B.SC. HONS. BIOTECHNOLOGY- 5TH SEMESTER
UNIT PLANS

B.Sc. Hons Biotechnology 2021-22
Semester 5

Subject:-Molecular biology

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.DNA **2.Genome organization in prokaryotes** **3. Genome organization in eukaryotes**	Chemical composition of DNA DNA structure-single stranded DNA, detailed account of double stranded DNA, BDNA, Z.DNA and other structural forms and their importance Molecular nature of the genetic material, Composition and structure of prokaryotic DNA and RNA. Composition and structure of eukaryotic DNA and RNA. Characteristic features of highly repetitive DNA, Tandem repetitive DNA and Mini and	This course of Molecular Biology will introduce the students with structure of various nucleic acids	Lecture cum discussion	Snusted and Simmons, 2006, Principles of genetics, John Wiley and Sons, Inc Brown, T.A, 2007, Genomes 3, Garland Science.

	microsatellite DNA and Insertional elements and their role and importance			

Question Bank

Long answer type questions

1. Differentiate between different tpes of DNA
2. Explain genome organization in prokaryotes
3. Describe microsatellite and minisatellite DNA
4. What is repetitive DNA. Explain
5. Write about the composition of DNA
6. Describe different forms of DNA
7. Explain genome organization in eukryotes
8. Describe the molecular nature of genetic material

Short answer type questions

1. Write about the most common form of DNA
2. Define microsatellite DNA
3. Define repetitive DNA
4. Describe cDNA
5. Write about C- value paradox
6. How genome is organized in prokaryotes

Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Prokaryotic DNA replication **2. Eukaryotic DNA replication**	replication origin and site and structure and DNA Ter regions and structure. DNA polymerases, composition and features, replication factors and the mechanism of replication, leading strand and lagging strand synthesis, procesessivity and fidelity. Replication of single stranded DNA, M13 viral DNA. origins, replication initiation complexes and their assembly, licensing factors, DNA polymerases and their composition, telomerase and mode of action, replication factors, disassembly of chromatin components and reassembly during replication	To learn about the detailed molecular mechanisms of gene expression such as DNA replication in prokaryote and in eukaryotes.	classroom teaching with examples	Snusted and Simmons, 2006, Principles of genetics, John Wiley and Sons, Inc Brown, T.A, 2007, Genomes 3, Garland Science.

Question Bank

Long answer type questions

1. Describe the termination mechanism in eukaryotes
2. Write about the various replication origins and initiation complexes in eukaryotes
3. Write about eukaryotic DNA polymerases
4. Explain various replication factors
5. Explain telomerase mode of action
6. Write about assembly and disasemnly of chromatin components
7. Exlain the rolling circle mechanism of DNA replication

8. Write the whole replication process and its mechanism

Short answer type questions

1. What is lambda DNA polymerase
2. write about M13 phage
3. write about Ter region
4. write about ORI
5. what is telomerase
6. what is fidelity
7. define prcessivity

unit 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Gene Expression **2. RNA types** **3. Transcription**	Overview of central dogma rRNAs; Structural features of rRNAs-prokaryotic and eukaryotic. tRNAs: structural features, their anticodon feature. mRNAs-prokaryotic and eukaryotic mRNAs, structural features regulatory elements and mechanism of transcription regulation in prokaryotes and eukaryotes	.to learn about the gene expression, different types of RNA ; their characteristics and transcriptional regulation	After the completion of the discussion of the topics in the class. The students will again give the seminar of the same topic.	Snusted and Simmons, 2006, Principles of genetics, John Wiley and Sons, Inc Brown, T.A, 2007, Genomes 3, Garland Science.

Question Bank

Long answer type questions

1. Write about central dogma of life
2. Give detailed information about the structural features of rRNA

3. Explain the regulation of transcription in prokaryotes and eukaryotes
4. Write about the features of genetic code
5. Explain different types of RNA

Short answer type questions

1. Define central dogma
2. Define transcription
3. What is the function of mRNA
4. What are codons and anticodons
5. What do you understand by ubiquitous nature of genetic code
6. Write about the various enzymes involved in transcription
7. Enlist the regulatory enzymes of transcription
8. Define operon

Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. **Translation** 2. **Gene Regulation**	Overview and mechanism of translation process in prokaryotes, characteristics of the genetic code, structure and charging of tRNA Regulation of gene expression in response to environmental conditions. Operon concept- the Lactose and the Tryptophan operon	To learn about the translation mechanism and characteristics of genetic code along with the regulatin of gene expression	classroom teaching with power point presentation	Snusted and Simmons, 2006, Principles of genetics, John Wiley and Sons, Inc Brown, T.A, 2007, Genomes 3, Garland Science.

