

Syllabus of Zoology

Section- C

UNIT-1

Biochemistry and cellular organization

- A. Composition, structure and function of biomolecules (Carbohydrates, lipids, proteins, nucleic acid and vitamins)
- B. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
- C. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
- D. Structure stability of protein and nucleic acid structure.
- E. Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.
- F. Membrane structure and function : Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- G. Structural organization and function of intracellular organelles: cell wall, nucleus, mitochondria, golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.
- H. Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.
- I. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

UNIT-2

Cell and its fundamental Processes

- A. DNA replication, repair and recombination: Unit of replication, enzymes involved in replication, origin and replication fork, extra chromosomal replica; DNA damage and repair mechanisms,

- B. RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.
- C. Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination genetic code, aminoacylation of rRNA, rRNA-identity, rRNA synthesis, translational proof-reading, translational inhibitors, post- translation modification of protein.
- D. Control of gene expression at transcription and translation level: Regulation in phages, viruses, prokaryotic and eukaryotic gene expression. role of chromatin in regulating gene expression and gene silencing.
- E. Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal host cell, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals cell, cell fusion in both normal and abnormal cell.
- F. Cell signaling: hormones and their receptor, cell surface receptor, signaling through G- protein coupled receptors, signal transduction pathways, second messengers regulation of signaling pathways, bacterial signaling systems, bacterial chemotaxis and quorum sensing.
- G. Cellular communication : Regulation of hematopoiesis, general principles of cell communication, cell adhesion and role of different adhesion molecules, gap junctions, extracellular matrix, neurotransmission and its regulation.
- H. Cancer: Genetic rearrangements in progenitor cell, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cell with normal cell, apoptosis, therapeutic interventions of uncontrolled cell growth.

UNIT- 3

Developmental Biology

- A. Basic concepts of development: Potency, commitment, specification, induction competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the

- cytoplasmic determination; imprinting; mutants and transgenic in analysis of development.
- B. Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development, zygote formation, cleavage, blastula formation, embryonic folds, gastrulation and formation of germ layers in higher vertebrates; embryogenesis.
 - C. Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in *Drosophila* *amphibia* and chick; organogenesis- vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates, differentiation of neurons. post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.
 - D. Programmed cell death, aging and senescence.
 - E. Placentation in mammals.

UNIT-4

Structure and Function of Different - organ- system and Invertebrates

- A. Origin of metazoa, organization of coelom (Acoelomates, Pseudocoelomates and coelomates)
- B. Locomotion- Amoeboid, flagellar and ciliary movement in protozoa, Hydrostatic movement in coelenterata, Locomotion in Annelida and Echinodermata.
- C. Nutrition & Digestion, pattern of feeding and digestion in lower metazoa, Mollusca ; Echinodermata, filter feeding in Polychaeta.
- D. Respiration- Organs of respiration: Gills, lungs and trachea respiratory pigments, mechanism of respiration.
- E. Excretion- Excretion in lower and higher invertebrates.
- F. Mechanism of Osmoregulation in invertebrates.
- G. Nervous system - primitive and advanced nervous system.
- H. Larval forms and their evolutionary significance in Helminths, Arthropodes, Molluscs and Echinodermates.
- I. Structure, affinities and life history of- Rotifera, Entoprocta, Phoronida and Ectoprocta.

UNIT- 5

Structure and Function of Different organ-systems of Lower & Higher Vertebrates -

- A. Integumentary system in vertebrates
- B. Blood: Blood corpuscles, haemopoiesis, plasma function, blood volume regulation, blood groups. hemoglobin, haemostasis.
- C. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, , ECG- its principle and significance, cardiac cycle, heart as pump, blood pressure, neural and chemical regulation.
- D. Respiratory system: Comparative anatomy of respiratory organs, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
- E. Nervous, system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
- F. Sense organs: Vision, hearing and tactile response.
- G. Excretory system : Comparative anatomy of kidney and physiology of excretion, urine formation, urine concentration, waste elimination micturition, regulation of water balance, electrolyte balance, acid base balance.
- H. Thermoregulation : Comfort zone, body temperature- physical, chemical, neural regulation, acclimatization.
- I. Stress and adaptation.
- J. Digestive system: Digestion, absorption, energy balance, BMR.
- K. Endocrinology: Endocrine glands, basic mechanism of hormone action, hormones and diseases; neuroendocrine regulation.
- L. Urino-genital system and reproduction process in vertebrates.

UNIT- 6

Inheritance biology and Taxonomy

- A. Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance.
- B. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests.

- C. Extensions of Mendelian principles: Codominance, Incomplete dominance, gene interactions, pleiotropy. genomic imprinting, penetrance and expressivity, phenocopy. linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- D. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids
- E. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.
- F. Microbial genetics: Methods of gene transfers - transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes .
- G. Human genetics: Pedigree analysis, karyotypes , genetic disorders.

- H. Principles and methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical and quantitative methods of taxonomy of plants, animals and microorganisms.

- I. Important criteria used for classification in each taxon; classification of animals evolutionary relationship among taxa.

