

BIOSYSTEMATICS AND TAXONOMY

Scheme of examination:

MM: 70

1. Each theory paper is divided into FOUR units. There will be FIVE questions in all; each will be of 14 marks.
2. Q. No. 1 will be compulsory and will contain 7 very short answer type questions, each of **two** marks. Questions will be evenly distributed covering the entire syllabus.
3. Q. No. 2, 3, 4 and 5 will be from unit No. I, II, III and IV respectively. Two questions will be set from each unit. First question of the unit will be having two short notes of 7 marks each and second question will be of long answer type of 14 marks. The students may attempt either of the two questions from a unit.

UNIT - I

- Definition and basic concepts of biosystematics and taxonomy.
- History of taxonomy.
- Importance and applications of biosystematics in biology.
- Definition and understanding of various taxonomic categories, **micro and macro taxonomy.**
- Species concepts and species categories –subspecies and infra species.

UNIT – II

Modern trends in taxonomy-

- **Behavioural taxonomy**
- Chemotaxonomy
- Cytotaxonomy
- Molecular taxonomy
- Neotaxonomy
- **Numerical taxonomy.**

UNIT - III

- Taxonomic procedures: collection, preservation, curation and process of identification.
- **Interpretation and application of important rules and formation of scientific names of different taxa.**
- Theories of biological classification.

UNIT - IV

- Different kinds of systematic Publications.
- Taxonomic Keys: their kinds, merits and demerits. Uses of taxonomic keys.
- International Code of Zoological Nomenclature (ICZN)
- Interpretation and application of important rules and formation of scientific names of different taxa.

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BIOLOGY OF INVERTEBRATES

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UNIT I

- Origin of Protozoa, parazoa and metazoa
- Basis of classification
- Classification of invertebrates up to order level.
- Locomotion: Flagella and ciliary movement in Protozoa.
- Hydrostatic movement in Coelenterata, Annelida and Echinodermata.

UNIT II

- Nutrition and Digestion: Strategies of feeding in invertebrates and digestion in lower Metazoa. Feeding in Polychaeta, Mollusca and Echinodermata.
- Respiration: Organs of respiration in invertebrates - Gills, book lungs and trachea. Mechanism of respiration
- Excretion: Organs of excretion in invertebrates specially Coelomoducts, Nephridia and Malphigian tubules, organ of bojanus, green gland. Mechanisms of excretion.

UNIT III

- Nervous System: Primitive nervous system-Coelenterata and Echinodermata. Advanced Nervous system -Annelida, Crustacea, Insecta and Cephalopoda
- Reproduction: Regeneration, Asexual and sexual reproduction.

UNIT IV

- Important systems: Canal system in sponges, parasitic helminthes.
- Proto, meso and metanephridia, Respiration in unio and pila
- Water vascular system in star fish
- Minor Phyla: Organization and general characters, Tardigrada, Entoprocta, Ctenophora, Rhynchocoela, Sipunculida, Rotifera, Gastrotricha

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BIOCHEMISTRY*Scheme of examination:**MM: 70*

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UNIT I

- Scope of biochemistry, Bio molecules, Chemical bonds, pH, Acid, Base, and Buffer, Concept of free energy.
- **Proteins:** Covalent properties of Proteins, Structure and chemistry of amino acids, Isolation and purification of protein, Protein sequencing, Covalent modifications, Protein splicing
- Protein secondary and tertiary structure, Peptides and peptide bonds, Ramchandaran plots and amino acid propensities, Common secondary structures, Protein tertiary structure and, folding patterns , Common tertiary structural motifs.
- Globular and fibrous proteins. Motifs in globular proteins, Fibrous proteins (keratin, fibrin, collagen and elastin)
- Protein folding and thermodynamics, Levinthal paradox, Condensation and molten globules , Chaperone-assisted protein folding
- Amino acid sequence variation and protein misfolding diseases. Allostery (Hemoglobin), Myoglobin structure and oxygen binding
- Hemoglobin subunits cooperatively, the Hill coefficient. Quaternary structure changes and Sickle cell and other molecular diseases

UNIT II

- **Carbohydrates:** Structure and biological importance of Monosaccharide, Oligosaccharides, Polysaccharides(Storage and structural polysaccharides, glycosaminoglycans, Glycoconjugates(glycoprotein and proteoglycans)
- **Lipids:** Fatty acids: structure, nomenclature, acylglycerols, wax, phospholipids, sphingolipids, glycolipids, lipoproteins, Terpenoids and sterols: structure, properties and function of lipids.

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- **Nucleic acid structure:** Nucleotides, Primary, Secondary and tertiary structures of nucleic acids; Triple helices and H-DNA; unusual secondary structure of DNA
- Duplex stability, Hybridization, DNA and RNA sequencing.

