

# **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*

<b>Unit</b>	<b>Contents</b>	<b>Marks</b>
I.	Introduction to Biotechnology	10
II.	Biomolecules	20
III.	Cell and Development	20
IV.	Genetics and Molecular Biology	20
<b>Total</b>		<b>70</b>

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

<b>I</b>	<b>WEIGHTAGE TO OBJECTIVES:</b>					
	<b>Objectives</b>			<b>Marks</b>	<b>Percentage</b>	
	Knowledge (K)			14	20	
	Understanding (U)			32	46	
	Application (A)			21	30	
	Skill (S)			3	4	
<b>Total :</b>			<b>70</b>	<b>100</b>		
<b>II</b>	<b>WEIGHTAGE TO FORM OF QUESTIONS:</b>					
	<b>Form of Questions</b>		<b>No. of Question</b>	<b>Time (in minute)</b>	<b>Marks</b>	<b>Percentage</b>
	Essay/Long Answer(E/LA)		3	60	15	21
	Short Answer(SA-I)		7	56	21	30
	Short Answer(SA-II)		10	40	20	29
	Very Short Answer(VSA)		10	20	10	14
	MCQ		4	4	4	6
<b>Total:</b>		<b>34</b>	<b>180</b>	<b>70</b>	<b>100</b>	
<b>III</b>	<b>WEIGHTAGE TO CONTENT:</b>					
	<b>UNIT/CONTENTS:</b>			<b>Marks</b>	<b>Percentage</b>	
	I.	Introduction to Biotechnology		16	16	
	II.	Bio molecules		20	28	
	III.	Cell and Development		20	28	
	IV.	Genetics & Molecular Biology		20	28	
<b>Total :</b>			<b>70</b>	<b>100</b>		
<b>IV</b>	<b>SCHEME OF SECTIONS : Nil</b>					
<b>V</b>	<b>SCHEME OF OPTIONS : Nil</b>					
<b>VI</b>	<b>DIFFICULTY LEVEL :</b>					
	Difficulty			: 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)

**BIOTECHNOLOGY**  
**THEORY**  
**COURSE STRUCTURE**  
**CLASS - XII**

*One Paper*

*Time : 3 Hours*

*70 Marks*

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

**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 :**

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

**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.

★★★★★★

# DESIGN OF QUESTION PAPER

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

<b>WEIGHTAGE TO OBJECTIVES:</b>					
<b>I</b>	<b>Objectives</b>			<b>Marks</b>	<b>Percentage</b>
	Knowledge (K)			14	20
	Understanding (U)			32	46
	Application (A)			21	30
	Skill (S)			3	4
	<b>Total :</b>			<b>70</b>	<b>100</b>
<b>WEIGHTAGE TO FORM OF QUESTIONS:</b>					
<b>II</b>	<b>Form of Questions</b>	<b>No. of Question</b>	<b>Time (in minute)</b>	<b>Marks</b>	<b>Percentage</b>
	Essay/Long Answer (E/LA)	3	60	15	21
	Short Answer (SA-I)	7	56	21	30
	Short Answer (SA-II)	10	40	20	29
	Very Short Answer (VSA)	10	20	10	14
	MCQ	4	4	4	6
	<b>Total:</b>		<b>34</b>	<b>180</b>	<b>70</b>
<b>WEIGHTAGE TO CONTENT:</b>					
<b>UNIT/CONTENTS:</b>				<b>Marks</b>	<b>Percentage</b>
<b>III</b>	<b>1 Protein &amp; Gene Manipulation</b>				
	I	Protein Structure & Engineering		15	22
	II	Recombinant DNA Technology		15	22
	III	Genomics & Bioinformatics		10	14
	<b>2 Cell Culture Technology</b>				
	I	Microbial Culture & Application		10	14
	II	Plant Cell Culture & Application		10	14
III	Animal Cell Culture & Application		10	14	
<b>Total :</b>			<b>70</b>	<b>100</b>	
<b>IV</b>	<b>SCHEME OF SECTIONS : Nil</b>				
<b>V</b>	<b>SCHEME OF OPTIONS : Nil</b>				
<b>VI</b>	<b>DIFFICULTY LEVEL :</b>				
	Difficulty		: 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)