

**B.SC. HONS. BIOTECHNOLOGY- 6<sup>TH</sup>**  
**SEMESTER**  
**UNIT PLANS**

**B.Sc. Hons Biotechnology**  
**Semester 6**

**BIOT-Sem-VI-IV-T: GENOMICS AND**  
**PROTEOMICS**

**UNIT-I**

<b>Topic</b>	<b>Teaching points</b>	<b>Specific objectives</b>	<b>Methods /approaches /techniques</b>
Introduction to Genomics, DNA sequencing methods	manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.	To understand concept of genomics	classroom teaching with examples

**Unit 2**

<b>Topic</b>	<b>Teaching points</b>	<b>Specific objectives</b>	<b>Methods /approaches /techniques</b>
1. Managing and Distributing Genome Data	Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.	To understand the use of softwares for genome data	Lecture cum discussion

**Unit- 3**

<b>Topic</b>	<b>Teaching points</b>	<b>Specific objectives</b>	<b>Methods /approaches /techniques</b>
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Introduction to protein structure,	Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.	Knowledge of protein structure and functions	classroom teaching with the use of blackboard
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#### Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
1. Introduction to Proteomics	Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.	Study the proteome of the organism	classroom teaching with power point presentation of the topic hybridoma technology

#### **SUGGESTED READING**

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
4. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
5. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition

#### Question Bank

##### Long answer type questions

1. explain the concept of genomics
2. what is proteome and explain 2d electrophoresis
3. what is mass spectrometry
4. difference between SDS page and native gel electrophoresis
5. give the automated sequencing method for DNA
6. explain Maxam Gilbert method
7. describe Edman degradation method
8. explain the web server UCSC browser
9. Explain ENSEMBLE

what are the different types of protein structure

## **BIOT-Sem-VI-I-T Paper: GENETIC ENGINEERING**

BIOT-Sem-VI-I-T Paper: GENETIC ENGINEERING			
UNIT	TOPIC: TEACHING POINTS	OBJECTIVES	METHODS APPROACHES TECHNIQUES
I	<p>Introduction to genetic engineering. Why gene cloning and DNA analysis is important. . How to clone a gene - What is clone, Overview of the procedure</p> <p>Tools in Recombinant DNA Technology: Restriction and modifying enzymes, Type I , Type II and Type III enzymes and their characteristic features; restriction sequences, isoschizomers, rare cutting enzymes, enzyme cutting similar sequence in different manner. DNA Modifying enzymes: Characteristics and applications of Nucleases – DNase and RNase, DNA-Pol I, Klenow fragment, T4DNA polymerase, T7 DNA polymerase, T4 Polynucleotide kinase, Phosphatase, Reverse transcriptase, Taq polymerase and Ligase. Terminal deoxy ribonucleotidyl transferase.</p> <p>Polymerase Chain Reaction: Types and applications</p>	<p>Genetic engineering refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics. The students will learn how the genes can be cut and paste from one organism to another and what are its implications.</p>	
II	<p>Basic biology of plasmids and Phage vectors Basic features of plasmids, plasmid classification, Bacteriophage <math>\lambda</math>, lytic &amp; lysogeny, Promoter control circuits. linear and circular forms of lambda vector, DNA cloning with single stranded DNA vectors.</p> <p>DNA cloning vectors Cloning vectors for E. coli- Nomenclature, pBR 322, pBR 327, pUC 8, pGEM3Z. insertion and replacement vectors; Vectors based on M13. Methods of identification of recombinants: Insertional inactivation, blue/white selection. Cloning vectors for yeast- YE<sub>p</sub>, YI<sub>p</sub>, YR<sub>p</sub>.</p> <p>Advanced Vectors: cosmid, phagemid, Bacterial Artificial Chromosomes (BACs),</p>		

	shuttle vectors, yeast artificial chromosomes.		
III	<p>Preparation of genomic and cDNA library: Partial digests, Choice of vectors, Construction and Evaluation of a genomic library. cDNA library: mRNA enrichment, cDNA synthesis, Random, arrayed and Ordered library.</p> <p>Finding The Right Clone: Gene identification, Nucleic acid hybridization, screening Procedure, Probe selection, immuno screening, functional complementation. Southern blotting, northern blotting.</p> <p>Preparation of nucleic acid probes: DNA and RNA labeling techniques, nick translation , random priming, end labelling, radioactive and non- radioactive labels.</p>		
IV	<p>Site directed mutagenesis (cassette , primer extension, RT, real time, multiplex, inverse), DNA sequencing (Maxam-Gilbert, Sanger, pyro).</p> <p>Production of Protein from Cloned Genes: Special vectors for expression of foreign genes in E. coli, General problems with the production of recombinant protein in E. coli.</p> <p>Production of recombinant protein by eukaryotic cells</p>		

