SYLLABUS FOR UNDERGRADUATE COURSE IN ZOOLOGY
(Bachelor of Science Examination)

UNDER
CHOICE BASED CREDIT SYSTEM
<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
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| Semester-VI     |                                                    | Total                                               | 148| 2600|
ZOOLOGY

HONOURS PAPERS:
Core course – 14 papers
Discipline Specific Elective – 4 papers (Out of 9 suggested papers)
Generic Elective for Non Zoology students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.
Marks per paper - Midterm: 15 marks, End term: 60 marks (Theory) + 25 marks (Practical), Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 40 hours (theory) + 10 hours (practical)

Core Paper I

Non-Chordates I: Protista to Pseudocoelomates

Unit 1: Protista, Parazoa, Metazoa and Porifera
General characteristics and Classification up to classes. Study of Euglena, Amoeba. Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica. Locomotion and Reproduction in Protista. General characteristics and Classification up to classes, Canal system and spicules in sponges.

Unit 2: Cnidaria & Ctenophora
General characteristics and Classification up to classes, Metagenesis in Obelia, Polymorphism in Cnidaria, Corals and coral reefs. General characteristics and Evolutionary significance of Ctenophora.

Unit 3: Platyhelminthes
General characteristics and Classification up to classes. Life cycle and pathogenicity of Fasciola hepatica and Taenia solium.

Unit 4: Nemat helminthes
General characteristics and Classification up to classes. Life cycle, and pathogenicity of Ascaris lumbricoides and Wuchereria bancrofti. Parasitic adaptations in helminthes


PRACTICAL
1. Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium.
2. Examination of pond water collected from different places for diversity in protista.
5. One specimen/slide of any ctenophore.

7. Study of adult Ascarislumbricoides and its life stages (Slides/micro-photographs).


**TEXT BOOKS**

**SUGGESTED READINGS**
3. Hyman, L.H. Invertebrate Series (Recent edition)

Core Paper II

**Principles of Ecology**

**Unit 1: Ecosystem and Applied Ecology**

**Unit 2: Population**

**Unit 3: Community**
Community characteristics: species richness, dominance, diversity, abundance,vertical stratification, Ecotone and edge effect; Ecological succession with one example. Theories pertaining to climax community.
Unit – 4: Biometry
Biological data, graphical representation of data (frequency polygon and histogram), sampling techniques, measures of central tendency (Mean, median and mode), Measures of dispersion (range, quartile deviation, mean deviation and standard deviation), Hypothesis and hypothesis testing (Chi-square test, t-test)

PRACTICAL
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 quadrat method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton collection, preservation and mounting, Measurement of temperature, turbidity/penetration of light, determination of pH, Dissolved Oxygen content (Winkler’s method), BOD, COD, Free CO₂, Hardness, TDS.
5. Chi-square analysis using seeds/beads/Drosophila.
6. Problems on standard deviation.
7. Graphical representation of data (Frequency polygon and Histogram).

Text Book

Suggested Readings
8. Cengage Publication, New Delhi
Core Paper III

Non-Chordates II: Coelomates

Unit 1: Coelomates and Annelids
Evolution of coelom and metamerism. General characteristics and Classification up to classes; Excretion in Annelida.

Unit 2: Arthropoda and Onychophora
General characteristics and Classification up to classes. Vision and Respiration in Arthropoda. Metamorphosis in Insects. Social life in bees and termites. Onychophora: General characteristics and Evolutionary significance.

Unit 3: Mollusca
General characteristics and Classification up to classes. Respiration in Mollusca. Torsion and detorsion in Gastropoda. Evolutionary significance of trochophore larva.

Unit 4: Echinodermata
General characteristics and Classification up to classes. Water-vascular system in Asteroidea, Larval forms in Echinodermata, Affinities with Chordates.


PRACTICAL

1. Study of following specimens:
   2. Annelids - Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria
   3. Arthropods – Tachypleus, Carcinoscorpius, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julius, Bombyx, Periplaneta, termites and honey bees
   4. Onychophora – Peripatus
   5. Molluscs - Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus
   6. Echinodermates - Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon
   7. Study of digestive system, nephridia of earthworm (Virtual).
   8. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
   9. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta.
   10. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

Text Books

Suggested Readings


Core Paper IV

Cell biology

Unit 1: Overview of cells and plasma membrane

Unit 2: Cytoskeleton & Endomembrane System

Unit 3: Mitochondria and Peroxisomes
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis; Mitochondrial Respiratory Chain, Chemiosmotic hypothesis. Peroxisomes.

Unit 4: Nucleus, Cell Division and Cell signalling
Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus; Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome); Mitosis, Meiosis, Cell cycle and its regulation; GPCR and Role of second messenger (cAMP)

Practical
1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
   i. DNA by Feulgen reaction
   ii. DNA and RNA by MGP
   iii. Mucopolysaccharides by PAS reaction
   iv. Proteins by Mercuric bromophenol blue/Fast Green
5. Demonstration of osmosis (RBC/ Egg etc.).

Text Books
Suggested Readings


Core Paper V

Diversity and distribution of Chordates

Unit 1: Protochordates and Origin of Chordates
Protochordata: General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata. General characteristics and outline classification Chordata. Dipleurula concept and the Echinoderm theory of origin of chordates.

Unit 2: Agnatha, Pisces & Amphibia
General characteristics of Agnatha: General characteristics and classification of cyclostomes up to class Chondrichthyes and Osteichthyes: classification up to order, Migration, Parental care in fishes, Accessory respiratory organs in pisces, Evolutionary significance of Dipnoi. Amphibian: Origin of Tetrapoda (Evolution of terrestrial ectotherms); General characteristics and classification up to order. Parental care in Amphibia.

Unit 3: Reptilia & Aves
General characteristics and classification up to order in reptiles; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes. General characteristics and classification up to order in Aves Archaeopteryx - a connecting link; Flight adaptations and Migration in birds.

Unit 4: Mammals & Zoogeography
General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages. Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms.

