

B.Sc. Second Year – Biotechnology

Paper I: Biophysics and Biochemistry

Unit 1:

Thermodynamics: Thermodynamic system, Equilibrium, Thermodynamic Laws and their Applications. Different type of processes of Heat Transfer; Thermodynamic variable; entropy, enthalpy, free energy, Thermodynamic Potentials and relations, Maxwell equation, Fundamental Equation of Heat flow.

Unit II:

General Biophysical Methods, Measurement of pH, Radioactive labeling and counting, Autoradiography, Diffusion, Sedimentation, Osmosis, Viscosity- definition, factors influencing it and its application in Biology.

Bragg's Equation, Reciprocal Lattice, Miller Indices, Unit cell, Concept of different crystal structure, determination of crystal structure

Unit III:

Fundamentals of Biochemistry: Biochemistry as Molecular logic of living beings, Axioms of living matter, major inorganic compounds of animate objects- a general view, Chemical elements, structure of Atoms, molecules and chemical bonds. Ionic, Covalent, Coordinate Hydrogen Bonds and Van der Waal forces. Structure, Function and Properties of Water; Water as a universal Solvent; Acids, Bases and salts, pH and buffers

Unit IV:

Biomolecules: Introduction and Occurrence, Classification, Properties, Importance of Carbohydrates. Lipids, Proteins, amino acids and Nucleic Acids: Variations in coding and non-coding RNA

Unit V:

Enzymes, Structure, Classification and Function- Active site, Energy of Activation, Transition state Hypothesis, Lock and key hypothesis, Induced fit hypothesis; Concept of K_m – Michaelis

Menten Equation. Various types of enzyme inhibition and identification using Double Reciprocal Plot. Introduction to Allosteric enzymes. Definition of Holozyme, apoenzyme, coenzyme, cofactor, prosthetic groups and their examples. Concept of Ribozyme, multiple forms, isozymes and abzymes.

Paper II: Bioinstrumentation, Biostatistics and Bioinformatics

Unit I:

Microscopy-Principle and working of Light, Phase contrast, Fluorescence and Electron Microscopy

Centrifugation Technique: Principle, types and Separation of Biological Molecules

Unit II:

Chromatography and Electrophoresis: Principles of Chromatography, Principle and Applications of Electrophoresis, Agarose gel Electrophoresis, Immuno Electrophoresis, Blotting: Southern, Western and Northern.

Unit III:

Spectrophotometry: Principle, working and its application, Colorimetry, Radio and non radio labeling, Autoradiography

Unit IV:

Biostatistics- Introduction, scope, applications and use of statistic collection and classification, data summarization, presentation of data, Arithmetic mean, median, mode, standard deviation, probability-definition, Random Variable and its distribution, Binomial Probability distribution.

Unit V:

Basic Bioinformatics: Introduction to Internet, Search Engines (Google, Yahoo, Entrez etc)
Biological databases: NCBI, Sequence database (EMBL, Genbank, DDBJ, UNIPROT, PIR, TrEMBL), Protein family/ Domain databases (PROSITE, PRINTS, Pfam, BLOCK etc), Cluster Databases- An introduction, Specialized databases (KEGG), Database technologies (Flat file), Structural Databases (PDB)

BT- 203 Laboratory

List of Practical

1. To study principles and working of instruments like Colorimeter, pH meter, Centrifuge, Spectrophotometer, Microscope etc. AG
2. To perform qualitative analysis of Carbohydrates, Proteins and Lipids PB
3. To perform quantitative estimation of Protein by Folin-Lowry method AG/PB
4. To study the effect of pH and temperature on enzyme activity AG/SP
5. To perform separation of amino acids by TLC SS
6. To perform separation of Leaf pigments by Paper Chromatography SS
7. To estimate amount of Hemoglobin SP
8. Introduction to NCBI and data retrieval TN
9. To analyzing Protein sequences TN
10. To analyze DNA Sequences TN

Scheme of Practical Examination

MM: 50

Duration: 3 hours

1. Major (10)
2. Major (10)
3. Minor (05)
4. Minor (05)
5. Spotting (10)
6. Viva Voce (05)
7. Practical Record (05)

Suggested Reading

1. A Textbook of Bioinformatics by Sharma & Munjal & Shankar
2. Bioinformatics by C.S.V Murthy
3. Basic Bioinformatics by S. Ignacimuthu, S.J
4. Bioinformatics: Concepts, Skills and Applications by S.C Rastogi, N. Mendiratta and Parag Rastogi

5. Practical Guide for Basic Bioinformatics and Biostatistics by P.Tiwari and P. Pandey
6. Biostatistics by B. Prasad
7. Statistical Methods by S.P Gupta
8. Fundamentals of Statistics by S.C Gupta
9. Biostatistics by P.N Arora
10. Principles of Biochemistry by Lehninger
11. Fundamentals of Biochemistry by J.L Jain
12. Biochemistry by Voet and Voet
13. Textbook of Biochemistry by S.P Singh
14. Biophysics by Mohan P Arora
15. Biophysics by Patabh and Gautam
16. Biochemistry by A.C Deb
17. Biomolecules by Mohan P. Arora
18. Principles of Biochemistry (2005) by Nelson and Cox

B.Sc Third Year – Biotechnology

Paper I: Molecular Biology and Genetic Engineering

Unit-I:

DNA and RNA, Chemical structure, Types and Properties, Experimental Proof of DNA as Genetic Material, Genome- Concept, Plant, Animal, Bacterial and Viral Genome, Eukaryotic Chromosomal Organization, Euchromatin, Heterochromatin, Chromatin structure, Nucleosomes, Histone and non-histone proteins, Histone modifications, Introduction to Epigenetics

Unit-II:

DNA Replication, Types, Experimental proof of Semi Conservative Replication, Replicon- Concept, proteins and enzymes involved in replication in Prokaryotes and Eukaryotes, Modes of DNA replication: Unidirectional, Bidirectional, Types of DNA replication: Y-shaped, θ mode, Rolling circle mechanism.. Transcription, Translation and Gene Expression in Eukaryotes (yeast), Splicing and its types.

