Course Code:** UGZOOCC 09

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO9.1	Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids; Digestive enzymes. 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.	PO3,PO5,PO10	PSO3,PSO 7	U
CO9.2	Components of Blood and their functions; Structure and functions of haemoglobin Haemostasis; Blood clotting system, Fibrinolytic system Haemopoiesis; Basic steps and its regulation Blood groups; ABO and Rh factor. Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibres, Origin and conduction of cardiac impulses Cardiac Cycle and cardiac output Blood pressure and its regulation.Physiological classification based on thermal biology.	PO1,PO5, PO10	PSO3,PSO9	U
CO9.3	Thermal biology of endotherms Osmoregulation in aquatic vertebrates. Extrarenal osmoregulatory organs in vertebrates. Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid- base balance.	PO1,PO5, PO10	PSO3	U
CO9.4	Determination of ABO Blood group.Enumeration of red blood cells and white blood cells using haemocytometer.Estimation of haemoglobin using Sahli's haemoglobinometer.Preparation of haemin and haemochromogen crystals.Recording of blood pressure using a sphygmomanometer.	PO1, PO2, PO5, PO10, PO13	PSO3	AN, AP

**Course Name:** Immunology

**Course Code:** UGZOCC 10

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO10.1	Basic concepts of health and diseases, Historical perspective of Immunology, Cells and organs of the Immune system. Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).	PO1, PO5, PO10	PSO3	R, U
CO10.2	Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production. Structure and functions of MHC molecules. Structure of T cell Receptor and its signalling, T cell development & selection.	PO2, PO5, PO10	PSO3, PSO5	R, U
CO10.3	Types, properties and functions of cytokines. Components and pathways of complement activation. Gell and Coombs' classification and brief description of various types of hypersensitivities. Malaria, Filariasis, Dengue and Tuberculosis. Various types of vaccines. Active & passive immunization (Artificial and natural).	PO2, PO5, PO10	PSO5, PSO8	U
CO10.4	Demonstration of lymphoid organs. Histological study of spleen, thymus and lymph nodes through slides/ photographs. Preparation of stained blood film to study various types of blood cells. ABO blood group determination. Demonstration of ELISA.	PO5, PO10, PO12, PO13	PSO5	AN, AP

## SEMESTER V

**Course Name:** Molecular Biology

**Course Code:** UGZOOCC 11

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO11.1	Salient features of DNA and RNA. Watson and Crick Model of DNA. Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres. Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.	PO8	PSO3,PSO9	U
CO11.2	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. Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA.	PO8, PO12	PSO3,PSO9	R,U
CO11.3	Regulation of Transcription in prokaryotes: lac operon and trp operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting. Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair. PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing.	PO8	PSO3,PSO9	U

**Course Name:** Genetics

**Course Code:** UGZOOCC 12

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO12.1	Principles of inheritance, Incomplete dominance and co-dominance, Epistasis Multiple alleles, Lethal alleles, Pleiotropy, Sex-linked, sex- influenced and sex-limited inheritance, Polygenic Inheritance. Linkage and Crossing Over, molecular basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence.	PO8	PSO3,	R, U
CO12.2	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.	PO8, PO12	PSO5,PSO8	U
CO12.3	Mechanisms of sex determination in Drosophila.Sex determination in mammals.Dosage compensation in Drosophila & Human Criteria for extra chromosomal inheritance, Antibiotic resistance in Chlamyadomonas, Kappa particle in Paramoecium Shell spiralling in snail. Conjugation, Transformation, Transduction, Complementation test in Bacteriophage. Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, LINE, SINE, Alu elements in humans.	PO5, PO8	PSO3,	U
CO12.4	Chi-square analyses.Linkage maps based on conjugation.Identification of chromosomal aberration in Drosophila and man from photograph.Pedigree analysis of some human inherited traits.	PO12, PO13	PSO5,PSO9	AN, AP, E

