

BIOTECHNOLOGY (Code No. 045)

2021-22

An unprecedented growth of human knowledge in the field of Biological Sciences coupled with equally significant developments in the field of technology have brought significant changes into existing social and economic systems. The emerging field of Biotechnology is likely to further enhance the applications of Science and Technology for human welfare. Modern Biotechnology processes encompass a wide range of new products such as antibiotics, vaccines, monoclonal antibodies and many more. Furthermore, developments in recombinant DNA technology have yielded numerous new useful products in the fields of healthcare and agriculture. The present syllabus takes care of all these aspects. Due emphasis has been laid on familiarizing the learners with the fundamental concepts, basic techniques and their applications. It is expected that the knowledge gained through the study of different topics and the skills acquired through the prescribed practical work will make the learners competent to meet the challenges of academic as well as professional courses after studying the subject at senior secondary stage.

Objectives

The broad objectives of teaching Biotechnology at senior secondary level are to:

- help the learners know and understand basic facts and concepts of the subject at elementary stage.
- expose the students to different basic processes and basic techniques used in Biotechnology.
- familiarize the learners to understand the relationship of the subject to health, nutrition, environment, agriculture and industry, etc.
- develop conceptual competence in the learners so as to cope up with professional courses in future career.
- acquaint students with different applications of Biotechnology in everyday life.
- develop an interest in students to study Biotechnology as a discipline.

CLASS- XI (2021-22) COURSE STRUCTURE

One Paper

Time: 3 hrs.
Max. Marks 70+30

Units		Marks	No. of Periods
Unit- I	Biotechnology: An overview	5	20
Unit-II	Molecules of Life	20	50
Unit-III	Genetics and Molecular Biology	20	50
Unit-IV	Cells and Organisms	25	60
	Practical	30	60
	Total	100	240

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CLASS XI
(Theory)

One Paper

Time: 3 hrs.

Total Marks: 70

Unit-I Biotechnology: An overview

5 Marks

Chapter 1: Biotechnology: An Overview

Historical Perspectives, Technology and Applications of Biotechnology, Global market and Biotech Products, Public Perception of Biotechnology, Biotechnology in India and Global Trends

Unit-II Molecules of Life

20 Marks

Chapter 1: Biomolecules: Building Blocks

Building Blocks of Carbohydrates - Sugars and their Derivatives, Building Blocks of Proteins - Amino Acids, Building Blocks of Lipids - Simple Fatty Acids, Sphingosine, Glycerol and Cholesterol, Building Blocks of Nucleic Acids - Nucleotides, Biochemical Transformations

Chapter 2: Macromolecules: Structure & Function

Carbohydrates - The Energy Givers, Proteins - The Performers, Enzymes - The Catalysts, Lipids and Biomembranes - The Barriers, Nucleic Acids - The Managers

Unit-III Genetics and Molecular Biology

20 Marks

Chapter 1: Concepts of Genetics

Historical Perspective, Multiple Alleles, Linkage and Crossing Over, Genetic Mapping, Gene Interaction, Sex-Linked Inheritance, Extra nuclear Inheritance, Quantitative Inheritance, Genes at the Population Level

Chapter 2: Genes and Genomes: Structure and Function

Discovery of DNA as Genetic Material, DNA Replication, Fine Structure of the Genes, From Gene to Protein, Transcription – The Basic Process, Genetic Code, Translation, Regulation of Gene Expression, Mutations, DNA Repair, Human Genetic Disorders, Genome Organization

Unit IV: Cells and Organisms

25 Marks

Chapter 1 The Basic Unit of Life

Cell Structure and Components, Tissues and Organs, Stem Cells, Biodiversity, Organization of Life

Chapter 2: Cell Growth and Development

Cell Division, Cell Cycle, Cell Communication, Nutrition, Gaseous Exchange, Internal Transport, Maintaining the Internal Environment, Reproduction, *In vitro* Fertilization, Animal and Plant Development, Immune Response in Animals, Programmed Cell Death, Defense Mechanisms in Plants

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PRACTICALS

Note: Every student is required to do the following experiments during the academic session.

1. Recording practical results and safety rules in the laboratory
2. Preparation of buffers and pH determination
3. Sterilization techniques
4. Preparation of bacterial growth medium
5. Determination of bacterial growth curve
6. Cell counting
7. Isolation of milk protein (Casein)
8. Sugar Estimation using Di Nitro Salicylic Acid test (DNS test)
9. Assay for amylase enzyme
10. Protein estimation by biuret method
11. Study of various stages of mitosis and calculation of mitotic index
12. Preparation of karyotype

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Scheme of Evaluation

Time: 3 Hours

Max. Marks 30

The scheme of evaluation at the end of session will be as under:

Two experiments	:	20
Marks Viva on experiments	:	5
Marks Practical record	:	5 Mark

CLASS XII (2021-22)

COURSE- STRUCTURE- (THEORY)

One Paper

Max. Marks 70+30

Time: 3 hrs.