Unit-III:

Origin of Life: Classical experiments and current concepts, Evolution of Biological Macromolecules, Evolution of Early forms, Mendelian Genetics: Mendelian Law, Chromosomal basis of Heredity, chromosomal Analysis, Allelic Variation, Dominance, Linkage and Crossing over.

Unit-IV:

Mutation: Types of Mutation: Point Mutation (Base pair change, Frameshift, Deletion). Chemical and biological mutagens-UV rays, nitrous acid, 5-bromouracil, 2-aminopurine, EMS. Reversion in mutation; true reversion; DNA repair mechanism; photo reactivation; excision, mismatch, SOS repair and dealkylation repair.

Unit-V:

Introduction to Recombinant DNA Technology, Scope and Importance, Gene Cloning, PCR, Introduction to Restriction Endonuclease, Vectors for DNA transfer and their types: Plasmids, Phagemids, Cosmids, BAC, YAC, Gene Amplification.

Paper II: Applied Biotechnology

Unit-I: Microbial Biotechnology

Food Microbiology- Food preservation techniques, Industrial production of Ethyl alcohol, Penicillin, Cyanocobalamin, Glutamic acid, Citric acid, Amylase, Protease. Processing of milk and milk products in Dairy industry.

Unit-II: Plant Biotechnology and Animal Biotechnology

Introduction to Plant Tissue Culture, Nutritional Requirements, *In-vitro* culture: Embryo Culture, Anther Culture, Ovule Culture, Somatic Embryogenesis, Organogenesis, Protoplast Culture, Somatic Hybridization, Genetic manipulation of plants using *Agrobacterium tumefaciens*.

Equipment and Materials and physical requirements for Animal cell culture technology, Commonly used Cell lines- Their Organization and Characteristics, Differentiation of cells,

Applications of Animal Biotechnology: Methods of Transfection and Cell fusion of animal cells, Selectable markers, HAT Selection, Transgenic animals, Stem cell culture, Transplantation of Cultured cells,

Unit-III: Immunology

Immunity- Innate and Acquired, Host defense mechanism- Infection and its types, Organs and Cells of the Immune system, Vaccines and its types. Antigens- Properties and types, Adjuvants, Immunoglobulins- Structure, types and functions. Generation of Antibodies: Primary and Secondary response, Agglutination and Precipitation reactions. Sensor based diagnostics.

Unit-IV: Fermentation Technology

Fermentation Technology, Primary and Secondary screening, Strain improvement, Inoculums development, Industrial Sterilization process, Scale-up and Harvest and Recovery.

Types of Fermentation- Batch, Continuous, Fed-Batch process, Submerged and Solid state fermentation process, Basic design of a Fermentor and factors affecting fermentor design. Types of Fermentor- Fluidized, Packed bed, Air lift Fermentor, Tray Fermentor and Tower Fermentor. Bioreactors for large scale production of animal cells

Unit-V: Environmental Biotechnology

Environment: Basic Concept, Significance, Public awareness, Environmental pollution, Assessment of Water Quality, Treatment of Waste water- Primary, Secondary and Tertiary treatment. Solid waste management (composting, vermi composting, methane production).

Biopesticides- Bacterial and Fungal, Genetically modified crops, Biofertilizers- Nitrogen fixers, PSB, Mycorrhiza and VAM, microbial leaching, Microbial Enhanced oil-recovery, Bioremediation and Biodeterioration. Modern fuels- Methanogenic bacteria and Biogas, Microbial hydrogen production.

BT- 303 LABORATORY

List of Practical

1. To isolate Chromosomal DNA from Plant cells. PB
2. To isolate Genomic DNA from Micro-organisms. PB
3. To perform DNA estimation using Diphenyl method. SP
4. To perform RNA estimation using Orcinol method. AG
5. To perform isolation of Plasmid DNA from bacteria. PB
6. To study effect of UV Radiation on Microbial cell TN
7. To perform RNA Isolation from Yeast. PB
8. To study growth of plant tissue into undifferentiated mass of Callus. TN
9. To study demonstration of a Fermentor. AG
10. To study demonstration of PCR. TN
11. To study immobilization of microbial cells. AG
12. To study Radial immuno diffusion assay. SP
13. To perform blood-group analysis. SS
14. To observe agglutination reaction using Widal test. SS
15. To determine the concentration of an unknown antigen using Radial Immuno diffusion technique. SP

Note: 70% of the above list should be compulsorily performed.

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3. Minor (05)
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5. Spotting (10)
6. Viva-Voce (05)
7. Practical Record (05)

Suggested Reading

1. Industrial Microbiology by A.H. Patel
2. Microbial Biotechnology by Hazarre
3. Molecular Biology by Avinash and Kakoli Upadhyay
4. Gene Biotechnology by Jogdand
5. Essential of biotechnology by S.N. Das
6. Textbook of Biotechnology by R.C Dubey
7. Biotechnology and Genomics by P.K. Gupta
8. Modern Concept of Biotechnology by H.D. Menon
9. Problems of Genetics, Molecular genetics and Evolutionary Genetics by Pranobh K. Banerjee