## SEMESTER VI

**Course Name:** Developmental Biology

**Course Code:** UGZOOCC 13

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO13.1	Basic concepts: Phases of Development, Cell cell interaction, Differentiation and growth, Differential gene expression. Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal); Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers.	PO2, PO5	PSO5	U
CO13.2	Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta). Development of brain and Eye in Vertebrate. Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each). Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis.	PO5	PSO2, PSO3	U
CO13.3	Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages). Study of the developmental stages and life cycle of Drosophila from stock culture. Study of different sections of placenta (photomicrograph/ slides). Project report on Drosophila culture/chick embryo development.	PO2, PO13	PSO3, PSO5, PSO9	AN, AP



**Course Name:** Evolutionary Biology

**Course Code:** UGZOOCC 14

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO14.1	Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, evolution of eukaryotes. Historical review of Evolutionary concepts, Lamarkism, Darwinism and Neo Darwinism.	PO8	PSO2	U
CO14.2	Sources of variations: Heritable variations and their role in evolution. 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 selection heterozygous superiority).Genetic Drift mechanism ( <i>founder's effect, bottleneck phenomenon</i> ). Role of Migration and Mutation in changing allele frequencies.	PO4, PO5	PSO5	U
CO14.3	Species concept, Isolating mechanisms, modes of speciation. Adaptive radiation /macroevolution (exemplified by Galapagos finches). Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction. Origin and Evolution of Man, Unique Hominin characteristics contrasted with primate characteristic Molecular analysis of human origin. Phylogenetic trees, Construction & interpretation of Phylogenetic tree using parsimony, Convergent & Divergent evolution.	PO1, PO6	PSO4,PSO6	U
CO14.4	Study of fossils from models/ pictures. Study of homology and analogy from suitable specimens. Study and verification of Hardy-Weinberg Law by chi square analysis. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.	PO12, PO13	PSO8	AN

**Generic Elective****SEMESTER III****Course Name:** Aquatic Biology**Course Code:** UGZOOGE03**Course Outcomes:** After completion of this course the students will be able to

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PO Addressed</b>	<b>POS Addressed</b>	<b>Cognitive Level</b>
<b>CO1.1</b>	Brief introduction to the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs. Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico- chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes (Nitrogen, Sulphur and Phosphorous). Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill- stream fishes.	PO1	PSO1	R,U
<b>CO1.2</b>	Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds. Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.	PO6	PSO1	R,U
<b>CO1.3</b>	Determine the area of a lake using graph metric and gravimetric method. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem. Determine the amount of Turbidity/transparency, Dissolved Oxygen, and Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake / water body. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance. A Project Report on a visit to a Sewage treatment plant/Marine bio-reserve/Fisheries Institute.	PO13	PSO9	AN,AP,E,C

## Semester IV

**Course Name:** Insect, Vector & Disease

**Course Code:** UGZOOGE4

**Course Outcome:** After completion of this course students will able to

Co. No	Course Outcome	PO Addressed	POS Addressed	Cognitive Level						
CO1.1	General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits, Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity, Classification of insects up to orders. Detailed features of orders withinsects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera.	PO1	PSO1	RU						
CO1.2	Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies, Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes. Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever;	PO6	PSO1	RU						
CO1.3	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Fleas as important insect vectors; Host-specificity.</td> </tr> <tr> <td style="padding: 5px;">Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas.</td> </tr> <tr> <td style="padding: 5px;">Human louse (Head, Body and Pubic louse) as important insect vectors.</td> </tr> <tr> <td style="padding: 5px;">Study of louse borne diseases – Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse.</td> </tr> <tr> <td style="padding: 5px;">Bugs as insect vectors; Blood-sucking bugs; Chagas disease.</td> </tr> <tr> <td style="padding: 5px;">Bed bugs as mechanical vectors, Control and prevention measures.</td> </tr> </table>	Fleas as important insect vectors; Host-specificity.	Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas.	Human louse (Head, Body and Pubic louse) as important insect vectors.	Study of louse borne diseases – Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse.	Bugs as insect vectors; Blood-sucking bugs; Chagas disease.	Bed bugs as mechanical vectors, Control and prevention measures.	PO13	PSO9	AN, AP, E, C
Fleas as important insect vectors; Host-specificity.										
Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas.										
Human louse (Head, Body and Pubic louse) as important insect vectors.										
Study of louse borne diseases – Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse.										
Bugs as insect vectors; Blood-sucking bugs; Chagas disease.										
Bed bugs as mechanical vectors, Control and prevention measures.										

