

R4534

Sub. Code

25MBT2C1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

GENETIC ENGINEERING

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the objective type questions by choosing the correct option.

1. Which is one of the major impacts of genetic engineering on modern society (CO1, K1)
 - (a) Increased mutation rates
 - (b) Development of recombinant therapeutics
 - (c) Elimination of genetic diseases
 - (d) Complete replacement of traditional breeding
2. The first essential requirement for a genetic engineering experiment is (CO1, K1)
 - (a) Host organism
 - (b) Restriction enzyme
 - (c) Vector DNA
 - (d) DNA ligase

3. The most important feature of a plasmid used as a cloning vector is (CO2, K2)
- (a) Presence of telomeres
 - (b) Ability to integrate into host genome
 - (c) Origin of replication
 - (d) Presence of introns
4. Blue-white screening in pUC19 is based on (CO2, K2)
- (a) Antibiotic resistance
 - (b) lacZ α -complementation
 - (c) GFP expression
 - (d) Repressor binding
5. The melting temperature (T_m) of a primer mainly depends on (CO3, K2)
- (a) Primer length and GC content
 - (b) Template concentration
 - (c) Extension time
 - (d) Polymerase type
6. The lack of proofreading activity in Taq polymerase results in (CO3, K1)
- (a) Faster amplification
 - (b) Blunt-end products
 - (c) Higher mutation rate
 - (d) RNA synthesis

7. Transduction differs from transformation because it involves (CO4, K1)
- (a) Plasmids
 - (b) Viruses as DNA carriers
 - (c) Chemical treatment
 - (d) Electrical pulses
8. Which element is absent in cDNA libraries? (CO4, K2)
- (a) Exons
 - (b) Promoters
 - (c) Poly(A) tail-derived sequences
 - (d) Coding sequences
9. RNA interference (RNAi) is mediated primarily by (CO5, K1)
- (a) rRNA
 - (b) tRNA
 - (c) siRNA and miRNA
 - (d) mRNA
10. miRNAs generally regulate gene expression by (CO5, K2)
- (a) Partial base pairing with target mRNA
 - (b) Blocking transcription
 - (c) Complete degradation of mRNA
 - (d) DNA methylation

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the general requirements for performing a genetic engineering experiment. (CO1, K3)

Or

- (b) Write a short note on polynucleotide kinase and alkaline phosphatase. (CO1, K3)

12. (a) Explain the principles for maximizing gene expression in expression vectors. (CO2, K4)

Or

- (b) Write a short note on inclusion bodies and mention their methodologies to reduce its formation. (CO2, K4)

13. (a) Briefly explain about the basic principles of PCR. (CO3, K4)

Or

- (b) Write a short note on fidelity of thermostable enzymes. (CO3, K4)

14. (a) Elaborate the mechanism of insertion of foreign DNA into host cells. (CO4, K5)

Or

- (b) Illustrate the steps involved in cDNA synthesis. (CO4, K5)

15. (a) Define gene silencing and explain its biological significance. (CO5, K6)

Or

- (b) Write a brief account on CRISPR-Cas genome editing system. (CO5, K6)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain about DNA labelling techniques, write briefly about nick translation and random priming techniques. (CO1, K4)

Or

- (b) Explain the role of DNA ligase, Klenow enzyme and DNA polymerase in recombinant DNA technology. (CO1, K4)

17. (a) Categories different types of vector systems used in genetic engineering. (CO2, K5)

Or

- (b) Compare and outline the three types of large-insert cloning vectors used in genetic engineering. (CO2, K5)

18. (a) Describe the importance of PCR in molecular diagnostics and write about its advantages and limitations. (CO3, K5)

Or

- (b) Describe on chemical synthesis of oligonucleotides with its applications. (CO3, K5)

19. (a) Describe about DNase foot printing assay, write its experimental setup and give some of its applications. (CO4, K6)

Or

- (b) Explain the methodology involved in construction of a genomic library and its screening methods. (CO4, K6)

20. (a) What is siRNA technology? Mention its applications in gene silencing. (CO5, K5)

Or

- (b) Discuss the ethical and scientific debate over genetically modified (GM) crops. (CO5, K5)

R4535

Sub. Code

25MBT2C2

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

IMMUNOLOGY

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** of the following objective type questions by choosing the correct option.