PRACTICAL
1. Protochordata: Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata, Sections of Balanoglossus through proboscis and branchio-genital regions, Sections of Amphioxus through pharyngeal, intestinal and caudal regions. Permanent slides of Herdmania spicules.
5. Reptilia: Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, CrocodylusKey for Identification of poisonous and non-poisonous snakes
8. Power point presentation on study of any two animals from two different classes by students. Submission of album of local species.

**TEXT BOOKS**

**SUGGESTED READINGS**

**Core Paper VI**

**Physiology: Controlling and Coordinating Systems**

**Unit 1: Tissues & Tissue system**
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue. Structure and types of bones and cartilages, Ossification, bone growth and resorption.

**Unit 2: Muscle & Nervous System**
Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction. 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 - reflex arc; Physiology of hearing and vision.

**Unit 3: Reproductive System**
Histology of testis and ovary; Physiology of male and female reproduction; Hypothalamus-Pituitary & Gonadal axis. Puberty, Ovarian Cycle, Methods of contraception in male and female, Placental hormones.

**Unit 4: Endocrine System**
Histology of endocrine glands – Hypothalamus (Neuroendocrine gland) pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones and mechanism of hormone action, (steroidal and non-steroidal hormones).
PRACTICAL
1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
2. Study of permanent slides- Squamous epithelium, Striated muscle fibres and nerve cells.
3. Study of permanent slides-Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.
4. Microtomy: Preparation of permanent slides/photographs/computer models of any five types of mammalian (Goat/rat,etc) tissues

TEXT BOOKS
2. Endocrinology, Hadley ME and Levine JE (2009), Pearson Education India; 6 edition

SUGGESTED BOOKS

Core Paper VII
Fundamentals of Biochemistry

Unit 1: Carbohydrates & Lipids
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates; Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids.

Unit 2: Proteins
Amino acids: Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids.
Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Renaturation, Denaturation; Introduction to simple and conjugate proteins
Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants.

Unit 3: Nucleic Acids
Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA, Types of DNA and RNA, Complementarity of DNA, Hpyo-Hyperchromaticity of DNA.
Unit 4: Enzymes
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

PRACTICAL
1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase/urease/acid or alkaline phosphatase
5. Demonstration of proteins separation by SDS-PAGE.

TEXT BOOKS

SUGGESTED READING

Core Paper VIII
Comparative Anatomy of Vertebrates

Unit 1: Integumentary & Skeletal System
Structure, functions and derivatives of integument (Scale, claw, nail, hair, feather and dentition). Axial and appendicular skeleton, Jaw suspensorium, Visceral arches.

Unit 2: Digestive & Respiratory System
Alimentary canal and associated glands; Respiration through Skin, gills, lungs and air sacs; Accessory respiratory organs.
Unit 3: Circulatory and Urinogenital system
General plan of circulation, evolution of heart and aortic arches; Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri.

Unit 4: Nervous System & Sense Organs
Comparative account of brain; Nervous system, Spinal cord, Cranial nerves in mammals. Classification of receptors: Brief account of visual and auditory receptors in man. Chemo and mechano receptors

PRACTICAL
1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit.
3. Carapace and plastron of turtle/tortoise (Photographs, charts etc).
4. Mammalian skulls: One herbivorous and one carnivorous animal.
5. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted).
6. Project on skeletal modifications in vertebrates (may be included if dissection not permitted).

TEXT BOOKS

SUGGESTED READINGS
1. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate structure, John Wiley and Sons
2. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House

Core Paper IX

Physiology: Life Sustaining Systems

Unit 1: Physiology of Digestion
Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.

Unit 2: Physiology of Respiration
Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration.
Unit 3: Renal Physiology and Blood
Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance. Components of blood and their functions; Structure and functions of haemoglobin haemostasis: Haemopoiesis, Blood clotting system, Blood groups: Rh factor, ABO and MN.

Unit 4: Physiology of Heart
Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation.

PRACTICAL
1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli’s haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer
6. Examination of sections of mammalian slides: oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney.

TEXT BOOKS

SUGGESTED READINGS
Core Paper X

Biochemistry of Metabolic Processes

Unit 1: Overview of Metabolism
Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms.

Unit 2: Carbohydrate Metabolism
Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.

Unit 3: Lipid and protein Metabolism
β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis
Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids.

Unit 4: Oxidative Phosphorylation
Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

PRACTICAL
1. Estimation of total protein in given solutions
2. Detection of SGOT and SGPT or GST and GSH in serum/ tissue
3. To study the enzymatic activity of Trypsin/ Lipase.
4. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
5. Dry Lab (Virtual): To trace the labelled C atoms of Acetyl-CoA till they evolve as CO₂ in the TCA cycle.

TEXT BOOKS

SUGGESTED READINGS
Core Paper XI

Molecular Biology

Unit 1: Nucleic Acids, DNA Replication & Repair

Unit 2: Transcription & Translation
RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors and regulation of transcription. 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 tRNAsynthetases 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 3: Post Transcriptional Modifications and Processing of Eukaryotic RNA
Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA.

Unit 4: Gene Regulation & 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, silencer elements; Gene silencing, RNA interference, miRNA, siRNA.

PRACTICAL
1. Study of Polytene chromosomes from Chironomous / Drosophila larvae
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. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A_{260}\text{nm} measurement)
6. Quantitative estimation of RNA using Orcinol reaction
7. Study and interpretation of electron micrographs/ photograph showing (a) DNA replication, (b) Transcription and (c) Split genes.

TEXT BOOKS
SUGGESTED READINGS

Core Paper XII

Principles of Genetics

Unit 1: Mendelian Genetics, Linkage, Crossing Over and Chromosomal Mapping
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance. Polygenic inheritance with suitable examples; simple numericals based on it. Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Unit 2: Mutations
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Unit 3: Sex Determination & Extra-chromosomal Inheritance
Chromosomal mechanisms of sex determination in Drosophila and Man; Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces, Infective heredity in Paramecium and Maternal effects.

