

SYLLABUS FOR M.SC. (BIOTECHNOLOGY)

BIOTECHNOLOGY

UNIT-I: INTRODUCTION TO BIOTECHNOLOGY

Definition of Biotechnology; Old Biotechnology and the beginning of modern Biotechnology; Overview of plant, animal and microbial cultures; Basic principles of recombinant DNA technology; Common methods and applications- Plant, Animal and Medical Biotechnology; Ethical, legal and social implications of Biotechnology.

UNIT-II: BIO-MOLECULES AND ENZYME TECHNOLOGY

Concept of Biomolecules, Chemical bonds, Water: structure, ionization, weak acids and weak bases, Buffers. Amino Acids and proteins: types, properties, peptides, Conformation of proteins: Ramachandran plot, secondary structure, three-dimensional structure of protein, Carbohydrates: Monosaccharides, disaccharides, polysaccharides, Proteo- glycans, Glycoprotein and Glycolipids, Lipids: Storage Lipids, Structural Lipids, Lipids as signals, cofactors and pigments, Vitamins, Nucleotides and Nucleic Acids. History, General characteristics, Nomenclature and classifications of enzymes, Enzyme kinetics, Competitive, noncompetitive, uncompetitive inhibition, Allosteric enzymes, Enzyme activity, Factors affecting enzyme activity.

UNIT-III: CELL BIOLOGY

Prokaryotic and eukaryotic cell-structure, Organelle functions, Transport across membrane, Cell communication and signalling. Cell signalling systems, second messengers and their role in signal transduction, Cell surface receptors; Interaction and regulation of cell signalling pathways; Cell Cycle and Cell Division, Photo-autotrophism, Heterotrophism, Stress physiology, Ageing of cells.

UNIT-IV: BIOCHEMISTRY

Metabolic disorders, Oxidation-reduction potentials, ATP synthesis-oxidative and photo-phosphorylation, Electron acceptors and donors in plants and animals.

UNIT-V: MOLECULAR BIOLOGY

Introduction to Molecular Biology; DNA replication: Prokaryotic and Eukaryotic DNA replication; DNA Repair; Recombination. Transcription: Prokaryotic and Eukaryotic transcription, RNA polymerases, General and specific transcription factors, Regulatory elements, and Mechanism of transcription regulation. Splicing, Editing, Nuclear export of mRNA, mRNA stability; Transcriptional and Post-transcriptional gene silencing. Translation: Prokaryotic and Eukaryotic translation, Regulation of translation, Co- and Post- translational modifications of proteins. Oncogenes and Tumor Suppressor Genes: Cellular and Viral oncogenes, Tumor suppressor genes from humans. Structure, function and mechanisms of action of pRB and p53 tumor suppressor proteins.

UNIT-VI: CONCEPT OF RECOMBINANT DNA TECHNOLOGY

Tools of recombinant technology, Restriction enzymes, Ligases, Enzymes used in gene cloning, Cloning vectors: Plasmids, Bacteriophages, Cosmids, Phagemids, YACs, BACs, Adapters and Linkers, Genomic libraries, Methods of gene transfer: Physical, Chemical and Biological methods. Alpha complementation, Gene regulation, Gene silencing, Gene therapy strategies. Transposons and its types. Recombinant proteins, production of recombinant proteins. Applications of recombinant DNA technology.

UNIT-VII: PLANT AND ANIMAL TISSUE CULTURE

History of tissue culture techniques, General requirements of plant and animal tissue culture, Micropropagation, Shoot-tip culture, callus culture, suspension culture, protoplast culture, Somatic hybridization, Somaclonal variation, Somatic hybrids and cybrids, Germplasm conservation, Animal organ culture, Hybridoma technology, Cryopreservation, Applications of tissue culture.

UNIT-VIII: IMMUNOLOGY

Introduction to Immunology, Innate and adaptive immunity, T-cells and B-cells, Antigen and super antigens, Antibodies, Antigen-Antibody interaction, Structure and functions of immunoglobulin, ELISA

UNIT-IX: BIO-TECHNIQUES

Microscopy: Principles of Light microscope, Phase-contrast microscope, Fluorescence microscope, Transmission and scanning microscope. Principle and use of analytical instruments: pH meter, UV-VIS Spectrophotometer, IR- spectrophotometer, ESR and NMR Spectroscopy. Separation Techniques in Biology: Molecular separation by Chromatography, Electrophoresis, Organelles separation by centrifugation, cell separation by flow cytometry. Polymerase Chain Reaction, Isotopes Techniques in Biology, their safety and handling.

