SYLLABUS, ZOOLOGY

Max Marks : 100

1. BIOMOLECULAR INTERACTION

A. Structure of atoms, molecules and chemical bonds.
B. Structure of carbohydrates, lipids, proteins, nucleic acids and vitamins.
C. Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding,and hydrophobic interaction.).
D. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, coligative properties).
E. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
F. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
G. Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).
H. Conformation of nucleic acids *(A-*, B-, Z-, DNA), t-RNA, micro-RNA).
I. Stability of protein and nucleic acid structures.
J. Metabolism of lipids, amino acids, nucleotides and vitamins.

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: Plasma membrance, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, structure & function of cytoskeleton and its role in motility.
C. Organization of genes and chromosomes: Operon, interrupterd genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, lheterochromatin, euchromatin, transposons.
D. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

3. MOLECULAR BIOLOGY

A. DNA replication, repair and recombination: unit of replication enzymesinvolved, 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 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 itsfactors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.
D. Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression.

4. CELL COMMUNICATION AND CELL SIGNALING

A. Host parasite interaction: Recognition and entry processes of different pathogens like

bacteria, viruses into host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals cell-cell fusion in both normal and abnormal cells.

B. Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial two-component signaling systems, bacterial chemotaxis and quorum sensing.

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. Concept of oncogenes& its regulation,interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

E. Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. Band T cell epitopes, structure and function of antibody molecules, generation of antibody diversity,monoclonal antibodies and T cells, Band T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediatedeffector functions, inflammation,hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis),parasitic (malaria) and viral (HIV) infections, vaccines.

5. DEVELOPMENTAL BIOLOGY

A. Basic concepts of development: Potency, ommitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and themutants and transgenics in analysis of development.

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,axes and pattern formations in amphibian and chick; organogenesis; differentiation of neurons, post embryonic development-larval metamorphosis; environmental regulation of normal development; sex determination.

D. Programmed cell death, aging and senscence.

6. INHERITANCE BIOLOGY

A. Mendelian principles:Dominance, segregation, independent assortment, deviation from Mendelian inheritance.

B. Concept of gene: Allele, alleles, pseudoallele, complementation tests.

C. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interaction, 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 maternal inheritance .

F. Microbial genetics: Methods of genetic transfer-transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

G. Human genetics: Pedigree analysis,lod score for linkage testing, karyotypes, genetic disorders.

H. Quantitative genetics: Polygenic inheritance, heritability and its measurements,

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

7. DIVERSITY OF LIFE FORMS

A. Principles and methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical and quantitative methods of taxonomy of animals and microorganisms.
B. Levels of structural organization: unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems;
C. Outline classification of bacteria & animals : Important criteria used for classification in each taxon; classification, evolutionary relationships among taxa.

D. Natural history of Indian subcontinent: Major habitat types of the subcontinent, geographic origins and migrations of species; common Indian mammals, birds; seasonality and phenology of the subcontinent.
E. Organisms of health and agricultural importance: Common parasites and pathogens of humans, domestic animals.

8. ECOLOGICAL PRINCIPLES

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, pollination, 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. Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems; terrestrial (forest, desert,grassland) and aquatic (fresh water, marine, estuarine)
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 approachesto management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

9. EVOLUTION AND BEHAVIOUR

A. Emergence of evolutionary thoughts: Lamarck; Darwin-concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutation; the evolutionary synthesis.

B. 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, and aerobic metabolism.

C. Paleontology and evolutionary history; The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; 'major groups of animals; stages in primate evolution including Homo.

D. Molecular Evolution: Concepts of natural evolution, molecular divergence and molecular clocks; molecular tools in pnytogeny, classification and identification; protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence; 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.

E. 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.

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; socialconl 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 navitgation; domestication and behavioral changes.

10. APPLIED BIOLOGY

A. Microbial fermentation and production of small and macro molecules.

B. Application of immunological principles (vaccines, diagnostics). Tissue andcell culture methods for animals.

C. Transgenic animals, molecular approaches to diagnosis and strain identification.

D. Genomics and its application to health and agriculture, including gene therapy.

E. Bioresource and uses of biodiversity.

F. Breeding in animals, including rnarKer- assisted selection.

G. Bioremediation and phytoremediation.

H. Biosensors .•

11. METHODS IN BIOLOGY

A. Molecular biology and recombinant DNA methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, two dimensional gel electrophoresis, isoelectric focusing gels; molecular cloning of DNA or RNA fragments in bacterial,and animal vector, isolation of specific nucleic acid sequences; generation of genomic and cDNA Iibraries in plasmid, phage, cosmid, BAC and YAC vectors; in vitro mutagenesis and deletion techniques,

protein sequencing methods, detection of post-translation medofication of proteins DNA sequencing methods,

B. Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot immunoprecipitaion.

C. Biophysical methods: Analysis of biomolecules using UV/ visible, fluorescence, circular dichroism, NMR and ESR spectroscopy,

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; level of significance; regression and correlation; t-test; X^2 test;

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 ~nd freeze-fracture methods for EM,

F. 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 behavior, habitat characterization-groungand remote sensing methods.

G. Computational methods: Nucleic acid and protein sequence databases; web-based tools for sequence searches, motif analysis and presentation.

12. INVERTEBRATESTRUCTURE AND FUNCTIONS

A. Organization of coelom : Acoelomates, Pseudocoelomates, Coelomates : Protostomia and Deuterostomia, Locomotion : Flagellary and ciliary movement in Protozoa, Hydrostatic movement in Coelenterata, Annelida and Echinodermata

B. Nutrition and Digestion : Patterns of feeding and digestion in lower metazoa, feeding in Annelida, Arthropoda, Mollusca and Echinodermata.

C. Respiration : Organs of respiration : Gills, funds, and trachea; respiratory pigments; Mechanism of respiration; Excretion : Organs of excretion : Coelom, coelomoducts, nephridia and malphigian tubules, coxal gland, Kaber's organ, Bojanus organ: Mechanisms of excretion and osmoregulation.

D. Nervous system : Primitive nerous system : Coelenterata and Echinodermata; Advanced nervous system : Annelida; Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda); Trends in neural evolution.

E. Invertebrate larvae : Larval forms of free-living invertebrates; Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor phyla : Concept and significance, Organization and general characters of Nemertini, Nematophora and Rotifera.

13. VERTEBRATE PHYSIOLOGY

A. Biochemical process of food digestion, absorption and assimilation. Kinds of respiratory pigments, mechanism of breathing and gaseous exchange.

B. Composition and functions fo blood and lymph. Cardiac cycle and heart beat; Clotting factors and blood clotting mechanism.

C. Structure and types of nephrons, mechanism of urine formation and elimination; arginine – ornithine cycle; Osmoregulation. Structure and physiology of eye.

D. Types of muscle, their ultrastructure and physiology of contraction; of various endocrine glands, hormonal abnormalities.

E. Nerve conduction, types of neurotransmitters and their mode of action; cholinergic mechanisms; Thermoregulation, hibernation, bioluminiscence, chromatophores and colour change.