B.Sc. Hons. Biotechnology 1st year

Unit plans

SESSION 2021-22

THEORY: 67 MARKS

B.Sc. HONS. BIOTECHNOLOGY- I SEM **ASSESSMENT: 08 MARKS**

SUBJECT: INTRODUCTION TO BIOTECHNOLOGY

Sr. no.	Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
Y1	**Biotechnology Basics:** **Introduction to model organisms**	• Advent, scope and basics of biotechnology. • Bacteria as workhorses of biotechnology; E. coli as the model bacterium. • Yeast and fungi in Biotechnology • Introduction to multicellular organisms as research models: 1. Drosophila melanogaster 2. Caenorhabditis elegans 3. Daniorerio 4. Musmusculus 5. Arabidopsis thaliana as model for plant genetics. • Role of viruses and bacteriophages in biotechnology	To give introduction about Biotechnology. Brief introduction to workings of Biotech. Model organisms. vectors	Classroom teaching. Examples from textbooks, life. Presentation.	1. Comprehensive Biotechnology, Murray Moo-Young, 2nd edition (2011), Pergamon Press. 2. Introduction to Biotechnology, William J. Thieman& Michael A. Palladino, 3rd edition (2012), Benjamin Cummings. 3. Biotechnology Expanding Horizons, BD Singh, 4th edition (2012), Kalyani Publishers. 4. The Ethics of Biotechnology (Biotechnology in the 21st
2	**Structure and Functioning of**	• Structure and	Basic introduction	Classroom teaching.	

	cells. **Biotechnological techniques.**	function of the cell: the basic unit of life • Prokaryotic and Eukaryotic cells • Biomolecules in a cell (DNA, RNA and proteins) • Introduction to genomics, transcriptomics, proteomics and metabolomics; bioinformatics and its role in biotechnology. • Introduction to basic techniques like sterilization, centrifugation, electrophoresis, chromatography, sonication. • Fundamentals of recombinant DNA technology: Restriction Enzymes, Vectors and their properties.	to cell biology, Genetics Biochemistry Bio-informatics Genetic engineering	Examples from textbooks, life. Presentation.	Century), Jonathan Morris, Chelsea House Pub (L), 1st edition (2005). 5. Biotechnology, Applying the Genetic Revolution, David P. Clark & Nanette J. Pazdernik, 1st edition (2008), Academic Cell. 6. Molecular Biotechnology, Sandy B. Primrose, 2nd edition (1991), Blackwell Scientific Publications, ISBN. 7. Biotechnology: Demystifying the concepts, David Bourgaize, Thomas R. Jewell & Rodolfo G. Buiser, 1stedition(1999), Benjamin Cummings. 8. Ethical Issues in Biotechnology, Richard Sherlock & John D. Morrey, 1st
3	**Applications of Biotechnology**	• Applications of biotechnology: today and tomorrow • Basics of Biotechnology in fermentation and pharmaceutical processes. • Green technology to control pollution. • Role of biotechnology in	Introduction to various applications of biotechnology Fermentation Environmental Diagnostic and medical biotech.	Classroom teaching. Examples from textbooks, life. Presentation.	

		diagnostics, introduction to gene therapy.			edition (2002), Rowman & Littlefield Publishers.
4	**Ethics and issues in Biotechnology.**	• Biotechnology and society: genetically modified organisms (GMOs) - transgenic plants and animals and their applications in biotechnology. • Public concerns and risks associated with genetic engineering: Bioterrorism and biowarfare. • Ethical, social and legal implications of biotechnology.	Bioethics	Classroom teaching. Examples from textbooks, life. Presentation.	

Question bank:

1. DEFINE BIOTECHNOLOGY
2. WHAT DO YOU UNDERSTAND BY BLOTTING?
3. DEFINE VECTORS
4. GIVE PROPERTIES OF VECTORS
5. DESCRIBE THE GENE THERAPY
6. EXPLAIN THE IMPORTANCE OF MODEL ORGANISMS IN BIOTECHNOLOGY
7. WHAT DO YOU UNDERSTAND BY BIOWARFARE?
8. WHAT ARE THE ETHICAL ISSUES RELATED TO THE EXPERIMENTS IN BIOTECHNOLOGY?
9. GIVE THE IMPORTANCE OF BIOTECHNOLOGY IN MEDICAL FIELD.
10. WHAT DO YOU UNDERSTAND BY GREEN BIOTECHNOLOGY?
11. EXPLAIN THE NOMENCLATURE, NATURE OF CLEAVAGE AND TYPES OF RESTRICTION ENDONUCLEASES.
12. DESCRIBE DIFFERENT TYPES OF ENZYMES USED IN RECOMBINANT DNA TECHNOLOGY
13. DEFINE METABOLOMICS.
14. DEFINE GENOMICS.
15. WHAT DO YOU UNDERSTAND BY TRANSCRIPTOMICS?
16. EXPLAIN THE ROLE OF *E. coli* AS MODEL ORGANISM IN BIOTECHNOLOGY
17. GIVE THE ROLE OF YEAST AND FUNGEI IN BIOTECHNOLOGY
18. DESCRIBE THE APPLICATIONS OF BIOTECHNOLOGY IN IMPROVING THE ENVIRONMENT BY REMOVING POLLUTANTS
19. WHAT IS BIOREMEDIATION?
20. EXPLAIN THE DIFFERENT TYPES OF MULTICELLULAR MODEL ORGANISMS
21. EXPLAIN IN BRIEF THE ADVENT OF BIOTECHNOLOGY