UNIT- 7

Ecology and Environment Biology

- A. The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

- B. Habit, Habitat and niche: Major habitat types, Concept of habitat and niche; niche width and overlap: fundamental and realized niche; resource partitioning; character displacement.

- C. Population ecology : Characteristics of a population; population growth curve & population regulation; life history strategies (r and k selection); concept of metapopulation, interdemic extinctions, age structured population.

- D. Species interactions: Types of interactions, interspecific competition and relationship herbivory, carnivory, and Omnivory
- E. Community ecology: Nature of communities; structure and attributes; levels of species diversity and its measurement; edges and ecotones.
- F. Ecological succession: Types; mechanisms; changes involved in succession concept of climax.
- G. Ecosystem: Structure and function; energy flow and mineral cycling (CNP), primary production and decomposition, structure and function of some Indian ecosystems, terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine), Food chain.
- H. Biogeography: Major terrestrial biomes, theory of island biogeography, biogeographical zones of India.
- I. Applied ecology: Environmental pollution, global environmental change, biodiversity-status, monitoring and documentation, major drivers of biodiversity change, biodiversity management approaches.
- J. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).
- K. Pollution : causes, effect and remedy of water, air, soil and sound pollution. Heavy metal pollution and its effect on Human body.

UNIT-8

Evolution and Behaviour

- A. Emergence of evolutionary thoughts: Lamarckism; Darwin-concepts of variation, adaptation, struggle, fitness and natural selection, Devries, spontaneity of mutations; the modern synthetic theory of Evolution.
- B. Origin of cells and unicellular evolution: Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin and Haldane, experiment of Miller (1953), the first cell, evolution of

prokaryotes, origin of eukaryotic cells, evolution of unicellular eukaryotes, anaerobic metabolism, photosynthesis and aerobic metabolism.

- C. Paleontology and evolutionary history: The evolutionary time scale, eras, periods and epoch, major events in the evolutionary time scale, origin of unicellular and multicellular organisms, major groups of animals, stages in primate evolution including homo.
- D. Molecular Evolution : concepts of neutral evolution, molecular divergence and molecular clocks, molecular tools in phylogeny, classification and identifications, protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence.
- E. The mechanisms: Population genetics - population, gene pool, gene frequency, Hardy-Weinberg law, concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modifications, isolating mechanisms, speciation, allopatricity and sympatricity, convergent evolution, sexual selection, co-evolution.
- F. Brain, Behavior and Evolution : Approaches and methods in study of behavior, proximate and ultimate causation, altruism; and evolution-group selection, kin selection, reciprocal altruism; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; development of behavior, social communication, social dominance, use of space and territoriality, mating systems, parental investment and reproductive success, parental care, aggressive behavior, habitat selection and optimality in foraging, migration, orientation and navigation, domestication and behavioral changes.

UNIT-9

Applied Zoology

- A. Common parasites and pathogens of human and domestic animals.
- B. Application of immunological principles (vaccines, diagnostics). Tissue and cell culture methods for animals.

- C. Transgenic animals, molecular approaches to diagnosis and strain identification.
- D. Genomics and its application to health, including gene therapy.
- E. Bioresource and biodiversity.
- F. Breeding in pet animals.
- G. Bioaccumulation and biomagnification.
- H. Biosensors.
- I. Bioindicators.
- J. Culture: Fish culture , frog culture, apiculture, lac culture, silk culture.

UNIT-10

Tools and Techniques

- A. Molecular biology and recombinant DNA methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods, analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, focusing gels, molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems, expression of recombinant proteins using bacterial, animal and plant vectors, isolation of specific nucleic acid sequences, generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vector, in vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms, protein sequencing methods, detection of post- translation modification of proteins, DNA sequencing methods, strategies for genome sequencing, methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques, isolation separation and analysis of carbohydrate and lipid molecules, RFLP, RAPD and AFLP techniques.
- B. Histochemical and immunotechniques : Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow-cytometry and immunofluorescence microscopy, detection of molecules in living cells, in-situ localization by techniques such as FISH and GISH.
- C. Biophysical methods : Analysis of biomolecules using UV-visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR, analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

- D. Statistical Methods: Measures of central tendency and dispersal, probability distributions (Binomial, poisson and normal), sampling distribution, difference between parametric and non-parametric statistics, confidence interval, errors levels of significance, regression and correlation, t-test, analysis of variance, X^2 test, basic introduction to Muetrovariate statistics.
- E. Radiolabeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.
- F. Microscopic techniques: Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission electron microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.
- G. Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, FMRI, CAT.
- H. Methods in field biology : Methods of estimating population density of animals ranging patterns through direct, indirect and remote observations, sampling methods in the study of behaviour, habitat characterization- ground and remote sensing methods.
- I. Computational methods: Nucleic acid and protein sequence databases, data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.
- J. Microtomy : fixation, dehydration, block preparation, sectioning and stretching of tissue; single and double stain staining of histological tissue.

. ----XXXX----