

M.Sc. Sem.-3 Examination

504

Life Science (EC)

(Mole. Bio.)

November-2025

Time : 2-30 Hours]

[Max. Marks : 70

Instructions: Illustrate your answers with neat diagrams wherever necessary.

Question 1 Write the following

- (i) Explain in detail the physical and chemical properties of DNA and RNA. (7 Marks)
How do these properties contribute to their biological functions?
- (ii) Describe the structural organization of eukaryotic chromosomes. Discuss the (7 Marks)
role of histones and non-histone proteins in chromatin packaging.

OR

- (i) Discuss the various techniques used for the separation and characterisation (7 Marks)
of nucleic acids. Include the principles of electrophoresis and explain them
in detail.
- (ii) Discuss the kinetic and chemical complexity of eukaryotic DNA. How do (7 Marks)
repetitive and non-repetitive sequences contribute to this complexity?

Question 2 Write the following

- (i) Briefly explain the mechanism of translation in prokaryotes. (7 Marks)
- (ii) How does the C-terminal domain of RNA polymerase involve each stage of (7 Marks)
transcription and RNA processing in eukaryotes?

OR

- (i) Which are the proteins involved in the initiation of DNA replication? Discuss (7 Marks)
the initiation of DNA replication with regulation.
- (ii) What is the role of the *sigma* (σ) factor in the initiation of transcription? How (7 Marks)
is the initiation of transcription carried out? Explain in detail.

Question 3 Write the following

- (i) Write the steps of molecular cloning in a flowchart. If a researcher wants to (7 Marks)
clone the "X" gene from a plant, what are the steps for it?
- (ii) What are the criteria for selecting restriction enzymes for cloning? Explain (7 Marks)
with a proper example.

OR

- (i) What is a Genomic DNA library? How to prepare it? Write the merits and (7 Marks)
demerits of the genomic DNA library.
- (ii) Write the mode of action of the following enzymes, which are used in cloning (7 Marks)
(a) DNA Polymerase, (b) T4 DNA Ligase, (c) Restriction endonuclease

Question 4 Write the following

- (i) Describe the methods used for the isolation and purification of proteins from biological samples. Explain the principles behind chromatography techniques. (7 Marks)
- (ii) Explain the process of protein folding. Describe the role of chaperones and discuss how misfolding leads to diseases with suitable examples. (7 Marks)

OR

- (i) Discuss the nature and types of inter- and intra-molecular interactions that stabilize protein structure and influence protein-protein interactions. (7 Marks)
- (ii) Discuss the purification and characterization techniques of monoclonal antibodies and highlight their applications in diagnostics and therapeutics. (7 Marks)

Question 5 Attempt any seven out of twelve

(14 Marks)

- (i) Define nucleic acids. Name their basic building blocks.
- (ii) What is the base composition rule of DNA as proposed by Chargaff?
- (iii) What is the function of histone proteins in eukaryotic cells?
- (iv) What does the term "Cot value" represent in nucleic acid hybridization studies?
- (v) Write the difference between a genomic DNA library and a cDNA library.
- (vi) How many serine residues are present in the CTD of eukaryotic RNA polymerase?
- (vii) How many times does DNA replication occur during the lifespan of a single cell, and how is this process regulated?
- (viii) What is a Plasmid?
- (ix) DNA replication requires many proteins, whereas transcription is primarily governed by a single enzyme. What could be the reason for this difference?
- (x) What are molecular chaperones?
- (xi) What is a monoclonal antibody? Give an example.
- (xii) Mention any two applications of proteomics in modern biology.

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