1. Which of the following is considered a primary lymphoid organ? (CO1, K1)
(a) Spleen (b) Lymph nodes
(c) Thymus (d) Peyer's patches
2. MALT (Mucosal Associated Lymphoid Tissue) is a key component of: (CO1, K1)
(a) The central nervous system
(b) The innate and acquired mucosal immune system
(c) The endocrine system
(d) Bone marrow differentiation
3. The specific part of an antigen that is recognized by an antibody or T-cell receptor is called: (CO2, K2)
(a) Hapten (b) Adjuvant
(c) Epitope (d) Idiotype

4. Which Immunoglobulin class is the first to be secreted during a primary immune response? (CO2, K1)
- (a) IgG (b) IgA
(c) IgE (d) IgM
5. Major Histocompatibility Complex (MHC) Class I molecules are primarily involved in: (CO3, K2)
- (a) Presenting extracellular antigens to Helper T-cells
(b) Presenting endogenous antigens to Cytotoxic T-lymphocytes
(c) Activating the lectin pathway
(d) Neutralizing bacterial toxins
6. Small signaling proteins that guide the migration of immune cells to sites of infection are known as: (CO3, K1)
- (a) Hormones (b) Antigens
(c) Chemokines (d) Immunogens
7. Type I hypersensitivity is mediated primarily by which of the following? (CO4, K2)
- (a) IgE antibodies (b) T-cells
(c) MHC Class II (d) Complement system
8. Which one of the following is an example of an organ-specific autoimmune disease? (CO4, K2)
- (a) Systemic Lupus Erythematosus
(b) Rheumatoid Arthritis
(c) Type 1 Diabetes Mellitus
(d) Graft-versus-host disease

9. The transfer of pre-formed antibodies from maternal antibodies to a fetus is an example of: (CO5, K2)
- (a) Active immunization
 - (b) Passive immunization
 - (c) Innate immunity
 - (d) Herd immunity
10. A vaccine consisting of an inactivated bacterial toxin is referred to as (CO5, K2)
- (a) Conjugate vaccine
 - (b) Subunit vaccine
 - (c) Toxoid
 - (d) DNA vaccine

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Demonstrate the process of maturation and differentiation of B cells within the bone marrow. (CO1, K3)

Or

- (b) Illustrate the physical and chemical barriers that constitute the first line of innate immunity. (CO1, K3)

12. (a) Analyze the structural features of an IgG molecule and explain how they relate to its biological functions. (CO2, K4)

Or

- (b) Compare and contrast the mechanisms of the Endocytic and Cytosolic pathways of antigen processing. (CO2, K4)

13. (a) Classify the different components of the complement system and outline the steps of the Classical pathway. (CO3, K4)

Or

- (b) Analyze the role of cytokines in regulating the immune response during a bacterial infection. (CO3, K4)

14. (a) Evaluate the immunological basis of organ transplantation rejection and suggest ways to minimize it. (CO4, K5)

Or

- (b) Justify the mechanism behind Type IV hypersensitivity using a clinical example. (CO4, K5)

15. (a) Breakdown the structure and production process of monoclonal antibodies using hybridoma technology. (CO5, K4)

Or

- (b) Distinguish between live-attenuated and killed vaccines, highlighting their respective advantages and risks. (CO5, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Formulate a model explaining how the signalling pathways of Toll-like Receptors (TLRs) initiate an innate immune response. (CO1, K6)

Or

- (b) Assess the importance of secondary lymphoid organs in the generation of a systemic immune response. (CO1, K5)

17. (a) Design a diagrammatic representation of V(D)J recombination to explain how antibody diversity is generated. (CO2, K6)

Or

- (b) Critique the role of Pathogen Associated Molecular Patterns (PAMPs) in the recognition of non-self-antigens. (CO2, K5)

18. (a) Evaluate the clinical significance of the Major Histocompatibility Complex (MHC) in disease susceptibility and therapeutic uses. (CO3, K5)

Or

- (b) Integrate the roles of the Alternate and Lectin pathways of the complement system into a unified model of host defense. (CO3, K6)

19. (a) Develop a hypothesis explaining how tumor cells successfully evade the hosts immune surveillance mechanisms. (CO4, K6)

Or

- (b) Appraise the immunological mechanisms involved in the development of Insulin-Dependent Diabetes Mellitus (Type I). (CO4, K5)

20. (a) Create a strategic plan for developing a new conjugate vaccine against a specific bacterial pathogen. (CO5, K6)

Or

- (b) Conclude why catalytic antibodies are considered a promising frontier in the treatment of specific chronic diseases. (CO5, K5)
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R4536

Sub. Code

25MBT2C3

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

BIOINFORMATICS

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Gen Bank is a _____ database. (CO1, K1)
(a) Protein (b) Structure
(c) Nucleotide (d) Pathway
2. Which database contains curated protein sequence information? (CO1, K1)
(a) GenBank (b) EMBL
(c) UniProt (d) PDB
3. FASTA format begins with the symbol (CO2, K1)
(a) @ (b) #
(c) > (d) %
4. Why is sequence alignment important in bioinformatics? (CO2, K2)
(a) To delete sequences
(b) To compare biological sequences
(c) To store structures
(d) To predict pathways