Unit 4: Recombination in Bacteria and Viruses & Transposable Genetic Elements

PRACTICAL
2. Linkage maps based on data from conjugation, transformation and transduction.
3. Linkage maps based on data from Drosophila crosses.
5. Pedigree analysis of some human inherited traits.
TEXT BOOKS

SUGGESTED READINGS

Core Paper XIII
Developmental Biology

Unit 1: Introduction to Developmental Biology, Gametogenesis & Fertilization
Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division. Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy.

Unit 2: Early Embryonic Development
Cleavage: Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers.

Unit 3: Late Embryonic Development
Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

Unit 4: Post Embryonic Development & Implications of Developmental Biology
Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories. Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis.

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).
4. Study of different sections of placenta (photomicrograph/ slides).
5. Project report on Drosophila culture/chick embryo development.
6. Study of developmental stages by raising chick embryo in the laboratory

TEXT BOOKS

SUGGESTED READINGS

Core Paper XIV

Evolutionary Biology

Unit 1: Theories, Evidences of Evolution and Extinction

Unit 2: Process of Evolutionary changes
Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection). Genetic Drift (mechanism, founder’s effect, bottleneck phenomenon); Role of Migration and Mutation in changing allele frequencies.

Unit 3: Species concept and Speciation
Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Parapatric. Adaptive radiation / macroevolution (exemplified by Galapagos finches);

Unit 4: Concept of Origin and Evolution of man
Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, molecular analysis of human origin. Phylogenetic trees, Multiple sequence alignment, construction and interpretation of phylogenetic trees.
PRACTICAL
1. Study of fossils from models/pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

TEXT BOOKS

SUGGESTED READINGS

Discipline Specific Elective Paper-1
Animal Behaviour and Chronobiology

Unit 1: Animal Behaviour
Origin and history of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behaviour; 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
Stereotyped Behaviours (Orientation, Reflexes); Individual behavioural patterns; Instinct vs Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour
Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects’ society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.
Unit 4: Chronobiology
Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks, Relevance of biological clocks, Types and characteristics of biological rhythms: Short- and Long-term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

PRACTICAL
1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice in dry and humid condition.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Study and actogram construction of locomotor activity of suitable animal models.
6. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
7. Visit to Forest/ Wildlife Sanctuary/Biodiversity Park/Zoological Park to study behavioral activities of animals and prepare a short report.

TEXT BOOKS

SUGGESTED READINGS

OR

Animal Biotechnology

Unit 1. Introduction to Animal Biotechnology
Concept and scope of biotechnology, Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC and Expression vectors (characteristics). Restriction enzymes: Nomenclature, detailed study of Type II, Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Transformation techniques: Calcium chloride method and electroporation

Unit 2. Molecular Techniques
Southern, Northern and Western blotting, DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA microarray
Unit 3. Genetically Modified Organisms
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.

Unit 4. Culture Techniques and Applications
Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Thalassemia, Haemophilia and Sickle cell anemia), Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

PRACTICAL
1. Genomic DNA isolation from E. coli / Animal tissue
2. Plasmid DNA isolation (pUC 18/19) from E. coli
3. Restriction digestion of plasmid DNA / Lambda Phage DNA
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs
   a. Southern Blotting
   b. Northern Blotting
   c. Western Blotting
   d. DNA Sequencing (Sanger's Method)
   e. PCR
   f. DNA fingerprinting

TEXT BOOKS

SUGGESTED READINGS
4. California, USA.

OR

ENDOCRINOLOGY

Unit 1: Introduction to Endocrinology
History of endocrinology, Types of endocrine glands and hormones, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones.

Unit 2: Epiphysis, Hypothalamo-hypophysial Axis
Unit 3: Peripheral Endocrine Glands

Unit 4: Regulation of Hormone Action
Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action.

PRACTICAL
1. Dissect and display of Endocrine glands in laboratory bred rat*
2. Study of the permanent slides of all the endocrine glands
3. Compensatory ovarian/ adrenal hypertrophy in vivo bioassay in laboratory bred rat*
4. Demonstration of Castration/ ovariectomy in laboratory bred rat*
5. Estimation of plasma level of any hormone using ELISA
6. Designing of primers of any hormone
7. Report on endocrine disorders in human
(*Subject to UGC guidelines)

TEXT BOOKS

SUGGESTED READINGS

Discipline Specific Elective Paper-II

Basics of Neuroscience

Unit 1: Introduction to Neuroscience & Nervous System
Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology. Introduction to the structure and function of the nervous system: Cellular components: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron – axons and dendrites as unique structural components of neurons.

UNIT 2: Cellular and Molecular Neurobiology
Molecular and cellular approaches used to study the CNS at the level of single molecules, The ionic bases of restingmembrane potential; The action potential- its generation and properties; The action potential conduction. Synapse: Synaptic transmission, Types of synapses; synaptic function; Principles of chemical synaptic transmission; Principles of synaptic integration; EPSPs and IPSPs. Ion channels, Neural transmission.

Unit 3. Neurotransmitters
Different types of neurotransmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.
UNIT 4: Neurobiology and Neuropharmacology of Behaviour
The principles of signal transduction and information processing in the vertebrate central nervous system, and the relationship of functional properties of neural systems with perception and behavior; sensory systems, molecular basis of behavior including learning and memory. Molecular pathogenesis of pain and neurodegenerative diseases such as Parkinson’s, Alzheimer’s, psychological disorders, Addiction.

PRACTICAL
1. Dissection and study of Drosophila nervous system using GFP reporter.
2. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
4. Study of neurons and/or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
5. Study of olfaction in Drosophila.

TEXT BOOKS

SUGGESTED READINGS
1. From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham.

OR

Reproductive Biology

Unit 1: Reproductive System and Endocrinology
Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.
Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamic – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female.

Unit 2: Functional anatomy of male reproduction
Outline and histology of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract
Unit 3: Functional anatomy of female reproduction
Outline and histology of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization, prevention of polyspermy; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto-maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation.

