

BIOTECHNOLOGY

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

BIOTECHNOLOGY
THEORY
COURSE STRUCTURE
CLASS - XI

One Paper

Time : 3 Hours

70 Marks

| Unit | Contents | Marks |
|--------------|--------------------------------|-----------|
| I. | Introduction to Biotechnology | 10 |
| II. | Biomolecules | 20 |
| III. | Cell and Development | 20 |
| IV. | Genetics and Molecular Biology | 20 |
| Total | | 70 |

| | | |
|-------------------|--|-----------|
| Unit-I : | Introduction to Biotechnology | 10 |
| | Fundamentals of Biochemical Engineering Biotechnology and Society. | |
| Unit-II : | Biomolecules | 20 |
| | Building Bliocks of Biomolecules-Structure and dynamics Structure and function of Macromolecules. Biochemical Techniques | |
| Unit-III : | Cell and Development | 20 |
| | The basic unit of life Cell Gowth and development Cellular Techniques | |
| Unit-IV: | Genetics and Molecular Biology | 20 |
| | Principles of Genetics Genome Function Genetical Techniques | |

PRACTICALS

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

1. Preparation of buffers and pH determination.
2. Sterlization techniques (Wet and Dry Sterlization, Chemical sterlization and Ultrafiltration)
3. Media preparation (Solid and Liquid LB medium)
4. Isolation of bacterial from curd and staining of bacteria.
5. Determination of bacterial growth curve.

6. Study of various stages of mitosis and calculation of mitotic index.
7. Preparation of Karyotype.
8. Cell counting (using Haemocytometer)
9. Isolation of genomic DNA.
10. Detection of DNA by gel electrophoresis.
11. Isolation of milk protein (casein).
12. Estimation of protein by Biuret method.
13. Assaying the enzyme acid phosphatase.

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 Marks |

DESIGN OF QUESTION PAPER

Subject : **BIOTECHNOLOGY**
 Paper : Theory
 Class : XI
 Full Mark : 70
 Time : 3 Hours

| | | | | | | |
|----------------|--|-------------------------------|------------------------|-------------------------|-------------------|-------------------|
| I | WEIGHTAGE TO OBJECTIVES: | | | | | |
| | Objectives | | | Marks | Percentage | |
| | Knowledge (K) | | | 10 | 15 | |
| | Understanding (U) | | | 35 | 50 | |
| | Application (A) | | | 21 | 30 | |
| | Skill (S) | | | 4 | 5 | |
| Total : | | | 70 | 100 | | |
| II | WEIGHTAGE TO FORM OF QUESTIONS: | | | | | |
| | Form of Questions | | No. of Question | Time (in minute) | Marks | Percentage |
| | Essay/Long Answer(E/LA) | | 3 | 60 | 15 | 21 |
| | Short Answer(SA-I) | | 6 | 37 | 18 | 26 |
| | Short Answer(SA-II) | | 10 | 40 | 20 | 29 |
| | Very Short Answer(VSA) | | 7 | 21 | 7 | 10 |
| | MCQ | | 10 | 22 | 10 | 14 |
| | Total: | | 36 | 180 | 70 | 100 |
| III | WEIGHTAGE TO CONTENT: | | | | | |
| | UNIT/CONTENTS: | | | Marks | Percentage | |
| | I. | Introduction to Biotechnology | | 10 | 14 | |
| | II. | Biomolecules | | 20 | 29 | |
| | III. | Cell and Development | | 20 | 28 | |
| | IV. | Genetics & Molecular Biology | | 20 | 29 | |
| Total : | | | 70 | 100 | | |
| IV | SCHEME OF SECTIONS : Nil | | | | | |
| V | SCHEME OF OPTIONS : i) Internal option will be given in Essay Type Question ii) Internal option will be given in three questions of SA-I including one case study based question. | | | | | |
| VI | DIFFICULTY LEVEL : | | | | | |
| | Difficult | : 35% of the total marks | | | | |
| | Average | : 50% of the total marks | | | | |
| | Easy | : 15% of the total marks | | | | |

Abbreviation : K(Knowledge), U(Understanding), A(Application), Skill(S), E/LA (Essay/Long Answer Type), SA (Short Answer Type), VSA (Very Short Answer Type), MCQ(Multiple Choice Question)

NOTE- (i) Two questions out of 10 (ten) questions of MCQ will be assertion & reason type question.
 (ii) Only one question of SA-I will be Case Study based question.