5. Which tool is commonly used for multiple sequence alignment? (CO3, K1)
- (a) BLAST (b) FASTA
(c) CLUSTALW (d) Primer3
6. What is the main purpose of phylogenetic analysis? (CO3, K2)
- (a) Structure prediction
(b) Motif discovery
(c) Inferring evolutionary relationships
(d) Pathway mapping
7. RMSD is used to measure _____ deviation between structures. (CO4, K1)
- (a) Sequence (b) Structural
(c) Functional (d) Database
8. Why is homology modelling preferred in protein structure prediction? (CO4, K2)
- (a) No template is required
(b) Availability of similar template structures
(c) Random prediction is accurate
(d) Faster sequence storage
9. Threading technique is mainly used for _____ recognition (CO5, K1)
- (a) Motif (b) Fold
(c) Pathway (d) Nucleotide
10. What is the main objective of protein function prediction? (CO5, K2)
- (a) To store sequences
(b) To assign biological role to proteins
(c) To align structures
(d) To delete annotations

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the role of computers in biology and medicine. (CO1, K3)

Or

- (b) List out any five basic UNIX / Linux commands with their functions. (CO1, K3)

12. (a) Outline the steps involved in submitting a DNA sequence to a public database. (CO2, K5)

Or

- (b) Describe the types of local structural variants of DNA with examples. (CO2, K5)

13. (a) Explain the role of CLUSTALX in sequence alignment. (CO3, K6)

Or

- (b) Outline the procedure for performing multiple sequence alignment using CLUSTALW. (CO3, K6)

14. (a) Describe the importance of side chains and neighbouring residues in protein stability. (CO4, K4)

Or

- (b) Describe the importance of sequence alignment in protein modelling. (CO4, K4)

15. (a) List out the major methods used for analyzing secondary structures. (CO5, K4)

Or

- (b) Describe the basic concept of threading techniques in structure prediction. (CO5, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Outline the steps involved in identification of protein sequence from a given DNA sequence. (CO1, K5)

Or

- (b) Explain the resources available at EBI and their applications in bioinformatics research. (CO1, K5)

17. (a) Explain the features and applications of the GenBank sequence database in molecular biology. (CO2, K4)

Or

- (b) Describe the principles and applications of pair-wise sequence alignment techniques. (CO2, K4)

18. (a) Compare CLUSTALW and CLUSTALX used for multiple sequence alignment. (CO3, K6)

Or

- (b) Explain the procedure for submitting DNA and protein sequences to public databases. (CO3, K6)

19. (a) Explain force field methods with reference to energy calculations in protein modelling. (CO4, K6)

Or

- (b) Explain how buried and exposed residues influence protein folding and stability. (CO4, K6)

20. (a) Explain protein folding and model generation in protein structure prediction. (CO5, K5)

Or

- (b) Detailed account on secondary structure prediction methods and their significance. (CO5, K5)

R4537

Sub. Code

25MBT2C4

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

GENOMICS AND PROTEOMICS

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Nucleosome is made up of _____. (CO1, K1)
 - (a) DNA, histone core protein
 - (b) DNA, histone core protein, linker H1
 - (c) RNA, histone core protein
 - (d) RNA, histone core protein, linker H1
2. The feature that distinguishes the prokaryotic genome is (CO1, K1)
 - (a) Presence of introns
 - (b) Large non-coding regions
 - (c) Circular chromosomes with operons
 - (d) Linear DNA with histones

3. Radiation hybrid (RH) mapping determines marker order by: (CO2, K3)
- (a) Measuring recombination frequencies in meiosis
 - (b) Sequencing overlapping clones for contig assembly
 - (c) Using restriction enzyme digestion patterns
 - (d) Assessing co-retention of markers in irradiated cell hybrids
4. Which physical mapping technique can localize a DNA sequence to a chromosomal band using fluorescently labelled probes? (CO2, K3)
- (a) Restriction fragment length polymorphism (RFLP) mapping
 - (b) Fluorescence in situ hybridization (FISH)
 - (c) Two-point linkage analysis
 - (d) Bulk segregant analysis
5. Which of the following describes the primary goal of the Human Genome Project? (CO3, K2)
- (a) To sequence the entire human genome and produce a high-quality reference sequence
 - (b) To sequence all human exons only
 - (c) To sequence the genomes of model organisms instead of humans
 - (d) To identify only disease-causing mutations in select genes

6. SNPs can occur within the short sequences that are recognized by restriction enzymes and thus the length of a fragment generated by cutting a DNA molecule with a restriction enzyme could be different for each allele. This technique is known as (CO4, K5)
- (a) Polymerase Chain Reaction (PCR)
 - (b) Real Time PCR
 - (c) Variable Number Tandem Repeats (VNTRs)
 - (d) Restriction Fragment Length Polymorphism (RFLP)
7. Which proteomic approach is used to identify the intact protein forms including combinations of PTMs and sequence variants? (CO5, K3)
- (a) Bottom-up proteomics with tryptic peptides
 - (b) Top-down proteomics analysing intact proteins by high-resolution MS
 - (c) Shotgun metabolomics
 - (d) Single-cell RNA sequencing
8. What is the relation of time of flight with the molecular mass of the ion in the TOF mass analyzer? (CO5, K3)
- (a) Time of flight is inversely proportional to the square root of the molecular mass of the ion
 - (b) Time of flight is inversely proportional to the molecular mass of the ion
 - (c) Time of flight is directly proportional to the molecular mass of the ion
 - (d) Time of flight is directly proportional to the square root of the molecular mass of the ion

