

SARVAJANIK UNIVERSITY
FACULTY OF SCIENCE
Ph. D. Entrance Test Syllabus - Biotechnology



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INCLUSIVE | INTEGRATED | INNOVATIVE

Faculty of Science
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Biotechnology

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Unit 1: Cell Biology

Organization of prokaryotic and eukaryotic cells. Structural organization and functions of intracellular organelles - Cell wall, Cell membrane, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes, Plastids, Vacuoles, Chloroplast, Membrane protein diffusion, Osmosis, Ion channels, Active transport, Mechanism of sorting and regulation of intracellular transport, Protein Targeting and sorting to various organelles, Cell division, Cell cycle & its regulation, Role of the cyclins and cyclin-dependent kinases, Cell cycle checkpoints, Modes of cell signaling, Steroid hormone receptors, G-protein coupled receptors, Ras, Raf, MAP kinase pathway.

Unit 2: Biomolecules and Metabolism

Composition, Structure, Conformation and Functions of biomolecules - Carbohydrates, Lipids, Proteins, Nucleic Acids, Structure, Classification and Importance of vitamins, Coenzymes, Cofactors and Prosthetic groups, Biochemistry of water, Metabolism and regulation of carbohydrates, proteins, lipids and amino acids, oxidative phosphorylation, ATP synthesis, HMP shunt, De novo and Salvage pathway of nucleotide synthesis, C3, C4 and CAM pathway in plants, Photosynthesis, Role of plant and animal hormones, Nomenclature and classification of enzymes, Michaelis - Menten kinetics, Types of enzyme inhibition, Biological roles of enzymes, Allosteric enzymes.

Unit 3: Recombinant DNA Technology

DNA modifying enzymes, Linker, Adaptor, Homopolymer tailing, Restriction Endonucleases, Isolation and Purification of nucleic acid, Characteristics of cloning and expression vectors, Plasmid, phage and cosmid vectors, Multipurpose cloning vectors, Shuttle vectors, Bacterial, yeast, plant, viruses and mammalian expression vectors. Preparation of genomic and cDNA libraries, Criteria for selection of cloning vectors - plasmid, bacteriophage and cosmid, Transformation and transfection, Electroporation, Screening of gene library and selection of clone, Blotting techniques,

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Protein-Protein interactions, Polymerase chain reaction, Site directed mutagenesis and protein engineering, Applications of r-DNA technology in industry, agriculture and forensic science

Unit 4: Techniques in Molecular Biology & Biotechnology

Quantitative and real time PCR, Nucleotide sequencing techniques, Protein DNA interaction assays, Radioimmunoassay, ELISA, Flow cytometry, Chemical and physical cell disruption techniques for biomolecules, Methods of separation of peptides, proteins, oligonucleotides and DNA by electrophoresis and chromatography, Advanced techniques of separation- 2D gel electrophoresis, HPLC and GC, Detection of molecular mass by MALDI, ESI-MS and structure of molecules by Nuclear Magnetic Resonance spectroscopy, Transcriptomics- Microarray, EST, SAGE. Next generation sequencing technologies, Genome editing techniques.

Unit 5: Molecular Biology

DNA as genetic material, Structure of DNA, RNA and their types, Replication of DNA in prokaryotes and eukaryotes, DNA damage and mechanism of repair, Homologous recombination, Transcription in prokaryotes and eukaryotes, promoters, enhancers and terminators, RNA splicing and processing of pre-mRNA, Regulation of gene expression in prokaryotes- Inducible and repressible operons, Genetic code and its characteristics, Prokaryotic and eukaryotic translation- Ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Post-translational modifications of proteins.

Unit 6: Inheritance Biology

Genes and alleles, Mendelian inheritance, Multiple alleles, Allelic interactions, Linkage and recombination, Pedigree analysis, Sex linked inheritance, Sex determination - XX/XY, XX/X0, ZW/ZZ and ZZ/Z0 mechanisms, Gene interactions, Penetrance and expressivity, Human genetic disorders, Hardy-Weinberg equilibrium, Molecular and structural organization of chromosomes, Genome size and complexity, Structure of eukaryotic and prokaryotic chromosome, Polytene chromosomes, Lampbrush chromosomes, Euchromatin and heterochromatin, Satellite DNA, Centromere and telomere structure, Chromosomal staining, Nucleosome structure, Chromosome banding and Karyotyping, Transposon.

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Unit7: Plant & Environmental Biotechnology: Plant tissue culture, Cellular totipotency, Media used in plant tissue culture, Sterilization techniques, Callus and suspension cultures, Micropropagation, Clonal propagation, Production of virus-free plants, Propagation by direct and indirect organogenesis, Somatic embryogenesis, Artificial seed production. Somaclonal and gametoclonal variations and their practical application, Protoplast culture, Somatic hybridization, Cybrids, Haploid production, Embryo rescue and ovary culture, Endosperm culture, Production of triploids. Transgenic technology, Molecular mechanism of Agrobacterium mediated transformation, Gene transformation methods in plant, Marker free transgenics. Molecular markers types and applications, Herbicide tolerance, BT cotton, Golden rice, Plant Virus interactions, Bioleaching, Biomining, Bioremediation, Phytoremediation, Biopolymers, Biosensors

Unit 8: Immunology

Innate and adaptive immune system, Antibody types and structure, B- cells and T-cells, Antigen presenting cells, Antigenic specificity, Diversity, Immunologic memory, Self / non-self-recognition, Antigen-Antibody Interactions- Cross-Reactivity, Precipitation Reactions, Agglutination Reactions, Radioimmunoassay, Enzyme-Linked Immunosorbent Assay, Western, Blotting, Production and application of monoclonal antibody- Hybridoma technology, Major histocompatibility complex- Structure of MHC I and II molecule, Complement system, Recognition of antigens by T and B Cells, T-cell receptor complex, B-cell receptor complex, Types of vaccines, traditional methods of vaccine production, production of DPT and Rabies vaccine, Production of Modern Vaccines - production of Hepatitis vaccine; DNA vaccine. B-cell epitope and T-cell epitope prediction methods, Production of peptide based vaccine with examples.

Unit 9: Computation and Bioinformatics

Type of databases and DBMS, Nucleotide sequence databases, Primary nucleotide sequence databases, Protein structure databases, Sequence motif databases, Analysis and submission of EST and GSS data, Clustering of ESTs, Whole genome annotation strategies, Human and Arabidopsis genomes, Introduction to DNA and

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protein sequencing techniques, Human Genome Project, Bioinformatics methods in transcriptomics, KEGG, CATH and SCOP databases, Applications of Bioinformatics

Unit 10: Animal and Industrial Biotechnology

Concept of fermentation technology, Fermenter design, Types of fermenters, Aseptic operation and Containment, Batch and continuous fermentation, Air-lift bioreactor and CSTF, Fermentative production of Citric acid & Penicillin, Animal tissue culture - Types of tissue culture – Adherent culture, Suspension culture, Short term culture and Long term culture, Applications, advantages and limitation of animal tissue culture, animal cell culture media and culture environment, Cell viability and cryopreservation of cell lines, nomenclature of cell lines.