BIOTECHNOLOGY
THEORY
COURSE STRUCTURE
CLASS - XII

One Paper

Time : 3 Hours

70 Marks

| Unit | Contents | | Marks |
|--------------|--------------------------------------|-------------------------------------|-----------|
| I. | Protein and Gene Manipulation | | |
| | Chapter I | Protein Structure and Engineering | 15 |
| | Chapter II | Recombinant DNA Technology | 15 |
| | Chapter III | Genomics and Bioinformatics | 10 |
| II. | Cell Culture Technology | | |
| | Chapter I | Microbial Culture and Application | 10 |
| | Chapter II | Plant Cell Culture and Application | 10 |
| | Chapter III | Animal Cell Culture and Application | 10 |
| Total | | | 70 |

Unit-I : Protein and Gene Manipulation **Marks 40**

Chapter I: Protein Structure and Engineering **15 Marks**

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
 Proteomics

Chapter II: Recombinant DNA Technology **15 Marks**

Introduction
 Tools of DNA Technology
 Making Recombinant DNA
 DNA Library
 Introduction of Recombinant DNA into host cells
 Identification of recombinants
 Polymerase Chains Reaction (PCR)
 DNA Probes
 Hybridization Techniques
 DNA Sequencing
 Site-directed mutagenesis

Chapter III: Genomics and Bioinformatics **10 Marks**

Introduction
Genome Sequencing Projects
Gene Production and counting
Genome similarity, SNP's and comparative genomics
Functional Genomics
History of Bioinformatics
Sequences and Nomenclature
Information Sources
Analysis using Bioinformatics tools.

Unit-II : Cell Culture Technology **Marks 30**

Chapter I: Microbial Culture and Applications **10 Marks**

Introduction
Microbial 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
Bioethics in microbial technology

Chapter II: Plant Cell Culture and Applications **10 Marks**

Introduction
Cell and Tissue Culture Techniques
Applications of Cell and Tissue Culture
Gene Transfer Methods in Plants
Transgenic Plants with Beneficial Traits
Diagnostics in Agriculture and Molecular Breeding
Bioethics in Plant Genetic Engineering.

Chapter III: Animal Cell Culture and Applications **10 Marks**

Introduction
Animal Cell Culture Techniques
Characterisation of Cell Lines
Scale-up of Animal Culture Process
Applications of Animal Cell Culture
Stem Cell Technology
Bioethics of Genetic Engineering in Animals

PRACTICALS

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

1. Isolation of bacterial plasmid DNA and its detection by gel electrophoresis.
2. Restriction digestion of plasmid DNA and its analysis by gel electrophoresis
3. Bacterial transformation using any plasmid.
4. Data retrieval and data base search using internet site NCBI.
5. Download a DNA and protein sequence from internet, analyse and comment on it.
6. Cell viability assay (using Evans blue Stain)
7. Determination of blood groups.
8. Estimation of DNA
9. Ion-exchange chromatography for proteins.
10. Reading of a DNA sequencing gel and arrive at the sequence.
11. Estimation of blood glucose by enzymatic method (GOD/POD)
12. Project work.

Scheme of Evaluation :

Time : 3 Hours

Max. Marks 30

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

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

Recommended Books :

1. A Textbook of Biotechnology-Class XI : published by CBSE, New Delhi.
2. A Laboratory Manual of Biotechnology-Class XI : Published by CBSE, New Delhi.
3. A Textbook of Biotechnology-Class XII. : published by CBSE, New Delhi.
4. A Laboratory Manual of Biotechnology-Class XII : Published by CBSE, New Delhi.

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FOR THE ACADEMIC SESSION 2024-25