9. GEAC stands for _____. (CO6, K4)
- (a) Genetic Ethical Approval Committee
 - (b) Genetic Engineering Approval Committee
 - (c) Genetic Ethical Active Commission
 - (d) Genetic Engineering Active Commission
10. Which technique is commonly used in metagenomics to study the genetic diversity of microbial communities? (CO6, K4)
- (a) PCR
 - (b) Microarray
 - (c) Western blotting
 - (d) Shotgun sequencing

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain about plasmids and its functions in bacterial system. (CO1, K4)

Or

- (b) Discuss about the non-coding regions of the genome. (CO1, K2)

12. (a) Give a brief account of comparative gene mapping. (CO2, K3)

Or

- (b) Discuss the advantages and disadvantages of in situ hybridization. (CO2, K3)

13. (a) Discuss the genome sequencing methods for microbes. (CO3, K2)

Or

- (b) Give a brief account on the classification of organisms using molecular markers. (CO4, K5)

14. (a) Briefly explain about SDS-PAGE and its applications. (CO5, K3)

Or

- (b) Give an account on protein databases with examples. (CO5, K3)

15. (a) Define and differentiate between the terms 'reads', 'contigs', and 'scaffolds' in the context of genome assembly. (CO6, K4)

Or

- (b) Briefly describe the workflow of a metabolomics- from sample collection to data analysis. (CO6, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss in detail about the genome organization in prokaryotes and eukaryotes. (CO1, K2)

Or

- (b) Discuss in detail about the structure and functions of mitochondria in humans. (CO1, K2)

17. (a) Give a brief note on the steps involved in FISH technique in gene mapping. Highlight its advantages and limitations. (CO2, K3)

Or

- (b) Discuss in detail about the principle, types and applications of: Genetic and Physical maps. (CO2, K3)

18. (a) Explain in detail about the timeline of Human Genome Project. Add a note on its significance and application in the field of genomics. (CO3, K4)

Or

- (b) Explain the fundamental principles of drug design. Briefly explain the major stages of the new drug development process. (CO4, K4)

19. (a) Give an account on the aim, principle, steps and applications of mass spectrometry. (CO5, K3)

Or

- (b) Explain in detail about the principle and methodology of two-dimensional polyacrylamide gel electrophoresis (2D-PAGE) and its applications. (CO5, K4)

20. (a) Explain the steps involved in transcriptome analysis and how it is utilized for the identification and functional annotation of genes. (CO6, K4)

Or

- (b) Differentiate between forward and reverse genetics. Discuss the advantages and limitations of the forward genetics approach in modern research. (CO6, K4)

R4538

Sub. Code

25MBT2C5

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

MOLECULAR DIAGNOSTICS

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. A permanent alteration in the DNA sequence in a frequency of 1% of population is known as a: (CO1, K2)
(a) Transcription (b) Translation
(c) Polymorphism (d) Mutation
2. Which of the following is a direct functional product of gene expression? (CO1, K3)
(a) DNA (b) RNA
(c) Protein (d) Lipid
3. Which techniques is used to visualize the location of a specific DNA sequence on a chromosome? (CO2, K2)
(a) Comparative array genomic hybridization
(b) ELISA
(c) Spectral Karyotyping
(d) Fluorescence In Situ Hybridization (FISH)

4. ARMS-PCR is specifically designed to: (CO2, K3)
- (a) Amplify all DNA present in a sample indiscriminately
 - (b) Detect specific single nucleotide mutations
 - (c) Sequence long fragments of DNA
 - (d) Detect gene expression changes
5. Molecular techniques for identifying pathogens often target: (CO3, K3)
- (a) Specific protein antigens on the cell surface
 - (b) Unique carbohydrate structures
 - (c) Species-specific genomic sequences
 - (d) The metabolic byproducts in the medium
6. A multiplex PCR assay for pathogen detection is designed to: (CO3, K2)
- (a) Amplify a single target with very high sensitivity
 - (b) Amplify multiple different DNA targets in a single reaction
 - (c) Investigate multiple samples in one reaction set up
 - (d) Quantify the exact number of multiplying virus
7. VHL gene product functions as a (CO4, K1)
- (a) Tumor suppression
 - (b) Oncogene
 - (c) Cell cycle promoter
 - (d) Growth factor receptor

