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University Examinations 2023/2024

SECOND YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MEDICAL LABORATORY

HMM 3227: FUNDAMENTALS OF MOLECULAR MICROBIOLOGY

DATE: APRIL 2024 **TIME: 2 HOURS**

INSTRUCTIONS:

(i) The paper consists of **Three** Sections
(ii) Section A: Multiple Choice Questions
(iii) Section B: Short Answer Questions
(iv) Section C: Long Answer Questions

SECTION A: 20 MARKS (SELECT THE MOST APPROPRIATE ANSWER)

1. Which of the following techniques is commonly used to amplify specific DNA sequences in molecular microbiology?
    a) Southern blotting
    b) Western blotting
    c) Polymerase Chain Reaction (PCR)
    d) Gel electrophoresis
2. Which of the following is NOT a method used for bacterial transformation?
    a) Electroporation
    b) Conjugation
    c) Transduction
    d) Reverse transcription

3. Which enzyme is commonly used to generate complementary DNA (cDNA) from RNA templates in molecular microbiology?
    a) DNA polymerase
    b) RNA polymerase
    c) Reverse transcriptase
    d) Ligase
4. Which of the following is a technique used for the visualization of DNA fragments separated by gel electrophoresis?
    a) UV fluorescence
    b) Autoradiography
    c) Staining with ethidium bromide
    d) All of the above
5. Which of the following is a function of restriction enzymes in molecular microbiology?
    a) Polymerization of DNA strands
    b) Introduction of mutations into DNA sequences
    c) Cleavage of DNA at specific recognition sequences
    d) Repair of damaged DNA molecules
6. What is the function of a plasmid in molecular microbiology?
    a) It serves as a vehicle for the transfer of genetic material between bacteria.
    b) It encodes for essential metabolic enzymes in bacteria.
    c) It regulates gene expression in eukaryotic cells.
    d) It enhances the pathogenicity of bacteria.
7. Which of the following is NOT a component of the CRISPR-Cas system?
    a) Cas9 protein
    b) sgRNA (single-guide RNA)
    c) Polymerase Chain Reaction (PCR)
    d) crRNA (CRISPR RNA)
8. What is the primary function of PCR (Polymerase Chain Reaction) in molecular microbiology?
    a) Amplification of specific DNA sequences
    b) Cleavage of DNA at specific sites

c) Integration of foreign DNA into host genomes

d) Visualization of DNA fragments

9. Which technique is used to determine the sequence of nucleotides in a DNA molecule?

a) Southern blotting

b) Polymerase Chain Reaction (PCR)

c) Sanger sequencing

d) Gel electrophoresis

10. What is the role of a vector in molecular cloning?

a) To cut DNA at specific recognition sites

b) To facilitate the integration of foreign DNA into a host organism

c) To amplify DNA fragments

d) To visualize DNA fragments

11. Which of the following is a technique used to introduce foreign DNA into bacterial cells by making them permeable to DNA?

a) Transformation

b) Transduction

c) Conjugation

d) Electrophoresis

12. Which of the following is an example of a DNA repair mechanism in bacteria?

a) Base excision repair

b) Polymerase Chain Reaction (PCR)

c) RNA interference

d) DNA ligation

13. Which of the following enzymes is involved in the process of DNA ligation?

a) DNA polymerase

b) Ligase

c) Restriction enzyme

d) Reverse transcriptase

14. In the polymerase chain reaction (PCR), which step involves the heating of the reaction mixture to separate the DNA strands?

a) Annealing

b) Extension

c) Denaturation

d) Ligation

15. Which of the following techniques allows for the simultaneous detection and quantification of gene expression levels?

a) Southern blotting

b) Northern blotting

c) Western blotting

d) Reverse transcription-quantitative PCR (RT-qPCR)

16. What is the primary role of antibiotics in molecular microbiology experiments?

a) To promote bacterial growth

b) To inhibit bacterial growth

c) To enhance DNA replication

d) To stabilize DNA molecules

17. Which of the following is a method used for the purification of plasmid DNA from bacterial cells?

a) Reverse transcription

b) Gel electrophoresis

c) Alkaline lysis

d) DNA amplification

18. Which of the following is an essential component of a cloning vector?

a) Reporter gene

b) Primers

c) Restriction enzyme

d) All of the above

19. Which technique is commonly used to identify bacterial strains based on the unique pattern of DNA fragments generated by restriction enzymes?

a) PCR

b) RFLP analysis

c) DNA sequencing

d) Northern blotting

20. Which of the following is an example of a bacterial CRISPR-associated protein used for genome editing?

a) Casper
b) Cas9
c) Casanova
d) Casablanca

SECTIONB: 40 MARKS (ANSWER ANY EIGHT (8) QUESTIONS)

1. Describe the steps involved in the Polymerase Chain Reaction (PCR). (5 Marks)
2. Explain the principle behind gel electrophoresis and its role in molecular microbiology (5 Marks)
3. Discuss the significance of restriction enzymes in recombinant DNA technology (5 Marks)
4. Explain the process of bacterial transformation and its importance in molecular microbiology research (5 Marks)
5. Describe the role of reverse transcriptase in molecular biology and provide an example of its application (5 Marks).
6. Discuss the concept of gene expression regulation in bacteria and the role of transcription factors (5 marks)
7. Explain the process of DNA sequencing and its importance in microbial genomics (5 Marks)
8. Describe the CRISPR-Cas9 system and its application in genome editing (5 Marks)
9. Discuss the importance of plasmids in genetic engineering and molecular cloning (5 marks)
10. Explain the process of DNA hybridization and its application in microbial identification (5 marks)

SECTION C: (40 MARKS) (CHOOSE ANY TWO QUESTIONS)

1. Discuss the principles and applications of recombinant DNA technology in the field of molecular microbiology (20 Marks)

2. Discuss the role of microbial genomics in understanding microbial diversity, evolution, and pathogenesis (20 Marks).
3. Explain the process of gene regulation in bacteria giving detailed steps of the process. (20 Marks)