BOARD OF SCHOOL EDUCATION HARYANA

Syllabus and Chapter wise division of Marks (2025-26)

Class: XII **Subject: Biotechnology** **Code: 871**

General Instructions:

1. There will be an Annual Examination based on the entire syllabus.
2. The Annual Examination will be of 60 marks, Practical Examination will be of 20 marks and 20 marks weightage shall be for Internal Assessment.
3. For Practical Examination:
   - i) Two experiments of 6 marks each.
   - ii) One activity of 3 marks.
   - iii) Practical record of 2 marks.
   - iv) Viva-voce of 3 marks.
4. For Internal Assessment:
   There will be Periodic Assessment that would include:
   - i) For 4 marks- Two SAT exams will be conducted and will have a weightage of 04 marks towards the final Internal Assessment.
   - ii) For 2 marks- One half-yearly exam will be conducted and will have a weightage of 02 marks towards the final Internal Assessment.
   - iii) For 2 marks- One Pre-Board exam will be conducted and will have a weightage of 02 marks towards the final Internal Assessment.
   - iv) For 2 marks- Subject teacher will assess and give maximum 02 marks for CRP (Classroom participation).
   - v) For 5 marks- A project work to be done by students and will have a weightage of 05 marks towards the final Internal Assessment.
   - vi) For 5 marks- Attendance of student will be awarded 05 marks as:

     75% to 80% - 01 marks
     80% to 85% - 02 marks
     85% to 90% - 03 marks
     90% to 95% - 04 marks
     95% to 100% - 05 marks

Course Structure (2025-26)

Class- XII **Subject-Biotechnology** **Code:871**

Sr. No.	Unit	Chapter	Marks
1	Protein and Gene Manipulation	Recombinant DNA Technology	30
		Protein Structure and Engineering	
		Genomics and Bioinformatics	
2	Cell Structure and Genetic Manipulation	Microbial Cell Culture and its Application	30
		Plant Cell Culture and Application	
		Animal Cell Culture and Application	
	Total		60
	Practical Examination		20
	Internal Assessment		20
	Grand Total		**100**

Unit V: PROTEIN AND GENE MANIPULATION

Chapter 1: Recombinant DNA Technology

Introduction; Tools of rDNA Technology: Restriction enzymes, Restriction Fragment Length Polymorphism (RFLP), Other enzymes used in cloning, Vectors: Plasmids, vector based on bacteriophages, cosmids, YAC vectors, BAC vectors, Animal and plant viral vectors, Host cells; **Marking rDNA; Introduction of rDNA to Host Cells:** Transformation, Transfection, Electroporation, Microinjection, Biolistics; **Identification of Recombinants; Polymerase Chain Reaction (PCR); Hybridisation Techniques:** Southern Hybridisation Technique; **DNA Library:** DNA Sequencing: Dideoxynucleotide chain termination method; **Site-directed Mutagenesis**

Unit V: PROTEIN AND GENE MANIPULATION

Chapter 2: Protein Structure and Engineering

Introduction to the World of Proteins; **3-D Shape of Proteins:** Non-covalent bonds: ionic bonds, hydrogen bonds, Vander Wals forces, hydrophobic interactions; **Structure-Function relationship in Proteins:** Chymotrypsin - a proteolytic enzyme, Molecular Disease- Sickle cell anaemia, Protein Finger printing- Peptide Mapping, 2-D Gel Electrophoresis; **Purification of Proteins:** Calculation of amount of bacterial ferment required, Downstream Processing, Aqueous two-phase partition, Industrial scale production of proteins, Special techniques for therapeutic /diagnostic proteins; **Characterization of Proteins:** Mass spectrometry**; Protein Based Products:** Blood products and vaccines, Therapeutic antibodies and enzymes, Therapeutic hormones and growth factors, Regulatory factors, Analytical applications, Industrial enzymes, Functional non-catalytic proteins, Nutraceutical Proteins; **Designing Proteins (Protein Engineering):** Improving laundry detergent Subtilisin**,** Creation of Novel Proteins, Improving nutritional value of cereals and legumes.

