



DEPARTMENT OF ZOOLOGY

PART I: SEMESTER 1

Core Course: 1

Non-Chordates I

ZOOA-CC1-1-TH

CO 1: Basics of Animal Classification-Student's understanding of basic concepts about Classification, Taxonomy and Systematic, different theories of classification.

CO 2: Protista and Metazoa - Students learn about the general features and classification of the phylum Protozoa and understanding lifecycle and pathogenicity of some common Protozoans.

Beside this, it explains the evolution of symmetry and segmentation of Metazoa.

CO 3: Porifera - Explaining the general features and classification scheme and canal system in sponges to students.

CO 4: Cnidaria- Students are explained about the general features and classification scheme and metagenesis and polymorphism in Cnidaria. In addition to that it is explaining the process of formation of corals and types & the effect of climate change on coral reef.

CO 5: Ctenophora- Describing the general features of Ctenophore to students.

CO 6: Platyhelminthes- Students learn about the general features and classification of the phylum and understanding lifecycle and pathogenicity of two common disease causing species.

CO 7: Nematoda– Students learn about the general features and classification of the phylum and understanding lifecycle and pathogenicity of two common disease causing species. And in addition to that it also explains the parasitic adaptations in helminthes.

Duration 50 hours

ZOOA-CC-1-1-P

Non-Chordates I: Protists to Pseudocoelomates- Students learn about Identifying features of organisms from each phylum through study of museum specimens and staining of protozoa or helminth from gut of *Periplaneta* sp

Duration 60hoUR

PART I: SEMESTER 1 Core Course 2 Molecular Biology ZOOA-CC1-2-TH

CO 1: Nucleic Acids: Students learn about the structure and features of DNA and RNA with types, their properties.

CO 2: DNA replication: Description of the processes of copying the genetic materials i.e, the DNA in prokaryotic as well as eukaryotic systems, study of the major enzymes that regulate the process of replication in a semi-conservative manner & after primer removal how telomerase enzyme solves the end replication problem for students' benefit.

CO 3: Transcription: The process and mechanism of transcription in both prokaryotes and eukaryotes, detailed idea about transcription factors are explained to students.

CO 4: Translation: Description of the process of translation in prokaryotes, detailed idea on genetic code, wobble hypothesis is explained to students.

CO 5: Post Transcriptional Modifications and Processing Of Eukaryotic RNA: Students get a detailed idea about 5' capping, splicing, polyadenylation and editing of eukaryotic RNA. Special emphasis on splicing, RNA editing.

CO 6: Gene Regulation: Students learn about the lactose and tryptophan operon concept, the role of activator, enhancers, silencer, repressor, siRNA and miRNA mediated gene silencing and DNA methylations etc.

CO 7: DNA Repair Mechanism: Students are imparted with detailed study about the DNA repair mechanisms to understand how a cell identifies and corrects damage to the DNA molecules that encode its genome. DNA repair ensures the survival of a species by enabling parental DNA to be inherited as faithfully as possible by offspring. Various mechanisms are involved regarding this process.

CO 8: Molecular Techniques: Understanding various functions i.e, separation of DNA or protein their interactions etc. Our syllabus includes PCR and Blotting techniques for students.

Duration 50 hours

ZOOA-CC1-2-P

Demonstration of Genomic DNA isolation, agarose gel electrophoresis, demonstration of polytene and lamp brush chromosomes and histological staining of DNA, RNA to students.

Duration 60 hours

PART I: SEMESTER 2
Core Course:3
Non-chordates II- Coelomates
ZOOA-CC2-3-TH

CO 1: Introduction- Students get a brief idea on coelomates and their evolution.

CO 2: Annelida- Students learn about the Classification along with characterization of each class and detailed study on its excretion and metamerism.

CO 3: Arthropoda- Students learn about the Classification and characterization of each class along with special emphasis on the studies of cockroach eye, respiration of prawn and cockroach, termite social life and insect metamorphosis.

CO 4: Onychophora- Analysis of the evolutionary significance of Onychophora and general characteristics.

CO 5: Mollusca- Students learn about the Classification along with characterization of each class and detailed study on nervous system, torsion, feeding and respiration in *Pilasp*

CO 6: Echinodermata- Students learn about the Classification and characterization of each class along with starfish water vascular system. A detailed study on echinoderm larvae and their affinities with chordates.

CO 7: Hemichordata- Students get a brief idea of the characters of hemichordates and their relationship with non-chordates and chordates.

Duration 50 hours

ZOOA-CC2-3-P

CO 1: Students study various specimens (including identification and distinguishing characters) of Annelids, Arthropods, Molluscs and Echinoderms.

CO 2: Detailed study and analysis of nervous system, male and female reproductive system, mouth parts and salivary apparatus of cockroach for the students.

Duration 60 hour

PART I: SEMESTER 2

Core Course: 4

Cell Biology

ZOOA-CC2-4-TH

CO 1: Plasma Membrane:Students are imparted with detailed study about plasma membrane structure, fluid mosaic model, different types of transporters and junctions.

CO 2: Cytoplasmic Organelles:Description of the structure and functions of ER, Golgi apparatus, Lysosome and their involvement in protein sorting and mechanism of vesicular transport to students.

CO3: Cytoplasmic Organelles 2: Students get a knowledge dealing with the structure of mitochondria and their functions on ETC, chemo-osmotic hypothesis for ATP production &a brief idea on the structure of peroxisomes.

CO 4: Cytoskeleton: Students understanding of the structure and function of of cytoskeleton i.e microfilaments and microtubules which provides an important structural framework for cell shape.

CO 5: Nucleus: Studying of the structure and function of nucleus with nuclear pore complex and nucleolus, how they restore the genetic materials i.e chromatin materials for the students.

CO 6: Cell Cycle: Students are imparted with detailed study on replication and reproduction of cells, any altered pathway leading to cancer, involvement of numerous genes in cell cycle regulations. Brief idea on the tumor suppressor gene and oncogenes.

CO 7: Cell Signaling:Studying and understanding various cell signaling mechanisms, detailed process of apoptosis for the students.

Duration 50 hours

ZOOA-CC-2-4-P

Students get a knowledge by studying various stages of mitosis, meiosis, permanent slide preparation for visualizing Barr body of human female, visualizing DNA and studying cell viability.

Duration 60 hours

PART II: SEMESTER 3
Core Course 5: Chordata
ZOOA-CC3-5-TH

CO 1: Introduction to Chordates– Students are explained about the general characteristics and outline classification of Phylum Chordata.

CO 2: Protochordate - Students are imparted knowledge about the general characteristics and classification of Urochordata and cephalochordate.

CO 3: Agnatha -Students learn about the general characteristics and classification of cyclostomes up to order.

CO 4: Pisces -Students learn about the general characteristics and classification up to living sub classes and in addition to that accessory respiratory organ, Migration in fishes; Parental care in fishes; Swim bladder in fishes.

CO 5: Amphibia- Students learn about the general characteristics and classification up to living Orders Metamorphosis, Pedomorphosis, Parental care in Amphibia.

CO 6: Reptilia -Students learn about the general characteristics and classification upto living Orders. Poison apparatus and Biting mechanism in Snake. Poisonous & Non-Poisonous snake.

CO 7: Aves -Students learn about the general characteristics and classification up to living Sub-Classes, Exoskeleton and migration in Birds; Principles and aerodynamics of flight.

CO 8: Mammals- Students learn about the general characters and classification. It explains exoskeleton derivatives of mammals and adaptive radiation in mammals. Beside this, it describes the Echolocation in Micro chiropterans.

Duration 50 hours

ZOOA-CC-3-5-P

Students learn to identify organisms from each class of PhChordata and Dissection of brain and pituitary – ex situ, digestive and Urino-genital system of Tilapia Pecten from Fowl head which helps students to know anatomical features different organisms.

Duration 60 hours

PART II: SEMESTER
Core Course: 6
Animal Physiology: Controlling and Co-ordinating System
ZOOA-CC3-6-TH

CO 1: Tissues- Detailed explanation on structure, location and functions of different types of tissues (epithelial, connective, muscular and nervous) to students.

CO 2: Bone and cartilage- Students learn about the different of types of bones and cartilages along with ossification process.

CO 3: Nervous system- Explanation on neuron structure, action potential and its propagation, synapse, synaptic transmission, and neuromuscular junction for students' knowledge.

CO 4: Muscular system- Histological study on muscle, its ultra-structure, characters, muscle fiber and an elaborative study on muscle contraction are discussed with students.

CO 5: Reproductive system- Histological study of mammalian testis and ovary and detailed mechanism of menstrual and estrous cycle are discussed with students.

CO 6: Endocrine system- Histological study and function of mammalian thyroid, pancreas, pituitary and adrenal. Detailed study on hormones along with classification and their mechanism of action are discussed with students.

Duration 50 hours

ZOOA-CC3-6-P

Students get a knowledge by studying the temporary mount preparation of striated muscle slides, histological section of mammalian tissues, learning the microtomy technique and permanent slide preparation of mammalian tissues

Duration 60 hours

PART II: SEMESTER 3
Core Course:7
Fundamentals of Biochemistry
ZOOA-CC3-7-TH

CO 1: Carbohydrates: Students learn about the monosaccharides, disaccharides, polysaccharides; derivatives of monosaccharides; carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis.

Through this course the students are exposed to importance of carbohydrate as biological molecules. Gather basic concepts of Cells along with various cellular functions.

CO 2: Students learn about the structure and significance: of physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpenoids. Lipid metabolism: β -oxidation of fatty acids - a. Palmitic acid {saturated (C 16:0)}, b. Linoleic acid {unsaturated (C 18:2)}; Fatty acid biosynthesis. & acquire knowledge about physiological significance of lipids in biological system.

CO 3: Proteins: Students learn about the amino acids: Structure, Classification, General and Electro chemical properties of α -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. Studying the influence and role of proteins in the process of biological regulation

CO 4: Nucleic acids: Students are expected to learn Structure of purines, pyrimidines, nucleosides and nucleotides; nucleic acid metabolism: Catabolism of adenosine, guanosine, cytosine and thymine. Understanding role of nucleic acids and basic concepts of molecular Biology along with functions of DNA and RNA.

CO 5: Enzyme: Students learn about the structure, nomenclature and classification of enzymes; 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. It is important to acquire knowledge of function and significance of enzymes in biological process.

CO 6: Oxidative phosphorylation: Students get a knowledge to understand mechanism of the metabolic pathway used to produce energy through ATP inside cells, Redox systems; Mitochondrial respiratory chain, Inhibitors and uncouplers of Electron Transport System

Duration 50 hours

ZOOA-CC3-7-P

Students perform Qualitative tests for carbohydrates, proteins, lipids, urea, uric acid. Quantitative estimation of protein and paper chromatography of amino acids for better understanding.

Duration 60 hours

Skill Enhancement courses (SEC)

SEMESTER 3

SEC-1 Apiculture

ZOOA-SEC(A)-3-1-TH

CO 1: Biology of Bees: Students get a brief idea of *Apis* and Non-*Apis* Bee species and their identification. General Morphology of *Apis* Honey Bees. Social Organization of Bee Colony

CO 2: Rearing of Bees: Students are explained about bee rearing modern techniques and associated modern bee keeping equipment and methods of Extraction of Honey.

CO 3: Diseases and Enemies: Students get a brief idea of disease and enemies of bee and their control measures

CO 4: Bee Economy: Students get a brief knowledge about the products of apiculture industry like Honey, Bees Wax, Propolis, Pollen etc & their uses

CO 5: Entrepreneurship in Apiculture: Students get a brief knowledge of the recent scenario of Bee Keeping Industry and Modern Methods employed in artificial Beehives for cross pollination in horticultural gardens

Duration 30 hours

PART II: SEMESTER 4

Core Course: 8

Comparative Anatomy of Vertebrates

CO1: Integumentary System - Students get a brief knowledge of the Structure, function, and derivatives of integument in amphibian, birds, and mammals.

CO 2: Digestive System – Students get an overview of the Comparative anatomy of stomach; dentition in mammals.

CO 3: Respiratory System – Students get a brief knowledge of the Respiratory organs in fish, birds, and mammals.

CO 4: Circulatory System – Students get an overview of the General plan of circulation, Comparative account of heart and aortic arches.

CO 5: Urinogenital System – Students get a brief knowledge of the Succession of kidney in different vertebrate groups; evolution of urino-genital ducts.

CO 6: Nervous system and sense organs – Students get a brief knowledge of the Comparative account of brain in vertebrates; cranial nerves; olfactory and auditory receptors in vertebrates

CO 7: Skeletal system – Students get an overview of axial and appendicular skeleton – limbs, girdles of pigeon; jaw suspension in mammals.

Duration 50 hours

ZOOA-CC4-8-P

Students are imparted knowledge through -

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Study of disarticulated skeleton of toad, Pigeon, Guinea pig (limb bones, vertebrae, limb, and girdle).
3. Comparative study of heart and brain, with the help of model/picture.
4. Identification of skulls: Pigeon, one herbivore (Guinea pig) and one carnivore (Dog).

Duration 60 hours

PART II: SEMESTER 4
Core Course: 9
Animal Physiology: Life Sustaining Systems
ZOOA-CC4-9-TH

CO 1: Physiology of Digestion:Detailed study of structural organization and function of gastro-intestinal tract; mechanical and chemical digestion of food, absorption of carbohydrates, lipids and proteins in Human are taught to students.

CO2: Physiology of Respiration: Students get an overview of respiratory mechanism, idea about respiratory volumes and capacities, transport of oxygen and carbondioxide in blood, Analysis of dissociation curves and the factors influencing it, short notes on respiratory pigments; carbonmonoxide poisoning.

CO 3: Physiology of Circulation: Detailedstructure and functions of hemoglobin; Study of blood clotting system; Basic steps andregulation of hematopoiesis; Blood groups; ABO and Rh factor are taught to students.

CO4: Physiology of Heart:Students get an overview ofCoronary Circulation, Structure and working of conducting myocardial fibers, Origin, andconduction of cardiac impulses; Cardiac Cycle and cardiac output.

CO5:Thermoregulation & Osmoregulation: Students get a brief knowledge ofThermoregulation in camel and polar bear, Osmoregulation in aquatic vertebrates.

CO6: Renal Physiology: Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-basebalance.

Duration 50 hours

ZOOA-CC4-9-P

Students are imparted knowledge through hands on practical including

1. Determination of ABO Blood group.
2. Estimation of hemoglobin using Sahil'shemoglobin meter.
3. Identification of blood cells from human blood
4. Preparation of hemin crystals and hemochromogen crystals.
5. Identification of blood cells from cockroach hemolymph.
6. Demonstration of blood pressure by digital meter.

Duration 60 hours

PART II: SEMESTER 4

Core Course: 10

Immunology

ZOOA-CC4-10-TH

CO1: Overview of Immune System: Students are given introduction of immunology – concept of health and disease; and related detail study of cells and organs of the Immune system.

CO 2: Innate and Adaptive Immunity: Students are imparted knowledge about anatomical barriers, Inflammation, Various cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).

CO 3: Antigens: Students are taught about antigenicity and immunogenicity, short note on immunogens, adjuvants and haptens and the factors influencing immunogenicity, B and T-Cell epitopes.

CO 4: Immunoglobulins: Detailed structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Monoclonal antibody production are taught to students.

CO 5: Major Histocompatibility Complex: Structure and functions of MHC molecules. The structure of T cell Receptor and its signaling, T cell development & selection are taught to students.

CO 6: Cytokines: Students get a brief knowledge of types, properties, and functions of cytokines.

CO 7: Complement System: Students get a brief knowledge of components and pathways of complement activation.

CO 8: Hypersensitivity: Students are taught about Gel and Combs' classification and brief description of various types of hypersensitivities.

CO 9: Vaccines: Students get a brief idea on various types of vaccines, active & passive immunization (Artificial and natural).

Duration 50 hours

ZOOA-CC4-10-P

Students are imparted knowledge through -

1. Pictorial demonstration of lymphoid organs.
2. Histological study of Bursa fabricius, spleen, thymus, and lymph nodes through slides/ photographs.
3. Demonstration of ELISA

Duration 60 hours

SEC-1. Aquarium Fish Keeping

ZOOA-SEC(B)-4-1-TH

CO 1: Introduction to Aquarium Fish Keeping: Students are taught about the potential scope of Aquarium Fish Industry as a Cottage Industry, Idea of exotic and endemic species of Aquarium Fishes.

CO2: Biology of Aquarium Fishes: Students are imparted knowledge about the common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.

CO 3: Food and feeding of Aquarium fishes: Students are taught about the use of live fish feed organisms. Preparation and composition of formulated fish feeds, aquarium fish as larval predator.

CO 4: Fish Transportation: Students get a brief idea about Live fish transport - Fish handling, packing, and forwarding techniques.

CO 5: Maintenance of Aquarium: Students get a brief idea about general aquarium maintenance – budget for setting up an Aquarium Fish Farm as a cottage industry.

Duration 30 hours

PART II: SEMESTER 5

Core Course: 11

Ecology

ZOOA-CC5-11-TH

CO1: Introduction to Ecology: Students are briefed about autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.

CO2: Population: Students are taught about the Unitary and Modular populations Unique and group attributes of population: Demographic factors, life tables, fecundity tables, 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, Gauss's Principle with laboratory and field examples, Lotka-Volterra equation for competition.

CO 3: Community: Students get a knowledge of community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone, and edge effect; Ecological succession with one example.

CO4: Ecosystem: Students are taught about the types of ecosystems with an example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow, Ecological pyramids and Ecological efficiencies; Nitrogen cycle.

CO 5: Applied Ecology: Students are taught about the types & level of biodiversity, Mega-diversity countries, biodiversity hot spot, Flagship species, Keystone species, Wildlife Conservation (*in situ* and *ex situ* conservation), concept of protected areas. red data book, Indian wild life act & Schedule. Concept of corridor, advantages, and problem of corridor. Study on the threats to survival conservation strategies for Tiger, Olive ridley, White Rumped Vulture.

Duration 50 hours

ZOOA-CC5-11-P

Students are imparted knowledge through hands on practical including

1. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
2. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, salinity, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂
3. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/ any place of ecological interest/ ecological uniqueness/ Zoological Garden.

Duration 60 hours

PART II: SEMESTER 5

Core Course :12

Principle of Genetics

ZOOA-CC5-12-TH

CO 1: Mendelian Genetics and its Extension: Students are taught about the principles of inheritance, Incomplete dominance and co-dominance, Concept of epistasis, Multiple alleles, Isoallele (White eye mutations), Pseudo allele (Lozenge Locus) & Cis-trans test for allelism, lethal alleles, pleiotropy, penetrance & expressivity.

CO 2: Linkage, Crossing Over and Linkage Mapping: Students get a knowledge of Linkage and Crossing, Complete & Incomplete Linkage, measuring recombination frequency. Linkage map construction using three factor crosses, Interference, and coincidence. Study of sex linkage in *Drosophila* (White eye locus) & Human (Hemophilia).

CO 3: Mutations: Students are taught about the Types of gene mutations (Classification), Types of chromosomal aberrations, variation in chromosome number; Notes on nondisjunction of X chromosome in *Drosophila*; Non-disjunction of Human Chromosome 21. Detailed study on molecular basis of mutations in relation to UV light and chemical mutagens. Mutation detection in *Drosophila* by attached X method. Biochemical mutation detection in *Neurospora*.