8. Which type of genetic mutation is characteristic of Fragile X syndrome? (CO4, K2)
- (a) Point mutation
 - (b) Repeat expansion
 - (c) Gene deletion
 - (d) Chromosomal inversion
9. Pharmacogenomics aims to optimize drug therapy based on a patient's which profile? (CO2, K2)
- (a) Disease
 - (b) Metabolic
 - (c) Genetic
 - (d) Clinical
10. Identifying specific DNA sequence changes such as single nucleotide variants and large structural deletion simultaneously is the primary strength of which technology? (CO5, K2)
- (a) Array CGH
 - (b) Next-Generation Sequencing (NGS)
 - (c) Flow Cytometry
 - (d) Multiplex Probe Ligation Analysis (MLPA)

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Briefly explain the process of transcription and its primary implication in molecular diagnostics. (CO1, K4)

Or

- (b) Elaborate on types of numerical genomic mutations and structural chromosomal mutations involved in diseases caused in humans. (CO1, K2)

12. (a) What is the fundamental principle of Real Time-PCR? How does it enable quantification of target gene and aid in disease diagnostics? (CO2, K2)

Or

- (b) Describe SAGE method of gene expression technique. Elaborate its principle and steps involved. (CO2, K2)
13. (a) What are the molecular detection techniques used to identify highly contagious and non-cultivable microorganisms. Elaborate on any three techniques. (CO3, K3)

Or

- (b) Discuss on advantages and limitations of PCR based molecular detection of non-cultivable microorganisms with examples. (CO3, K2)
14. (a) What is VHL disease?. What are the molecular methods employed in diagnosis of the disease. (CO4, K3)

Or

- (b) Why Martin-Bell syndrome is considered a paradigm of “dynamic mutation”? briefly explain on etiology and diagnosis of this condition. (CO4, K4)
15. (a) Define “pharmacogenomics” in the context of cancer therapy. How can it help reduce systemic toxicity? (CO5, K3)

Or

- (b) Briefly explain on advantages and limitation of next-generation sequencing, how does this dominate over traditional method of identifying mutations? (CO5, K5)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) What are the post translational modification of eukaryotic mRNA, and briefly explain why are they important from a clinical perspective? (CO1, K2)

Or

- (b) Compare different structure and functions of DNA. Explain with diagram. (CO2, K1)

17. (a) Discuss application of real time-PCR in clinical diagnostics, state its limitations and advantages. (CO2, K2)

Or

- (b) Compare the strengths and limitations of FISH with PCR-based methods used for clinical diagnosis. (CO3, K4)

18. (a) Describe the working principle of CSCE for detecting mutations. Discuss its advantages and limitations over other analysis techniques. (CO3, K4)

Or

- (b) Discuss on the application of in-situ hybridization in identifying non-cultivable pathogens. (CO3, K3)

19. (a) How fragile X syndrome is directly linked to its new mutational mechanism? explain its pathophysiology and diagnosis strategies. (CO4, K2)

Or

- (b) “NGS has revolutionized molecular diagnosis of cancer” discuss the statement with examples. (CO4, K4)

20. (a) Discuss on regulatory framework, quality assurance, molecular diagnostic methods to developed to ensure precise diagnosis in oncology. (CO5, K4)

Or

- (b) How does targeted therapy utilize biomarker identification to develop personalized therapeutic strategies? (CO5, K5)
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R4539

Sub. Code

25MBT2C6

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

**RESEARCH METHODOLOGY AND SCIENTIFIC
COMMUNICATION SKILLS**

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. What is the first step in the research process?

(CO1, K1)

- (a) Developing a research design
- (b) Formulating a research hypothesis
- (c) Deciding on data analysis procedures
- (d) Identifying a research question

2. Which type of reasoning starts from specific observation to form a general conclusion?

(CO1, K2)

- (a) Deductive reasoning
- (b) Inductive reasoning
- (c) Empirical reasoning
- (d) Descriptive reasoning

3. What is the primary purpose of using replicates in biological experiments? (CO1, K1)
- (a) To increase the cost of the experiment
 - (b) To estimate random error and assess treatment effects
 - (c) To test multiple variables simultaneously
 - (d) To replace the need for controls
4. A good mentor-mentee relationship is best characterized by (CO2, K2)
- (a) Strict hierarchy
 - (b) One-way communication
 - (c) Mutual respect and open communication
 - (d) Dependence of mentee on mentor
5. Which of the following best defines a SMART research question? (CO1, K2)
- (a) Broad and theoretical
 - (b) Specific, Measurable, Achievable, Relevant, Time-bound
 - (c) Simple and short
 - (d) Based only on personal interest
6. Which of the following practices BEST helps in maintaining the integrity and reproductively of research data in a laboratory? (CO1, K2)
- (a) Recording observations after completing all experiments
 - (b) Maintaining a properly dated, signed, and regularly updated laboratory notebook
 - (c) Storing raw data only in personal computers
 - (d) Discussing results verbally without written records
7. Verbal communication includes (CO3, K2)
- (a) Facial expressions
 - (b) Gestures
 - (c) Spoken and written words
 - (d) Posture