Question Bank

Long answer type questions

1. Explain the process of translation in prokaryotes
2. Give detailed information about lactose operon
3. Give detailed information about tryptophan operon
4. Explain the characteristics of genetic code
5. Explain the structure and charging of tRNA

6. Write about the Regulation of gene expression in response to environmental conditions.

Short answer type questions

1. Define operon
2. What is suppressor gene
3. Draw the well labeled diagram of tRNA
4. What are inducible operons
5. What are repressible operons
6. Write about TATA box
7. Write about the three letter code

B.Sc. Hons Biotechnology 2021-22
Semester 5

Subject:-Enzymology

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. Structure and functions of enzymes:	Historical background and general properties of enzymes, concept of active centre, binding sites, stereo specificity and ES complex formation, activation energy, Evidences for enzyme-substrate complex; Lock and key, Induced fit and Transition state hypotheses,Coenzymes and Cofactors-Prosthetic group, coenzymes involved in different metabolic pathways	The major emphasis of this course is to introduce the students to the world of Enzymes and their structure	classroom teaching with examples	Biochemistry text books by Stryer, Voet and Lehninger Structure and functions of enzymes:Enzymes: biochemistry, biotechnology and clinical chemistry (2001) by Trevor Palmer (Horwood).

Question Bank

Long answer type questions

1. Give the history of enzymology
2. Give general properties of enzymes
3. What do you understand by ES complex. Explain
4. Give the various hypothesis for interactions of enzymes and substrate
5. What are cofactors. Explain their role in different metabolic pathways
6. What do you understand by activation energy. Explain with diagram

Short answer type questions

1. Define enzymology
2. Define activation energy and give its formula
3. What are prosthetic group

4. Define transition state

Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Factors Affecting the Enzyme Activity	Concentration, pH and temperature. Kinetics of a single substrate enzyme catalysed reaction, derivation of Michealis-Menten Equation, significance of Km value, Vmax, Turnover number, Kcat. Enzyme activity, international units, specific activity, Enzymes as thrombolytic agents, Anti-inflammatory agents,streptokinase, Isoenzymes	To understand the mode of action of enzymes at various cellular metabolism	Lecture cum discussion	Biochemistry text books by Stryer, Voet and Lehninger Structure and functions of enzymes:Enzymes: biochemistry, biotechnology and clinical chemistry (2001) by Trevor Palmer (Horwood).

Question Bank

Long answer type questions

1. Explain Michealismenten equation
2. Give the various factors affecting enzyme activity
3. Give the significance of Km and how it is affected in the presence of inhibitors
4. Describe the role of enzymes as thrombolytic agents and anti-inflammatory agents
5. Describe the kinetics of a single substrate enzyme catalyzed reaction.
6. What are isoenzymes. Explain with examples.

Short answer type questions

1. Define isoenzymes
2. Define turn over number
3. What is the significance of Vmax
4. Give the international units of enzymes.
5. Define enzyme activity
6. What are thrombolytic agents.
7. What are anti- inflammatory agents.

Unit 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Enzyme Regulation	Feedback inhibition, Allosteric Regulation, Covalent Modification and ProteolyticActivation.Organization of enzymes in the cell, localization, enzymes in membranes. Acid-base catalysis, covalent catalysis, Metal ion catalysis, multienzyme complexes and ribozymes, catalytic antibodies, Allosteric enzymes	To understand the regulation of enzymes in the presence of various substrates.	classroom teaching with the use of black board	Biochemistry text books by Stryer, Voet and Lehninger Structure and functions of enzymes:Enzymes: biochemistry, biotechnology and clinical chemistry (2001) by Trevor Palmer (Horwood).

