



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya

Tel: +254(0) 799 529 958, +254(0) 799 529 959, + 254 (0) 712 524 293,

Website: [info@must.ac.ke](mailto:info@must.ac.ke) Email: [info@must.ac.ke](mailto:info@must.ac.ke)

---

## University Examinations 2023/2024

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

### HMM 3122: MEDICAL INSTRUMENTATION AND SAFETY

DATE: APRIL 2024

TIME: 2 HOURS

---

INSTRUCTIONS: Answer all questions in Section A and B, and any two in Section C

---

#### SECTION RMULTIPLE CHOICE QUESTIONS (20 MARKS)

1. How can flow cytometry contribute to understanding complex cellular interactions?
  - a) By measuring changes in pH levels within cells
  - b) By analyzing cellular morphology under a microscope
  - c) By assessing multiple parameters of individual cells simultaneously
  - d) By quantifying the amount of ATP produced by cells
2. In what way can gel electrophoresis be utilized beyond DNA analysis?
  - a) Separating protein molecules based on their charge
  - b) Generating 3D models of molecular structures
  - c) Quantifying the concentration of ions in a solution
  - d) Analyzing the viscosity of liquid samples
3. How can polymerase chain reaction be modified to improve its efficiency in amplifying longer DNA fragments?
  - a) Decreasing the annealing temperature
  - b) Increasing the number of PCR cycles
  - c) Using DNA polymerases with proofreading capabilities
  - d) Reducing the concentration of primer molecules

4. What role do de-ionizers play in maintaining the quality of water used in laboratory experiments?
- a) Filtering out microorganisms and bacteria
  - b) Removing ions and impurities from the water
  - c) Enhancing the taste and odor of the water
  - d) Adjusting the pH level of the water to neutral
5. What considerations should be taken into account when selecting a suitable centrifuge for a specific laboratory application?
- a) The color of the centrifuge rotor
  - b) The maximum speed and relative centrifugal force
  - c) The amount of amperes the centrifuge utilizes
6. How does the application of electrical impedance aid in cell analysis using flow cytometry?
- a) By measuring the mass of individual cells
  - b) By quantifying the concentration of ions within cells
  - c) By detecting change in the electrical properties of cells as they pass through a narrow
  - d) By visualizing the internal structures of cells under a microscope
7. What role does microtome play in the preparation of tissue samples for histological examination?
- a) It measures the volume of tissue samples with high precision
  - b) It stains tissue samples to enhance contrast under a microscope
  - c) It cuts thin sections of tissue for microscopic analysis
  - d) It quantifies the expression levels of specific genes within tissue samples
8. How can the use of a refrigerated centrifuge improve the separation efficiency of biological samples?
- a) By increasing the centrifuge speed to achieve higher relative centrifugal force (RCF)
  - b) By maintaining the temperature of the samples at a constant low temperature during centrifugation
  - c) By adding a stabilizing agent to the samples to prevent degradation during centrifugation
  - d) By adjusting the pH of the samples to optimize their separation characteristics
9. What is the primary purpose of an autoclave in a laboratory setting?

- a) To incubate bacterial cultures at a specific temperature
  - b) To sterilize laboratory equipment and media using high-pressure steam
  - c) To amplify DNA fragments using the polymerase chain reaction (PCR)
  - d) To measure the absorbance spectrum of chemical compounds
10. How can the integration of genome sequencers with bioinformatics tools enhance genomic data analysis?
- a) By increasing the speed of DNA sequencing reactions
  - b) By facilitating the storage and retrieval of large genomic datasets
  - c) By automating the process of DNA sample preparation
  - d) By enhancing the resolution of DNA sequencing results
11. In what way can an incubator be used to study the growth kinetics of microbial cultures?
- a) By maintaining a constant temperature and humidity level for optimal growth conditions
  - b) By measuring the optical density of bacterial cultures at regular intervals
  - c) By adjusting the pH of the growth medium to promote bacterial growth
  - d) By quantifying the expression levels of specific genes in response to environmental stimuli
12. What are the potential applications of genome sequencers in personalized medicine?
- a) By identifying genetic mutations associated with drug resistance in cancer patients
  - b) By analyzing the genetic predisposition to certain diseases in individuals
  - c) By predicting the efficacy of specific drugs based on an individual's genetic profile
  - d) All of the above
13. How does the principle of electrophoresis contribute to the separation of DNA fragments based on their size?
- a) By applying an electric field to the gel matrix, causing DNA molecules to migrate towards the positive electrode
  - b) By adding a tracking dye to the DNA samples, allowing visualization of the DNA bands under UV light
  - c) By adjusting the concentration of agarose in the gel to control the rate of DNA migration

- d) By incorporating intercalating agents into the gel matrix to enhance DNA binding
14. How can the accuracy and precision of ELISA results be affected by factors such as temperature and humidity fluctuations in the laboratory environment?
- a) By increasing the likelihood of nonspecific binding between antibodies and antigens
  - b) By altering the rate of enzyme-substrate reactions in the assay
  - c) By promoting the degradation of detection reagents over time
  - d) By reducing the reproducibility of results across different experimental runs
15. What does a spectrophotometer measure?
- a) Mass of samples
  - b) Light absorption or transmission of a sample
  - c) Electrical conductivity of a solution
  - d) Viscosity of a liquid
16. What is the main purpose of flow cytometry?
- a) Measure the rate of flow in a fluid
  - b) Analyze cells based on their size and shape
  - c) Count and analyze cells based on their fluorescence and light scattering properties
  - d) Determine the pH of a solution
17. Electrical impedance is commonly used in:
- a) DNA sequencing
  - b) Cell counting
  - c) Protein purification
  - d) Microbial culture
18. What is a microtome used for?
- a) Measure small volumes of liquid
  - b) Analyze protein structures
  - c) Cut thin sections of tissue for microscopic examination
  - d) Separate DNA fragments based on their size
19. What is mass spectrometry primarily used for:
- a) Counting cells
  - b) Measuring light absorption
  - c) Identifying and quantifying chemical compounds

d) Amplifying DNA fragments

20. Which of the following is NOT a component of a mass spectrometer?

- a) Ion source
- b) Detector
- c) Microscope

d) Mass analyzer

**SECTION B: SHORT ANSWER QUESTIONS (40 MARKS)**

- 1. Describe the procedure in polymerase chain reaction (5 marks)
- 2. Outline autoclave parts and components (5 marks)
- 3. Briefly describe types of centrifuge rotors (5 marks)
- 4. Describe the principle of gel electrophoresis (5 marks)
- 5. Highlight the components of a spectrophotometer (5 marks)
- 6. Outline the components of a light microscope (5 marks)
- 7. Distinguish between the forward and side scatter in flow cytometry (5 marks)
- 8. Write short notes on electrical impedance (5 marks)

**LONG ANSWER QUESTIONS – CHOOSE ANY TWO (20 MARKS)**

**QUESTION ONE**

- a) Describe the principles of mass spectrometry (8 marks)
- b) Describe the types of mass spectrometer (8 marks)
- c) Outline the components of a mass spectrometer (4 marks)

**QUESTION TWO**

- a) Describe the types of ELISA (8 marks)
- b) Describe the procedure for ELISA (7 marks)
- c) Outline the applications for ELISA (5 marks)

**QUESTION THREE**

Discuss the types of microtomes (20 marks)