8. A job application email should primarily highlight (CO3, K2)
- (a) personal life details
 - (b) Complaints
 - (c) Skills, qualification, and suitability
 - (d) Social media presence
9. Scientific writing differs from general writing because it is (CO4, K2)
- (a) Emotional
 - (b) Subjective
 - (c) Precise and evidence-based
 - (d) Informal
10. Which software is commonly used to detect plagiarism? (CO4, K1)
- (a) MS PowerPoint
 - (b) Turnitin
 - (c) SPSS
 - (d) MATLAB

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Illustrate how controls are applied in a biological experiment with an example? (CO1, K3)
- Or
- (b) Discuss the main differences between deductive and inductive reasoning. (CO1, K4)
12. (a) Examine the role of replicates in reducing experimental error. (CO1, K5)
- Or
- (b) Evaluate the importance of empirical science in advancing biological knowledge (CO1, K5)

13. (a) Evaluate different approaches used to identify research interests and research gaps, highlighting the importance of literature review. (CO2, K5)

Or

- (b) Analyze the values and characteristics of a good mentor-led laboratory. (CO2, K4)

14. (a) Discuss some potential barriers to effective verbal communication. (CO3, K4)

Or

- (b) Evaluate the first step in effective communication, and mention its significance. (CO3, K5)

15. (a) Plagiarism in scientific writing-Discuss. (CO4, K4)

Or

- (b) Write down the characteristics of effective technical writing. (CO4, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss empirical science and how it differs from theoretical science (CO1, K4)

Or

- (b) Evaluate the importance of statistical design in biological experiments. Justify why poorly designed experiments lead to misleading conclusions. (CO1, K5)

17. (a) Analyse the main advantage of using manipulative experiments in biological experiments, and how it connects with the cause-and-effect relationship.
(CO1, K4)

Or

- (b) Discuss the key characteristics of descriptive science and give an example in biological science.
(CO1, K4)

18. (a) Analyse the effects of digital technology on listening behaviour and evaluate methods to enhance effective listening in online communication environments.
(CO3, K4)

Or

- (b) Illustrate the key elements of formal presentation and how effective communication helps assist presentation skills.
(CO3, K6)

19. (a) Examine the roles of computing skills and web browsing in scientific research and academic work.
(CO3, K4)

Or

- (b) Compare verbal and non-verbal communication and explain how body language enhances communication effectiveness
(CO4, K4)

20. (a) Evaluate the concept of scientific misconduct and its various forms.

(CO4, K5)

Or

- (b) Write down the definition and importance of a literature review, proper citation and referencing in a scientific research paper

(CO4, K4)

R4540

Sub. Code

25MBT2P1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

**Lab – IV – MOLECULAR BIOLOGY AND GENETIC
ENGINEERING**

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Binding of the inducer to the lac repressor causes (CO1, K1)
 - (a) Repressor—operator binding
 - (b) Repressor inactivation
 - (c) Promoter inhibition
 - (d) RNA polymerase release

2. Low glucose concentration in *E. coli* results in (CO1, K2)
 - (a) Low cAMP levels
 - (b) High cAMP levels
 - (c) Inhibition of CAP
 - (d) Repressor activation

3. The most commonly used wavelength for UV mutagenesis is (CO1, K1)
- (a) 200 nm
 - (b) 365 nm
 - (c) 300 nm
 - (d) 254 nm
4. CaCl_2 treatment makes *E. coli* cells competent by (CO2, K2)
- (a) Neutralizing negative charges on DNA and cell surface
 - (b) Digesting cell wall
 - (c) Creating pores permanently
 - (d) Increasing plasmid copy number
5. Heat shock during transformation is usually carried out at (CO2, K1)
- (a) 25°C
 - (b) 37°C
 - (c) 42°C
 - (d) 60°C
6. Transformation efficiency is defined as (CO2, K2)
- (a) Total colonies obtained
 - (b) DNA uptake rate
 - (c) Number of transformants per μg DNA
 - (d) Number of plasmids per cell

7. Absence of insert in restriction digestion will result in (CO2, K2)
- (a) Additional bands
 - (b) Smear on gel
 - (c) No migration
 - (d) Only vector-sized band
8. β -mercaptoethanol in SDS-PAGE sample buffer is used to (CO3, K2)
- (a) Stain proteins
 - (b) Reduce disulfide bonds
 - (c) Increase protein charge
 - (d) Polymerize acrylamide
9. His-tag purification is an example of (CO3, K1)
- (a) Ion-exchange chromatography
 - (b) Size-exclusion chromatography
 - (c) Affinity chromatography
 - (d) Hydrophobic interaction chromatography
10. EDTA should be avoided during His-tag purification because it (CO3, K1)
- (a) Chelates nickel ions
 - (b) Denatures proteins
 - (c) Precipitates proteins
 - (d) Inhibits enzymes

