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University Examinations 2023/2024

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

HMM 3223: MICROBIAL GENETICS

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 (CHOOSE ONE BEST ANSWER).

1. Select all of the correct statements about DNA molecule
 - a) It carries genetic information
 - b) It consists of double-helical nucleotides
 - c) Exists as double-stranded DNA in all bacteria and viruses
 - d) Composed of four nitrogen-containing bases
2. All of the following are the major types of RNA that are classified based on their structure and functions, Except
 - a) messenger RNA
 - b) transfer RNA
 - c) ribosomal RNA
 - d) complementary RNA

- 3) Identify the correct statements about the nitrogen bases present in DNA and RNA
- a) Adenine is complementary to thymine only in DNA
 - b) Adenine is complementary to Uracil both in DNA and RNA
 - c) Cytosine is complementary to guanine only in DNA
 - d) Cytosine is complementary to guanine both in DNA and RNA
- 4) Which of the following organism consists of single-stranded DNA?
- a) Fungi
 - b) Viruses
 - c) Protozoa
 - d) Eukaryotes
- 5) Which of the following statement about chromosomes is correct?
- a) It consists of genetic information and is found in eukaryotes but not in bacteria
 - b) Present in DNA and RNA that carries the genetic information
 - c) The bacterial chromosome has DNA that exists in a linear form
 - d) It is a strand of nucleic acid and proteins of DNA that carry the genetic information
6. What is the term commonly used to describe circular DNA molecules present in the cytoplasm of bacteria?
- a) Chromosomal DNA
 - b) Chloroplast DNA
 - c) Extra-Chromosomal DNA
 - d) Mitochondrial DNA
- 7) What is the primary enzyme responsible for DNA replication?
- a) Helicase
 - b) DNA ligase
 - c) DNA polymerase
 - d) RNA polymerase
- 8) What is the function of a DNA primer in DNA replication?
- a) Initiates transcription
 - b) Initiates DNA replication

- c) Provides a template for RNA synthesis
 - d) Protects the DNA strands
- 9) The Delta variant is a mutation of which specific pathogen?
- a) Coronavirus
 - b) Ebola virus
 - c) Hepatitis B virus
 - d) Poxvirus
- 10) What is the term for the process of copying DNA into RNA, which is a key step in gene expression?
- a) Replication
 - b) Transcription
 - c) Translation
 - d) Transformation
- 11) In transcription, what is the role of RNA polymerase?
- a) Initiates translation
 - b) Repairs damaged DNA
 - c) Synthesizes DNA from an RNA template
 - d) Synthesizes RNA from a DNA template
- 12) What is the function of a promoter region in transcription?
- a) Encodes amino acids
 - b) Initiates translation
 - c) Signals the start of transcription
 - d) Terminates transcription
- 13) What is the role of tRNA in translation?
- a) Delivers amino acids to the ribosome
 - b) Initiates translation
 - c) Synthesizes mRNA
 - d) Transcribes DNA
- 14) Which codon serves as the start codon for translation?
- a) AUG
 - b) UAA

- c) UGA
 - d) UAC
15. R plasmids are the plasmids that
- a) influence bacterial toxin production
 - b) confer antibiotic resistance
 - c) regulate the structural components of pathogenic bacteria
 - d) None of the above
16. The gene transfers in microorganisms occur via the transposons or 'jumping genes', these are also known as?
- a) RNA molecule
 - b) Genome
 - c) Plasmids
 - d) DNA molecule
17. What is the transduction process?
- a) The genome is transferred from one bacterium to another bacterium
 - b) The part of the DNA is transferred by bacteriophage from one bacterium to another
 - c) The plasmid is transferred from one bacterium to another
 - d) The part of the DNA molecule is transferred into the RNA molecule
18. The antibiotic resistivity of bacteria occurs mainly by mutation or genetic transfer, which of the following is the mechanism of action through which bacteria acquires resistance to the penicillins
- a) Inhibition of Nucleic acid synthesis
 - b) Inhibition of metabolic pathways
 - c) Inhibition of cell wall synthesis
 - d) Inhibition of protein synthesis
19. Epigenetic modifications can influence gene expression. Which of the following is an example of an epigenetic modification?
- a) Altering the sequence of amino acids in a protein
 - b) Adding methyl groups to DNA
 - c) Changing the DNA sequence

d) Enhancing RNA polymerase activity

20. What cellular communication systems respond to external signals and modulate gene expression?

a) Enhancers

b) Promoters

c) Ribosomes

d) Signal transduction pathways

SECTION B: (40 MARKS) ANSWER ALL QUESTIONS

1. Describe the composition of a bacterial nucleoid (5 marks)

2. Outline the contributions of George W. Beadle and Edward L. Tatum to the study of microbial genetics (5 marks)

3. Identify proteins involved in supercoiling of prokaryotic DNA (5 marks)

4. Illustrate the structure of a bacterial operon (5 marks)

5. Outline the levels of gene regulation in prokaryotes (5 marks)

6. Describe the structure of a transposon (5 marks)

7. Illustrate the basic components of a nucleotide (4 marks)

8. Describe the following mechanisms of horizontal gene transfer in bacteria:

(i) Generalized transduction (2.5 marks)

(ii) Specialized transduction (2.5 marks)

SECTION C: 40 MARKS (CHOOSE TWO QUESTIONS)

1. Discuss the process of commercial insulin production (20 marks)

2. a) Discuss applications of bacteriophages (10 marks)

b) Discuss genetic mechanisms of antibiotic resistance in bacteria (10 marks)

3. a) Describe different types of bacterial mutations (10 marks)

b) Discuss properties of transposable genetic elements (10 marks)