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University Examinations 2024/2025

FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF
MEDICAL MICROBIOLOGY

HMM 3111: MICROBIAL DIVERSITY

DATE: JANUARY 2025

TIME: 3 HOURS

INSTRUCTIONS:

Answer *All* questions

Ensure that all your answers are properly numbered

Part I multiple Choice Questions (MCQ): Write the correct answer on the space provided in the answer booklet. Each MCQ is one mark

Part II: Short Answer Questions – Answer questions following each other on the answer booklet

Part III: Long Answer Questions – Answer each question on the answer booklet

SECTION A: MULTIPLE CHOICE QUESTIONS (20 marks)

- Which of the following is a characteristic of Gram-negative bacteria?
 - Thick peptidoglycan layer
 - Lack of outer membrane
 - Presence of lipopolysaccharide
 - Absence of periplasmic space
- The primary function of bacterial endospores is to:
 - Reproduce the bacterium
 - Protect against harsh conditions

- c) Facilitate nitrogen fixation
 - d) Aid in motility
3. Cyanobacteria are an example of:
- a) Chemolithotrophic bacteria
 - b) Photosynthetic bacteria
 - c) Heterotrophic bacteria
 - d) Saprophytic bacteria
4. Nitrogen fixation in bacteria involves converting
- a) Ammonia to nitrate
 - b) Nitrogen gas to ammonia
 - c) Nitrate to nitrogen gas
 - d) Ammonia to nitrite
5. Which molecular technique is commonly used in microbial ecology to analyze DNA sequences?
- a) Polymerase Chain Reaction (PCR)
 - b) Gram staining
 - c) Endospore staining
 - d) Koch's postulates
6. Escherichia coli is an example of a:
- a) Gram-negative bacterium
 - b) Gram-positive bacterium
 - c) Archaea
 - d) Fungi
7. The five-kingdom classification system was proposed by:
- a) Carl Woese
 - b) Robert Whittaker
 - c) Charles Darwin
 - d) Lynn Margulis

8. Spore formation in bacteria is a response to:
 - a) Nutrient availability
 - b) Unfavorable environmental conditions
 - c) Antibiotic presence
 - d) Lack of oxygen
9. Which of the following organisms is known for nitrogen fixation?
 - a) *Pseudomonas aeruginosa*
 - b) *Rhizobium*
 - c) *Bacillus anthracis*
 - d) *Staphylococcus aureus*
10. Antibiotic resistance occurs due to:
 - a) Overuse of antibiotics
 - b) Genetic mutations in bacteria
 - c) Spore formation
 - d) Both a and b
11. Which of the following bacteria is Gram-positive?
 - a) *Escherichia coli*
 - b) *Salmonella*
 - c) *Bacillus subtilis*
 - d) *Pseudomonas aeruginosa*
12. Which bacteria play a critical role in nitrogen fixation in non-leguminous plants?
 - a) *Nitrosomonas*
 - b) *Clostridium*
 - c) *Rhizobium*
 - d) *Azotobacter*
13. Which method is commonly used to determine microbial phylogeny?
 - a) Gram staining
 - b) 16S rRNA sequencing

- c) Endospore staining
 - d) DNA hybridization
14. The lipid content of the outer membrane is significantly higher in:
- a) Gram-positive bacteria
 - b) Archaea
 - c) Gram-negative bacteria
 - d) Fungi
15. Cyanobacteria are important in ecosystems because they:
- a) Cause human diseases
 - b) Fix nitrogen and produce oxygen
 - c) Decompose organic matter
 - d) Produce methane
16. Endospore formation in bacteria is triggered by:
- a) Excessive nutrient availability
 - b) Harsh environmental conditions
 - c) Lack of oxygen
 - d) High humidity
17. Which of the following bacteria is known for its antibiotic production?
- a) Streptococcus
 - b) Bacillus
 - c) Streptomyces
 - d) Mycobacterium
18. Which classification system includes Archaea?
- a) Whittaker's five-kingdom classification
 - b) Linnaean classification
 - c) Woese's three-domain system
 - d) Haeckel's protist classification

19. Nitrogen fixation is carried out by bacteria that:
- a) Convert nitrogen gas to nitrate
 - b) Convert ammonia to nitrogen gas
 - c) Convert nitrogen gas to ammonia
 - d) Convert nitrogen gas to nitrite
20. Bacteria that thrive in high-salt environments are known as:
- a) Halophiles
 - b) Thermophiles
 - c) Psychrophiles
 - d) Acidophiles

SECTION B: SHORT ANSWER ALL QUESTIONS (40 MARKS)

1. Describe microbial diversity and explain its ecological importance. (5 Marks)
2. Explain Whittaker's five-kingdom classification system and its relevance to microbial classification. (5 Marks)
3. Differentiate between Gram-positive and Gram-negative bacteria based on their structural differences. (5 Marks)
4. Provide two examples of photosynthetic bacteria and discuss their ecological roles. (5 Marks)
5. Outline the process of spore formation in bacteria, citing a spore-forming bacterium. (5 Marks)
6. Define nitrogen fixation, provide an example of a nitrogen-fixing bacterium, and discuss its significance in agriculture. (5 Marks)
7. Discuss the role of microbes in biogeochemical cycles, giving specific examples. (5 Marks)
8. Explain the significance of microbial interactions in the environment, focusing on symbiosis. (5 Marks)

SECTION C: LONG ANSWER TWO QUESTIONS (40 MARKS)

QUESTION ONE

- a) Define molecular microbial ecology and explain how it enhances our understanding of microbial communities in natural environments. (10 Marks)
- b) Discuss gene mutations in microbes and their impact on antibiotic resistance, providing examples of resistant microbial strains. (10 Marks)

QUESTION TWO

- a) Explain the role of phylogenetic evolution in the study of microbial diversity. (10 Marks)
- b) Describe the impact of evolutionary changes in wild-type microbial strains and how these changes have contributed to modern biotechnology (10 Marks)

QUESTION THREE

- a) Describe how phylogenetic studies have reshaped the understanding of microbial diversity, focusing on the distinction between archaea and bacteria (20 Marks)