SHRI GNANAMBICA DEGREE COLLEGE: MADANAPALLE

(AUTONOMOUS)
BIOTECHNOLOGY
COURSE-6: MOLECULAR BIOLOGY
SEMESTER III
(W.E.F. 2025-2026)
Program: B.Sc. Biotechnology Honors

Hours per week: 4 **Credits: 3**

COURSE OUTCOMES (COS)

By the end of this course, students will be able to:

Unit I – Genome Structure

CO1: Understand the structural and functional organization of genomes in prokaryotes and eukaryotes and analyze key experiments that proved DNA as the genetic material.

Unit II – DNA Replication

CO2: Explain the enzymatic machinery involved in DNA replication and evaluate its application in therapeutic targeting, especially in diseases like cancer.

Unit III – Transcription

CO3: Describe the molecular mechanisms of transcription and assess the significance of reverse transcription in viral replication and biotechnology applications like mRNA vaccines.

Unit IV – Gene Expression and Regulation

CO4: Examine the mechanisms of gene regulation in prokaryotes and eukaryotes and apply knowledge of operons to understand controlled gene expression systems.

Unit V – Genetic Code and Protein Synthesis

CO5: Illustrate the principles of the genetic code and the process of translation and evaluate the significance of codon-anticodon interaction, including the wobble hypothesis, in protein synthesis.

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SYLLABUS

Unit I Genome Structure

1. Watson and Crick model of DNA; Genome organization with specific reference to prokaryotic and eukaryotic genomes; Genome size.

2. Concepts of Genetic Material, Gene, Chromosome and Genome.

3. Experiments to prove DNA as genetic material (Griffith experiment, Hershey- Chase experiment)

Case Study: The Human Genome Project

How mapping the entire human genome revolutionized personalized medicine and genomics.

Unit II DNA Replication

1. Enzymology of replication (DNA polymerase I, pol II and III, helicases, topoisomerases, single strand binding proteins, DNA melting proteins, primase.

2. Proof of semiconservative replication, Replication origins,

3. Rolling circle replication of DNA

Case Study: Targeting DNA Polymerases in Cancer Therapy

Drugs like Aphidicolin and their effect on DNA polymerase for selective cancer treatment.

Unit III Transcription:

1. Enzymatic synthesis of RNA: Basic features of transcription, t h e structure of prokaryotic RNA polymerase (core enzyme and holo enzyme, sigma factor),

2. concept of promoter (Pribnow box, -10 and -35 sequences),

3. Four steps of transcription (promoter binding and activation, RNA chain initiation, chain elongation, termination and release). Reverse transcription.

Case Study: COVID-19 and mRNA Vaccine Transcription

How synthetic mRNA was transcribed for vaccine development.

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Unit IV Gene Expression and regulation

1. Regulation of gene expression; Clustered genes
2. the operon concepts - Negative and positive control of the Lac Operon, trp operon,
3. Control of gene expression. Poly and Mono cistronic m-RNA,

Unit V Genetic Code and Protein Synthesis

1. Genetic code: Features of genetic code, Structure of m RNA, brief structure of tRNA,
2. The adaptor hypothesis, attachment of amino acids to tRNA.
3. Codon-anticodon interaction - the wobble hypothesis. Initiation, elongation, termination protein.

COURSE 6: MOLECULAR BIOLOGY - PRACTICALS

Practical **Credits: 1** **2 hrs/week**

1. Effect of UV radiations on the growth of microorganisms.
2. Determination of absorption maxima of DNA and RNA and their quantification
3. Quantitative estimation of RNA
4. Quantitative estimation of DNA
5. Isolation of plasmid DNA from bacteria
6. Isolation of genomic DNA from *E.coli*
7. Isolation of DNA from sheep liver
8. Isolation of DNA from plant leaves (Rice or Tobacco or any other plant)
9. Purity analysis of the Nucleic acids

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SEMESTER III
(W.E.F.2025-2026)
Program: B.Sc. Biotechnology Honors
Question Paper Blue Print

Time : 3 Hrs | Max Marks: 70

(Draw diagrams wherever necessary)

I. Answer any Four Questions 4 X 5 =20

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. .....
8. .....

II. Answer all the questions 5 X 10 = 50

1. (A).....

   Or

   (B).....
2. (A).....

   Or

   (B).....
3. (A).....

   Or

   (B).....
4. (A).....

   Or

   (B).....
5. (A).....

   Or

   (B).....

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BIOTECHNOLOGY

COURSE-6: MOLECULAR BIOLOGY

SEMESTER III

(W.E.F.2025-2026)

Program: B.Sc. Biotechnology Honors

Model Question Paper

Time : 3 Hrs **Max Marks: 70**

(Draw diagrams wherever necessary)

I. Answer any Four Questions 4 X 5 =20

1. Define and differentiate between gene and genome.
2. What is the significance of replication origin?
3. What are the key structural features of prokaryotic RNA polymerase?
4. Differentiate between polycistronic and monocistronic mRNA.
5. What is the wobble hypothesis?
6. List the major features of the genetic code.
7. What are clustered genes? Give an example.
8. Describe the key features of the Watson and Crick model of DNA

II. Answer all the questions 5 X 10 = 50

1. (A) Compare and contrast the genome organization of prokaryotes and eukaryotes in detail.

Or

(B) Describe the experiments conducted to prove DNA as the genetic material.

2. (A) Explain the experimental proof for the semiconservative model of DNA replication.

Or

(B) Describe the initiation, elongation, and termination of DNA replication in prokaryotes.

3.(A) Describe promoter structure and the role of sigma factor in transcription initiation in prokaryotes.

Or

(B) Outline the four stages of transcription and explain each in detail.

4.(A) Explain the operon model of gene regulation using the lac operon as an example.

Or

(B) Discuss the various mechanisms involved in the control of gene expression in prokaryotes

5.(A) Discuss the process of translation: initiation, elongation, and termination in prokaryotes

Or

(B) Elaborate on the universal features, redundancy, and exceptions of the genetic code

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