UNIVERSITY OF SWAZILAND

Faculty of Health Sciences
Department of Environmental Health Science

DEGREE IN ENVIRONMENTAL HEALTH SCIENCE
DEGREE IN BACHELOR OF SCIENCE IN NURSING AND MIDWIFERY

MAIN EXAMINATION PAPER MAY 2017

TITLE OF PAPER	:	INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY
COURSE CODE	:	EHS 110
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
	:	**QUESTION ONE IS COMPULSORY,** THEN ANSWER ANY OTHER THREE QUESTIONS
	:	EACH QUESTION **CARRIES 25** MARKS.
	:	WRITE NEATLY & CLEARLY
	:	NO PAPER SHOULD BE BROUGHT INTO THE EXAMINATION ROOM.
	:	BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION 1: COMPULSORY [Youare required toanswer this question]

a. **MULTIPLE CHOICE**: Indicate your response to the items in this question by writing down the letter corresponding to your chosen answer. (20)

i. Which one of the scientists listed below proposed that infections of open wounds were due to microbes found in the air around a patient and started spraying the air inside operating theatres with phenols prior to surgical operations of patients?

A. Louis Pasteur
B. Antonie van Leeuwenhoek
C. Joseph Lister
D. John Snow
E. Robert Koch

ii. Which one of the following functions is not served by the smooth endoplasmic reticulum?

A. It is involved in the synthesis of steroids
B. It detoxifies drugs in the liver
C. It carries stimulus from nerve cells to muscle fibres
D. Produce glucose-6-phosphatase
E. It is involved in the manufacture of proteins using ribosomes attached to its surface

iii. Which of the following DOES NOT kill endospores?

A. autoclaving
B. incineration
C. hot-air sterilization
D. pasteurization
E. All the above methods kill endospores

iv. The part of the virus that defines its genotype and is important during development of a vaccine against the virus is the:

A. capsid
B. nucleic acid
C. capsomeres
D. ribosomes
E. mitochondrion

v. Which one of the bacteria below obtains nutrients by breaking down dead organic matter into soluble forms through the secretion of exogenous enzymes?

A. Nitrifying bacteria
B. Saprophytic bacteria
C. Nitrogen-fixing bacteria
D. Parasitic bacteria
E. Autotrophic bacteria

vi. The data below were obtained from a use-dilution test comparing four disinfectants against *Salmonella choleraesuis*.

Bacterial growth after exposure to

Dilution	Disinfectant A	Disinfectant B	Disinfectant C	Disinfectant D
1:2	-	+	-	-
1:4	-	+	-	+
1:8	-	+	+	+
1:16	+	+	+	+

Which disinfectant(s) is (are) effective?

A. A, B, C and D
B. A, C and D
C. A only
D. B only
E. None of the disinfectants

vii. Which one of the types of microscopes listed below has a low contrast with most biological samples and requires staining to increase contrast?

A. Darkfield microscope
B. Phase-contrast microscope
C. Brightfield microscope
D. Electron microscope
E. None of the above

viii. Which one of the following statements about viruses is NOT TRUE?

A. The growth and multiplication of viruses inside the human body may be controlled through the prescription of and strict adherence to appropriate antibiotics
B. Viruses only multiply when they are inside a host cell
C. Viruses contain genetic material made of either DNA or RNA
D. Viruses cannot survive for long periods outside the host
E. Some viruses may infect and multiply inside bacterial cells

ix. F_c receptors that are recognized and bind to the F_c region of antibody molecules are found on the surface of:

A. neutrophils
B. eosinophils
C. macrophages
D. Natural Killer cells
E. all the above cells

x. Which one of the types of hypersensitivities listed below is/are mediated by cytotoxic cells of the immune system?
   A. Type I Hypersensitivity
   B. Type II Hypersensitivity
   C. Type III Hypersensitivity
   D. Type IV Hypersensitivity
   E. Type I Hypersensitivity and Type IV Hypersensitivity

a. TRUE or FALSE: Indicate your responses to the items in this section of the question by writing **T** (for true) or **F** (for false) against each item. (5)
   i. Bacteria contain genetic material of DNA or RNA type
   ii. Prokaryotic cells have flagella which they use for locomotion but Eukaryotic cells use other apparatus for locomotion and not flagella
   iii. Lysozyme occurs naturally in eukaryotic cells
   iv. The poliovirus identifies a receptor called CD155 to enter cells of human or primates
   v. Natural Killer (NK) cells play an important role in the innate immune defences against tumour cells and viruses

[25 marks]

QUESTION 2

a. Robert Koch, a German scientist, made significant contributions to the understanding of the germ theory of disease. Using Robert Koch's first three postulates, explain how the understanding of the germ theory of disease was enhanced. (6)
b. Microscopes enhanced the understanding of the existence of microbes.
   i. Name the scientist who developed the first simple microscope. (1)
   ii. What is the difference between a simple microscope and a compound microscope? (2)
   iii. Describe THREE differences between a light microscope and an electron microscope. (6)
c. A student microbiologist wants to view and study the characteristic structures of live microbes. What type of microscope would be best for use and why? (3)
d. Antibiotics have become a major weapon in controlling bacterial diseases since the discovery of the first antibiotic effect by the Scottish bacteriologist, Alexander Fleming in 1928.
   i. Define what an antibiotic is in disease control? (2)
   ii. What is the name of the first antibiotic that was developed by Alexander Fleming? Also describe the events that led to its discovery? (3)
   iii. Antibiotics are not used against bacteria but are ineffective against viral pathogens. Explain why antibiotics are ineffective against viruses. (2)