Unit 4: Reproductive Health
Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.

PRACTICAL
Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
1. Examination of vaginal smear rats from live animals.
3. Examination of histological sections from photomicrographs/permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
4. Human vaginal exfoliate cytology.
5. Sperm count and sperm motility in rat

TEXT BOOKS

SUGGESTED READINGS
Immunology

Unit 1: Innate and Adaptive Immunity
Historical perspective of Immunology, Early theories 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), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).

Unit 2: Antigens and Immunoglobulins
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes, Immunoglobulins: Structure and functions of different classes of immunoglobulins, Antigen antibody interactions, Immunoassays (ELISA-Direct, Indirect, Competitive, Sandwich and RIA)

Unit 3: Major Histocompatibility Complex, Cytokines and Complement system
Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation; Cytokines -Properties and functions of cytokines, Therapeutics Cytokines Complement System -Components and pathways of complement activation.

Unit 4: Hypersensitivity and Vaccines
Gell and Coombs’ classification and brief description of various types of hypersensitivities Vaccines -various types of vaccines, Advances in vaccine production.

PRACTICAL
1. Study of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of White blood cells.
4. ABO blood group determination.
5. Total WBC counting.
6. Demonstration of ELISA.
7. Demonstration of Bone marrow smears to study Immune cells.

TEXT BOOKS

SUGGESTED READINGS
Discipline Specific Elective Paper-III

Fish and Fisheries

Unit 1: Systematics, Morphology and Physiology
Systematic classification of native/exotic fishes (upto classes), Types of fins and their modification; Locomotion in fishes; Hydrodynamics; Types of scales, Use of scales in classification and determination of age of fish; Gills and gas exchange; Swim bladder; Reproductive strategies (Special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Migration

Unit 2: Fisheries
Inland fisheries; Marine fisheries; Environmental factors influencing the seasonal variation in fish; Fishing crafts and Gears; Depletion of Fisheries resources; Fisheries laws and regulations.

Unit 3: Aquaculture
Sustainable aquaculture; Extensive, semi-intensive and intensive culture of fish; Polyculture; Composite fish culture; brood stock management; Induced breeding of fish; Management of fin fish hatcheries; Preparation and maintenance of fish aquarium. Factors affecting aquaculture.

Unit 4: Fish Pathology and Transgenesis
Fish diseases: bacterial, viral and parasites; Preservation, diagnosis and treatment, Processing of harvested fish, Fishery byproducts; Transgenic fish, zebrafish as a model organism in research.

PRACTICAL
1. Study of Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas
2. Study of different types of scales (Through permanent slides and photographs)
3. Study of crafts and gears used in fisheries.
5. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias.
6. Demonstration of induced breeding in fishes (Virtual).
7. Demonstration of parental care in fishes (Virtual).
8. Project report on a visit to any fish farm/ pisciculture unit/ zebrafish rearing lab

TEXT BOOKS
1. Q Bone and R Moore (2008), Biology of fishes, Taylor and Francis group, CRC Press, UK

SUGGESTED READINGS
1. D H Evans and J D Claiborne, The Physiology of fishes, Taylor and Francis group, CRC, UK
Wildlife Conservation And Management

Unit 1: Wildlife
Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies, Conservation and protection Laws, wild animal of India and Odisha.

Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

Unit 2: Management of habitats
Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats, In situ and Ex situ conservation, Wild life Protection act, wildlife trade and related laws.

Unit 3: Population estimation
Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Census methods; Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animals.

Unit 4: Management planning of wildlife in protected areas
Estimation of carrying capacity; Eco tourism / wildlife tourism in forests; Concept of climax persistence; Ecology of perturbation, National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

PRACTICAL
1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna India and Odisha.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, animal sounds.
4. Demonstration of different field techniques for flora and fauna.
5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).
6. Submission of field study report (national park/ reserve forest/ sanctuary)

TEXT BOOKS
SUGGESTED READINGS

Discipline Specific Elective Paper-IV

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; Honey extraction techniques; Physico-chemical analysis of honey; Other beneficial products from bee.

Unit 2: Silk and Silk Production (Sericulture)
Different types of silk and silkworms in India; Rearing of Bombyxmori, 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
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. Prawn farming; Culture of crab; Pearl culture.

Unit 4: 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.

PRACTICAL
1. Submission of report on anyone field visits related to Aquaculture/Apiculture/Sericulture/Poultry/Dairy farm.
2. Study of different types of bees (Queens, Drones and Worker bees).
3. Study of different types of silk moths.
4. Study of different types of pearls.
5. Study of different types of fish diseases.
6. Identification of different types of scales in fishes.
7. Study of different types of fins.
8. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.)
9. Identification of various types of natural silks.

TEXT BOOKS

SUGGESTED READINGS

OR

Project Work
Each student has to undertake a project work under the guidance of a teacher and submit the project report in the form of a thesis. There will be a presentation of the project work before an external examiner.

Generic Elective Paper I

Animal Diversity

Unit 1: Protista, Porifera, Radiata, Aceolomates and Pseudocoelomates
General characters of Protozoa; Life cycle of Plasmodium, General characters and canal system in Porifera, General characters of Cnidarians and polymorphism, General characters of Helminthes; Life cycle of Taeniasolium, General characters of Nemethhelminthes; Parasitic adaptations

Unit 2: Coelomate Protostomes, Arthropoda, Mollusca and Coelomate Deuterostomes
General characters of Annelida, Metamerism, General characters, Social life in insects, General characters of mollusca, torsion in gastropod, pearl formation, General characters of Echinodermata, larval form in Echinodermata.

Unit 3: Protochordata, Pisces, Amphibia
Salient features, Osmoregulation, Migration of Fishes, General characters, Adaptations for terrestrial life, Parental care in Amphibia.
Unit 4: Reptiles, Aves and Mammals
Amniotes, Origin of reptiles, Terrestrial adaptations in reptiles, Origin of birds; Flight adaptations, early evolution of mammals; Primates; Dentition in mammals.

