UNIVERSITY OF SWAZILAND

Faculty of Health Sciences
Department of Environmental Health Science

DEGREE IN ENVIRONMENTAL HEALTH SCIENCE

RE-SIT EXAMINATION PAPER 2021

TITLE OF PAPER	:	INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY
COURSE CODE	:	EHS127
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.

EHS 127 RE-SIT EXAMINATION 2021

QUESTION 1 COMPULSORY – ALL STUDENT MUST ANSWER THIS QUESTION

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

i. Which one of the scientists below was the first to postulate that disease was transmitted by invisible particles or seeds from one person to another following contact with clothing or utensils?

A. A non-trained scientist, Anton van Leuwenhoek
B. The Italian physician, Fracastorius
C. The Vienesse physician, Plenciz
D. The German physician, Robert Koch
E. The French chemist, Louis Pasteur

ii. Which one of the parts of the bacterial cell listed below has the function of assembling of amino acids to form proteins?

A. Flagella
B. Endoplasmic reticulum
C. Pili or Fimbriae
D. Cell membrane
E. Ribosomes

iii. Which of the viruses below has the highest fatality rate in humans?

A. Influenza A virus
B. Coronavirus
C. Ebola virus
D. Zika virus
E. Bundibugyo virus

iv. Some nitrogenous compounds that are components nucleic acid molecules are referred to as purines because they consist of double ring structures. Which pair of nucleotides among those listed below are purines?

A. Adenine and Guanine
B. Cytosine and Guanine
C. Cytosine and Thymine
D. Adenosine and Thymine
E. Adenine and Cytosine

v. Some bacteria consist of resistant spores. Which of the following is the best method to destroy bacteria with resistant spores?

A. Boiling the substance containing the bacteria for 5 hours at 100°C
B. Heating the material containing the bacteria at temperatures of 121°C and at a pressure of 15 pounds per square inch for 15 minutes

C. Placing the material at -13°C for 3 days and then boiling at 100°C for 2 hours
D. Placing the material in the sun for 12 hours to dry
E. None of the above

vi. A bacterium derives energy through the process defined by the equation below:

$$NH_4^+ + 2O_2 \longrightarrow NO_2 + 2H_2O + \text{Energy}$$

The bacterium is likely to be a:

A. Saprophytic bacteria
B. Nitrogen fixing bacteria
C. Nitrifying bacteria
D. Denitrifying bacteria
E. Cyanobacteria

vii. Serial dilutions are commonly used to derive plate counts during bacterial cultures. What would be the number of bacterial cells in culture that has 32 colonies on a plate of 1/10 000 dilutions?

A. 32
B. 320 000
C. 10 000
D. 32/10 000
E. 10 000/32

viii. The process whereby bacteria takes DNA from the culture medium resulting to changes in It's genetic make-up is called

A. conjugation
B. translation
C. transcription
D. genetic engineering
E. transformation

ix. Which of the statements about Tumour Necrosis Factor – alpha (TNFα) IS NOT true?

A. TNFα is secreted by activated microphages
B. TNFα kills cancerous cells in the human body
C. TNFα plays an important role in initiating the inflammatory response
D. TNFα is important is a colony stimulating factor that induces division and production of B and T lymphocytes
E. TNFα

x. Which one of the following statements does not describe a step in the inflammatory response?
   A. Blood flow to the damaged area is increased
   B. Capillaries leak releasing phagocytes and clotting factor into the wound
   C. Platelets move out of capillary to seal the wounded area
   D. Phagocytes angulf bacteria, dead cells and cell debris in the wound
   E. B cells attach to bacteria leading to T cell cytotoxicity

b. Write **T** (for true) or **F** (for false) to indicate your responses to each item in this question. (5)
   i. Bacterial cells possess only one chromosome, whereas eukaryotic cells may possess many chromosomes
   ii. Active transport of materials involves the movement of materials from an area of high concentration to an area of low concentration across a cell membrane
   iii. Actinomyces bacteria consist of short branching rods.
   iv. Nitrifying bacteria convert ammonium compounds into nitrates and nitrites
   v. Granulocytes include neutrophils, basophils and macrophages

[25 marks]

QUESTION 2

a. Explain what you understand by the term "bacterial virus". (2)
b. For attachment to human cells during infection, viruses recognize and attach to specific receptors on the human cell. Name the receptors that facilitate recognition and attachment of the following viruses:
   i. Influenza virus (1)
   ii. Poliovirus (1)
c. Shown below is the DNA template derived from part of the gene of a microorganism showing sequence of nucleotides. Write down the nucleotide sequence that would be transcribed onto mRNA during replication. (6)

d. Zika virus caused major epidemics in South America resulting in children incurring permanent complications.
   i. Briefly describe the shape on a Zika virus. (2)
   ii. Name two complications likely to arise from infections with Zika virus. (2)
   iii. Describe THREE ways the humans acquire infection with the Zika virus. (6)

iv. Mention ONE method you would recommend for prevention of Zika virus infections in humans? (2)

e. Global efforts to eradicate infections with the wild poliovirus have achieved major success in the last century. Name three parts of the human body commonly infected with the poliovirus to result in Acute Flaccid Paralysis (AFP). (3)

[25 marks]

QUESTION 3

a. What is the difference between autotrophic and heterotrophic bacteria? (4)

b. What is the difference between decomposition, fermentation and putrefaction? (3)

c. Define the following and explain how they are performed.

i. conjugation (3)

ii. transduction (3)

iii. transformation (3)

d. Explain how the following are used to destroy or prevent growth of bacteria:

i. Disinfectants (2)

ii. Antiseptic solution (2)

e. During autoclaving of hospital materials, pressure is added to the use of temperatures above $100^{o}C$. What is the importance of adding the pressure component? (2)

f. What is radiation sterilisation and what is it used for? (3)

[25 marks]

QUESTION 4

a. Other than availability of essential nutrients, list three factors that influence the growth of microorganisms *in vivo* and *in vitro*. (3)

b. Some microrganisms are said to be heterotrophs while others are autrotrophs.

i. What type of organisms are heterotrophs? (2)

ii. What type of organisms are autotrophs? (2)

c. All bacterial growth requires six major elements. List them. (6)

d. What is the importance of the following elements in the growth of bacteria.

