

# UNIVERSITY OF SWAZILAND

## FACULTY OF HEALTH SCIENCES

### DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCES

#### FINAL EXAMINATION 2009/2010

TITLE OF PAPER: INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY

COURSE CODE: HSC 105

DURATION: 3 HOURS

- INSTRUCTIONS:
1. READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
  2. THIS PAPER IS DIVIDED INTO **TWO** SECTIONS:-  
**SECTION A (NURSING SCIENCE) & SECTION B (ENVIRONMENTAL SCIENCE)**
  3. ANSWER ANY FOUR QUESTIONS IN YOUR SECTION
  4. EACH QUESTION CARRIES TWENTY FIVE (25) MARKS
  5. NO PAPER SHOULD NEITHER BE BROUGHT INTO NOR TAKEN OUT OF THE EXAMINATION ROOM
  6. BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER

SPECIAL REQUIREMENTS: NONE

THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATORS.

**SECTION A (NURSING SCIENCE)**  
**Answer any four questions from this section.**

**Question 1**

- (a) What are the practical applications of gram- staining and negative-staining?  
(3 marks)
- (b) What is differential staining? (2 marks)
- (c) Separate the following into gram-negative and gram-positive organisms:  
*Mycobacterium, Haemophilus, Clostridium, Staphylococcus, Escherichia, Klebsiella, Vibrio, Shigella, Bacillus, Neisseria, Salmonella and Corynebacterium species.* (8 marks)
- (d) Name one disease caused by each of the bacteria in (c) above. (6 marks)
- (e) Distinguish between a capsid and a capsomere in viruses. (1 mark)
- (f) Draw a diagram of bacteriophage. (2 marks)
- (g) Name a fungus that produces lethal mycotoxins. (1 mark)
- (h) Give a generalised sequence of stages of infection by microorganisms. (2 marks)

**[Total = 25 marks]**

**Question 2**

- (a) Indicate the importance of stem cell research and the clinical implications behind it. (5 marks)
- (b) Show that the specific immune response results from the cooperation of various cells of the immune system. (5 marks)
- (c) Write short notes on the following:  
(i) T-cells and their functions, (4 marks)  
(ii) Structure of an immunoglobulin, (4 marks)  
(iii) Names and classes of antibodies, (3 marks)  
(iv) Immune defects. (4 marks)

**[Total = 25 marks]**

**Question 3**

- (a) Outline the relevance of fungi to humans. (6 marks)
- (b) Elaborate on the major mechanisms of fungal pathogenesis. (4 marks)
- (c) Explain the types of mycoses known so far. (10 marks)
- (d) What is mycetism? (1 mark)
- (e) Elaborate on the toxic effects of aflatoxins. (4 marks)

**[Total = 25 marks]**

**Question 4**

- (a) Explain the functions of the following structures of bacteria:
- (i) capsule, (1 mark)
  - (ii) pilus, (1 mark)
  - (iii) flagellum, (1 mark)
  - (iv) endospore, (1 mark)
  - (v) ribosome. (1 mark)
- (b) Name and elaborate on the shapes of bacteria. (3 marks)
- (c) What do you understand by the term 'generation time'? (1 mark)
- (d) Explain the typical growth curve of a bacterium. (4 marks)
- (e) Show a graphical representation of bacterial growth rates in response to temperature. (4 marks)
- (f) Choose any two bacterial human pathogens and explain their pathogenicity. (8 marks)

**[Total = 25 marks]**

**Question 5**

- (a) Define a virus from a scientific point of view. (5 marks)
- (b) Explain the following:
- (i) Biology of influenza virus, (5 marks)
  - (ii) Use of bacteriophage as a model organism to explain viral multiplication, (5 marks)
  - (iii) Retroviruses, (4 marks)
- (c) Write an essay on the relevance of viruses to humans. (6 marks)

**[Total = 25 marks]**

**Question 6**

- (a) Define an antigen. (1 mark)
- (b) Draw and explain the following:
- (i) an incomplete antigen, (2 marks)
  - (ii) a partial antigen, (2 marks)
  - (iii) a complete antigen. (2 marks)
- (c) Explain the mechanism behind hypersensitivity type I. (4 marks)
- (d) Write short notes on the following:
- (i) the dual nature of the immune response, (3 marks)
  - (ii) the role of B-cells in the immune response, (4 marks)
  - (iii) transplantation immunity. (4 marks)

**[Total = 25 marks]**

**SECTION B (ENVIRONMENTAL SCIENCE)**  
**Answer any four questions from this section.**

**Question 7**

- (a) Draw and label a generalised bacterial cell. (5 marks)
- (b) Write short notes on the composition and functions of the following bacterial structures:
- (i) nucleus, (2 marks)
  - (ii) ribosome, (2 marks)
  - (iii) flagellum, (2 marks)
  - (iv) pilus, (2 marks)
  - (v) capsule. (2 marks)
- (c) Sketch and explain the forms defined by the following:
- (i) Streptobacillus, (2 marks)
  - (ii) Staphylococcus, (2 marks)
  - (iii) tetrad, (2 marks)
  - (iv) peritrichous, (2 marks)
  - (v) amphitrichous. (2 marks)

**[Total = 25 marks]**

**Question 8**

- (a) Draw and label a typical growth curve of a mesophile and then define the cardinal temperatures. (5 marks)
- (b) Explain five methods of asexual reproduction in bacteria. Illustrate your answer. (10 marks)
- (c) Outline steps in bacterial endospore formation. Provide labelled sketches to illustrate each step. (10 marks)

**[Total = 25 marks]**

**Question 9**

- (a) List the four sub-divisions of fungi and state what they have in common. (5 marks)
- (b) Prepare a table to differentiate between prokaryotes and eukaryotes. (10 marks)
- (c) Copy and complete the following table comparing fungi and bacteria.

Characteristic	Fungi	bacteria
1. Optimum pH		
2. Oxygen requirement		
3. Sugar concentration in media		
4. Cell wall structural component		
5. Antibiotic susceptibility		

(10 marks)

**[Total = 25 marks]**

**Question 10**

- (a) What are the characteristics of fungi? (10 marks)
- (b) Draw the life cycle of the bread mold *Rhizopus stolonifer*. (10 marks)
- (c) List five methods of decontamination or disinfection. (5 marks)
- [Total = 25 marks]**

**Question 11**

- (a) Draw and label a bacteriophage. (5 marks)
- (b) Explain the steps involved in bacterial chromosomal recombination when the donor is  
(i) double stranded, (2 marks)  
(ii) single stranded. (3 marks)  
**NB:** Illustrate your answer.
- (c) Explain transduction (phage mediated) in bacteria. (10 marks)
- (d) List 5 methods of identifying microbes. (5 marks)
- [Total = 25 marks]**

**Question 12**

- (a) Define the following:  
(i) potable water, (2 marks)  
(ii) indicator microorganisms in water. (3 marks)
- (b) Explain five characteristics of an indicator organism in water. (10 marks)
- (c) Explain five ways in which a water-borne disease such as salmonella gastroenteritis (typhoid fever) may be prevented. (10 marks)
- [Total = 25 marks]**

**END OF EXAMINATION PAPER**