U. P. HIGHER EDUCATION SERVICES COMMISSION, PRAYAGRAJ

Syllabus

ZOOLOGY

(Subject Code-72)

UNIT-1: Molecules and their interaction relevant to Biology :

A. Structure of atoms, molecules and chemical bonds.
B. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
C. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
D. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
E. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes
F. Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).
G. Conformation of nucleic acids (A-,B-,Z-, DNA), t-RNA, micro-RNA).
H. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

UNIT-2: Cellular Organization :

A. **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.
B. **Structural organization and function of intracellular organelles :** Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, vacuoles, structure & function of cytoskeleton and its role in motility.
C. **Organization of genes and chromosomes :** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.
D. **Cell division and cell cycle :** Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.
E. **Microscopic techniques :** Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy.

UNIT-3: Fundamental Processes and techniques :

A. **DNA replication, repair and recombination :** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.
B. **RNA synthesis and processing :** Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, 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 tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins.

D. **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.
Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; 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.

E. **Histochemical and Immunotechniques :** Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy.

F. **Biophysical Method :** 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.

UNIT-4: Cell Communication and cell signaling :

A. **Host parasite interaction :** Recognition and entry processes of different pathogens like bacteria, viruses into animal alteration of host cell behavior by pathogens.

B. **Cell Signaling :** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers.

C. **Cellular Communication :** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

D. **Cancer :** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, senescence.

E. **Innate and adaptive immune system :** Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system.

UNIT-5: Developmental Biology :

A. **Basic concepts of development :** Potency, commitment, specification, induction, competence, determination and differentiation.

B. **Gametogenesis, fertilization and early development:** Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; 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.

UNIT-6: Animal Physiology :

A. **Blood and circulation :** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
B. **Cardiovascular System :** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.
C. **Respiratory system :** Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
D. **Nervous system :** Neurons, action potential, neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and movements.
E. **Sense organs :** Vision, hearing and tactile response.
F. **Excretory system :** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
G. **Thermoregulation :** Comfort zone, body temperature-physical, chemical, neural regulation, acclimatization.
H. **Digestive system :** Digestion, absorption, energy balance, BMR.
I. **Endocrinology and reproduction :** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation, stress and strain.

UNIT-7: Inheritance Biology

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. **Mutation :** Types, causes and detection, mutant types-lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.
F. **Structural and numerical alterations of chromosomes :** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
G. **Recombination :** Homologous and non-homologous recombination, including transposition, site-specific.

UNIT-8: Animal Systematic, Invertebrates and Vertebrates :

A. **Principles & methods of taxonomy :** Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy, animals.
B. **Levels of structural organization:** Unicellular, colonial and multicellular forms; levels of organization of tissues, organs & systems.
C. **Classification of animals :** Important criteria used for classification in each taxon; classification of animals; evolutionary relationships among taxa.
D. **Invertebrate :** Type study of all important animals belong to different plylum of invertebrate.
E. **Vertebrate :** Specific topics : Evolution of chordates, origin and evolution of lungfishes, tetrapodes, poisonous and non-poisonous snakes and biting mechanism, flight adaptation in birds, aquatic and terrestrial mammals.

Unit-9: Ecology:

A. **The Environment :** Physical environment; biotic environment; biotic and abiotic interactions.
B. **Habitat and Niche :** 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 curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation- demes and dispersal, interdemic extinctions, age structured populations.
D. **Species Interactions :** Types of interactions, interspecific competition, herbivory, carnivory, symbiosis.
E. **Community Ecology :** Nature of communities; community 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. **Ecosystems :** Structure and functions; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).
H. **Zoogeography :** Major terrestrial biomes; theory of island biogeography; zoogeographical zones of the world.
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. **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, etc.

UNIT-10:Evolution and behaviour :

A. **Emergence of evolutionary thoughts :** Concepts of variation, adaptation, struggle and natural selection; Synthetic theory of evolution.
B. **Origin of cells and unicellular evolution :** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes.
C. **Evolutionary History :** The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale. Stages in primate evolution including Homo.
D. **The Mechanisms :** Population genetics-Populations, 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.
E. **Animal Behavior :** 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 care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.