WI-2-60-1-6

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS 2024/2025

END OF SEMESTER EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE IN MEDICINAL PHYTOCHEMISTRY

TPS 3103: INSTRUMENTAL METHODS OF ANALYSIS

DATE: DECEMBER 2024   TIME: 3 HOURS

QUESTION ONE (25 MARKS)

a) Highlight the principle of operation as a key aspect in instrumental methods of analysis   **8 Marks**

b) Summarize spectroscopy as a common method in instrumental methods of analysis   **8 Marks**

c) Discuss any three applications of instrumental methods of analysis in phytochemistry studies   **9 marks**

QUESTION TWO (25 MARKS)

a) Define the following terms   **3 marks**
   i. Detector
   ii. Transducer
   iii. Sensor

b) With an aid of a well labeled diagram, describe the basic components of analytical instrument   **6 marks**

c) Using a sketch, outline the flow of information in an analytical instrument during measurement   **10 marks**

d) Highlight the significance of signal to noise ratio in analytical instrumentation   **3 marks**

e) Explain any three strategies to improve signal to noise ratio   **3 marks**

QUESTION THREE (25 MARKS)

a) Define the following terms   **3 marks**

    i.   Galvanic cell

    ii.   Electrolytic cell

    iii. Liquid junction

b) Briefly explain the principle of cyclic Voltammetry   **6 marks**

c) Describe the significance cyclic Voltammetry in phytochemistry studies   **7 marks**

d) Describe the principle of operation of potentiometry. Include definition, electrodes, Nernst equation, measuring potential and calculation of the ion concentration   **6 marks**

e) Highlight the role of potentiometry in phytochemical research with respect to pH measurement, ion analysis and phytochemical characterization   **3 marks**

QUESTION FOUR (25 MARKS)

a) Compare and contrast TGA and DSC   **5 marks**

b) Explain differential thermal analysis (DTA) on relation to its definition, principle of operation, equipment set up and DTA curve interpretation   **10 marks**

c) Discuss the role of differential thermal analysis in phytochemistry   **10 marks**

QUESTION FIVE (25 MARKS)

a) Summarize five objectives of sample preparation in instrumental methods of analysis   **5 marks**

b) Outline the common steps involved in sample preparation   **7 marks**

c) Briefly explain the principle of operation of scanning electron microscope (SEM)   **7 marks**

d) Discuss the significance of SEM in phytochemical research.   **6 marks**

Limit your answers to investigation of plant interactions, nanoparticle analysis and study of biochemical distribution

QUESTION SIX (25 MARKS)

a) Explain why calibration is pivotal in instrumental methods of analysis   **3 marks**

b) A sample containing an unknown concentration of a metal ion is analyzed using the standard addition method. If 1.0 mL of a 10 µg/mL standard solution is added to 10.0 mL of the sample and the measured response increases from 0.2 to 0.6 units, calculate the concentration of the metal ion in the original sample.   **5 marks**

c) Propose five strategies that you can employ in detecting occurrence of systematic errors in instrumental methods   **5 marks**

d) A researcher analyzed the concentration of a specific phytochemical in five different samples (in mg/g). The recorded concentrations are as follows:

Sample 1: 15.2
Sample 2: 22.5
Sample 3: 10.3
Sample 4: 7.4
Sample 5: 12.1

Using this data, calculate the following statistical measures:

Mean	**1 mark**
Median	**1 mark**
Range	**1 mark**
Average Deviation	**2 marks**
Relative Average Deviation (as a percentage)	**2 marks**
Standard Deviation	**5 marks**

Moderated: