DAV AUTONOMOUS COLLEGE,TITILAGARH

**B.SC. (CORE) ZOOLOGY SYLLABUS**

**SEM-I CORE COURSE: I Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**DIVERSITY AND EVOLUTION OF NON-CHORDATA (PROTISTA TO PSEUDOCOELOMATES)**

**Unit 1: Phylum Protozoa, Parazoa and Metazoa**

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Plasmodium vivax, Trypanosoma gambiense* and *Entamoeba histolytica;* Locomotion and reproduction in Protozoa; Evolution of Parazoa and Metazoa.

**Unit 2: Phylum Porifera and Ctenophora**

General characteristics and classification up to classes; Canal system in sponges; General characteristics and evolutionary significance.

**Unit 3: Phylum Cnidaria**

General characteristics and classification up to classes; Metagenesis in *Obelia*; Polymorphism in Cnidaria; Corals and coral reefs.

**Unit 4: Phylum Platyhelminthes**

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Fasciola hepatica* and *Taenia solium;* Parasitic adaptations.

**Unit 5: Phylum Nemathelminthes**

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Ascaris lumbricoides* and *Wuchereria bancrofti;* Parasitic adaptations.

**Note:** Classification to be followed from “Barnes RD (1982) Invertebrate Zoology. 5th Edition.”

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICALS**

**Phylum Protozoa**

1. Morphology of *Paramecium,* Binary fission and Conjugation in *Paramecium.*

2. Life stages of *Plasmodium vivax, Trypanosma gambiense* and *Entamoeba histolytica* (Slides/Micro-photographs).

3. Examination of pond water for protists.

**Phylum Porifera**

4*.* Study of *Sycon* (including T.S. and L.S.), *Hyalonema,* and *Euplectella.*

5. Temporary mounts of spicules, gemmules and spongin fibres.

**SEM-I CORE COURSE: II PERSPECTIVES IN ECOLOGY Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**Unit 1: Introduction to Ecology**

Relevance of studying ecology; History of ecology; Autecology and synecology; Levels of organization; Laws of limiting factors; Detailed study of temperature and light as physical factors.

**Unit 2: Population**

Unitary and modular populations; Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion; Exponential and logistic growth, equation and patterns, r and K strategies, Population regulation - density-dependent and independent factors; Population interactions, Gause’s Principle with laboratory and field examples; Lotka-Volterra equation for competition and Predation, functional and numerical responses.

**Unit 3: Community**

Community characteristics: dominance, diversity, species richness, abundance, stratification; Ecotone and edge effect; Ecosystem development (succession) with example and Theories pertaining to climax community.

**Unit 4: Ecosystem**

Types of ecosystem; 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, Nitrogen cycle and Sulphur cycle.

**Unit 5: Conservation of Biodiversity**

Types of biodiversity, its significance, loss of biodiversity; Conservation strategies (in situ and ex situ); Role of ZSI, WWF, IUCN; Wildlife (Protection) Act, 1972.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICALS**

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.

2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.

3. Study of an aquatic ecosystem: fauna and flora Measurement of area, temperature,turbidity/penetration of light, determination of pH, and Dissolved Oxygen content(Winkler’s method), Chemical Oxygen Demand and free CO2.

4. Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary.

**SEM-3 CORE COURSE- III Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**DIVERSITY AND EVOLUTION OF NON-CHORDATA (COELOMATE NONCHORDATES)**

**Unit 1: Phylum Annelida**

General characteristics and classification up to classes; Evolution of Coelom; Metamerism and Excretion in Annelida.

**Unit 2: Phylum Arthropoda**

General characteristics and classification up to classes; Vision in Arthropoda; Respiration in Arthropoda; Moulting in insects, Metamorphosis in insects; Social life in insects (bees and termites) and Larval forms in Crustacea.

**Unit 3: Phylum Onychophora**

General characteristics, evolutionary significance and affinities of *Peripatus.*

**Unit 4: Phylum Mollusca**

General characteristics and classification up to classes; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves and Evolutionary significance of trochophore larva.

**Unit 5: Phylum Echinodermata**

General characteristics and classification up to classes; Water-vascular system in Asteroidea; Larval forms in Echinodermata and Evolutionary significance (Affinities with Chordates).

**Note:** Classification to be followed from “Barnes, R.D. (1982). *Invertebrate Zoology*, 5th Edition, Holt Saunders International Edition.”

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

**Phylum Annelida**

*1.* Study of *Aphrodite, Nereis, Heteronereis, Sabella, Terebella, Serpula, Chaetopterus, Pheretima and Hirudinaria.*

2. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.

3. T.S. through crop of leech.

**Phylum Arthropoda**

4. Study of *Limulus*, *Palamnaeus, Palaemon, Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, termite, louse, honeybee, silk moth, wasp and dragon fly.

**Phylum Onychophora**

**5.** Any one specimen/slide.

**Phylum Mollusca**

*6.* Study of *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Mytilus, Loligo, Sepia,Octopus* and *Nautilus* and *Cypraea* (cowrie).

**Phylum Echinodermata**

7. Study of echinoderm larvae.

*8.* Study of *Pentaceros, Asterias, Ophiura, Clypeaster, Echinus, Echinocardium, Cucumaria* and *Antedon.*

**SEM-III CORE COURSE- IV Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**PHYSIOLOGY: LIFE SUSTAINING SYSTEMS**

**Unit 1: Digestive System**

Structural organization, histology and functions of gastrointestinal tract and its associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Role of gastrointestinal hormones on the secretion and control of enzymes of gastrointestinal tract.

**Unit 2: Respiratory System**

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volume and capacity; Transport of oxygen in the blood; Oxygen- hemoglobin and myoglobin, dissociation curve and the factors influencing it; Carbon monoxide poisoning; Carbon dioxide transport in the blood; buffering action of blood and haemoglobin and Control of respiration.

**Unit 3: Excretory System**

Structure of kidney and its histological details; Renal blood supply; Mechanism of urine formation and its regulation and Regulation of acid-base balance.

**Unit 4: Blood**

Components of blood and their functions; Structure and functions of haemoglobin; Haemopoiesis; Haemostasis and Coagulation of blood and Disorders of blood.

**Unit 5: Heart**

Structure of heart; Coronary circulation; Structure of conducting and working of myocardial fibers; Origin and conduction of cardiac impulses functions of AV node; Cardiac cycle; Cardiac output and its regulation-Frank-Starling Law of the heart; Nervous and chemical regulation of heart rate; Blood pressure and its regulation and Electrocardiogram.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

**1.** Enumeration of red blood cells using haemocytometer.

2. Estimation of haemoglobin using Sahli’s haemoglobinometer.

3. Preparation of haemin and haemochromogen crystals.

4. Recording of blood pressure using a Sphygmomanometer.

5. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung and kidney.

**SEM-III CORE COURSE- V Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**DIVERSITY AND DISTRIBUTION OF CHORDATA**

**Unit 1: Protochordata and Origin of Chordates**

General characters of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata; Dipleurula concept and the Echinoderm theory of origin of chordates.

**Unit 2: Introduction to Vertebrata and Agnatha**

Advanced features of vertebrates over Protochordata; General characters and classification of cyclostomes up to class; Structural peculiarities and affinities of *Petromyzon* and *Myxine.*

**Unit 3: Pisces and Amphibia**

General characters of Chondrichthyes and Osteichthyes and classification up to order; Migration; Osmoregulation and Parental care in fishes; Scales in fishes; Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characters and classification up to order and Parental care in Amphibians.

**Unit 4: Reptilia and Aves**

General characters and classification up to order; Skull in Reptilia; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes; General characters and classification up to order; Principles and aerodynamics of flight, Flight adaptations; *Archaeopteryx*- a connecting link and Migration in birds.

**Unit 5: Mammalsand Zoogeography**

General characters and classification up to order; Affinities of Prototheria and Metatheria; Dentition in mammals; Adaptive radiation with reference to locomotory appendages; Zoogeographical realms; Theories pertaining to distribution of animals and Distribution of vertebrates in different realms.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

**1. Protochordata**

1. *Balanoglossus, Herdmania, Branchiostoma* and Colonial Urochordata.

2. Sections of *Balanoglossus* through proboscis and branchiogenital regions.

3. Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions.

4. Permanent slide of spicules of *Herdmania*.

**2.Agnatha**

*5. Petromyzon* and *Myxine.*

**3. Fishes**

6. *Sphyrna, Pristis, Trygon, Torpedo, Chimaera, Notopterus, Mystus, Heteropneustes, Hippocampus, Exocoetus, Echeneis, Anguilla, Tetrodon,Diodon, Anabas* and Flat fish.

**4.Amphibia**

*7. Ichthyophis/Ureotyphlus, Necturus, Duttaphrynus, Polypedates, Hyla, Alytes* and *Salamandra.*

**5. Reptiles**

*8. Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco, Ophiosaurus, Bungarus, Vipera, Naja, Hydrophis, Zamenis* and *Crocodylus.*

9. Key for Identification of poisonous and non-poisonous snakes.

**6. Aves**

10. Study of six common birds from different orders.

11. Types of beaks and claws.

12. Types of feathers.

**7. Mammalia**

*13. Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus, Loris, Herpestes* and *Hemiechenis.*

**SEM-III CORE COURSE- VI Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**PHYSIOLOGY – CONTROLLING AND COORDINATING SYSTEM**

**Unit 1: Tissues and Glands, Bone and cartilage**

Structure, location, function and classification of Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue; Types of glands and their functions; Structure and types of bones and cartilages; Ossification, bone growth and resorption.

**Unit 2: Nervous System**

Structure of neuron, resting membrane potential; Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; types of synapsis, Synaptic transmission; Neuromuscular junction; Reflex action and its types, Reflex arc and Physiology of hearing and vision.

**Unit 3: Muscle**

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor Unit, summation and tetanus.

**Unit 4: Reproductive System**

Histology of male and female reproductive systems; Puberty; Physiology of reproduction of male and female; Methods of contraception (depicted through flow chart).

**Unit 5: Endocrine System**

Functional Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, thymus, pancreas, adrenals; Hormones secreted by them and their mechanism of action; Gonadal hormones; Classification of hormones; Regulation of their secretion; Mode of hormone action; Signal transduction pathways utilized by steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland), principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system and Placental hormones.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICALS**

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).

2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells.

3. Examination of sections of mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.

**SEM-III CORE COURSE- VII Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**COMPARATIVE ANATOMY OF VERTEBRATES**

**Unit 1: Integumentary System and Skeletal System**

Structure, functions and derivatives of integument; Axial and appendicular skeletons; Jaw suspensorium in vertebrates.

**Unit 2: Digestive and Respiratory System**

Alimentary canal and associated glands; Skin, gills, lungs and air sacs and Accessory respiratory organs in fishes.

**Unit 3: Circulatory System**

General plan of circulation; Evolution of heart and aortic arches.

**Unit 4: Urinogenital System**

Succession of kidney; Evolution of urinogenital ducts and Types of mammalian uteri.

**Unit 5: Nervous System and Sense Organs**

Comparative account of brain; Autonomic nervous system; Spinal Nerves; Spinal cord; Cranial nerves in Mammals; Classification of receptors; visual receptors, chemo-receptors and mechanoreceptors.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.

2. Disarticulated skeleton of Frog, *Varanus,* Fowl and Rabbit.

3. Carapace and plastron of turtle or tortoise.

4. Mammalian skulls (One herbivorous and one carnivorous animal).

**SEM-IV CORE COURSE-VIII Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**BIOCHEMISTRY OF METABOLIC PROCESSES**

**Unit 1: Biomolecules**

Structures and properties of important mono-, di- and polysaccharides; Fatty acids, triglycerides and steroids; and amino acids and proteins.

**Unit 2: Carbohydrate Metabolism**

Glycolysis; Citric acid cycle; pentose phosphate pathway; Gluconeogenesis; Shuttle systems(Malate-aspartate shuttle, Glycerol 3-phosphate shuttle); Glycogenolysis; Glycogenesis.

**Unit 3: Lipid Metabolism**

β-oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid and Ketogenesis and its regulation.

**Unit 4: Protein Metabolism**

Catabolism of amino acids: Transamination, Deamination; Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids.

**Unit 5: Enzymes and Oxidative Phosphorylation**

Kinetics and Mechanism of action of enzymes; Inhibition of enzyme action; Allosteric enzymes; Oxidative phosphorylation in mitochondria; Respiratory chain, ATP synthase, Inhibitors and Uncouplers.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICALS**

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose).

2. Colour tests of functional groups in protein solutions.

3. Action of salivary amylase under optimum conditions.

4. Effect of pH on the action of salivary amylase.

5. Effect of temperature on the action of salivary amylase.

6. Estimation of total protein in given solutions by Lowry’s method.

**SEM-IV CORE COURSE- IX Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**CELL BIOLOGY**

**Unit 1: Cells and Plasma Membrane**

Prokaryotic and Eukaryotic cells; Mycoplasma;Virus, Viroids,Virionsand Prions; Various models of plasma membrane; Transport across membranes; Cell junctions:Occluding junctions (Tight junctions), Anchoring junctions (desmosomes), Communicating junctions (gap junctions) and Plasmodesmata.

**Unit 2: Endomembrane System, Mitochondria and Peroxisomes**

The Endoplasmic Reticulum; Golgi apparatus; Mechanism of vesicular transport; Lysosomes; Structure and function of mitochondria: Chemi-osmotic hypothesis; Semiautonomous nature of mitochondria; Endosymbiotic hypothesis and Peroxisomes.

**Unit 3: Cytoskeleton and Nucleus**

Structure and functions of intermediate filament, microtubules and microfilaments; Ultra structure of nucleus; Nuclear envelope: Structure of nuclear pore complex; Chromosomal DNA and its packaging; Structure and function of Nucleolus.

**Unit 4: Cell Cycle and Cell Signaling**

Cell cycle, Regulation of cell cycle; Signaling molecules and their receptors.

**Unit 5: Apoptosis and Cancer**

Extrinsic (Death Receptor) Pathway and Intrinsic (Mitochondrial) Pathway; Growth and development of tumors and Metastasis.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Gram’s staining technique for visualization of prokaryotic cells.

2. Study various stages of mitosis from permanent slides.

3. Study various stages of meiosis from permanent slides.

4. Study the presence of Barr body in human female blood cells/cheek cells. (Preparation of permanent slides).

5. Cytochemical demonstration (Preparation of permanent slides).

i. DNA by Feulgen reaction.

ii. Mucopolysaccharides by PAS reaction.

iii. Proteins by Mercurobromophenol blue.

iv. DNA and RNA by Methyl Green Pyronin.

**SEM-IV CORE COURSE- X Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**PRINCIPLES OF GENETICS**

**Unit 1: Mendelian Genetics and its Extension**

Principles of inheritance; Incomplete dominance and co-dominance; Multiple alleles, Lethal alleles; Epistasis; Pleiotropy; Sex-linked inheritance.

**Unit 2: Linkage, Crossing Over and Chromosomal Mapping**

Linkage and crossing over; Cytological basis of crossing over; Molecular mechanisms of crossing over; Recombination frequency as a measure of linkage intensity; Two factor and three factor crosses; Interference and coincidence and Somatic cell hybridization.

**Unit 3: Mutations**

Gene mutations; Chromosomal mutations: Deletion, duplication, inversion, translocation;Aneuploidy and polyploidy; Induced versus spontaneous mutations; Backward and forward mutations; Suppressor mutations; Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached *X* method and DNA repair mechanisms.

**Unit 4: Sex Determination and Quantitative Genetics**

Chromosomal mechanisms of sex determination; Sex-linked, sex-influenced and sex limited characters; Polygenic inheritance and Transgressive variation.

**Unit 5: Extra-chromosomal Inheritance**

Criteria for extra-chromosomal inheritance; Antibiotic resistance in *Chlamydomonas*; Mitochondrial mutations and Maternal effects.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. To study the Mendelian laws and gene interactions and their verification by Chisquare analyses using seeds/beads/*Drosophila*.

2. Identification of various mutants of *Drosophila*.

3. To calculate allelic frequencies by Hardy-Weinberg Law.

4. Linkage maps based on data from crosses of *Drosophila*.

5. Study of human karyotype (normal and abnormal).

6. Pedigree analysis of some human inherited traits.

7. Preparation of polytene chromosomes from larva of *Chironomous*/*Drosophila*.

8. To study mutagenicity in *Salmonella/E. coli* by Ames test.

**SEM-V CORE COURSE- XI Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**DEVELOPMENTAL BIOLOGY**

**Unit 1: Introduction**

History and basic concepts: Epigenesis, preformation, Mosaic and regulative development; Discovery of induction; Cell-Cell interaction; Pattern formation; Differentiation and growth; Differential gene expression; Cytoplasmic determinants and asymmetric cell division.

**Unit 2: Early Embryonic Development**

Gametogenesis (Spermatogenesis, Oogenesis); Types of eggs; Egg membranes; Fertilization: Changes in gametes, monospermy and polyspermy; Planes and patterns of cleavage; Early development of frog and chick up to gastrulation; Fate maps; Embryonic induction and organizers.

**Unit 3: Late Embryonic Development**

Fate of germ layers; Extra-embryonic membranes in birds; Implantation of embryo in humans and Placenta (Structure, types and functions of placenta).

**Unit 4: Post Embryonic Development**

Metamorphosis: Changes, hormonal regulations in amphibians; Regeneration: Modes of regeneration (epimorphosis, morphallaxis and compensatory regeneration); Ageing: Concepts and models.

**Unit 5: Implications of Developmental Biology**

Teratogenesis: Teratogenic agents and their effects on embryonic development; *in vitro* Fertilization; Stem cell culture and Amniocentesis.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).

2. 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).

3. Study of developmental stages (above mentioned) by raising chick embryo in the laboratory.

4. Study of the developmental stages and life cycle of *Drosophila* from stock culture.

5. Study of different types of placenta.

6. Project report on *Drosophila* culture/chick embryo development.

**SEM-V CORE COURSE-XII Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**MOLECULAR BIOLOGY**

**Unit 1: Nucleic Acids and DNA Replication**

Salient features of DNA double helix; Watson and Crick model of DNA; DNA denaturation and renaturation; DNA topology - linking number and DNA topo-isomerases; Cot curves; Structure of RNA, tRNA and DNA and RNA associated proteins; DNA Replication in prokaryotes and eukaryotes; Mechanism of DNA replication; Role of proteins and enzymes in replication; Licensing factors; Semi-conservative, bidirectional and semi-discontinuous replication; RNA priming; Replication of circular and linear *ds*-DNA and replication of telomeres.

**Unit 2:Transcription**

RNA polymerase and transcription Unit; Mechanism of transcription in prokaryotes and Eukaryotes; Synthesis of rRNA and mRNA; Transcription factors and regulation of transcription.

**Unit 3:Translation**

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation.

**Unit 4: Post Transcriptional Modifications and Processing of Eukaryotic RNA**

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing.

**Unit 5: Gene Regulation and Regulatory RNAs**

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencers elements; Gene silencing, Genetic imprinting; Ribo-switches, RNA interference, miRNA and siRNA.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Study of DNA replication using Photographs or slides and special cases, e.g., Polyteny using permanent slides of polytene chromosomes.

2. Preparation of liquid culture medium (LB) and raise culture of *E. coli*.

3. Estimation of the growth kinetics of *E. coli* by turbidity method.

4. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking.

5. Demonstration of antibiotic sensitivity/resistance of *E. coli* to antibiotic pressure and interpretation of results.

6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter(Diphenylamine reagent) or spectrophotometer (A260 measurement).

7. Quantitative estimation of RNA using Orcinol reaction.

**SEM- VI CORE COURSE- XIII Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**IMMUNOLOGY**

**Unit 1: Immune System and Immunity**

Historical perspective of Immunology, Early theories of Immunology, Haematopoiesis, Cells and organs of the Immune system; Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity and Immune dysfunctions.

**Unit 2: Antigens**

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T - Cell epitopes.

**Unit 3: Immunoglobulins**

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays, Polyclonal sera, Monoclonal antibodies and Hybridoma technology.

**Unit 4: Major Histocompatibility Complex and Complement System**

Structure and functions of endogenous and exogenous pathway of antigen presentation; Components and pathways of complement activation.

**Unit 5: Cytokines, Hypersensitivity and Vaccines**

Properties and functions of cytokines; Cytokine-based therapies;Gell and Coombs’ classification and Brief description of various types of hypersensitivities; Types of vaccines: Recombinant vaccines and DNA vaccines.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Demonstration of lymphoid organs.

2. Ouchterlony’s double immuno-diffusion method.

3. Determination of ABO blood group.

4. Preparation of single cell suspension of splenocytes from chick spleen, cell counting and viability test.

5. ELISA/ dot Elisa (using kit).

6. Principles, experimental set up and applications of immuno-electrophoresis, RIA, F.

**SEM-VI CORE COURSE- XIV Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**EVOLUTIONARY BIOLOGY**

**Unit 1: History of Life, theories of Evolution and Extinction**

Chemogeny, Biogeny, RNA World, Major Events in History of Life; Lamarckism; Darwinism; Neo-Darwinism; Background of extinction, Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail) and Role of extinction in evolution.

**Unit 2: Evidences of Evolution**

Fossils and its types; Dating of fossils, Phylogeny of horse and human; Molecular evidences (Globin gene families as an example) and Molecular clock concept.

**Unit 3: Processes of Evolutionary Change**

Organic variations; Isolating mechanisms; Natural selection (Industrial melanism, Pesticide/Antibiotic resistance); Types of natural selection (Directional, Stabilizing, Disruptive), Sexual Selection and Artificial selection.

**Unit 4: Principles of population genetics**

Concept of gene pool, Gene frequencies – equilibrium frequency (Hardy-Weinberg equilibrium), Shift in gene frequency without selection – Genetic drift, Mutation pressure and Gene flow and Shifts in gene frequencies with selection.

**Unit 5: Species Concept and Evolution above species level**

Biological concept of species (Advantages and Limitations); Sibling species, Polymorphic species, Polytypic species, Ring species; Modes of speciation (Allopatric, Sympatric); Macro-evolutionary Principles (Darwin’s Finches); Convergence, Divergence and Parallelism.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Study of fossil evidences from plaster cast models and pictures.

2. Study of homology and analogy from suitable specimens/ pictures.

3. Demonstration of changing allele frequencies with and without selection.

4. Construction of cladogram based on morphological characteristics.

5. Construction of phylogenetic tree with bioinformatics tools (Clustal X and Phylip).

6. Interpretation of phylogenetic trees.

**SEM-V DISCIPLINE SPECIFIC ELECTIVE-I**

 **Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**ANIMAL BEHAVIOUR**

**Unit 1: Introduction and Mechanisms of Behaviour**

Origin and history of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behavior; Objective of behaviour, Behaviour as a basis of evolution; Behaviour as a discipline of science; Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Code breakers.

**Unit 2: Patterns of Behaviour**

**Reflexes:** Types of reflexes, reflex path, characteristics of reflexes (latency, after discharge, summation, fatigue, inhibition) and its comparison with complex behavior.

**Orientation:** Primary and secondary orientation; kinesis-orthokinesis, klinokinesis; taxistropotaxis and klinotaxis and menotaxis (light compass orientation) and mnemotaxis.

**Learning**: Associative learning, classical and operant conditioning, Habituation and Imprinting.

**Unit 3: Social Behaviour**

Insects’ society; Honey bee: Society organization, polyethism, foraging, round dance, waggle dance, Experiments to prove distance and direction component of dance, learning ability in honey bee, formation of new hive/queen; Reciprocal altruism, Hamilton’s rule and inclusive fitness with suitable examples.

**Unit 4: Sexual Behaviour**

Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Infanticide, Consequences of mate choice for female fitness, Sexual conflict for male versus female parental care and Courtship behaviour in three spine stickleback.

**Unit 5: Biological Clocks**

Circadian rhythm, Tidal rhythm, Lunar rhythm, Advantages of biological clocks, Jet lag and Entrainment.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. To study different types of animal behaviour such as habituation, social life, courtship behaviour in insects, and parental care from short videos/movies and prepare a short report.