22. WHAT ARE THE DIFFERENT RISKS ASSOCIATED WITH THE GMO'S?

B.Sc. Hons Biotechnology 2021-22

Semester 1

Subject:- Life Sciences

Total units= 4

Theory marks=67
Internal assessment= 8
Total marks =75

Unit 1

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Plant Anatomy and Physiology	Structure of land plants. Nutrition and Transport phenomena in plants. Plant reproduction and development. Plant responses to the environment	To learn about the anatomy and physiology of plants and plant systems	Lecture cum discussion	Life Sciences (2001) by Rastogi and Dubey, S. Chand & Co., New Delhi. Biology- P.S. Dhami Pradeep publisher

Question Bank

Long answer type questions

1. Explain the transportation phenomenon in plants
2. Write about the structure of xylem and phloem
3. Explain the plant reproduction and development
4. Write about the transpiration pull in plants
5. Explain transpiration
6. Describe plant responses to the environmental factors such as gravity, stress, light etc
7. Explain macronutrients and micronutrients required for plant nutrition.

Short answer type questions

1. Define transpiration
2. Define guttation
3. Define osmosis and diffusion
4. Write about the vernalization in plants
5. Give the role of xylem and phloem in plants

Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. *Ecology* 2. *Ecosystems*	Community interactions Definition and components. Food chain and food web. Habitat. Ecological succession. Types of succession. Animal behaviour:- Definition and learning.	To study ecology, ecosystems and its biotic and abiotic components	classroom teaching with examples. Students will prepare the examples of food chain and food web from daily life	Life Sciences (2001) by Rastogi and Dubey, S. Chand & Co., New Delhi. Biology- P.S. Dhami Pradeep publisher

Question Bank

Long answer type questions

1. Explain different types of community interactions such as symbiotic and competitive interactions
2. Write about the different components of ecosystem
3. Explain grazing food chain and food chain in pond ecosystem
4. Write about the habitat
5. Define ecological succession and explain its types
6. Define ecosystem and explain different types of ecosystem
7. Write about the animal behavior and learning

Short answer type questions

1. Define ecology
2. Who gave the term ecology
3. Define ecosystem
4. Define ecological succession

5. Define habitat
6. What are mutualistic interactions
7. Define food chain
8. How energy is flowed in the universe
9. Define food web

Unit 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Animal Anatomy and Physiology	Homeostasis and organization of animal body. Circulation. Respiration. Nutrition and digestion. Urinary system and homeostasis. The immune response.	To learn about the anatomy and physiology of animals and animal systems.	Lecture cum discussion of the topic from the animated presentation	Life Sciences (2001) by Rastogi and Dubey, S. Chand & Co., New Delhi. Biology- P.S. Dhami Pradeep publisher

Question Bank

Long answer type questions

1. Explain the different types of circulatory mechanisms in animals
2. Write about the working of heart
3. Define homeostasis and explain the organization of animal body
4. Explain the working of lungs
5. Describe respiration in animals
6. Explain the working of kidneys
7. Describe nephron with well labeled diagram
8. Write about the first line of defense mechanism in animals
9. Write about the specific immune response
10. Explain the urinary system in animals