PRACTICAL

1. Study of following specimens:

**Non Chordates:** Euglena, Noctiluca, Paramecium, Sycon, Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, T. gigas, Limulus, Hermit crab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias and Antedon.

**Chordates:** Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds-(Crow, duck, Owl), Squirrel and Bat.

2. Study of following Permanent Slides:
Cross section of Sycon, Sea anemone and Ascaris (male and female). T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva

3. Temporary mounts of Septal & pharyngeal nephridia of earthworm.
Unstained mounts of Placoid, cycloid and ctenoid scales.

**TEXT BOOKS**

**SUGGESTED READINGS**

OR

**Insect Vectors and Diseases**

**Unit 1: Insects, Concept of Vectors, Insects as Vectors**
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with reference to 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 with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera
Unit 2: Dipteran as Disease Vectors
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; Control of Sand fly, Study of house fly as important mechanical vector, Myiasis, Control of house fly

Unit 3: Siphonaptera and Siphunculata as Disease Vectors
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

Unit 4: Hemiptera as Disease Vectors
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

PRACTICAL
1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: Aedes, Culex, Anopheles, Pediculushumanuscorporis, Phthirus pubis, Xenopsylla cheopis, Cimexlectularius, Phlebotomus argentipes, Musca domesticathrough permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors.
4. Submission of a project report on any one of the insect vectors and disease transmitted.

TEXT BOOKS

SUGGESTED READINGS

Generic Elective Paper II

Aquatic Biology

UNIT 1: Aquatic Biomes
Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, Streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs

UNIT 2: Freshwater Biology
**Streams:** Different stages of stream development, Physico-chemical, environment, Adaptation of hill-stream fishes.

**UNIT 3: Marine Biology**
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

**UNIT 4: Management of Aquatic Resources**
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment-BOD and COD.

**PRACTICAL**
1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free, Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from nearby lake/water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
5. A Project Report on a visit to a Sewage treatment plant/Marine bioreserve/ Fisheries Institutes.

**TEXT BOOKS**

**SUGGESTED READINGS**
4. Trivedi and Goyal : Chemical and biological methods for water pollution studies
5. Welch : Limnology Vols. I-II

**OR**

**Food, Nutrition And Health**

**Unit 1: Basic concept of food and nutrition**
Food Components and food-nutrients, Concept of a balanced diet, nutrient needs and dietary pattern for various groups, adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

**Unit 2: Nutritional Biochemistry:**
Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions
Unit 3: Health
Introduction to health- Definition and concept of health, Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications, Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention, Common ailments- cold, cough, and fevers, their causes and treatment

Unit 4: Food hygiene:
Potable water- sources and methods of purification at domestic level Food and Water borne infections: Bacterial infection: Cholera, typhoid fever, dysentery; Viral infection: Hepatitis, Poliomyelitis, Protozoan infection: amoebiasis, giardiasis; Parasitic infection: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and preventionBrief account of food spoilage: Causes of food spoilage and their preventive measures

PRACTICAL
1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
3. Estimation of Lactose in milk
4. Ascorbic acid estimation in food by titrimetry
5. Estimation of Calcium in foods by titrimetry
6. Study of the stored grain pests from slides/ photograph (Sitophilus oryzae, Trogodermagranarium, Callosobruchuschinensisand Triboliumcastaneum): their identification, habitat and food sources, damage caused andcontrol. Preparation of temporary mounts of the above stored grain pests.
7. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups. OR Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price OR Study of nutrition labeling on selected foods

TEXT BOOKS

SUGGESTED READINGS
1. Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
2. Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
3. Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO
Generic Elective Paper III

Human Physiology

Unit 1: Digestion and Respiratory Physiology
Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (in brief), Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

Unit 2: Functioning of Excitable Tissue (Nerve and Muscle)
Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fiber); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction

Unit 3: Renal Physiology and Cardiovascular Physiology
Functional anatomy of kidney, Mechanism and regulation of urine formation, Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

Unit 4: Endocrine and Reproductive Physiology
Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle.

PRACTICAL
2. Preparation of haemin and haemochromogen crystals.
3. Estimation of haemoglobin using Sahli’s haemoglobinometer.
4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.

TEXT BOOKS

SUGGESTED READINGS
OR

Environment And Public Health

UNIT 1: Environmental hazards
Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

UNIT 2: Pollution
Air, water, noise pollution sources and effects, Pollution control; Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit 3: Waste Management Technologies
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, biomedical waste handling and disposal, nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath

UNIT 4 Diseases
Causes, symptoms and control of: Tuberculosis, Asthma, Cholera, Typhoid, Malaria and AIDS

PRACTICAL (Credits 2)
1. To determine pH, Cl, SO₄, NO₃ in soil and water samples from different locations.

TEXT BOOKS
2. Park K (2017) Parks Text Book Of Preventive & Social Medicine, Banarsidas Bhanot Publishers

SUGGESTED BOOKS
Generic Elective Paper IV  
Animal Biotechnology

UNIT 1: Introduction and Techniques in Gene manipulation  
Concept and Scope of Biotechnology, Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes, Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, HAC. Shuttle and Expression Vectors, Construction of Genomic libraries and cDNA libraries, Transformation techniques: microbial, plants and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium, Phosphate Precipitation method.

UNIT2: Animal cell Culture  
Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting and DNA microarrays

UNIT 3: Fermentation  
Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized, Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization

UNIT 4: Transgenic Animal Technology and Application in Health  
Production of transgenic animals: nuclear transplantation, retroviral method, DNA microinjection method, Dolly and Polly, Development of recombinant Vaccines, Hybridoma technology, Gene Therapy, Production of recombinant Proteins: Insulin and growth hormones.

PRACTICAL  
1. Packing and sterilization of glass and plastic wares for cell culture.  
2. Preparation of culture media.  
3. Preparation of genomic DNA from E. coli/animals/ human.  
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).  
5. Restriction digestion of lambda (λ) DNA using EcoRI and Hind III.  
6. Preparation of competent cells and Transformation of E. coli with plasmid DNA using CaCl2, Selection of transformants on X-gal and IPTG (Optional).  
7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays.

