

## 10. BIOTECHNOLOGY (Code No. 045)

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 of 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, 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.

### COURSE STRUCTURE CLASS - XI (2017-18)

One Paper

Time: 3 hrs.  
Max. Marks 70+30

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

**CLASS XI  
(Theory)**

**One Paper** **Time : 3 Hrs.**

**Total Marks: 70**      **180 Periods**

**Unit-I Biotechnology: An overview** **5 Marks**      **20 Periods**

**Chapter-1: Biotechnology : An overview**

Historical perspectives, Technology and Applications of Biotechnology, Global Market of Biotech, Products, Public Perception of Biotechnology, Biotechnology in India and Global Trends.

**Unit-II Molecules of Life** **20 Marks**      **50 Periods**

**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-3: Macromolecules: Structure and 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**      **50 Periods**

**Chapter-1: Concepts of Genetics**

Historical Perspective, Multiple Alleles, Linkage and Crossing Over, Genetic Mapping, Gene Interaction, Sex-Linked Inheritance, Extranuclear 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 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**      **60 Periods**

**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.

## PRACTICALS

60 Periods

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

1. Recoding Practical results & 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. Estimation of whey protein by biuret method
9. Assaying the enzyme acid phosphate
10. Estimation of blood glucose by enzymatic & glucometer method (GOD/POD)
11. Study of various stages of mitosis and calculation of mitotic index
12. Preparation of karyotype

### 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  |

**CLASS XII (2017-18)**  
**(THEORY)**  
**COURSE STRUCTURE**

One Paper

Max. Marks 70+30

Time: 3 hrs.

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

One paper

Time: 3 hrs.

Total Marks: 70    180 Periods

**Unit-V Protein and Gene Manipulation**

**40 Marks    100 Periods**

**Chapter-1: Recombinant DNA Technology**

Introduction, Tools of Recombinant DNA technology, Making Recombinant 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

**Unit-VI Cell Culture and Genetic Manipulation**

**30 Marks    80 Periods**

**Chapter-1: Microbial Cell Culture and Its Applications**

Introduction, Microbial culture techniques, Measurement and kinetics of microbial growth, Scale-up of microbial process, Isolation of microbial products, Strain isolation, improvement and Preservation, 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, Characterisation 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

## PRACTICALS

30 Marks 60 Periods

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

### List of Experiments

1. Use of special equipment in biotechnology experiments.
2. Isolation of bacterial plasmid DNA
3. Detection of DNA by gel electrophoreses
4. Isolation of Genomic DNA (CTAB method)
5. Estimation of DNA
6. Bacterial transformation using any plasmid
7. Restriction digestion of plasmid DNA & its analysis by gel electrophoreses
8. Isolation of bacterial grom curd & staining of bacteria
9. Cell viability assay
10. Data retrieval and data base search using internet site NCBI and download a DNA and protein sequence from internet, analyse it and comment on it
11. Reading of a DNA sequencing gel to arrive at the sequence
12. Project work

### 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 Practicals | 04                                      |
| B | Project work       |   |
|   | Write up           | 05                                      |
|   | Viva on project    | 05                                      |
|   | <b>Total</b>       | <b>30</b>                               |

### Prescribed Books:

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

**BIOTECHNOLOGY (CODE - 045)**  
**QUESTION PAPER DESIGN**  
**Class - XI & XII (2017-18)**

Time 3 Hours

Max. Marks: 70

| S. No. | Typology of Questions                                      | Very Short Answer (VSA)<br>(1 mark) | Short Answer-I (SA-I)<br>(2 marks) | Short Answer-II (SA-II)<br>(3 marks) | Long Answer (L.A.)<br>(5 marks) | Total Marks | % Weightage |
|--------|--|-------------------------------------|------------------------------------|--------------------------------------|---------------------------------|-------------|-------------|
| 01     | Knowledge Based  | 2                                   | 1                                  | 2                                    | 1                               | 15          | 22%         |
| 02     | Conceptual Understanding (Application and Reasoning based) | 3                                   | 4                                  | 8                                    | 1                               | 40          | 57%         |
| 03     | Higher Order Thinking Skills (HOTS)                        | 1                                   | 2                                  | -                                    | -                               | 05          | 07%         |
| 04     | Skill Based  | -                                   | 1                                  | 1                                    | 1                               | 10          | 14%         |
|        | <b>Total</b>   | <b>6</b>                            | <b>8</b>                           | <b>11</b>                            | <b>3</b>                        | <b>70</b>   | <b>100%</b> |

**Total No. of questions = 28**

1. No chapter wise weightage. Care to be taken to cover all the chapters.
2. The above template is only a sample. Suitable internal variations may be made for generating similar templates keeping the overall weightage to different form of questions and typology of questions same.