[25 marks]

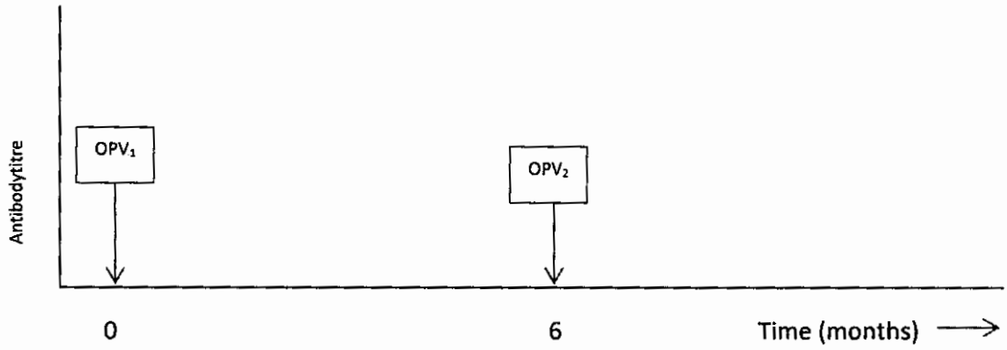
QUESTION 3

a. The development of microbial agents must adhere to certain important requirements before licencing. List six requirements of a good microbial agent. (6)

b. Explain the term "anamnestic response" as it applies to immune response against an infecting bacterial microorganism. (3)

c. What is the benefit of the "anamnestic response" during the fight against invading microorganisms? (2)

d. Shown below is part of the graph of the response during administration of a primary polio vaccine (OPV_1) and a secondary or booster vaccination (OPV_2) after 6 months. Copy and complete the graph showing the type and level of antibody responses that take place after the first vaccination and the second (booster) immunization. (4)



e. What is the difference between OPV and IPV? (3)

f. The World Health Organization has recommended sequential withdrawal of OPV and replacing it with IPV.

i. Why is it necessary to replace OPV with IPV during immunization against wild polio virus? (4)

ii. What is the rationale of introducing IPV prior to the switch from tOPV to bOPV? (3)

[25 marks]

QUESTION 4

a. Autoclaving is an important process useful in the destruction of several microorganisms and is used to sterilise hospital equipment.

i. Explain the meaning of sterilisation. (2)

ii. Explain how sterilisation differs from another commonly used process known as pasteurisation. (2)

iii. Describe the process of autoclaving, explaining why it is important during many sterilisation activities. (3)

b. A healthy woman gets involved in unprotected sexual intercourse with a man infected with the Human Immunodeficiency Virus (HIV) from which she acquires infection.

i. Explain the processes that occur in the body of the woman to establish an infection with the HIV following sexual transmission. (4)

ii. Explain the function of dendritic cells and macrophages in the body's immune response to HIV infection. (4)

iii. What role is played by B and T cells in the immune response against the virus? (6)
iv. Explain how the virus is able to render antibodies ineffective during the immune response. (2)
v. Explain why T and B cells generated and stored as memory cells become ineffective in removing the infection. (2)

[25 marks]

QUESTION 5

a. A 9-year old boy plays in schistosomiasis infested water resulting to skin penetration by cercariae of *Schistosoma haematobium*, the worm that causes bilharzias. Describe the immune mechanism that occur in the body of the boy to cause destruction of the adult worms of *Schistosoma haematobium* that develop from the cercariae. (10)
b. An antigen presenting cell, such as a dendritic cell, captures and processes a microbe infecting an organism.
   i. Where are dendritic cells located in the body of the host organism? (1)
   ii. In point form, describe the chronology of events that describe how a dendritic cell facilitate recognition of an infecting bacterium by phagocytic cells of the immune system? (5)
   iii. How does the dendritic cell relate to the helper T cell to induce an immune response? (2)
   iv. During an immune response, helper T cells secrete interleukin-2. List THREE functions of the interleukin-2 in the immune response. (4)
   v. Explain the contribution of dendritic cells to lymphadenitis following an infection. (3)

[25 marks]

QUESTION 6

a. Graft is a procedure commonly performed as a medical procedure to repair damaged tissue. Define each of the three different grafts listed below to indicate your understanding of the difference between them.
   i. Xenografts (2)
   ii. Autografts (2)
   iii. Allografts (2)
   iv. Isograft (2)
b. Often, transplant rejection occurs during organ or tissue grafting between two individuals.
   i. Explain the cause of transplant rejection. (2)
   ii. What can be done to minimize chances for the occurrence of transplant rejection. (2)
c. Autoimmune disease often results in insulin-dependent diabetes mellitus and Hashimoto's thyroiditis. Explain what the two diseases are including their immunological causes. (8)
d. Explain what X-linked hyperglobulinaemia is and what immunological disorder results in the defect. (5)

[25 Marks]