2. To study nests and nesting habits of the birds and social insects.

3. To study the behavioural responses of wood lice to dry condition.

4. To study behavioural responses of wood lice in response to humid condition.

5. To study geotaxis behaviour in earthworm.

6. To study the phototaxis behaviour in insect larvae.

7. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

**SEM-V DSE-II Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**ECONOMIC ZOOLOGY**

**Unit 1: Bee-keeping and Bee Economy (Apiculture)**

Varieties of honey bees and Bee pasturage; Setting up an apiary: Langstroth’s/Newton’s hive, bee veil, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees, artificial diet; Diseases of honey bee, American and European Foulbrood, and their management; Honey extraction techniques; Physico-chemical analysis of honey; Other beneficial products from bee; Visit to an apiculture institute and honey processing Units.

**Unit 2: Silk and Silk Production (Sericulture)**

Different types of silk and silkworms in India; Rearing of *Bombyx mori,* Rearing racks and trays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages, harvesting of cocoons; Silkworm diseases: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis, and their management; Silkworm pests and parasites: Uzi fly, Dermestid beetles and their management; Silk reeling techniques and Quality assessment of silk fibre.

**Unit 3: Aquaculture I**

Brood stock management; Induced breeding of fish; Management of hatchery of fish; Management of nursery, rearing and stocking ponds; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish; Fishery by-products.

**Unit 4: Aquaculture II**

Prawn farming; Culture of crab; Pearl culture and Culture of air breathing fishes.

**Unit 5: Dairy and Poultry Farming**

Introduction; Indigenous and exotic breeds; Rearing, housing, feed and rationing; Commercial importance of dairy and poultry farming; Varietal improvement techniques; Diseases and their management; Dairy or poultry farm management and business plan; Visit to any dairy farm or Poultry farm.

\* Submission of report on anyone field visits mentioned above.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Study of different types of bees (Queens, Drones and Worker bees).

2. Study of different types of silk moths.

3. Study of different types of pearls.

4. Study of different types of fish diseases.

5. Identification of different types of scales in fishes.

6. Study of different types of fins.

7. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.)

8. Identification of various types of natural silks.

**SEM-VI DSE-III Full Marks- Internal-15+ Practical-25+Sem End Exam-60**

**MICROBIOLOGY**

**Unit 1:** History of Microbiology; Microbial World – Characterization, Classification and

identification of microbes.

**Unit 2:** Prokaryotes: General morphology and classification of bacteria, their characters and

economic importance; Gram-positive and Gram-negative bacteria.

**Unit 3**: Eukaryotes: General morphology of Protista and Fungi – classification and economic

importance.

**Unit 4:** Viruses: structure, genome, replication cycle; Epidemiology of infectious diseases with reference of human hosts – Bacterial (Tuberculosis), Viral (Hepatitis), Protozoan (Amoebiasis) and Fungal (any one) disease.

**Unit 5:** Microbe interactions-Immune Responses-Antibiotics and other chemotherapeutic agents; Applied microbiology in the fields of food, agriculture, industry and environment.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

**1**. Cleaning of glasswares, sterilisation principle and methods - moist heat - dry heat and filtration methods.

2. Media preparation: Liquid media, Solid media, Agar slants, Agar plates. Basal, enriched, selective media preparation - quality control of media, growth supporting properties, sterility check of media.

3. Pure culture techniques: Streak plate, pour plate and decimal dilution.

4. Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description and demonstration of pigment production.

5. Staining techniques: Smear preparation, simple staining, Gram’s staining, Acid fast staining and staining for metachromatic granules.

6. Morphology of microorganisms.

7. Antibiotic sensitivity testing: Disc diffusion test - Quality control with standard strains

8. Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test, Carbohydrate fermentation, Maintenance of pure culture, Paraffin method, Stab culture and maintenance of mold culture.

**SEM-VI DSE-III PROJECT Full Marks-100**

**SEM-IV SKILL ENHANCEMENT COURSES**

**Full Marks- Internal-10 Sem End Exam-40 MARKS**

**PUBLIC HEALTH AND HYGIENE**

**Unit 1:** Scope of Public health and Hygiene; nutrition and health; classification of foods; Nutritional deficiencies; Vitamin deficiencies.