UNIT-IX: GENETICS

Mendelian laws of inheritance, Application, Linkage and crossing over, Gene mapping, Genetic polymorphism, Hardy-Weinberg genetic equilibrium, Causes of changes in gene frequency (migration, selection, genetic drift, inbreeding and mutations), Chromosomal aberration, Theories of mutation and evolution, Genetic disorders.

UNIT-X: GENOMICS AND BIOINFORMATICS

Introduction to genomics, sequencing of genomes, Molecular markers, DNA sequencing strategies, Structural and functional genomics, Introduction to bioinformatics, Databases and search tools; NCBI, EMBL, DDBJ, Homology search, Sequence alignment.

UNIT-XI: ANIMAL & PLANT PHYSIOLOGY

Physiology and development of circulatory, Nervous system, Photo systems, Endocrine and exocrine system, Hormone diversity and action, Plant hormones, Transport across plant cell, Transpiration, Flowering, Plant tissue culture, Production of transgenic plants

UNIT-XII: MICROBIOLOGY

Characterization, Classification and Identification of different groups of microorganisms, Microbiological methodologies: isolation, maintenance, preservation, sterilization, Antimicrobial agents, Drug resistance, Microbial Growth and metabolism: Cultivation of bacteria, growth, Nutrition and transport, Carbohydrate and Nitrogen metabolism, Microbial Genetics: bacterial recombination, transformation, transduction, conjugation, Mutation, isolation of mutants, Microbiology of environment: soil, air, water, Microorganisms and Diseases: Air and water- borne diseases and their control, Microbiology of fuel and Industrial microbiology.

UNIT-XII: ECOLOGY AND EVOLUTION

Components and types of ecosystem, Environmental pollution, Biogeochemical cycles, Biotic interactions, Hardy Weinberg law, Population genetics, Mechanism of speciation, Origin of life, Biological rhythms, Biological control.

CHEMISTRY

PHYSICAL CHEMISTRY

UNIT 1: SOME BASIC CONCEPTS IN CHEMISTRY

Matter and its nature, Dalton's atomic theory; Concept of atom, molecule, element and compound; Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures, S.I. Units, dimensional analysis; Laws of chemical combination; Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae; Chemical equations and stoichiometry.

UNIT 2: STATES OF MATTER

Classification of matter into solid, liquid and gaseous states. Gaseous State: Measurable properties of gases; Gas laws - Boyle's law, Charles's law, Graham's law of diffusion, Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation; Kinetic theory of gases (only postulates), Real gases.

UNIT 3: ATOMIC STRUCTURE

Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect; Spectrum of hydrogen atom, Bohr model of hydrogen atom - its postulates, derivation of the relations for energy of the electron and radii of the different orbits.

UNIT 4: CHEMICAL BONDING AND MOLECULAR STRUCTURE

Kossel - Lewis approach to chemical bond formation, concept of ionic and covalent bonds. Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds;

UNIT 5: CHEMICAL THERMODYNAMICS

Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes. laws of thermodynamics.

UNIT 6: SOLUTIONS

Different methods for expressing concentration of solution - molality, molarity, mole fraction, percentage, vapour pressure of solutions, vapour pressure.

UNIT 7: EQUILIBRIUM

Meaning of equilibrium, concept of dynamic equilibrium. Equilibria involving physical processes: Solid -liquid, liquid - gas and

solid - gas equilibria.

UNIT 8: REDOX REACTIONS AND ELECTROCHEMISTRY

Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions. Electrolytic and metallic conduction, conductance in electrolytic solutions.

UNIT 9: CHEMICAL KINETICS

Rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst; elementary and complex reactions

UNIT-10: SURFACE CHEMISTRY

Adsorption- Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids.

INORGANIC CHEMISTRY

UNIT 11: CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

Modern periodic law and present form of the periodic table, s, p, d and f block elements, periodic trends in properties of elements atomic and ionic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

UNIT 12: GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF METALS

Modes of occurrence of elements in nature, minerals, ores; Steps involved in the extraction of metals - concentration, reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al, Cu, Zn and Fe.

UNIT 13: HYDROGEN

Position of hydrogen in periodic table, isotopes, preparation, properties and uses of hydrogen; Physical and chemical properties of water and heavy water.

UNIT 14: S - BLOCK ELEMENTS (ALKALI AND ALKALINE EARTH METALS)

Group - 1 and 2 Elements General introduction, electronic configuration and general trends in physical and chemical properties of elements, Preparation and properties of some important compounds - sodium carbonate and sodium hydroxide; Industrial uses of lime, limestone, Plaster of Paris and cement; Biological significance of Na, K, Mg and Ca.