Question Bank

Long answer type questions

1. Explain the covalent modification of enzymes
2. Explain multienzyme complexes with examples
3. Give allosteric regulation of enzymes
4. What do you understand by feedback inhibition. Explain
5. What are inhibitors. Explain reversible inhibition with example
6. Explain irreversible inhibition
7. Describe the organization of enzymes in the cell

Short answer type questions

1. Define inhibition
2. Define allosteric enzymes
3. What is competitive inhibition
4. Give the allosteric regulation.
5. Explain covalent catalysis
6. What is acid base catalysis.
7. Explain metal ion catalysis

Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links

1. Applications of Enzymes	Immobilized enzymes, industrial applications of immobilized enzymes, Thermophilic enzymes, amylases, lipases, Proteolytic enzymes in meat and leather industry, enzymes used in fermentation processes, cellulose degrading enzymes, Metal degrading enzymes.	To understand the applications of various enzymes in different industries	classroom teaching with power point presentation	Biochemistry text books by Stryer, Voet and Lehninger Structure and functions of enzymes:Enzymes: biochemistry, biotechnology and clinical chemistry (2001) by Trevor Palmer (Horwood).

Question Bank

Long answer type questions

1. Give the methods of immobilizing enzymes
2. Give applications of immobilized enzymes
3. What are thermophilicenzymes. Explain
4. Give the industrial applications of enzymes
5. Explain proteolytic activity of enzymes

Short answer type questions

1. Define proteolytic activity
2. Give metal degrading enzymes
3. Name enzymes used in fermentation
4. What is immobilization
5. Give role of cellulases

B.Sc. Hons Biotechnology 2021-22
Semester 5

Subject:- Bioinformatics

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. Introduction to Bioinformatics, Biological Databases and Sequence analysis 2. Primary Databases 3. Secondary Databases 4. Molecular Structure Databases	Introduction, overview and needs of bioinformatics technology Primary Sequence database i.e. GenBank & EMBL. SwissProt/TrEMBL, Pfam Protein Data Bank (PDB), SCOP, CATH. Understanding the structure of each database and using it on the web.	This subject introduces the students to an advanced field of biotechnology which will give an insight how to handle the enormous data generated in biology in silico and the in silico tools applied to decipher and analyze the data.	classroom teaching with performance of the experiments using internet	Essential bioinformatics- Jin Xiong Bioinformatics: Sequence and genome analysis- David W. Mount

Question Bank

Long answer type questions

1. Give the applications of bioinformatics
2. Describe primary sequence databases
3. Explain secondary sequence databases
4. Explain in detail the database protein data bank
5. Give the structural classification of proteins
6. Give differences between SwissProt and TrEMBL

Short answer type questions

1. Define antigen
2. Define immunogen
3. Difference between antigen and immunogen
4. What are haptens
5. Define epitopes
6. What are cell adhesion molecules

Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Sequence Alignment 2. Pair wise sequence alignment 3. Substitution matrices	Introduction to sequence alignment and its applications Concept of global and local alignment, Dot Plot, algorithm for pair wise sequence alignment (Needleman Wunsch, Smith-watterman methods), Introduction to BLAST, types of BLAST, algorithm of BLAST and interpretation of its result. Introduction to substitution matrices: PAM and BLOSUM matrices, concept of log odd ratio. Methods of multiple sequence alignment. Introduction to consensus sequences, motifs and profiles.	The students will learn to use BLAST for sequence similarity studies. This unit will increase their knowledge about the relationship between sequence similarity	classroom teaching with examples . students will use the various tools in practical classes and will solve some problems their own	Essential bioinformatics- Jin Xiong Bioinformatics: Sequence and genome analysis- David W. Mount

4. Multiple sequence alignment		and ancestral relationship		

Question Bank

Long answer type questions

1. Explain BLAST and its types
2. Give differences between PAM and BLOSUM
3. Explain different methods of MSA
4. Describe the concept of log odd ratio
5. Give differences between local and global alignment
6. What are motifs and profiles. Explain
7. Explain the algorithm of BLAST
8. Give differences between pairwise and multiple sequence alignment
9. Explain Clustal W and Clustal X
10. Explain PSSM

Short answer type questions

1. Give full form of BLAST
2. Define motifs
3. Give web address of BLAST
4. What are substitution matrices
5. What are alignment

