

Total number of printed pages-7

14 (BOT-3) 3026

2023

BOTANY

Paper : BOT-3026

**(Molecular Biology, Plant Biotechnology
and Bioinformatics)**

Full Marks : 80

Time : Three hours

***The figures in the margin indicate
full marks for the questions.***

1. Choose the correct answer : $1 \times 8 = 8$
- (i) What is the function of small interfering RNAs (siRNAs) ?
- (a) Serve as primers in DNA replication
 - (b) Regulate gene expression by targeting mRNAs for degradation
 - (c) Act as templates for protein synthesis
 - (d) Facilitate splicing of pre-mRNA

Contd.

- (ii) What is the typical wavelength at which DNA absorbs UV light ?
- (a) 280 nm
 - (b) 260 nm
 - (c) 320 nm
 - (d) 360 nm
- (iii) How do cells regulate the duration and intensity of a signaling response ?
- (a) Increasing the number of receptors
 - (b) Reducing the availability of ligands
 - (c) Enhancing the activity of second messengers
 - (d) Decreasing the sensitivity of receptors
- (iv) What is the main focus of nucleic acid sequence analysis in bioinformatics ?
- (a) Predicting protein structures
 - (b) Identifying functional genes
 - (c) Studying metabolic pathways
 - (d) Analyzing protein-protein interactions

- (v) What is the primary genetic determinant involved in the regulation of circadian rhythms in plants?
- (a) Cryptochrome
 - (b) Gibberellin
 - (c) Abscisic acid
 - (d) Ethylene
- (vi) What is the function of quorum sensing in bacteria?
- (a) Inducing antibiotic resistance
 - (b) Regulating gene expression based on population density
 - (c) Facilitating bacterial motility
 - (d) Enhancing DNA replication
- (vii) What is the primary goal of genetic mapping?
- (a) Determining the size of a genome
 - (b) Identifying the location of genes on chromosomes
 - (c) Sequencing the entire genome
 - (d) Comparing genomes of different species

(viii) What is the main purpose of incorporating auxins and cytokinins in a plant tissue culture medium?

- (a) Enhancing root growth
- (b) Promoting shoot development
- (c) Inhibiting callus formation
- (d) Reducing the growth rate

2. Write briefly on the following : **(any four)**
3×4=12

- (a) What is the role of transcription factors in intracellular signaling?
- (b) Provide an overview of the characteristics that make plasmids commonly used as cloning vectors in genetic engineering.
- (c) Provide an example of a genomic database and explain its role in bioinformatics.
- (d) Explain the significance of DNA-protein interactions in cellular processes.
- (e) Briefly explain the role of phytochromes in the molecular mechanisms of light perception in plants.
- (f) Differentiate between organogenesis and somatic embryogenesis in plant tissue culture.

(g) Define DNA supercoiling and explain its importance in DNA structure and function.

3. Write briefly on the following : **(any four)**
5×4=20

(a) Explain how cyclic AMP (cAMP) acts as a second messenger.

(b) Discuss the importance of Intellectual Property Rights (IPR) in the field of genetic engineering, and highlight legal and biosafety issues associated with genetically modified organisms (GMOs).

(c) Briefly explain the importance of plant tissue culture in modern agriculture and biotechnology.

(d) Differentiate between nucleic acid sequence analysis and protein sequence analysis in bioinformatics. Provide an example for each.

(e) Provide examples and functions of two types of small RNAs involved in post-transcriptional gene regulation.

(f) Describe the role of histones in DNA packaging and gene regulation.

4. Answer *any four* of the following :
10×4=40

- (a) Elaborate on the role of bioinformatics in computer-aided drug discovery, highlighting its impact on identifying potential drug targets. 2+2+6=10
- (b) Explain the concept of biological clocks in plants and their significance in coordinating various physiological processes. Discuss the genetic and molecular determinants that regulate circadian rhythms in plants. How do these biological clocks contribute to the adaptation of plants to environmental changes? 2+2+6=10
- (c) Define molecular systematics and elaborate on how it contributes to our understanding of evolutionary relationships among organisms. Additionally, discuss the role of DNA markers in crop improvement. 5+5=10
- (d) Differentiate between G protein-coupled receptors (GPCRs) and receptor tyrosine kinases (RTKs). Explain the role of second messengers in cell signalling. Discuss how malfunctioning of cell surface receptors can contribute to diseases. 8+2=10

- (e) Explore the diversity and functions of small RNAs involved in post-transcriptional gene regulation. Compare and contrast microRNAs (miRNAs) and small interfering RNAs (siRNAs). Discuss how these small RNAs are generated, their mechanisms of action, and their impact on gene expression and cellular processes. Provide examples of diseases or conditions where dysregulation of small RNA pathways is implicated.

8+2=10

- (f) Elaborate on the interactions between DNA and proteins, with a particular emphasis on histones. Discuss the structural organization of nucleosomes and their role in chromatin packaging. Explain how modifications of histones contribute to epigenetic regulation and influence gene expression.

4+6=10