Short answer type questions

1. Define tidal volume
2. Define pulmonary respiration
3. Write about the lub-dub sound
4. Write about blood pressure

5. Define homeostasis

SESSION 2021-22

THEORY: 67 MARKS

B.Sc. HONS. BIOTECHNOLOGY- 2 SEM

ASSESSMENT: 08 MARKS

BASIC BIOCHEMISTRY

Sr. no.	Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1	**Water:** **Carbohydrate**	Physico chemical properties of water, dissociation and association constants. pH and buffers, pI, pka, Henderson Hasselbatch equation and its implications. Structure of important mono, di-, oligo- and polysaccharides, glycoproteins, peptidoglycan, glycolipids and lipopolysaccharides. Reaction of monosaccharides	To make student conversant with the biochemical aspect of cell, chemical structure & function of various biomolecules.	Classroom teaching. Examples from textbooks, life. Presentation.	1. Lehninger A.L., Nelson D.L. and Cox M.M. (2005).Principles of biochemistry (W. H. Freeman, USA). 2. Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York). 3. j.l. Jain biochemistry
2	**Lipids**	Classification of lipids and fatty acids, general functions of major lipid subclasses, acylglycerols, phosphoglycerols, phosphoglycerides, sphingolipids, glycosphingolipids and terpenes, sterols, steroids:	Knowledge of lipids	Classroom teaching. Examples from textbooks, life. Presentation.	4. G.L. Zubay, W.W. Parson, D.E. Vance. (1995). Principles of biochemistry:Student study art notebook (Wm.C. Brown).

		Prostaglandins..			5. H.R. Horton, A.J. Scism, L.A. Moran, R.S. Ochs, J.D Rawn, K.G. Scrimgeour. (2006). Principles of biochemistry (Prentice Hall).
3	**Vitamins and hormones:**	• Types of vitamins and their chemistry, vitamins as cofactors, steroids and peptide hormones.	Understanding the need and functions of vitamins	Classroom teaching. Examples from textbooks, life. Presentation.	
4	**Proteins**	• Structure of amino acids, non-protein and rare amino acids and their chemical reactions. Structural organization of proteins (primary, secondary, tertiary and quaternary domain structure), protein classification and function. Forces stabilizing primary, secondary and tertiary structure.	Essential and non- essential proteins and amino acids	Classroom teaching. Examples from textbooks, life. Presentation.	

Question bank:

1. What are the different properties of water
2. Explain the types of carbohydrates
3. What are essential amino acids
4. Write on structures of proteins
5. Give the examples of tertiary structure of proteins
6. What are lipids?
7. Explain the types and examples of steroids
8. Explain endocrine hormones
9. Explain exocrine hormones

10. What are terpenes
11. Explain polysaccharides
12. Derive Henderson Hasselbatch equation and its implications.
13. Write about dissociation and association constant
14. What are the different types of structures of proteins?
15. Describe the major classes of proteins

SESSION 2021-22

THEORY: 67 MARK
2 SEM
ASSESSMENT: 08 MARKS

Cell biology

Sr. no.	Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1	**Cell as a basic unit of living systems:** **Ultrastructure of cell membrane and cell organelle**	cell theory, pre-cellular evolution, artificial creation of "cells", broad classification and ultrastructure of cell types (PPLOs, Bacteria, eukaryotic microbes, plant and animal cells), tissue, organ and organism at different level of organization of other genetically similar cells; biochemical composition of cells (proteins, lipids, carbohydrates, nucleic acids and metabolic pool). structure and function of cell organelles, ultrastructure of cell membrane, cytosol, golgi bodies, vacuoles, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin microtubules etc), mitochondria, chloroplast, lysosomes, peroxisomes,	To understand the detailed overview of eukaryotic cell and its inner components	Classroom teaching. Examples from textbooks, life. Presentation.	1.The World of the Cell (2008) Becker, Klein Smith & Hardin Pearson education Inc 2.Cell and Molecular Biology (2010) E.D.P De Robertis and E.M.F. De Robertis, Jr. 3.Molecular Cell Biology (2007) Lodish et al.

		nucleus (nuclear membrane, nucleoplasm, nucleolus)			Freeman & Co 4.Molecular Biology of the Cell (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. 5.The Cell: A Molecular Approach (2013) Geoffrey M. Cooper and Robert E. Hausman 6.Cells and Cell Function: Advanced Level (2007) Sally Morgan 7.Stem Cells: An Insider's
2	**Cellular transport**	Passive & active transport, permeases, sodium, potassium, Calcium, ATPase pumps, lysosomal and vacuolar membrane, ATP dependent proton pumps, co-transport, symport, antiport, transport into prokaryotic cells, endocytosis and exocytosis, entry of viruses and toxins into cells.	To understand the processes of cell transport and cell locomotion	Classroom teaching. Examples from textbooks, life. Presentation.	
3	**Cell locomotion: Amoeboid, Flagellar and Ciliar. Chromosomes**	• discovery, morphology, chemical composition, structural organization of chromatids, centromere, telomere, chromatin, nucleosome organization, euchromatin and heterochromatin, special chromosomes (polytene, lampbrush chromosomes), banding patterns in human chromosomes.	Understanding movement of cells	Classroom teaching. Examples from textbooks, life. Presentation.	
4	**Basics of stem cells**	• introduction to concepts in stem cell biology, Cell differentiation in multicellular organisms: (renewal, potency:	Introduction to stem cells and their applications	Classroom teaching. Examples from textbooks, life.	