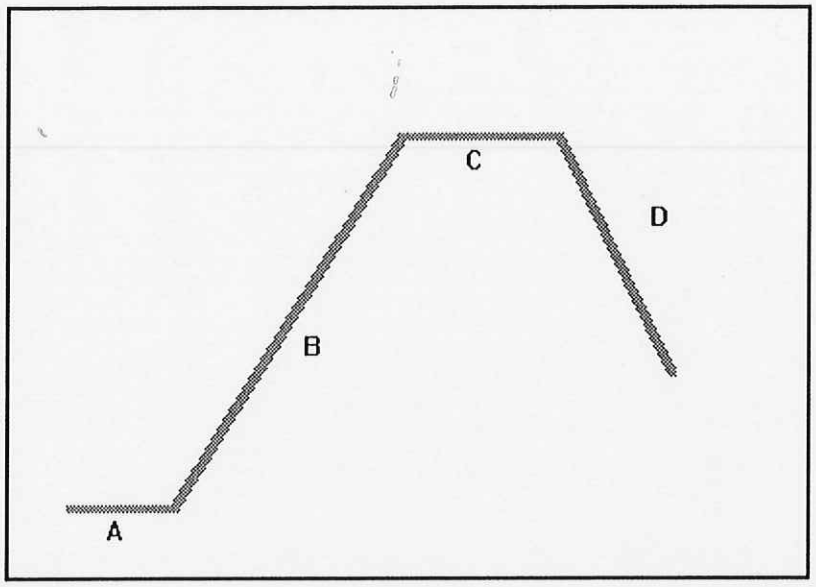
i. Nitrogen (3)

ii. Calcium (2)

e. Other microbes require iron for growth. What is the function of the iron? (2)

f. The diagram below represents the growth curve of bacteria. Use the diagram to answer the questions that follow:

y axis = log cell number



i. What is the term used to describe bacterial growth at time "A"? (1)

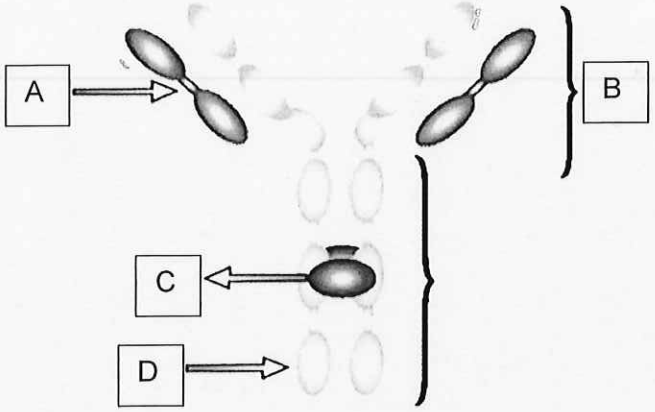
ii. What is the term used to describe bacterial growth at time "B"? (1)

iii. What is the cause of the population decline observed at time "D"? (3)

[25 marks]

QUESTION 5

a. Shown below is the structure of an antibody. Label the parts marked A – D. (4)



b. Name TWO <u>different</u> types of immune cells that bear the part marked D. (2)

c. List FOUR ways by which this antibody may inactivate an antigen in the body of an infected host that has been pre-immunized. (4)

d. Some antibody types predominate during the primary immune response while other predominate during the secondary immune response.
   i. Name one antibody that is predominately secreted during the primary response. (1)
   ii. Name one antibody that is predominately secreted during the secondary response. (1)
   iii. Which antibody can cross the placenta and is responsible for protection of newborns? (1)
   iv. Which antibody is responsible for allergies such as arthritis? (1)
   v. Explain how the antibody mentioned in (iv) causes allergic reactions resulting to hypersentitivity. (3)

e. Opportunistic infections such as candidiasis occur in individuals with immunodeficiency syndrome.
   i. Explain why *Candida albicans*, the pathogen that causes candidiasis, is an important normal flora of the human body. (4)
   ii. Why is candidiasis normally a problem among AIDS patients? (2)
   iii. What advice would you give to an individual who is infected by HIV to prevent development of candidiasis? (2)

[25 marks]

QUESTION 6

(a) Antibodies are involved in important immune reactions that all serve to protect the host from microorganisms.

i. Explain what antibodies are. (2)

ii. List FOUR functions of antibodies. (4)

iii. Three major events occur during the inflammatory response. List them. (6)

(b) A laboratory technologist identifies the cell shown below from the blood of a patient.

(i) Name three immune cells this cell is likely to be. (3)

(ii) What is the single most important function performed by these cells? (2)

(c) A 4-year child is infected by the giant intestinal worm, *Ascaris lumbricoides*, that parasitizes the gastrointestinal tract leading to malnutrition due to uptake of essential nutrients for the child. Explain the immune mechanisms that occur in the body of the child to cause reduction of the number of these worms and prevent severe disease or complications. (6)

(d) Immune responses are sometimes involved in autoimmune disease. Explain what you understand by the term "autoimmune disease". (2)

[25 marks]