UNIT III

- **Vitamins :** Classification, structure, occurrence and functions of fat soluble and water soluble vitamins
- **Enzymes:** Enzyme as biocatalyst, The kinetics of enzyme catalysis , Principles of enzyme catalysis , Proteases, polymerases, other examples,
- Coenzymes and Cofactor, Isozymes,
- Enzyme inhibition, Allosteric enzyme,
- RNA catalysis, Chemistry and structure of ribozymes, Evolutionary implications
Enzymes as biosensor

UNIT IV

- **Metabolism :** Catabolism, anabolism, Metabolic pathway, regulation, concept of free energy
- **Carbohydrate metabolism:** Enzymatic reaction, regulation and importance of Glycolysis, Citric acid cycle. Pentose phosphate pathway, glycogenolysis, glycogenesis.
- **Lipid metabolism:** fatty acid oxidation and biosynthesis, Beta-oxidation,
- **Amino acid metabolism:** Catabolism of amino acid, transamination, deamination, biosynthesis of nonessential amino acid, fate of carbon skeleton.
- **Nucleotide metabolism:** Degradation of purine and pyrimidines nucleotides, biosynthesis (De novo, salvage pathways) of purine and pyrimidine nucleotides
Oxidative phosphorylation and mechanism of ATP biosynthesis.
- **Inborn error of metabolism:** (Important diseases of carbohydrate, protein, lipid nucleotide metabolism).

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BIostatISTICS AND BIOinformatics*Scheme of examination:***MM: 70**

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UNIT I

- Introduction to Biostatistics - Definitions of biostatistics, Statistical symbols, Scope & Applications of biostatistics, Collection, organization and representation of data.
- Measures of central tendency and Variability
- Mean, median and mode, Mean deviation, Standard deviation and standard error Variance and coefficient of variation.
- Correlation and Regression, Types of correlation, Methods of studying correlation, Regression analysis.

UNIT II

- Tests of Significance
- Hypothesis testing and level of Significance, Significance of difference in means, Student's t-test, F-test.
- Analysis of Variance, One-way classification, Two-way classification
- Chi-square test, testing goodness of Fit, Chi-square distribution and characteristics, Applications of Chi-square test, Yate's correction.

UNIT III

- Introduction to Bioinformatics, Definitions of bioinformatics, Applications of bioinformatics, Scope of bioinformatics, Bioinformatics in India
- Biological Databases, Primary, secondary and composite databases,
- Nucleotide sequence databases, Protein sequence databases, Structural databases

UNIT IV

- Sequence Analysis, Types of sequence alignment, Methods of sequence alignment, Scoring schemes, Gaps and gap penalties
- Genomics : Structural genomics, Functional genomics, Comparative genomics
- Proteomics: Classification of proteomics, Data mining in proteomics, Significance of proteomics

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EVOLUTION AND POPULATION GENETICS

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3. Q. No. 2, 3, 4 and 5 will be from unit No. I, II, III and IV respectively. Two questions will be set from each unit. First question of the unit will be having two short notes of 7 marks each and second question will be of long answer type of 14 marks. The students may attempt either of the two questions from a unit.

UNIT I

- Organic Evolution: Concepts of evolution and theories of organic evolution- Lamarckism, Darwinism, Neo- Darwinism.
- Detailed account of destabilizing forces- Natural selection, Mutation, Genetic drift, Migration, Meiotic drive
- Population genetics: Genetic structure of natural populations, Models explaining changes in genetic structure of population. Hardy-Weinberg law of genetic equilibrium

UNIT II

- Genetics of speciation: Phylogenetic , biological and other concepts of species, Patterns and mechanisms of reproductive isolation, Models of speciation (Allopatric, sympatric, parapatric, peripatric), Co-evolution and sexual selection, altruism, punctuated equilibrium, phyletic gradualism
- Molecular phylogenetics: Gene duplication and divergence, Patterns of change in nucleotide and amino acid sequences, Ecological significance of molecular variations

UNIT III

- Genetics of Quantitative traits in populations: Analysis of quantitative traits, Quantitative traits and natural selection, Estimation of heritability, Genotype-environment interactions, **Inbreeding and Heterosis**, Phenotypic plasticity
- Molecular Evolution: Gene Evolution, Evolution of gene families, Molecular drive, **Molecular Clocks**.

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PHYSIOLOGY

Scheme of examination:

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3. Q. No. 2, 3, 4 and 5 will be from unit No. I, II, III and IV respectively. Two questions will be set from each unit. First question of the unit will be having two short notes of 7 marks each and second question will be of long answer type of 14 marks. The students may attempt either of the two questions from a unit.

UNIT-I

- **Digestive system:** Nature of food-stuff, Various types of digestive enzymes and their action in alimentary canal, Absorption and assimilation of food
- **Nervous** and hormonal control of digestion, Energy balance
- **Circulatory system:** Composition and function of blood, Haemopoiesis, blood clotting, Blood volume, blood volume regulation
- Comparative anatomy of heart structure, myogenic heart,
- ECG – its principle and significance, cardiac cycle, Heartbeat, blood pressure.
- **Respiratory system:** Respiratory organs (gills, trachea and lungs), respiratory pigments, Mechanism of breathing, Physiology of respiration, control of breathing, BMR.