		Totipotent, pleuripotent, multipotent); types of stem cells: early embryonic stem cells, blastocyst embryonic stem cells, fetal stem cells, umbilical cord stem cells, adult stem cells; applications; ethical issues related to stem cells.		Presentation.	Guide (2013) Paul Knoepfler

Question bank:

1. define cell biology
2. draw the structure of eukaryotic cell
3. draw the structure of prokaryotic cell
4. differentiate between prokaryotic and eukaryotic cell
5. what are stem cell?
6. Difference between pluripotent and multipotent cell
7. What are the applications of stem cells?
8. What do you understand by chromosomes?
9. What is heterochromatin and euchromatin?
10. Explain different types of cell locomotion
11. Describe cell theory
12. Explain cell doctrine
13. Draw the stuctures of polytene chromosomes
14. Describe telomeres.
15. Explain ATP dependent proton pumps
16. Explain the process of endocytosis and pinocytosis
17. Describe ribosomes
18. Explain different types of cell organelles with structures
19. What is symport and antiport?
20. What are microtubules . explain

B.Sc. HONS. BIOTECHNOLOGY- 2 SEM

ASSESSMENT: 08 MARKS

GENERAL MICROBIOLOGY

Sr. no.	Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1	**History of Microbiology**	• A. Leewenhook, L. Pasteur, R. Koch, J. Lister,	Microbes play significant role in understanding medical science	Classroom teaching. Examples	1. Tortora, G.J., Funke, B.R. and Case, C.L. (2009)

	Principle of microscopy	J.Tyndall, Koch postulates, • Discovery of antibiotics. • Bright field, dark field, phase contrast, fluorescent, electron microscopy.	and industries so study of microbes from basic to advance level.	from textbooks, life. Presentation.	Microbiology: An introduction (Benjamin/ Cummings publishing company, Inc). 2. R. Y. Stanier, M. Doudoroff, E. A. Adelberg (1999). General microbiology (MacMillian Press London). 3. M.J. Pelczar, E.C. Sun Chan, N.R. Krieg (2007). Microbiology (Tata McGraw Hill Publication, New Delhi). 5th edition. 4. S.C. Prescott, C.G. Dunn (1959). Industrial microbiology (McGraw-Hill). 5. Purohit, S.S. (2003). Microbiology: Fundamentals and applications
2	**Microbial classification:**	Bacteria, fungi • Morphology of bacteria, viruses and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, sporulation/ germination process. Enzymes, Vectors and their properties.	UNDERSTANDING THE CELL STRUCTURE OF MIROBES.	Classroom teaching. Examples from textbooks, life. Presentation.	
3	**Microbial growth, nutritional biodiversity.**	• phases of growth, generation time, growth rate, • monoauxic, diauxic and synchronous growth. Chemostat • Physical and chemical agents to kill microbes,	UNDERSTANDING THE BIOCHEMISTRY AND NUTRITIONAL BIODIVERSITY OF MICROBES.	Classroom teaching. Examples from textbooks, life. Presentation.	

		sterilization and pasteurization processes.			(Agrobios, India) 6. Postgate, J.R. (2000). Microbes and man (Cambridge University Press).
4	**Normal micro flora AND MICROBIAL INTERACTIONS**	• Normal micro flora in human/ animals. Types of microbial pathogens and diseases caused by them. • Microbial interactions like symbiosis and antibiosis. Host defense mechanism against pathogens.	Discussion of application of microbes	Classroom teaching. Examples from textbooks, life. Presentation.	

Question bank:

23. DEFINE microbiology
24. What is the difference between bacteria and virus?
25. Define fungi
26. What is symbiosis?
27. What is antibiosis?
28. Explain the different methods of sterilization
29. Describe physical methods of sterilization
30. Explain normal microflora of human skin
31. Give different types of nutritional biodiversity of microbes
32. Explain confocal microscopy
33. Describe bright field microscopy
34. Give classification of bacteria
35. Explain the discovery of antibiotics
36. Describe growth kinetics of microbes
37. Explain chemostat and turbidostat
38. Describe different types of microbial interactions .
39. Differentiate between gram positive and gram negative microbes
40. Explain different types of pasteurization
41. Explain TEM and SEM
42. Describe sporulation and germination of microbes.