TEXTBOOKS  

SUGGESTED READINGS  
Unit 1: Cells and Plasma Membrane
Prokaryotic and Eukaryotic cells, Various models of plasma membrane; Transport across membranes, The Endoplasmic Reticulum; Golgi apparatus; Lysosomes; Structure and function of mitochondria

Unit 2: Nucleus, cell division
Ultra structure of nucleus; Mitosis, Meiosis, Cell cycle and its regulation

Unit 3: Nucleic Acids and DNA Replication
Salient features of DNA double helix; Watson and Crick model of DNA, Structure of RNA, tRNA, DNA Replication in prokaryotes and eukaryotes; Mechanism of DNA replication

Unit 4: Transcription and Translation
Mechanism of transcription in prokaryotes and Eukaryotes, Process of protein synthesis in prokaryotes and translation

PRACTICAL
1. Study of prokaryotic and eukaryotic cell types through permanent slides.
2. Study of mitosis and meiosis through squashing in Grasshopper.
3. Demonstration of transport through cell membrane.
4. Preparation of DNA and RNA models.
5. Demonstration of protein synthesis through models.

TEXT BOOKS

SUGGESTED READINGS
# ZOOLOGY Papers for PASS students

- **Discipline Specific Core** – 4 papers
- **Discipline Specific Elective** – 2 papers
- Marks per paper - Midterm: 15 marks, End term: 60 marks, Practical: 25 marks,
- Total – 100 marks
- Credit per paper – 6
- Teaching hours per paper – 40 hours (theory) + 20 hours (practical)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Opted</th>
<th>Course Name</th>
<th>Credit</th>
<th>Marks</th>
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<tbody>
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<td>Semester-I</td>
<td>DSC-1(Theory)</td>
<td>Non-Chordata, Chordata, Comparative Anatomy, Evolution and Animal Behaviour</td>
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<td>Semester-IV</td>
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</table>
Discipline Specific Core Paper I

Non-Chordata, Chordata, Comparative Anatomy, Evolution
and Animal Behaviour

Unit 1: Non-Chordata
General characteristics and classification up to classes, Locomotion and reproduction in Protozoa, Canal system in sponges, Corals and coral reefs, Life cycle of Fasciola hepatica, Metamerism in Annelida, Metamorphosis in insects, Foot in Mollusca. Larval forms in Echinodermata.

Unit 2: Chordata & Comparative anatomy

Unit 3: Evolution
Lamarckism, Darwinism, Neo-Darwinism, Phylogeny of human, Natural selection, Modes of speciation (Allopatric, Sympatric and Parapatric).

Unit 4: Animal Behaviour
Primary and secondary orientation, Taxes of animals, Social structure in honey bee, Pheromones, Biological clocks.

PRACTICAL
1. Morphology of Paramecium, Binary fission and conjugation in Paramecium.
2. Life stages of Plasmodium vivax.
4. Study of adult Fasciola hepatica Study of adult Ascaris lumbricoides
5. Balanoglossus, Herdmania and Branchiostoma

TEXT BOOKS
Discipline Specific Core Paper II

Cell Biology, Genetics, Conservation Biology, Biostatistics and Aquatic Biology

Unit 1: Cell Biology
Prokaryotic and Eukaryotic cells, Plasma membrane, Lysosomes, Mitochondria, Ultrastructure of nucleus.

Unit 2: Genetics
Ultrastructure of chromosomes, Sex-linked inheritance, Chromosomal mechanisms of sex determination, Chromosomal and Gene mutation.

Unit 3: Conservation Biology & Aquatic Biology
Importance of conservation, Ex situ and In situ conservation methods, Evaluation and management of wildlife, Wildlife (Protection) Act, 1972, Protected areas (Sanctuaries, National Parks, Biosphere reserves). Physico-chemical condition of water of fish pond, Composite pisciculture, Ornamental pisciculture,

Unit 4: Biostatistics
Measures of central tendency (mean, median and mode), Measures of dispersion (Standard deviation), Hypothesis and testing of hypothesis (chi square test, t test and Z test), Correlation and regression analysis.

PRACTICAL
1. Study various stages of mitosis from permanent slides.
2. Study various stages of meiosis from permanent slides.
4. Study of oral squamous cells.
5. Study of different types of aquatic insects and aquatic weeds.
6. Study of different types of major carps, minor carps and catfishes.
7. Mounting of cycloid andctenoid scales of fish.

TEXT BOOKS
Discipline Specific Core Paper III

Developmental Biology, Immunology, Endocrinology and Microbiology

Unit 1: Developmental Biology
Gametogenesis (Spermatogenesis, Oogenesis), Types of eggs, early development of frog and chick up to gastrulation, Placenta.

Unit 2: Immunology
Cells and organs of the immune system, Antigens, Structure and functions of different classes of immunoglobulin, Vaccines.

Unit 3: Endocrinology
Types of endocrine glands of human body, Classification of hormones and mechanism of hormone action, Structure and function of Pituitary, Thyroid and Gonads.

Unit 4: Microbiology
Structure of a typical bacterium, Structure of bacteriophage, Bacterial and viral diseases of human, Microbes of food, agriculture and industry.

PRACTICAL
1. 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).
2. Temporary preparation of chick embryo.
3. ABO blood group determination.
6. Slides of different mammalian endocrine glands.

TEXT BOOKS
Discipline Specific Core Paper IV

Physiology, Biochemistry and Molecular Biology

Unit 1: Physiology I
Digestion, Structural organization, histology and functions of gastrointestinal tract and its associated glands, Mechanical and chemical digestion of food, Respiration: Transport of respiratory gases, Structure of heart and cardiac cycle, Composition and clotting of blood, Blood group.

Unit 2: Physiology II
Excretion in human, Structure of neuron and transmission of nerve impulse, Structure of skeletal muscle and muscle contraction.