Unit V: PROTEIN AND GENE MANIPULATION

Chapter 3: Genomics and Bioinformatics

Introduction: Progress in stages, Evolving approaches, Structural genomics, Functional genomics; **Genome Sequencing Projects:** Directed sequencing of Bacterial Artificial Chromosome (BAC) contigs, Random shotgun sequencing; **Gene prediction and counting; Genome Similarity, SNPs and Comparative Genomics; Functional Genomics:** Fluorescence in situ hybridization, Microarray Technology: principle, procedure, interpretation; **Proteomics:** Types of Proteomics: Expression proteomics, Structural proteomics, Functional proteomics, Genes and Proteins: Number of genes vs Number of proteins; **History of Bioinformatics; Sequences and nomenclature:** DNA and protein sequences, The concept of directionality, Different types of sequences; **Information Sources:** Major databases: NCBI, Database retrieval tools, BLAST family of search tools, Resources for gene level sequences, Analysis using Bioinformatics tools.

Unit VI: CELL CULTURE AND GENETIC MANIPULATION

Chapter 1: Microbial Cell Culture and Its Applications

Introduction; Microbial culture techniques: Nutrients for microbial culture, Culture Procedures, Equipment for microbial culture**,** Types of microbial culture**:** Batch culture, Fed-batch culture, continuous culture; **Measurement and kinetics of microbial growth:** Measurement of microbial growth, Growth kinetics and specific growth rate**; Scale-up of microbial processes; Isolation of microbial products; Strain isolation, improvement and preservation:** Strain isolation**,** Strain improvement: Mutation Selection, Genetic Engineering Techniques, Metagenomics, Strain preservation, Culture Collections Centers; **Applications of microbial culture technology; Biosafety issues in Microbial Technology.**

Unit VI: CELL CULTURE AND GENETIC MANIPULATION

Chapter 2: Plant Cell Culture and Applications

Introduction; Cell and Tissue Culture Techniques: Basic Technique, Nutrient Media, Types of cultures: organ culture, explant culture, callus culture, cell suspension culture, mass cell culture, protoplast culture, protoplast fusion, Plant Regeneration pathways; **Applications of Cell and Tissue Culture:**

Micropropagation, Virus-free plants, Artificial seeds, Embryo rescue, Haploids and triploids, Somatic hybrids and cybrids, Production of secondary metabolites, Somaclonal variation, *In vitro* plant germplasm conservation; **Gene transfer methods in plants:** Vector-mediated or indirect gene transfer, Vectorless or direct gene transfer, Transgene analysis; **Transgenic plants with beneficial traits:** Stress tolerance, Biotic stress tolerance: Herbicide tolerance, Pest resistance, Disease resistance, Virus resistance, Fungi and bacteria, Abiotic stress tolerance: Delayed fruit ripening, Male sterility, Transgenic plants as bioreactors, Nutrient quality, Diagnostic and therapeutic proteins, Edible vaccines, Biodegradable plastics, Metabolic engineering and secondary products, Other applications; **Biosafety in Plant Genetic Engineering.**

Unit VI: CELL CULTURE AND GENETIC MANIPULATION

Chapter 3: Animal Cell Culture and Applications

Introduction; Animal Cell Culture Techniques: Features of animal cell growth in culture, Primary Cell Cultures, Secondary Cell Cultures and Cell Lines, Types of Cell Lines: Finite Cell Lines, Continuous Cell Lines**,** Physical environment for culturing Animal Cells: temperature, pH, osmolality, Medium, serum and antibiotics, vessels and equipment's required for animal cell culture, tissue culture hood, CO_2 incubator, centrifuge, inverted microscope**; Characterization of Cell Lines:** storage and revival of cells; **Methods of Gene Delivery into Cells; Scale-up of Animal Culture Process; Applications of Animal Cell culture:** Erythropoietin, Factor VIII, Factor IX, Tissue Plasminogen Activator (tPA), Hybridoma Technology for Monoclonal Antibody Production, Therapeutic mAb - OKT3, Therapeutic mAb – Herceptin; **Stem Cell Technology:** ES Cell culture and its applications; **Tissue engineering.**