Unit 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links

1. Phylogenetic Analysis 2. Genome Annotation	Introduction to phylogenetic analysis and its application, phylogenetic tree topologies, methods of phylogenetic tree construction and tools. Concept of genome annotation, methods of gene identification. Tools of gene identification: GenScan and Glimmer	Students will learn about the concept of phylogenetic data analysis and various tools and methods of gene identification	Lecture cum discussion and practicing of the flow diagrams of the procedure of working of tools	Essential bioinformatics- Jin Xiong Bioinformatics: Sequence and genome analysis- David W. Mount

Question Bank

Long answer type questions

1. Give different methods of phylogenetic tree construction
2. Explain UPGMA method
3. Explain NJ method of phylogenetic tree construction
4. Give different tools of gene identification
5. Explain the method of gene identification in prokaryotes
6. Give the applications of phylogenetic analysis

Short answer type questions

1. Define phylogenetic analysis
2. Write about Genscan
3. Describe Glimmer
4. What do you understand by genome annotation
5. Give different tree topologies

Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links

1. Protein Structure Prediction	Concepts and strategies of protein structure prediction, methods of secondary structure prediction, and methods of protein tertiary structure prediction. Structure visualization tool – RasMol.	To learn the methods to predict and visualize the structure of proteins	classroom teaching with examples. Students will learn how to use the various tools and then visualize the structures using RasMol	Essential bioinformatics- Jin Xiong Bioinformatics: Sequence and genome analysis- David W. Mount

Question Bank

Long answer type questions

1. Explain the methods of secondary structure prediction of proteins
2. Explain the methods of tertiary structure prediction of proteins
3. Describe the different levels of protein stuctures
4. Explain homology modelling
5. Describe structure visualization tool
6. Give the strategies of protein structure prediction

Short answer type questions

1. Write about Ramachandran plot
2. Describe RasMol
3. Draw the flow diagram of homology modeling
4. Describe Chou Fasman method
5. Explain GOR method
6. Describe JPred method of protein structure prediction

B.Sc. Hons Biotechnology
Semester 5

BIOT-Sem-V-III-T : ENVIRONMENTAL BIOTECHNOLOGY

Objective: The course focuses on an introduction to environment, major threats to environment by various polluting agents and the remedies for the same, incorporating design and monitoring of waste treatment processes. As well as learning environmental technology fundamentals, with special focus on biological treatment processes, environmental management. The course is use of biotechnology to design cleaner manufacturing processes and to solve pollution problems. It is ideal for under graduates just embarking on their career, or scientists and engineers who have been working for a few years and wish to develop their career in this direction.

UNIT-I

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
Basics of Environment and Environmental pollution, air, water, soil and noise.	Air – Types, Sources & Effects, Soil - Physicochemical and bacteriological analysis of soil, soil pollutants (fertilizers, insecticides fungicides, pesticides). Noise pollution, its control and impact on human health. Renewable and Non Renewable resources. and their Environmental Impacts. Modern Fuels (gasohol, hydrogen and solar energy) and their Environmental Impacts.	To understand concept of environment and pollution	classroom teaching with examples

Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
1. Water pollution and its management:	Measurement of water, pollution, sources of water pollution. Microbiology of waste water treatment, aerobic processes, activated sludge, oxidation ponds, trickling filters, and rotating biological contactors.	To understand the strategies for waste management	Lecture cum discussion

	Anaerobic processes: Anaerobic digesters, upward flow anaerobic sludge blanket reactors. General strategies for wastewaters treatment.		

Unit- 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
Bioremediation of contaminated soil and its applications,	Degradation of pesticides and other toxic chemicals by microorganism. Integrated Pest management Biodegradation of environmental pollutants: pesticides, hydrocarbons, dye, etc. Biofertilizers for clean environment– Nitrogen fixing microorganism, enrichment of the soil with assimilable nitrogen	Knowledge of biofertilizers and bioremediation	classroom teaching with the use of blackboard

Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques
1. Introduction to solid waste and municipal solid waste management: Sources, types, composition.	Bioabsorption of metals:- Role of Microorganisms in biosorption and bioleaching. , Enrichment of ores by microorganisms Bioindicators for detection of pollution	Study the use of microbes	classroom teaching with power point presentation of the topic hybridoma technology