

Printing Pages: 3

Paper Code: B040502T

A

(SVSU:2025-26/R)

Enrollment No.

Program Name B.Sc. Botany

V Semester / 3rd Year Examination

Subject Code: B040502T

Subject Name: Molecular Biology & Bioinformatics

[Time: 03:00 Hours]

[Max. Marks: 75]

Note: 1. Attempt all the questions as per given instructions.

- I. Multiple Choice Questions (MCQs)** [01×15=15]
- I** Which experiment proved semi-conservative replication of DNA?
 A. Avery–MacLeod–McCarty experiment B. Meselson–Stahl experiment
 C. Griffith's transformation D. Hershey–Chase experiment
- II** Which of the following lists three major types of RNA with their primary functions correctly?
 A. mRNA — template for protein synthesis; tRNA — brings amino acids to ribosome; rRNA — structural and catalytic component of ribosome
 B. mRNA — stores genetic information permanently; tRNA — stores energy; rRNA — transports proteins
 C. mRNA — ribosomal building; tRNA — enzyme catalyst; rRNA — messenger for proteins
 D. mRNA — carries amino acids; tRNA — code for proteins; rRNA — regulatory RNA
- III** RFLP stands for:
 A. Restriction Fragment Length Polymorphism
 B. Random Fragment Length Polymorphism
 C. Restriction Fragment Linkage Polymorphism
 D. Repetitive Fragment Length Pattern
- IV** Which of the following is a genetically engineered crop and the trait introduced?
 A. RoundUp Ready soybean — improved color
 B. Bt-cotton — insect resistance
 C. Flavr Savr tomato — herbicide tolerance
 D. Golden Rice — drought tolerance
- V** GenBank primarily stores which type of data?
 A. Three-dimensional protein structures
 B. Clinical trial protocols
 C. Small-molecule structures only
 D. Nucleotide sequences and related information

- VI Which statement best describes the purpose of FASTA format?
- A plain-text format for representing nucleotide or peptide sequences with a single-line header
 - A binary format for storing microarray images
 - A compressed archive for multiple protein structures
 - A database query language for Entrez
- VII The central dogma of molecular biology states:
- DNA is synthesized from proteins which are synthesized from RNA
 - Proteins encode RNA which encodes DNA
 - RNA is reverse-transcribed into DNA which directly makes proteins
 - Information flows from DNA to RNA to protein
- VIII BLAST is primarily used to:
- Predict three-dimensional protein structures from sequence
 - Assemble raw sequencing reads into contigs
 - Edit sequences in GenBank
 - Compare a query sequence to sequence databases to find regions of local similarity
- IX An operon is:
- A type of viral genome replication unit
 - A cluster of functionally related genes under control of a single promoter in prokaryotes
 - A translation initiation complex component
 - A eukaryotic unit of chromatin modification
- X PCR requires which essential enzyme?
- DNA ligase
 - RNA polymerase II
 - Taq DNA polymerase (or thermostable DNA polymerase)
 - Reverse transcriptase
- XI Reverse transcriptase synthesizes DNA from:
- DNA template
 - RNA template
 - Protein template
 - Lipid template
- XII Which RNA is part of the ribosome?
- mRNA
 - tRNA
 - rRNA
 - miRNA
- XIII A stop codon in mRNA: (CO1)
- Codes for methionine
 - Terminates translation
 - Initiates translation
 - Is read as an amino acid by ribosome always
- XIV Which of the following is a primary nucleotide database?
- Swiss-Prot
 - GenBank
 - KEGG
 - PubChem
- XV Which file format is commonly used to store a single sequence with a header line beginning with > ?
- FASTA
 - SAM
 - BAM
 - VCF

2. Answer in long (any three) [10×3=30]
- Critically compare prokaryotic and eukaryotic transcription processes with emphasis on enzymes and post-transcriptional modifications.
 - Give a detailed account of application of genetic engineering in pest resistant and herbicide resistant plants.
 - What do you know about the bioinformatics? Describe the various types of biological databases.
 - Discuss different experiments involved in setting the DNA as a genetic material.
3. Answer in short (any five) [6×5=30]
- Describe the mechanism for replicating the 5' end of linear eukaryotic chromosomes and role of telomerase.
 - Explain the basic steps and regulatory components of the lac operon in presence and absence of lactose.
 - Outline the principle, workflow and an application of Northern blotting.
 - Define SNP and RFLP markers and discuss one advantage and one limitation of each in plant genotyping.
 - Describe major biosafety categories applicable to field trials of transgenic crops and key containment measures.
 - Write a short note on role of super computers in biology.
 - Describe the small molecule databases.