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain about lactose induction of β -galactosidase in the lac operon. (CO1, K3)

Or

- (b) What is UV mutagenesis? Outline its principle. (CO1, K3)

12. (a) Write a note on the structural genes of the lac operon. (CO1, K4)

Or

- (b) What are amino acid auxotrophs? How are they identified? (CO1, K4)

13. (a) Describe the principle of plasmid DNA isolation. (CO2, K4)

Or

- (b) Write a short note on restriction enzyme digestion of plasmid DNA. (CO2, K4)

14. (a) Explain recombinant protein expression in *E. coil*. (CO3, K5)

Or

- (b) What are inclusion bodies? State their significance. (CO3, K5)

15. (a) Write a short note on catabolite repression in *E. coil*. (CO1, K6)

Or

- (b) Write a note on plaque morphology in filamentous phages like M13. (CO1, K6)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Illustrate the diauxic growth of *E. coli* with a neat diagram. (CO1, K4)

Or

- (b) Describe about the phage titre determination using epsilon phage. (CO1, K4)

17. (a) Explain on polymerase chain reaction and analysis of PCR products by agarose gel electrophoresis. (CO2, K5)

Or

- (b) Describe about the agarose gel electrophoresis technique in detail. (CO2, K5)

18. (a) Describe methods used to confirm the presence of insert in recombinant clones. (CO2, K5)

Or

- (b) Describe the transformation of *E. coli* with plasmid and explain how to calculate the transformation efficiency. (CO2, K5)

19. (a) Explain the purification method of His-tagged recombinant protein using Ni-NTA column. (CO3, K6)

Or

- (b) Explain about the SDS-PAGE analysis of recombinant proteins. (CO3, K6)

20. (a) Describe the expression of recombinant proteins in *E. coli* and factors affecting inclusion body formation. (CO3, K5)

Or

- (b) Discuss the factors affecting binding and elution of His-tagged proteins on Ni-NTA resin. (CO3, K5)
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R4541

Sub. Code

25MBT2P2

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

Laboratory V – IMMUNOLOGY

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Which anticoagulant is preferred for lymphocyte culture studies? (CO1, K1)
(a) EDTA (b) Heparin
(c) Citrate (d) Oxalate
2. The major cell type isolated in Ficoll-Hypaque separation is (CO1, K1)
(a) Granulocytes (b) Platelets
(c) Mononuclear cells (d) Erythrocytes
3. Which blood cell shows kidney-shaped nucleus? (CO2, K2)
(a) Neutrophil (b) Eosinophil
(c) Basophil (d) Monocyte
4. The antigen—antibody precipitation line in double diffusion forms due to (CO2, K1)
(a) Electrical charge
(b) Zone of equivalence
(c) Zone of antigen excess
(d) Zone of antibody excess

5. Which gel is commonly used in SDS-PAGE? (CO3, K2)
(a) Agarose (b) Polyacrylamide
(c) Starch (d) Cellulose
6. PVDF membranes are preferred over nitrocellulose because they (CO3, K1)
(a) Are cheaper
(b) Bind nucleic acids
(c) Have higher protein binding capacity
(d) Do not require blocking
7. Complement fixation test mainly detects (CO4, K2)
(a) Cell-mediated immunity
(b) Antibody-mediated immunity
(c) Innate immunity
(d) Autoimmunity
8. Protein G binds to which region of IgG? (CO4, K2)
(a) Fab (b) Fc
(c) Light chain (d) Hinge region
9. ELISPOT assay detects cytokines secreted by (CO5, K2)
(a) Cell populations (b) Cell lysates
(c) Individual cells (d) Serum proteins
10. Side scatter (SSC) in flow cytometry represents (CO5, K2)
(a) Cell size
(b) Cell granularity
(c) Fluorescence intensity
(d) Cell viability

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the procedure for blood smear preparation and leukocyte identification using Giemsa stain. (CO1, K3)

Or

- (b) Explain the principles and applications of immunohematological blood grouping techniques. (CO1, K3)

12. (a) Explain the principle and methodology of radial immunodiffusion. (CO2, K4)

Or

- (b) Discuss immunoelectrophoresis and its diagnostic applications. (CO2, K4)

13. (a) Describe the principle and steps involved in dot blot assay. (CO2, K4)

Or

- (b) Explain SDS-PAGE with reference to protein separation and analysis. (CO2, K4)

14. (a) Explain the isolation and purification of IgY from chicken egg yolk. (CO3, K5)

Or

- (b) Describe the principle and applications of ELISPOT assay. (CO3, K5)

15. (a) Explain the principle and applications of complement fixation test. (CO3, K4)