**DESIGN OF
QUESTION PAPER**

Subject : **BIOTECHNOLOGY**
 Paper : Theory
 Class : XII
 Full Mark : 70
 Time : 3 Hours

| | | | | |
|----------------|--|------------------------|-----------------------------------|-------------------|
| I | WEIGHTAGE TO OBJECTIVES: | | | |
| | Objectives | | Marks | Percentage |
| | Knowledge (K) | | 14 | 20 |
| | Understanding (U) | | 32 | 46 |
| | Application (A) | | 21 | 30 |
| | Skill (S) | | 3 | 4 |
| Total : | | 70 | 100 | |
| II | WEIGHTAGE TO FORM OF QUESTIONS: | | | |
| | Form of Questions | No. of Question | Time (in minute) | Marks |
| | Essay/Long Answer (E/LA) | 3 | 60 | 15 |
| | Short Answer (SA-I) | 6 | 36 | 18 |
| | Short Answer (SA-II) | 10 | 40 | 20 |
| | Very Short Answer (VSA) | 10 | 30 | 10 |
| | MCQ | 7 | 14 | 7 |
| Total: | | 36 | 180 | 70 |
| III | WEIGHTAGE TO CONTENT: | | | |
| | UNIT/CONTENTS: | | | Marks |
| | Protein & Gene Manipulation | | | |
| | 1 | I | Protein Structure & Engineering | 15 |
| | | II | Recombinant DNA Technology | 15 |
| | | III | Genomics & Bioinformatics | 10 |
| | Cell Culture Technology | | | |
| | 2 | I | Microbial Culture & Application | 10 |
| | | II | Plant Cell Culture & Application | 10 |
| | | III | Animal Cell Culture & Application | 10 |
| Total : | | | 70 | |
| IV | SCHEME OF SECTIONS : Nil | | | |
| V | SCHEME OF OPTIONS : Internal option may be given in Essay Type Question & SA-I. | | | |
| VI | DIFFICULTY LEVEL : | | | |
| | Difficult | : 30% | | |
| | Average | : 50% | | |
| | Easy | : 20% | | |

Abbreviation : K(Knowledge), U(Understanding), C(Comprehension), Exp.(Expression), Skill(S), E(Essay Type), SA (Short Answer Type), VSA (Very Short Answer Type), MCQ(Multiple Choice Question)

FROM THE ACADEMIC SESSION 2025-26

DESIGN OF QUESTION PAPER

Subject : **BIOTECHNOLOGY**
 Paper : Theory
 Class : XII
 Full Mark : 70
 Time : 3 Hours

| WEIGHTAGE TO OBJECTIVES: | | | | | | |
|--|--|--|----------------------------------|-------------------|-------------------|------------|
| I | Objectives | | | Marks | Percentage | |
| | Knowledge (K) | | | 10 | 15 | |
| | Understanding (U) | | | 35 | 50 | |
| | Application (A) | | | 21 | 30 | |
| | Skill (S) | | | 4 | 5 | |
| | Total : | | | 70 | 100 | |
| WEIGHTAGE TO FORM OF QUESTIONS: | | | | | | |
| II | Form of Questions | No. of Question | Time (in minute) | Marks | Percentage | |
| | Essay/Long Answer (E/LA) | 3 | 60 | 15 | 21 | |
| | Short Answer (SA-I) | 6 | 37 | 18 | 26 | |
| | Short Answer (SA-II) | 10 | 40 | 20 | 29 | |
| | Very Short Answer (VSA) | 7 | 21 | 7 | 10 | |
| | MCQ | 10 | 22 | 10 | 14 | |
| | Total: | | 36 | 180 | 70 | 100 |
| WEIGHTAGE TO CONTENT: | | | | | | |
| UNIT/CONTENTS: | | | Marks | Percentage | | |
| III | 1 | Protein & Gene Manipulation | | | | |
| | | I | Protein Structure & Engineering | | 15 | 21 |
| | | II | Recombinant DNA Technology | | 15 | 21 |
| | | III | Genomics & Bioinformatics | | 10 | 14 |
| | 2 | Cell Culture Technology | | | | |
| | | I | Microbial Culture & Application | | 10 | 15 |
| | | II | Plant Cell Culture & Application | | 10 | 15 |
| III | | Animal Cell Culture & Application | | 10 | 14 | |
| Total : | | | 70 | 100 | | |
| IV | SCHEME OF SECTIONS : Nil | | | | | |
| V | SCHEME OF OPTIONS : i) Internal option will be given in Essay Type Question ii) Internal option will be given in three questions of SA-I including one case study based question. | | | | | |
| VI | DIFFICULTY LEVEL : Difficult : 35% of the total marks Average : 50% of the total marks Easy : 15% of the total marks | | | | | |

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NOTE- (i) Two questions out of 10 (ten) questions of MCQ will be assertion & reason type question.
 (ii) Only one question of SA-I will be Case Study based question.