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Note: 1. Attempt all the questions as per given instructions.

1. Multiple Choice Questions (MCQs) [01×15=15]
- I Who first isolated DNA (nuclein) from pus cells?
A. Frederick Griffith B. Friedrich Miescher
C. Watson and Crick D. Hershey and Chase
- II Which enzyme removes RNA primers during prokaryotic DNA replication?
A. DNA polymerase I B. Primase
C. DNA polymerase III D. RNase H only
- III During translation, a tRNA anticodon binds to:
A. The promoter region of DNA
B. A complementary mRNA codon on the ribosome
C. The amino acid active site of the ribosome
D. The poly-A tail of mRNA
- IV What is an SNP?
A. Single Nucleotide Polymorphism; useful marker due to single base variation among individuals
B. Short Nuclear Protein
C. Sequence Numbering Protocol
D. Small Nucleotide Peptide
- V PIR is best described as:
A. Pathway Interaction Registry
B. Primary Immuno Reagent repository
C. Protein Information Resource (a protein sequence database)
D. A database for small molecules
- VI Supercomputers in bioinformatics are mainly used because they:
A. Replace laboratory experiments
B. Provide high-throughput experimental data generation
C. Handle large-scale computations and big datasets faster than typical workstations
D. Reduce the need for algorithms

- VII** Local alignment differs from global alignment in that local alignment:
- Is always slower than global alignment
 - Aligns complete sequences end-to-end
 - Finds the best matching region(s) between sequences, not necessarily over the whole length
 - Requires sequences of equal length
- VIII** One limitation of microarray compared with RNA-Seq is:
- Microarray has higher sensitivity for low-abundance transcripts
 - Microarray cannot detect transcripts not represented on the array, whereas RNA-Seq can discover novel transcripts
 - Microarray gives exact counts of transcript copies without bias
 - Microarray data is always cheaper to analyze computationally
- IX** Hybridoma technology is used to produce:
- Monoclonal antibodies
 - Recombinant enzymes
 - Transgenic plants
 - DNA vaccines
- X** ELISA primarily detects:
- RNA secondary structures
 - DNA sequence variants
 - Protein or antigen presence via antibody binding
 - Enzyme catalytic rate constants only
- XI** Entrez is:
- A protein structure viewer
 - An integrated search and retrieval system for NCBI databases
 - A sequence alignment algorithm
 - A commercial sequencing platform
- XII** A dendrogram in phylogenetic analysis is:
- A file format for sequence submission
 - A numerical scoring matrix for alignment
 - A lab technique for measuring gene expression
 - A tree-like diagram showing relationships or clustering among sequences or taxa
- XIII** Spliceosomes remove:
- Exons from pre-mRNA
 - Introns from pre-mRNA
 - Poly-A tails
 - 5' caps
- XIV** Which blot detects RNA?
- | | |
|------------------|------------------|
| A. Southern blot | B. Northern blot |
| C. Western blot | D. Eastern blot |

- XV** Which of the following is a primary nucleotide database?
- A. Swiss-Prot B. GenBank C. KEGG D. PubChem
- 2. Answer in long (any three) [10×3=30]**
- I** Explain the process of replication in prokaryotes and also discuss the differences in the process in prokaryotes and eukaryotes.
- II** Elaborate the DNA sequencing techniques. How the DNA sequencing differ from DNA fingerprinting?
- III** Discuss transgenic crops with the suitable examples for improved quality traits.
- IV** What is bioinformatics? Give an account of historical background and scope of bioinformatics.
- 3. Answer in short (any five) [6×5=30]**
- I** Describe the mechanism of replication of the 5' end of a linear eukaryotic chromosome and explain the role of telomerase.
- II** Compare and contrast the trp operon regulatory mechanism with the lac operon, highlighting feedback and attenuation.
- III** A student obtains a BLAST result with E-value $1e-50$ and another hit at 0.05. Interpret both hits and explain which is more reliable and why.
- IV** Explain the principle of RAPD markers and list two practical limitations when used for plant genotyping.
- V** Outline the steps for sequence submission to GenBank using BankIt and mention required metadata.
- VI** Explain the principle of ELISA and give one example where it is used in plant pathology.
- VII** Describe Southern blotting: principle, main steps, and one application in plant genetics