UNIT-II

- **Excretory system:** Comparative physiology of excretion, functional architecture of kidney and nephron,
- Nitrogenous end products, formation of urine and its hormonal control,
- Role of kidney in osmoregulation, urine concentration, Waste elimination, micturition, Electrolyte balance, acid-base balance.
- **Muscular system:** Types and properties of muscles, Functional architecture of skeletal muscles, Biophysical and biochemical events during muscular activity.
- **Nervous system:** Functional architecture of neurons,
- Origin and propagation of nerve impulse through axon, Action potential, synaptic transmission,
- Reflex arc and reflex action, Gross neuroanatomy of the brain and spinal cord, Central and peripheral nervous system,
- Neural control of muscle tone and posture.

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UNIT-III

- **Sense organs:** Structural architecture and functioning of eyes and ears, tactile response.
- **Thermoregulation and cold tolerance:** Heat balance and exchange, endotherms Vs ectotherms, Counter-current heat exchanger, Torpor, hibernation and aestivation, Adaptations to extreme climate, Comfort zone,
- **Body temperature-** physical, chemical and neural regulation.
- **Stress:** Basic concepts of environmental stress and strain, Homeostasis, physiological response to body exercise,
- **Meditation, yoga and their effects.**

UNIT-IV

- **Endocrinology:** Endocrine glands in vertebrates, hormones and related diseases.
- **Reproduction:** Reproductive cycle, Reproductive processes (implantation, parturition and lactation),
- **Neuroendocrine regulators in insects and mammals, pheromones.**

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MOLECULAR BIOLOGY & BIOTECHNOLOGY

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UNIT I

- DNA replication: Prokaryotic and eukaryotic DNA replication. Mechanics of DNA replication. Enzymes and accessory proteins involved in DNA replication.
- Recombination and repair, Holiday junction. FLP/FRT and Cre-Lox recombination. Rec A and other recombinases. DNA repair mechanisms.

UNIT II

- Transcription- Prokaryotic and Eukaryotic transcription. Regulatory elements and mechanisms of transcription regulation. Transcription termination – attenuation and anti-termination. Gene silencing.
- Post-transcriptional modifications in RNA, 5'- Cap formation. End processing and polyadenylation. Splicing and editing. Nuclear export of mRNA. RNA stability.

UNIT III

- Translation - Genetic code, Prokaryotic and eukaryotic translation, Regulation of translation, Co- and post-translation modifications of proteins.
- Organelles and protein sorting - Translocation of secretory proteins across the ER membrane, Insertion of membrane proteins in the ER membrane, Post-translation modifications in ER, Synthesis and targeting of mitochondrial and chloroplast proteins, Golgi apparatus-glycosylation, protein sorting and export, Molecular mechanisms of vesicular traffic. Synthesis and targeting of peroxisomal proteins.

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UNIT IV

- Molecular mapping of genome - Genetic and physical maps, Southern hybridization, fluorescence in *situ* hybridization (FISH) for genome analysis. Molecular markers in genome analysis(RFLP, RAPD and AFLP)
- Application of RFLP in forensic, disease prognosis, genetic counseling and pedigree analysis.
- Transgenic animals and knock-outs – Production, Applications , Embryonic stem cells, Bioethics
- Assisted reproduction technologies - Embryo sexing and cloning.
- Screening for genetic disorders- ICSI, GIFT etc.
- Cloning of animals by nuclear transfer.

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ECONOMIC ZOOLOGY

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UNIT-I

- Economic importance of Protozoa: Beneficial and Harmful Protozoa.
- Economic importance of Helminthes: Beneficial and Harmful Helminthes.
- Economic importance of Arthropods: Beneficial and Harmful mites and ticks, crustaceans, spiders, insects.
- Insects as pollinators, ornamental insects, as food.
- Lac insect, Honey bees, Silk worm and industries related to them.
- Harmful insects: - Insect pests: crop pests, storage pests, pests of fruits and vegetables, Pests of medical and veterinary importance and their management.

UNIT-II

- Pisciculture and products of fishing industry - Common Freshwater and Marine Food Fishes of India.
- Freshwater Aquarium, Common Freshwater aquarium Fishes. Exotic Food and Game Fishes.
- Prawn fisheries.
- Economic importance of Mollusca: Pearl culture.

UNIT-III

- Poultry keeping and Duck poultry.
- Dairy farming and Piggery.
- Leather industry, wool industry, Fur Industry

UNIT-IV

- Pharmaceuticals from animals (Snake venom).
- Wild life in India its conservation and Significance.
- Economic Importance of Mammals (Rodents and their management).

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