Unit 3: Biochemistry I
Structures and properties of important mono-, di- and polysaccharides, Fatty acids, triglycerides and steroids, Amino acids and Proteins. Glycolysis, Citric acid cycle, β-oxidation of saturated fatty acids, Urea cycle.

Unit 4: Molecular Biology
Structure and types of DNA and RNA, DNA replication, Genetic code, Transcription and Translation.

PRACTICAL
1. Enumeration of red blood cells using haemocytometer.
2. Estimation of haemoglobin using Sahli’s haemoglobinometer.
3. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose).
5. Action of salivary amylase under optimum conditions.

TEXT BOOKS
Discipline Specific Elective Paper I
Economic Zoology

Unit 1: Bee-keeping and Bee Economy (Apiculture)
Varieties of honey bees, Setting up an apiary: Lang troth’s/Newton’s hive, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees, artificial diet, Diseases of honey bee, honey extraction techniques, -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 offish, 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, Fish by-products. Prawn farming, Culture of crab, Pearl culture and Culture of air breathing fishes.

Unit 4: 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.

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

TEXT BOOKS
Discipline Specific Elective Paper II
Wildlife Conservation And Management

Unit 1:  Wildlife: Values of wildlife, positive and negative; Our conservation ethics, Importance of conservation, Causes of depletion and World conservation strategies. Habitat analysis; Management of habitats; Biological parameters: food, cover, forage, browse and cover estimation, Standard evaluation procedures: remote sensing and GIS

Unit 2: Population estimation: Population density, Natality, Birth rate, Mortality, fertility Schedules and sex ratio computation, Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method


Unit 4: Management of excess population & translocation, Bio- telemetry, Care of injured and diseased animal, Quarantine and common diseases of wild animal, Protected areas National parks & sanctuaries, Community reserve, Important features of protected areas in India, Tiger conservation: Tiger reserves in India and Management challenges in Tiger reserve.

PRACTICALS
1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna.
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker’s 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).

TEXT BOOKS
OPTIONAL FOR SECC II PAPER

SKILL ENHANCEMENT COURSE (SECC II Option I)

Apiculture

**Unit 1**: History – Biology and classification of honey bee species of honey bees, Social Organization of honey bee colony.

**Unit 2**: Bee hive, Flora for apiculture, Selection of bees for apiculture, Method of bee Keeping and Indigenous method of extraction of honey.

**Unit 3**: Modern methods of apiculture, Appliances for modern method, Products of bee keeping: Honey, Bee wax, Chemical composition and economic importance of honey bee wax.

**Unit 4**: Diseases of honey bee and control measures, Bee enemies, Bee keeping industry, Modern method in employing honey bees for cross pollination in horticultural gardens.

**TEXT BOOKS:**


SKILL ENHANCEMENT COURSE (SECCII Option II)

Aquarium Fish Keeping

**Unit 1**: The potential scope of aquarium Fish Industry as a cottage Industry, Exotic and endemic species of aquarium Fishes, Food and feeding of aquarium fishes, Use of live fish feed organisms, Preparation and composition of formulated fish feeds.

**Unit 2**: 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.

**Unit 3**: Live fish transport, Fish handling, packing and forwarding techniques, General aquarium maintenance, budget for setting up an aquarium fish farm as a cottage industry.

**Unit 4**: Health education in India, WHO programmes, Government and voluntary Organizations and their health services, Precautions, First Aid and awareness on sporadic diseases.

**TEXT BOOKS**

SKILL ENHANCEMENT COURSE (SECC Option III)

Medical Diagnostics

Unit 1: Introduction to Medical Diagnostics and its Importance

Unit 2: Diagnostic Methods Used for Urine Analysis
Urine, Composition of urine, Urine Analysis: Physical characteristics; Abnormal constituents of urine.

Unit 3: Non-infectious Diseases and Infectious Diseases
Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit, Commercial diagnostic kits for identification of infectious diseases. Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis.

Unit 4: Tumours
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

TEXT BOOKS

SUGGESTED READINGS
2. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
3. Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
5. Chand and Co. Ltd.

SKILL ENHANCEMENT COURSE (SECC Option IV)

Research Methodology

Unit 1: Foundations of Research
Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs applied.

Unit 2: Research Design
Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.


Unit 3: Data Collection, Analysis and Report Writing

Unit 4: Ethical Issues
Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.

TEXT BOOKS

SUGGESTED READINGS
2. Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, Universal Law publishing

SKILL ENHANCEMENT COURSE (SECC Option V)

Sericulture

Unit 1: Biology of Silkworm
Life cycle of Bombyxmori, Structure of silk gland and secretion of silk, Sericulture: Definition, history and present status; Silk route, Types of silkworms, Distribution and Races, Exotic and indigenous races, Mulberry and non-mulberry Sericulture.

Unit 2: Rearing of Silkworms
Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances, Disinfectants: Formalin, bleaching powder, RKO, Silkworm rearing technology: Early age and Late age rearing, Types of mountages, Spinning, harvesting and storage of cocoons.

Unit 3: Pests and Diseases
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates, Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial, Control and prevention of pests and diseases.

Unit 4: Entrepreneurship in Sericulture
Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various, sericulture centers.

