

**IASE Deemed University**  
Gandhi Vidya Mandir, Sardarshahr  
Combined Entrance Test for M.Phil./Ph.D. : 2012-13

Duration: 2 Hours

Written test:

Max. Marks : 300

Viva-Voce:

Max. Marks : 30

## **SYLLABUS**

The question paper will contain 100 Multiple Choice Questions of 3 marks each. Answers will be made on OMR sheet. Question papers in Science subjects will be in English and rest, other than those of languages, will be both in English and Hindi.

### **Biotechnology**

#### **1. MOLECULES AND THEIR INTERACTION RELAVENT 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. Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).
- D. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative 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 carbohydrates, 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:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, 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.

### 3. FUNDAMENTAL PROCESSES

- 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 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 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, role of chromatin in regulating gene expression and gene silencing.

### 4. CELL COMMUNICATION AND CELL SIGNALING

- A. 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 and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.
- B. 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, therapeutic interventions of uncontrolled cell growth.
- C. 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 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, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

### 5. SYSTEM PHYSIOLOGY - PLANT

- A. Nitrogen metabolism:** Nitrate and ammonium assimilation; amino acid biosynthesis.
- B. Plant hormones:** Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

**C. Secondary metabolites** - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

## **6. SYSTEM PHYSIOLOGY - ANIMAL**

**A. Blood and circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

**B. Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.

## **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, development of mapping population in plants.

**E. Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

**F. Microbial genetics:** Methods of genetic transfers – 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 alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

**K. Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.

## **8. ECOLOGICAL PRINCIPLES**

**A. Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

**B. Applied ecology:** Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

**C. Conservation biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

## **9. EVOLUTION AND BEHAVIOUR**

**A. Molecular Evolution:** Concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence.

**B. 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.

## **10. APPLIED BIOLOGY:**

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

B. Application of immunological principles (vaccines, diagnostics). tissue and cell culture methods for plants and animals.

C. Transgenic animals and plants, 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 plants and animals, including marker – assisted selection.

G. Bioremediation and phytoremediation.

H. Biosensors.