## Sem 6

# Food Biotechnology

Food Biotechnology				
UNIT	TOPIC: TEACHING POINTS	OBJECTIVES	METHODS APPROACHES TECHNIQUES	RESORURCES & LINKS
I	Food and Microorganisms: History and scope of Food biotechnology, food as substrates for microbes, factors affecting growth of microorganisms, Detection of microorganisms in food: Sampling plan & procedure for microbial analysis; Qualitative methods to isolate pathogenic microorganisms, test for bacterial toxins in foods; Quantitative methods for microbial enumeration: Direct enumeration, indirect estimations and standard and recommended methods; Applications of enzymes in food technology.	Students are apprised of scope of biotechnology in field of Food industries.  They learn about various applications of microbiological and biotechnology techniques in food productions and quality testing.	Classroom teaching with examples.  Powerpoint presentations.  Practicals.	Reference Books: 1. Frazier W.C., Westhoff, D.C. (Ed). (1988). Food microbiology (McGraw-Hill). 2. Admas, M.R., Moss, M.O (2005). Food microbiology (Edition 3, Illustrated Publisher Royal Society of Chemistry). 3. SriLakshmi B. (2003) Food science (New Age International Publishers, India). 4. Jay J.M., M.J. Loessner, D.A. Golden. (2005). Modern food microbiology (Edition 7, Illustrated Publisher Springer). 5. B. Sivasankar (2004). Food processing and preservation
II	Principles of food preservation: Physical, chemical, and biological methods of preservations. Contamination, preservation and spoilage of different kind of foods: Milk and milk products (milk, butter, yoghurt and cheese), beverages (beer, wine, tea and coffee), meat and fish products (sausages, vegetables and fruits.			
III	Food adulterants and food additives: Major food adulterants, types and their methods of assay, food additives their function and uses, flavoring agents, coloring agents and vitamins as food additives. Fermented foods and their production: Bakers yeast, Bread, cheese, yoghurt, tofu, miso, tempeh, sauerkraut,meat and alcoholic beverages ( beer and wine) Production of algal, fungal and other microbial proteins( SCP and mushroom etc) Probiotics, prebiotics,fortified and biofortified foods, functional foods, nutraceuticals, organic foods. Genetically modified food (Golden rice,			

	Favr savr tomato, protato, pomato etc)			(PHI Private Ltd, New Delhi). 6. Michael P. Doyle (1989). Food borne bacterial pathogens (Edition illustrated, Publisher Marcel Dekker).	
IV	Food and water borne diseases: Shigellosis, Salmonellosis, Cholera. Food borne intoxications: Staphylococcal, Bacillus and Clostridium botulinum Exotoxins and Endotoxins, their mechanism of action Rapid and advanced estimation methods (Immunoassays, nucleic acid probe)for detection of pathogens.				

**B.Sc. Hons Biotechnology**  
**Semester 6**

**BIOT-Sem-VI-II-T: BIOPROCESS ENGINEERING**  
**AND TECHNOLOGY**

**UNIT-I**

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
<b>1. Introduction</b> <b>2. sterilization</b>	Fundamental principles of biochemical engineering. Sterilization of air and media sterilization, design of batch sterilization process. Del factor, sterilization cycle, continuous sterilization process	To understand general aspects of fermentation and processes	classroom teaching with examples

**Unit 2**

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
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<b>2. microbial growth kinetics</b>	Simple kinetics of microbial growth (Batch and Continuous, Feed Back System), yield coefficient, doubling time, specific growth rate, internal and external feedback systems, metabolic and Biomass productivities, effect of temperature and pH on the product formation	How microbes grow , time period required to produce product	Lecture cum discussion
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### Unit- 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
<b>1. design of fermenter</b>	Components of Fermenter, Aseptic operation of the fermenters, control and measurement equipment of fermenters, pH and DO probes, impeller and spargers,	To provide knowledge of fermenter parts used in industries	classroom teaching with the use of blackboard

### Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
<b>2. downstream processing</b>	removal of microbial cells and other solid materials, foam separations, filtration, industrial filters, centrifugations and industrial centrifuges, cell Disruption, aqueous two phase extraction system, super critical extraction, whole broth process. Waste water treatment for fermentation process	The students will gain the knowledge of the various methods in product recovery	classroom teaching with power point presentation of the topic hybridoma technology

### Question Bank

#### Long answer type questions

1. explain the various processes of downstream processing
2. describe different types of centrifuges

3. explain different types of filtration
4. what is super critical fluid extraction?
5. explain DO probes with diagram
6. explain the microbial growth kinetics
7. describe sterilization cycle
8. explain the working of continuous sterilizers
9. what are the functions of batch filters and explain the theory behind filtration
10. explain del factor and how it is volume dependent?
11. explain the aseptic operation of fermenter
12. what are the various methods used for waste water treatment in industries

INTELLECTUAL PROPERTY RIGHTS AND ETHICAL ISSUES IN BIOTECHNOLOGY AND ENTREPRENEURSHIP				
UNIT	TOPIC: TEACHING POINTS	OBJECTIVES	METHODS APPROACHES TECHNIQUES	RESORURCES & LINKS
I	<p>IPR: Introduction to Intellectual Property Rights. Tangible and intangible property.</p> <p>Patents: Introduction to patent law and brief history (early GATT and TRIPS), conditions for patentability; procedure for obtaining patents, patent filing through PCT, rights of a patentee; patent infringements and litigation.</p> <p>Indian patent laws and amendments. Patents from an international perspective.</p>	<p>To introduce the students to intellectual rights and how to use the current intellectual property system to protect and commercialize their biotechnological invention. This course also covers the ethical issues, controversies and social-ethical impact of biotechnology on society.</p>	<p>Classroom studies with electronic aids.</p> <p>Case studies.</p> <p>Assignments.</p>	<p>1. J.E. Smith (2004). Biotechnology (Cambridge Univ. Press).</p> <p>2. V. Santaniello (2000). Agriculture and intellectual property rights: economic institutional, and implementation issues in biotechnology (Edition illustrated Publisher CABI).</p> <p>3. Thackeray, A (ed) (1998). Private science: Biotechnology and the rise of the molecular sciences (Univ. of Pennsylvania Press, Phil).</p> <p>4. Inderpal Singh and Baljinder Kaur (2006) Patent law</p>
II	<p>Design, copyright and Trademark:</p> <p>Copyright: Registration procedure and copyright authorities; assignment and transfer of copyright, copyright infringement and exceptions to infringement; software copyright.</p> <p>Designs: Introduction to the law on industrial designs; registration and piracy; International perspective; commercial exploitation and infringement.</p> <p>Trademark: Importance, Registration, Trademark infringement and piracy.</p>			
III	<p>Patenting in biotechnology: Biotechnology patents and its economic, ethical and depository considerations.</p> <p>Patentable subject matter and legal aspects of transfer of biotechnology in India.</p> <p>Other multilateral treaties &amp; International conventions – Paris convention, CBD, UPOV, PGRFA.</p> <p>Writing a patent specification.</p> <p>Information sources in patent literature search.</p>			
IV	<p>Entrepreneurship:</p> <p>Entrepreneur and its types, Women Entrepreneurship. Selection of a product, Product line design and development processes, economics on material and energy requirement, stock the product and release the</p>			

same for making The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential.			and Entrepreneurship. Kalyani Publishers, India.
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## Question Bank

### Long answer type:

1. What is Patentability? Explain various conditions and procedure to obtain patents.
2. Explain various treaties which govern Patent rights. Explain provisions of PCT in application procedure.
3. Explain Indian Patent Laws.
4. Differentiate between Copyright, Trademark and Industrial Rights.
5. Explain about the issues faced while issuing IPR protection in Biotechnology.
6. Explain Entrepreneurship? Highlight issues faced specifically by female entrepreneurs.
7. Explain about Economics of entrepreneurship. Explain about excise regulations faced.

### Short answer type:

1. What is a patent?
2. What is a copyright?
3. What is a trademark?
4. What is an industrial design?
5. What is farmer rights?
6. What is GI??
7. What is GATT?
8. What is TRIPS?
9. What is PCT?
10. What issues are faced by women in business?