TEXT BOOKS
SUGGESTED READINGS
1. M. S. Jolly, Appropriate Sericultural Techniques; (Ed., Director,) CSR & TI, Mysore.
Part of syllabus (ZOOLGY B.Sc. ) to be covered in Refresher Course

Theory
1. Linear and Y-shaped food chains
2. Energy flow through the ecosystem
4. Laws of limiting factors
5. Gause’s Principle with laboratory and field examples
6. Hypothesis and hypothesis testing (Chi-square test, t- test)
7. Global warming and Climate change
8. Impacts of environmental disturbances
9. Biodiversity patterns and global biodiversity hot spots; India as a mega-biodiversity nation
10. Solid waste management: Control measures of urban and industrial wastes
11. Convention on Biological Diversity (CBD)
12. Mitochondrial Respiratory Chain
13. Chemi-osmotic hypothesis
14. Cell signaling
15. Origin of chordates and Tetrapoda (Evolution of terrestrial ectotherms)
16. Adaptive radiation in mammals
17. Plate tectonic and Continental drift theory
18. Distribution of vertebrates in different realms
19. Ossification, bone growth and resorption
20. Neural receptors and transmission
21. Hypothalamus-Pituitary & Gonadal axis
22. Mechanism of hormone action
23. Structural organization of Proteins
24. Hypo-Hyperchromaticity of DNA
25. Enzyme kinetics
26. Respiratory pigments
27. Regulation of water and acid-base balance
28. Haemoglobin and haemopoiesis
29. Cardiac cycle
30. Biological oxidation reduction reactions
31. Oxidative Phosphorylation
32. Electron Transport System
33. DNA Damage & Repair
34. Regulation of transcription and translation
35. RNA editing
36. Operon concept
37. Gene silencing
38. RNA interference
39. Polygenic inheritance
40. Chromosome mapping
41. Molecular mechanisms of recombination
42. Detection of mutations
43. Molecular mechanism of sex determination in *Drosophila* and Man
44. Transposons
45. Cell-Cell interaction
46. Pattern formation
47. Differential gene expression
48. Metamorphosis and Regeneration
49. Teratogenesis
50. *In vitro* fertilization
51. Stem cell
52. Natural selection
53. Genetic drift
54. Species concept and Speciation
55. Phylogenetic trees
56. Insect vectors borne diseases and their control
57. RNA world & origin of life
58. Extinctions
59. Hardy-Weinberg Law
60. Coral reefs diversity and their role in ecosystem
61. Origin and morphometry of lakes
62. Adaptation of hill-stream fishes.
63. Eutrophication and management of aquatic resources and conservation (legislations), Sewage
64. Nutritional Biochemistry
65. Life style related diseases
66. Social health problems
67. Food spoilage and their preventive measures
68. Environmental hazards
69. Effect of climate change on public health
70. Biomedical waste handling and disposal
71. Nuclear waste handling and disposal
72. Waste from thermal power plants
73. Cloning Vectors
74. Genomic libraries and cDNA libraries
75. Cloning in mammalian cells, Integration
76. Animal cell culture and organ culture
77. DNA sequencing
78. DNA Fingerprinting and DNA microarrays
79. Transgenic animals
80. Development of recombinant Vaccines
81. Gene Therapy
82. Artificial beehives and cross pollination
83. Aquarium Fish Industry
84. Hypertension
85. Commercial diagnostic kits
86. Research Design
87. Technical Reports and Thesis writing
88. Intellectual property Rights and Patent law
89. Plagiarism
90. Entrepreneurship in Sericulture
91. Behaviour as a basis of evolution
92. Social Behaviour in Honey bee
93. Biological clocks, and Circadian rhythms
94. Restriction enzymes
95. DNA Finger Printing
96. Transgenic animals
97. Molecular diagnosis of genetic diseases
98. Cells of the Nervous system
99. Neurotransmitters
100. Neurodegenerative diseases
101. Psychological disorders
102. MHC molecules
103. Therapeutics Cytokines
104. Complement System
105. Hypersensitivity
106. Advances in vaccine production
107. Sustainable aquaculture
108. Census methods in wildlife
109. Common diseases of wild animals
110. Eco tourism
111. Bee Economy
112. Dairy or poultry farm management and business plan
113. Developing Projects for students

Practical
1. Examination of pond water collected from different places for diversity in protista.
2. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
3. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community.
4. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
5. Preparation of permanent slide to demonstrate: DNA by Feulgen reaction; DNA and RNA by MGP; Mucopolysaccharides by PAS reaction; Proteins by Mercuric bromophenol blue/Fast Green
6. Microtomy: Preparation of permanent slides/photographs/computer models of any five types of mammalian (Goat/rat, etc) tissues
8. Effect of pH, temperature and inhibitors on the action of salivary amylase/Urease/acid or alkaline phosphatases
9. Demonstration of proteins separation by SDS-PAGE.
10. Determination of ABO Blood group
11. Estimation of total protein in given solutions
12. Detection of SGOT and SGPT or GST and GSH in serum/tissue
13. To study the enzymatic activity of Trypsin/Lipase.
14. To perform the Acid and Alkaline phosphatase assay from serum/tissue.
15. Study of Polytene chromosomes from Chironomous/Drosophila larvae
16. Preparation of liquid culture medium (LB) and raise culture of E. coli
17. Study of Mendelian laws and gene interactions.
18. Linkage maps based on data from conjugation, transformation and transduction.
19. Linkage maps based on data from Drosophila crosses.
22. Study of homology and analogy from suitable specimens
23. Study and verification of Hardy-Weinberg Law by chi square analysis
24. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
25. Determine the area of a lake using graphimetric and gravimetric method.
26. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
27. Estimation of Lactose in milk
28. Ascorbic acid estimation in food by titrimetry
29. Estimation of Calcium in foods by titrimetry
31. Preparation of genomic DNA from E. coli/animals/human.
32. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays.
33. Study of mitosis and meiosis through squashing in Grasshopper.
34. Plasmid DNA isolation (pUC 18/19) from E. coli
35. Restriction digestion of plasmid DNA/Lambda Phage DNA
36. Construction of circular and linear restriction map from the data provided.
37. Estimation of plasma level of any hormone using ELISA
38. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
40. Study of neurons and/or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
41. Human vaginal exfoliate cytology.
42. Sperm count and sperm motility in rat
43. Demonstration of ELISA.
44. Demonstration of Bone marrow smears to study Immune cells.
45. Demonstration of different field techniques for flora and fauna.
46. Trail/transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)
## List of instruments/equipments

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<td>Stereo Microscope</td>
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<td>Haemocytometer</td>
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<td>UV-Visible Spectrometer</td>
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<td>Bench Top Centrifuge</td>
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<td>18</td>
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