Units		Marks	No. of Periods
Unit V	Protein and Gene Manipulation	40	100
Unit VI	Cell Culture and Genetic Manipulation	30	80
	Practicals	30	60
	Total	100	240

One paper

Time: 3 hrs.

Total Marks: 70

Unit-V Protein and Gene Manipulation

40 Marks

Chapter-1: Recombinant DNA Technology

Introduction, Tool of DNA technology, Making DNA, Introduction of recombinant DNA into host cells, Identification of recombinants, Polymerase Chain Reaction (PCR), Hybridization techniques, DNA library, DNA Sequencing, Site-directed Mutagenesis

Chapter-2: Protein Structure and Engineering

Introduction to the world of proteins, 3-D shape of proteins, Structure-function Relationship in proteins, Purification of proteins, Characterization of proteins, Protein based products, Designing proteins (Protein Engineering)

Chapter-3: Genomics, Proteomics and Bioinformatics

Introduction, Genome, Sequencing projects, Gene prediction and counting, Genome similarity, SNPs and Comparative genomics, Functional genomics, Proteomics, History of bioinformatics, Sequences and nomenclature, Information sources, Analysis using bioinformatics tools

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Unit-VI Cell Culture and Genetic Manipulation

30 Marks

Chapter-1: Microbial Cell Culture and its Applications

Introduction, Microbial nutrition and culture techniques, Measurement and kinetics of microbial growth, Scale-up of microbial process, Isolation of microbial products, Strain isolation and improvement, Applications of microbial culture technology, Biosafety issues in microbial technology

Chapter -2: Plant Cell Culture and Applications

Introduction, Cell and tissue culture techniques, Applications of cell and tissue culture, Gene transfer Methods in plants, Transgenic plants with beneficial traits, Biosafety of transgenic plants

Chapter-3: Animal Cell Culture and Applications

Introduction, Animal cell culture techniques, Characterization of cell lines, Methods of gene delivery into cells, Scale-up of animal culture process, Applications of animal cell culture, Stem cell technology, Tissue engineering

PRACTICAL

30 Marks

Note: Every student will be required to do the following experiments during the academic session.

1. Use of special equipment in biotechnology experiments
2. Isolation of bacterial plasmid DNA
3. Detection of DNA by gel electrophoresis
4. Isolation of genomic DNA (CTAB method)
5. Estimation of DNA by UV spectroscopy
6. Bacterial transformation using any plasmid
7. Restriction digestion of plasmid DNA & its analysis by gel electrophoresis
8. Isolation of bacteria from curd & staining of bacteria
9. Cell viability assay using Evan's blue dye exclusion method
10. Data retrieval and database search using internet site NCBI and download a DNA and protein sequence from internet, analyze it and comment on it
11. Reading of a DNA sequencing gel to arrive at the sequence
12. Project work

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Scheme of Evaluation

Time: 3 Hours

Max. Marks 30

The scheme of evaluation at the end of the session will be as under:

A	Two experiments	6+6 (only one computer based practical)
	Practical record	04
	Viva on Practical	04
B	Project work	
	Write up	05
	Viva on project	05
	Total	30

Note:- More emphasis should be given on hands on work in projects.

Prescribed Books:

1. **A Text Book of Biotechnology** - Class XI : Published by CBSE, New Delhi
2. **As reference- Biotechnology** - Class XI : Published by NCERT, New Delhi
3. **A Laboratory Manual of Biotechnology** - Class XI : Published by CBSE, New Delhi
4. **A Text Book of Biotechnology** - Class XII : Published by CBSE, New Delhi
5. **A Laboratory Manual of Biotechnology** - Class XII : Published by CBSE, New Delhi

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Assessment Areas (Theory) 2021-22

Class XII

Time : 3 hrs.
Marks

Maximum Marks: 70

Competencies	
Demonstrate Knowledge and Understanding	50%
Application of Knowledge / Concepts	30%
Analyze, Evaluate and Create	20%

Note:

- Typology of questions: VSA including MCQs, Assertion – Reasoning type questions; SA; LA-I; LA-II; Source-based/ Case-based/ Passage-based/ Integrated assessment questions.
- An internal choice of approximately 33% would be provided.

Suggestive verbs for various competencies

- **Demonstrate, Knowledge and Understanding**
State, name, list, identify, define, suggest, describe, outline, summarize, etc.
- **Application of Knowledge/Concepts**
Calculate, illustrate, show, adapt, explain, distinguish, etc.
- **Analyze, Evaluate and Create**
Interpret, analyse, compare, contrast, examine, evaluate, discuss, construct, etc.