CO 4: Sex Determination: Students get a knowledge of Mechanisms of sex determination in *Drosophila* and in man; Dosage compensation study in *Drosophila* & Human.

CO 5: Extra-chromosomal Inheritance: Students are taught about the Kappa particle in *Paramecium*, Shell spiraling in snail.

CO 6: Genetic Fine Structure: Students are taught about the Complementation test in Bacteriophage (Benzer's experiment on rII locus).

CO 7: Transposable Genetic Elements: Students get a knowledge of IS element in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, LINE, SINE, Alu elements in humans.

Duration 50 hours

ZOOA-CC5-12-P

Students are taught -

1. Chi-square analyses for genetic ratio test
2. Identification of chromosomal aberration in *Drosophila* and man from photograph
3. Pedigree analysis of some inherited traits in animals

Duration 60 hours

DSE1. Parasitology
Core Course: 14
ZOOA-DSE(A)-5-1-TH

CO 1: Introduction to Parasitology: Students are briefed about Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector); Host parasite relationship.

CO 2: Parasitic Protists: Students get a knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*.

CO3: Parasitic Platyhelminthes: Students get a knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*, *Taenia solium*.

CO 4: Parasitic Nematodes: Students get a knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti*, Study of nematode plant interaction.

CO 5: Parasitic Arthropods: Students are briefed about biology, importance and control of ticks: soft tick (*Ornithodoros*), Hard tick (*Ixodes*), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*) and Bug (*Cimex*). Parasitoid.

CO 6: Parasite Vertebrates: Students get a knowledge of cook cutter Shark, Hood Mocking bird, Vampire bats their parasitic behavior and effect on host.

Duration 50 hours

ZOOA-DSE(A)-5-1-P

Students are imparted knowledge through -

1. Study of life stages of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax*, *Plasmodium falciparum* through permanent slides/micro photographs
2. Study of adult and life stages of *Schistosoma haematobium*, *Taenia solium* through permanent slides/micro photographs
3. Study of adult and life stages of *Ancylostoma duodenale* through permanent slides/micro photographs.
4. Study of monogenea from the gills of fresh/marine fish.
5. Study of nematode/cestode parasites from the intestines of Poultry bird.
6. Submission of a brief report on parasitic vertebrates

Duration 60 hours

DSE1. Endocrinology ZOOA-DSE(B)-5-1-TH

CO 1: Introduction to Endocrinology: Students get a brief idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neuro-secretions, and Neuro-hormones: Examples and Functions.

CO 2: Hypothalamo-Hypophyseal Axis: Students are taught about the structure and functions of hypothalamus and hypothalamic nuclei, regulation of neuroendocrine glands, feedback mechanisms, Hypothalamo-Hypophyseal-Gonadal Axis. Structure of pituitary gland, Hormones, and their functions, Hypothalamo-hypophyseal portal system.

CO 3: Peripheral Endocrine Glands: Students are taught about the structure, hormones and functions of thyroid gland, parathyroid, adrenal, pancreas, ovary and testis. Disorders of endocrine glands (*Diabetes mellitus* type I & Type II; Graves' Disease).

CO 4: Regulation of Hormone Action: Students are briefed about the mechanism of action of steroidal, non-steroidal hormones with receptors (cAMP, IP3-DAG), Studying calcium and glucose homeostasis in mammals. Bioassays of hormones using RIA & ELISA, estrous cycle in rat and menstrual cycle in human.

CO 5. Non-Mammalian Vertebrate Hormone: Students are briefed about the functions of prolactin in fishes, amphibia & birds, function of Melanotropin in teleost fishes, amphibians, and reptiles.