UNIT 15: P - BLOCK ELEMENTS

Group - 13 to Group 18 Elements General Introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups; unique behaviour of the first element in each group. Groupwise study of the p - block elements.

UNIT 16: d - and f - BLOCK ELEMENTS

Transition Elements General introduction, electronic configuration, occurrence and characteristics, general trends in properties of the first row transition elements - physical properties, ionization enthalpy, oxidation states, atomic radii, colour, catalytic behaviour, magnetic properties, complex formation, interstitial compounds, alloy formation.

UNIT 17: CO-ORDINATION COMPOUNDS

Introduction to co-ordination compounds, Werner's theory; ligands, co-ordination number, denticity, chelation; IUPAC nomenclature of mononuclear co-ordination compounds, isomerism; Bonding-Valence bond approach.

UNIT 18: ENVIRONMENTAL CHEMISTRY

Environmental pollution - Atmospheric, water and soil. Atmospheric pollution- Tropospheric and Stratospheric Greenhouse effect and Global warming; Acid rain; Particulate pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention. Stratospheric pollution-Formation and breakdown of ozone, depletion of ozone layer, Water Pollution -Major pollutants such as, pathogens, organic wastes and chemical pollutants; Soil pollution - Major pollutants such as: Pesticides (insecticides, herbicides and fungicides), Strategies to control environmental pollution.

ORGANIC CHEMISTRY

UNIT 19: PURIFICATION & CHARACTERISATION OF ORGANIC COMPOUNDS

Purification - Crystallization, sublimation, distillation, differential extraction and chromatography - principles and their applications. Qualitative analysis - Detection of nitrogen, sulphur, phosphorus and halogens. Quantitative analysis (basic principles only) - Estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus. Calculations of empirical formulae and molecular formulae; Numerical problems in organic quantitative analysis.

UNIT 20: SOME BASIC PRINCIPLES OF ORGANIC CHEMISTRY

Tetravalency of carbon; Shapes of simple molecules - hybridization (s and p); Classification of organic compounds based on functional groups: - C = C -, - C h C - and those containing halogens, oxygen, nitrogen and sulphur; Homologous series; Isomerism structural and stereoisomerism. Nomenclature (Trivial and IUPAC) Covalent bond fission, free radicals, electrophiles and nucleophiles. Electronic displacement in a covalent bond -Inductive effect, electromeric effect, resonance and hyperconjugation.

UNIT 21: HYDROCARBONS

Classification, isomerism, IUPAC nomenclature, Alkanes, Mechanism of halogenation of alkanes. Alkenes - Geometrical isomerism; Ozonolysis and polymerization. Alkynes - Acidic Nomenclature, benzene - structure and aromaticity; Mechanism of electrophilic substitution: halogenation, nitration, Friedel - Craft's alkylation and acylation.

UNIT 22: ORGANIC COMPOUNDS CONTAINING HALOGENS

General methods of preparation, properties and reactions; Nature of C-X bond; Mechanisms of substitution reactions. Uses; Environmental effects of chloroform & iodoform.

UNIT 23: ORGANIC COMPOUNDS CONTAINING OXYGEN

General methods of preparation, properties, reactions and uses. alcohols, phenols and ethers Alcohols: Identification of primary, secondary and tertiary alcohols; mechanism of dehydration. Important reactions such as - Nucleophilic addition reactions (addition of HCN, NH₃ and its derivatives), Grignard reagent; oxidation; reduction (Wolff Kishner and Clemmensen); acidity of - hydrogen, aldol condensation, Cannizzaro reaction,

UNIT 24: ORGANIC COMPOUNDS CONTAINING NITROGEN

General methods of preparation, properties, reactions and uses. Amines: Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character.

UNIT 25: POLYMERS

General introduction and classification of polymers, general methods of polymerization- addition and condensation, copolymerization; Natural and synthetic rubber and vulcanization; some important polymers with emphasis on their monomers and uses - polythene, nylon, polyester and bakelite.

UNIT 26: CHEMISTRY IN EVERYDAY LIFE

Chemicals in medicines - Analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamins - their meaning and common examples. Chemicals in food - Preservatives, artificial sweetening agents - common examples. Cleansing agents - Soaps and detergents, cleansing action.

Section	No. of Questions (60)
Biotechnology	48 (80%)
Chemistry	12 (20%)