**Course Name:** Animal Biotechnology

**Course Code:** UGZOODEC 02

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO2.1	Organization of prokaryotic and eukaryotic genome, Concept of genomics Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Southern, Northern and Western blotting.DNA sequencing: Sanger method.Polymerase Chain Reaction, DNA Finger Printing and DNA micro array.	PO1,PO8	PSO5	U
CO2.2	Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knockout mice. Animal cell culture, expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia).	PO8	PSO5	U
CO2.3	Genomic DNA isolation from E. coli.Plasmid DNA isolation (pUC 18/19) from E. coli.Restriction digestion of plasmid DNA.Construction of circular and linear restriction map from the data provided.Calculation of transformation efficiency from the data provided.To study following techniques through photographs.Southern Blotting.Northern Blotting. Western Blotting.DNA Sequencing (Sanger's Method),PCR,DNA fingerprinting.Project report on animal cell culture.	PO8, PO12, PO13	PSO3,PSO5	AN, AP, E

## SEMESTER VI

**Course Name:** Parasitology

**Course Code:** UGZOODEC 03

**Course Outcomes:** After completion of this course the students will be able to

CO No.	Course Outcomes	PO Addressed	POS Addressed	Cognitive Level
CO3.1	Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector Host parasite relationship. Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Giardia intestinalis</i> , <i>Trypanosoma gambiense</i> , <i>Leishmania donovani</i> .	PO1, PO2	PSO1,	R,U
CO3.2	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Schistosoma haematobium</i> , <i>Taenia sajinata</i> . Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Ascaris lumbricoides</i> , <i>Ancylostoma duodenale</i> , <i>Wuchereria bancrofti</i> and <i>Trichinella spiralis</i> , <i>Brugia malayi</i> ; Nematode plant interaction; Gall formation. Biology, importance and control of ticks (Soft tick <i>Ornithodoros</i> , Hard tick <i>Ixodes</i> ), mites ( <i>Sarcoptes</i> ), Lice ( <i>Pediculus</i> ), Flea ( <i>Xenopsylla</i> ) and Bug ( <i>Cimex</i> ). Brief account of Cookicutter Shark, Hood Mocking bird, Vampire bat.	PO2, PO5	PSO1,	R,U
CO3.3	Study of life stages of <i>Giardia intestinalis</i> , <i>Trypanosoma gambiense</i> , <i>Leishmania donovani</i> through permanent slides/micro photographs. Study of adult and life stages of <i>Schistosoma haematobium</i> , <i>Taenia sajinata</i> through permanent slides/micro photographs. Study of adult and life stages of <i>Ancylostoma duodenale</i> , <i>Brugia malayi</i> and <i>Trichinella spiralis</i> through permanent slides/micro photographs. Study of plant parasitic root knot nematode, <i>Meloidogyne</i> from the soil sample. Study of <i>Pediculus humanus</i> , <i>Xenopsylla cheopis</i> and <i>Cimex lectularius</i> through permanent slides/ photographs. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from Poultry.	PO2, PO5	PSO1, PSO7	AN, AP

## Semester IV

**Course Name:** Biology of Insects

**Course Code:** UGZOODSE4

**Course Outcome:** After completion of this course students will able to

Co. No	Course Outcome	PO Addressed	POS Addressed	Cognitive Level
CO1.1	General Features of Insects. Distribution and Success of Insects on the Earth. Basis of insect classification; Classification of insects up to orders (according to Brusca and Brusca, 2016). External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits. Thorax: Wings and wing articulation. Types of Legs adapted to diverse habitat Abdominal appendages and genitalia. Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system.	PO1	PSO1	RU
CO1.2	Photoreceptors: Types, Structure and Function Metamorphosis: Types and Neuroendocrine control of metamorphosis.	PO6	PSO1	RU
CO1.3	Social insects with special reference to termites. Trophallaxis in social insects such as ants, termites and bees. Trophallaxis in social insects such as ants, termites and bees. Theory of co-evolution, role of allelochemicals in host plant mediation Host-plant selection by phytophagous insects. Major insect pests in paddy. Insects as mechanical and biological vectors.	PO13	PSO9	AN, A, P, E, C