Duration 50 hours

ZOOA-DSE(B)-5-1-P

Students are imparted knowledge through hands on practical including

1. Dissection 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. H-E staining of Histological slides.

Duration 60 hours

PART III: SEMESTER 6

Core Course: 13

Developmental Biology

ZOOA-CC6-13-TH

CO 1: Early Embryonic Development: Students get a knowledge of Concept of gametogenesis: spermatogenesis, oogenesis (sea urchin & mammal); Types of eggs, Egg membranes; Fertilization in sea urchin and mammal; Planes and patterns of cleavage; Types of blastula [frog and chick]; Fate map in chick embryo, fate mapping using vital dye and radioactive technique; Gastrulation in frog and chick; Embryonic induction and organizers in *Xenopus* (Spemann & Mangold's experiment).

CO 2: Late Embryonic Development: Students are taught about extra-embryonic membranes in Chick; Implantation of embryo in humans, placenta (Structure, types, and functions of placenta).

CO 3: Post Embryonic Development: Students are taught about development of brain and eye in Chick, Molecular Induction in Brain and Eye development.

CO 4: Implications of Developmental Biology: Students get a knowledge of *In vitro* fertilization (IVF), Stem cell: Concept of potency, types, markers, and applications of stem cell therapy in bone marrow transplantation and cartilage regeneration

Duration 50 hours

ZOOA-CC6-13-P

Students get hands on knowledge through -

1. Study of whole mounts of developmental stages of chick embryo through permanent slides: 24, 48, and 96 hours of incubation
2. Study of the developmental stages and life cycle of *Drosophila*
3. Study of different sections of placenta (photomicrographs/ slides)
4. Identification of Invertebrate larva through slides/ photographs of Phylum Annelida, Arthropoda, Mollusca, and Echinodermata

Duration 60 hours

PART III: SEMESTER 6

Core Course: 14

Evolutionary Biology

ZOOA-CC6-14-TH

CO 1: Students are taught about origin of Life (Chemical basis), RNA world hypothesis.

CO 2: Students are introduced to historical review of Evolutionary concepts: Lamarckism, Darwinism and Neo Darwinism.

CO 3: Students are given brief idea about Geological time scale, Fossil: types and age determination by Carbon dating, Evolution of horse.

CO 4: Students are introduced to Natural Selection: study of the modes with examples.

CO 5: Students are taught about Species concept, Isolating mechanisms, modes of speciation; Speciation by chromosomerearrangement in *Drosophila*. Adaptive radiation/macroevolution (exemplified by Galapagos finches).

CO 6: Students are taught about Origin and Evolution of Man, Unique Hominid characteristics contrasted with primate characteristic.

CO 7: Students are introduced to Population genetics: Hardy-Weinberg Law; factors disrupting H-W equilibrium (Genetic Drift, Migration and Mutation and Selection in changing allelic frequencies (only derivations required). Simple problems related to estimation of allelic and gene frequencies.

CO 8: Students are introduced to extinction, background and mass extinctions, detailed example of K-T extinction.

CO 9: Students are taught Phylogenetic tree construction and interpretation of Phylogenetic tree using parsimony, convergent and divergent evolution.

Duration 50 hours

ZOOA-CC6-14-P

Students get practical exposure through -

1. Study of fossils from models/ pictures: Dickinsonia, Paradoxides (Trilobites), Asteroceras (Ammonoid), Pentremites (Blastoid Echinoderm), Ichthyosaur, Archaeopteryx, Cynodont.
2. Study of homology and analogy from suitable specimens.
3. Phylogenetic trees, Construction & interpretation of Phylogenetic tree using parsimony, Construction of dendrogram following principles of phenetics & cladistics from a data table.

Duration 60 hours

PART III: SEMESTER 6

DSE2

Animal Biotechnology

ZOOA-DSE(A)-6-2-TH

CO 1: Introduction: Students study about the organization of *E. coli* and *Drosophila* genome.

CO 2: Molecular Techniques in Gene manipulation: Detailed study on recombinant DNA technology, Restriction endonucleases. Cloning Vectors & their features: plasmids, phage vectors, cosmids, phagemids, BAC, YAC, and HAC. Shuttle and expression Vectors. Construction of Genomic libraries and cDNA libraries. Transformation techniques: cloning in bacteria and detection technique of clone. Agarose and Polyacrylamide gel electrophoresis, southern, northern and western blotting, Polymerase chain reaction: Allele specific, RAPD & RT PCR, DNA Fingerprinting are imparted to students.