Or

- (b) Describe the working principle of flow cytometry. (CO3, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss different methods of blood collection from experimental animals and their ethical considerations. (CO1, K6)
- Or
- (b) Explain the significance of mononuclear cell isolation and cryopreservation in immunological research. (CO1, K5)
17. (a) Describe the complete procedure of Western blotting and its applications in immunodiagnostics. (CO2, K6)
- Or
- (b) Compare SDS-PAGE and immunoelectrophoresis in protein analysis. (CO2, K5)
18. (a) Discuss antigen—antibody interactions with reference to precipitation and diffusion techniques. (CO2, K5)
- Or
- (b) Explain the role of blocking agents in immunoassays. (CO2, K6)
19. (a) Describe antibody purification using Protein A/G affinity chromatography. (CO3, K6)
- Or
- (b) Explain the isolation of macrophages and methods to assess phagocytic activity. (CO3, K5)
20. (a) Discuss the principle, instrumentation, and applications of flow cytometry. (CO3, K6)
- Or
- (b) Explain the importance and methodology of cryopreservation of immune cells. (CO3, K5)

R4542

Sub. Code

25MBT2E1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Biotechnology

Elective – ENVIRONMENTAL BIOTECHNOLOGY

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Biodiversity refers to the variety of life at _____, species, and ecosystem levels. (CO1, K1)
(a) molecular (b) genetic
(c) cellular (d) biochemical
2. Microorganisms play a major role in the _____ cycle by converting nitrogen into different usable forms. (CO1, K1)
(a) carbon (b) sulfur
(c) nitrogen (d) phosphorus
3. The bioremediation strategy that introduces specific microorganisms into a contaminated site is called _____. (CO2, K2)
(a) Phytoremediation (b) Bioaccumulation
(c) Bioaugmentation (d) Biovolatilization
4. Uranium is classified under _____ pollutants in bioremediation. (CO2, K1)
(a) Organic (b) Gaseous
(c) Radionuclide (d) Nutrient

5. The enzyme primarily responsible for pollutant degradation by white rot fungi is (CO3, K1)
- (a) Amylase (b) Laccase
(c) Protease (d) Lipase
6. What is phytostabilization mainly used for? (CO3, K2)
- (a) Uptake of metals into leaves
(b) Volatilization of pollutants
(c) Immobilization of contaminants in soil
(d) Degradation of organic compounds
7. *Trichoderma* acts as a biofungicide mainly through _____ and antibiosis. (CO4, K2)
- (a) Symbiosis (b) Mycoparasitism
(c) Nitrogen fixation (d) Pathogenicity
8. What is the major role of mycorrhizal association in plants? (CO4, K2)
- (a) Carbon fixation
(b) Disease transmission
(c) Enhanced nutrient uptake
(d) Insect resistance
9. Biohydrogen production is commonly carried out by _____ bacteria. (CO5, K1)
- (a) Nitrifying (b) Sulphur-oxidizing
(c) Photo synthetic (d) Denitrifying
10. What is the main product of anaerobic digestion in biogas plants? (CO5, K2)
- (a) Hydrogen (b) Methane
(c) Ethanol (d) Carbon monoxide

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the methods used for management of domestic waste. (CO1, K3)

Or

- (b) Explain the treatment strategies for industrial waste. (CO1, K3)

12. (a) Explain how selenium (Se) is transformed during microbial bioremediation. (CO2, K4)

Or

- (b) Explain the role of microorganisms in the bioremediation of chromium (Cr). (CO2, K4)

13. (a) Describe rhizofiltration and its application in contaminant removal. (CO3, K4)

Or

- (b) Explain phytovolatilization with one suitable example. (CO3, K4)

14. (a) Explain the role of *Pseudomonas fluorescens* in plant disease suppression. (CO4, K5)

Or

- (b) Describe nitrogen-fixing symbiosis between legumes and *Rhizobium*. (CO4, K5)

15. (a) List out the microorganisms involved in biodiesel production and their role. (CO5, K6)

Or

- (b) Describe the role of microorganisms in MEOR. (CO5, K6)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain pollution control strategies for air, water, and soil pollution. (CO1, K4)
- Or
- (b) Explain the methods used for treatment and disposal of hazardous waste. (CO1, K4)
17. (a) Explain the methods and applications of biostimulation in contaminated sites. (CO2, K5)
- Or
- (b) Explain the microbial degradation pathways of organic pollutants such as PAHs and PCBs. (CO2, K5)
18. (a) Explain the application of bacteria in bioremediation with examples and limitations. (CO3, K4)
- Or
- (b) Compare microbial bioremediation and phytoremediation. (CO3, K4)
19. (a) Discuss the production and formulation strategies of baculovirus-based bioinsecticides. (CO4, K5)
- Or
- (b) Explain the role of mycorrhizal fungi in nutrient uptake and plant growth promotion. (CO4, K5)
20. (a) Explain the process of bioleaching of metals with suitable examples. (CO5, K6)
- Or
- (b) Explain the production and applications of biosurfactants in environmental remediation. (CO5, K6)