Practicals:

1. Use of special equipment in biotechnology experiments
2. Isolation of bacterial plasmid DNA
3. Detection of DNA by gel electrophoresis
4. Estimation of DNA by UV spectroscopy
5. Isolation of bacteria from curd & staining of bacteria
6. Cell viability assay using Evan's blue dye exclusion method

7. Data retrieval and database search using internet site NCBI and download a DNA and protein sequence from internet, analyse it and comment on it
8. Reading of a DNA sequencing gel to arrive at the sequence
9. Project work. (Any topic from theory syllabus)

Month wise Syllabus Teaching Plan (2025-26)

Class: XII **Subject: Biotechnology** **Code: 871**

Month	Subject-content	Teaching Periods	Revision Periods	Practical Work
April	Unit V Chapter 1: Recombinant DNA Technology Practical: Use of special equipment in biotechnology experiments Practical: Isolation of bacterial plasmid DNA Practical: Detection of DNA by gel electrophoresis Practical: Estimation of DNA by UV spectroscopy	22	2	 6 2 2 2
May	Unit V Chapter 2: Protein	22	2	

	Structure and Engineering Practical: Isolation of bacteria from curd & staining of bacteria			2
June	Summer Vacation (Project Work)			
July	Unit V Chapter 3: Genomics, Proteomics and Bioinformatics (Introduction, Genome Sequencing Projects, Gene prediction and counting) Practical: Cell viability assay using Evan's blue dye exclusion method	18	2	2
August	Unit V Chapter 3: Genomics, Proteomics and Bioinformatics (Genome Similarity, SNPs and Comparative Genomics,	20	4	

	Functional Genomics, Proteomics, History of Bioinformatics; Sequences and nomenclature, Information Sources) Practical: Data retrieval and database search using internet site NCBI and download a DNA and protein sequence from internet, analyse it and comment on it. Practical: Reading of a DNA sequencing gel to arrive at the sequence.			6 4
September	Revision for Half-Yearly Exam Half-Yearly Exam		16	
October	Unit VI Chapter 1: Microbial Cell Culture and its Applications.	20	4	
November	Unit VI	22	2	

	Chapter 2: Plant Cell Culture and Applications.			
December	Unit VI Chapter 3: Animal Cell Culture and Applications.	22	2	
January	Revision		16	
February	Revision Annual Practical Exam		12	
March	Annual Exam			

Note:

- **Subject teachers are advised to direct the students to prepare notebook of the Terminology/Definitional Words used in the chapters for enhancement of vocabulary or clarity of the concept.**

Prescribed Books:

1. Biotechnology - Text book for Class XII, CBSE Publication
2. Laboratory Manual-Biotechnology-Class XII, CBSE Publication

Question Paper Design (2025-26)

Class: XII **Subject: Biotechnology** **Code: 871**

Time 2½ Hours

Competencies	Marks	Percentage
Knowledge	24	40%
Understanding	18	30%
Application	12	20%
Skill	6	10%
Total	**60**	**100%**

Types Of Questions	Marks	Number	Description	Total Marks
Objective Questions	1	15	06 Multiple Choice Questions, 03 Fill in the Blanks Questions, 03 One Word Answer Type Questions, 0 3 Assertion Reason Questions	15
Very Short Answer Type Question	2	6	Internal choice will be given in any 2 questions	12
Short Answer Type Question	3	6	Internal choice will be given in any 2 questions	18
Essay Answer Type Question	5	3	Internal choice will be given in all the questions	15
Total		30		60