CO 3: Genetically Modified Organisms: Students get a knowledge about production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock-out mice.

CO 4: Culture Techniques and Applications: Students get a knowledge of animal cell culture, Expression of cloned genes in mammalian cells, Molecular diagnosis of genetic diseases like Cystic fibrosis, Sickle cell anaemia, Thalassaemia etc. Concept on Dolly & Polly cloning. Genetically modified economically important animals and Gene Therapy.

Duration 50 hours

ZOOA-DSE(A)-6-2-P

Students get hands on knowledge through –

1. Genomic DNA isolation from *E. coli* and Plasmid DNA isolation (pUC 18/19) from *E. coli*.
2. To study Southern Blotting, Northern Blotting, Western Blotting, PCR, DNA fingerprinting.
3. Project report on animal cloning & Application & ethical Issues.

Duration 60 hours

PART III: SEMESTER 6
DSE1
Animal Behaviour and Chronobiology
ZOOA-DSE(B)-6-1-TH

CO 1: Patterns of Behavior: Students get a knowledge of Stereotyped Behaviours (Orientation, Reflex); Individual Behavioural patterns; Instinct vs. Learned Behaviour; FAP, Associative learning, classical and operant conditioning, Habituation, Imprinting.

CO 2: Social and Sexual Behaviour: Students study about the social organization in termites; Communication (dance & pheromones in Bees), Concept of social behavior: Altruism (Hamilton's rule and concept of haplodiploidy), Cooperation and selfishness, Sexual Behavior: Sexual dimorphism, Mate choice in peacock, Intra-sexual selection (male rivalry in red deer). Kinship theory: Relatedness & inclusive fitness; parental care in fishes (Nest Building & coast benefit), conflict within families: parent offspring conflict and sibling rivalry.

CO 3: Chronobiology & Biological Rhythm: Students get a knowledge of types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms, Circannual rhythms; Photic and non-photic Zeitgebers; Role of melatonin. Biological clock and its adaptive significance. Circannual rhythm in bird migration.

Duration 50 hours

ZOOA-DSE(B)-6-1-P

Students' practical exposure occurs through –

1. Study nests and nesting habits of the birds and social insects.
2. Study the behavioural responses of wood lice to dry and humid conditions (demonstration only).
3. Study geotaxis behaviour in earthworm.
4. Study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

Duration 60 hours



DEPARTMENT OF ZOOLOGY

Program outcome:

The subject Zoology includes the scientific study of classification, diversity, evolution, morphology, anatomy, physiology, habitats, behavior and health of animals and humans. Beside this, it is necessary to study molecular biology, genetics, biotechnology, immunology and also biochemistry. During this changing environment, it is also necessary to study effect of environment on animals and human and some strategies for conservation of wild life and sustainable use of environment for future. Applied Zoology explains the methodology for rearing poultry, cows and buffaloes etc. which help to get eggs, meat, milk etc. It also helps to know the basic idea of different cottage industry like apiculture, sericulture. This subject also helps to know the causative organisms or vectors of different human disease like Dengue, Malaria, Chingungunia, Filaria, Taeniasis, Plaque etc. With the study of eugenics and genetics, human race can be improved a lot and it helps to suppress different hereditary disease. Many animals especially birds, butterflies have some aesthetics value. The Zoology helps to remove several misconceptions about snakes or owls, etc.

Thus, after graduation with Zoology Honors, students can opt for M.Sc in the concerned subject. Beside this mother subject, student can select other subjects like M.Sc in fishery, M.Sc in Entomology, M.Sc Biotechnology etc. based on the applied Zoology. Or students can select master degree in Environmental Science or Conservation Biology, biotechnology, microbiology, biochemistry, genetics, etc.