**Unit 2:** Pollution: water pollution, air pollution, soil pollution, noise pollution, thermal pollution and radioactive pollution.

**Unit 3:** Environment and Health hazards; Environmental degradation and health hazards due to pollutants.

**Unit 4:** Communicable diseases and their control measures such as Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS.

**Unit 5:** Non-Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**SEM-III -GE-I FULL MARKS- INTERNAL-15+ PRACTICAL-25+SEM END EXAM-60 MARKS**

**FOOD, NUTRITION AND HEALTH**

**Unit 1:** Food; Diet; Nutrient; Vitamins; Disorders due to deficiency of vitamins; Synthetic foods and drinks.

**Unit 2:** Functions of food; Components of food; Nutrients (Macro and micronutrients): their biochemical role and dietary sources;

 Food groups and the concept of a balanced diet; Causes of food spoilage; Food adulteration; Nutrition through the life

 cycle- Physiological considerations, nutrient needs and dietary pattern for various groups- adults, pregnant and nursing

 mothers, infants, preschool and school children, adolescents and elderly.

**Unit 3:** Nutritional Biochemistry Carbohydrates, Lipids, Proteins - Definition, Classification,

 Structure and properties Significance of acid value, iodine value and saponification value of lipids; Essential and Non-

 essential amino acids; Enzymes- Definition, Classification, Properties; Coenzymes Vitamins- Fat-soluble and Water-

 soluble vitamins; their Structure and properties Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc and their

 properties.

**Unit 4:** Introduction to health- Definition and concept of health; Major nutritional deficiency Diseases: Protein Energy

 Malnutrition; Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through

 dietary or lifestyle modifications. Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno

 Deficiency Syndrome (AIDS); Common ailments- cold, cough, fevers, diarrhoea, constipation: their causes and dietary

 treatment.

**Unit 5:** Food hygiene, Potable water- sources and methods of purification, Food and Water borne Infections.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICALS**

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric.

2. To determine absorbed oil content in fried foods.

3. Estimation of lactose in milk.

4. Ascorbic acid estimation in food by titrimetry.

5. Estimation of calcium in foods by titrimetry.

6. Preparation of temporary mounts of various stored grain pests.

7. Project- Undertake computer aided diet analysis and nutrition counselling for different age groups. OR Identify nutrient rich sources of foods, their seasonal availability and price; study of Nutrition labelling on selected foods.

**SEM-IV -FULL MARKS- INTERNAL-15+ PRACTICAL-25+SEM END EXAM-60 MARKS**

**GE-II BIO INSTRUMENTATION**

**Unit 1:** Units of measurements – Metric system, conversion of Units, Microscopy – principles & types (simple, light, phase

 contrast, polarizing darkfield& Electron) Autoclave – principle & applications and types.

**Unit 2:** Centrifuge: principles & types (clinical, ultra centrifuges); pH: Sorenson’s pH scale, pH meter: principle and applications;

 Manometry: Warburg manometer: principle and working.

**Unit 3:** Chromatography: Principles, types (paper, Thin layer, column) and applications; Electrophoresis: Principles, types-paper

 & gel (AGE & PAGE) and applications.

**Unit 4:** Spectroscopy: principles and uses of colorimetry and NMR (Nuclear Magnetic Resonance) spectroscopy; Radio isotopic

 technique: Radio immuno assay, Biochemical applications of radio isotopes.

**Unit 5:** Biosensors: principle, types (Enzyme, Bacterial electrodes, Environmental Bio sensors & Bioreporters & applications)

 DNA & RNA sequencing methods, PCR: principle & Application; DNA Micro array and its applications.

**Each unit shall have one long question carrying 12 marks and as option to the long questions 2/3(Two or Three) short questions carrying 6/4(Six or Four) marks each will be asked.**

**PRACTICAL**

1. Analysis of glucose, amino acids / proteins fatty acids/ lipids and RNA/DNA in animal tissues by spectrophotometry.

2. Identification of amino acids by paper chromatography.

3. Demonstration of blotting techniques and PCR.

4. Sub-cellular fractionation by centrifugation.