JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCES)

3ʳᵈ YEAR SECOND SEMESTER 2022/2023 ACADEMIC YEAR

MAIN REGULAR

COURSE CODE: SPB 9303

COURSE TITLE: METHODS OF CHEMICAL ANALYSIS

EXAM VENUE: **DATE:**

TIME: **EXAM SESSION:**

STREAM:

INSTRUCTIONS:

1. **Answer question 1 (Compulsory) in section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

SECTION A

Question 1 (30 Marks)

Question 1 (30 Marks)

a. Describe three properties of electromagnetic radiation (3 Marks)
b. Derive beer lamberts law (6 Marks)
c. Explain the importance of beer lamberts law (1 Marks)
d. A 7.25×10^{-5} M solution of potassium permanganate has a transmittance of 44.1% when measured in a 2.10 cm cell at a wavelength of 525 nm. Calculate;
   (i) the absorbance of this solution (2 marks)

   (ii) the molar absorptivity of $KMnO_4$ (2 marks)

e) Substances A and B have retention times of 16.40 and 17.63 min, respectively, on a 30.0-cm column. An unretained species passes through the column in 1.30 min. The peak widths (at base) for A and B are 1.11 and 1.21 min, respectively. Calculate
   (i)   the column resolution (2 marks)
   (ii)   the average number of plates in the column (2 marks)
   (iii)   the plate height (2 marks)
   (iv)   the length of column required to achieve a resolution of 1.5 (2 marks)

v) the time required to elute substance B on the column that gives an *R*s value of 1.5. (2 marks)

   e. Describe the six types of photon transducers used in the UV/Vis region (6 marks).

SECTION B

Question 2 (20 marks)

   a. Describe suitable sources for ultraviolet (UV)/visible (vis), infra red (IR) and atomic absorption (AA) instruments (6 marks)
   b. Calculate;
      i)   the wavenumber of a beam of infrared radiation with a wavelength of 5.00 μm (2 marks).
      ii)   Calculate the energy in joules of one photon of radiation with the above wavelength (2 marks).
   c. Using a well labelled block diagram, discuss in detail the various components of a a mass spectrometer (10 marks).

Question 3 (20 marks)

   a. Describe the various types of wavelength selectors in the UV/Vis region (6 marks)
   b. Using a well labelled diagram, describe the various types of electronic transitions (8 Marks)
   c. Using a well labelled block diagram, discuss the various components of a typical gas chromatography instrument. (6 marks)

Question 4 (20 marks)

   a. Describe the principle of operation
      i.   Microwave Plasma Atomic Emission Spectroscopy (5 marks)
      ii.   Inductively Coupled Plasma Optical Emission Spectroscopy (5 marks)
   b. Describe the various Mass Analyzers for Mass Spectrometry (10 marks)

Question 5 (20 marks)

   a. Explain how a chromopore differs from auxochrome (2 marks)
   b. Explain how conjugation affects the intensity of the absorption band (2 marks)
   c. Explain the terms Hypsochromic shift and Bathochromic shift. What structural features may lead to these shifts in organic molecules (2 marks)
   d. Explain the effect of polar solvent on $\pi - \pi^*$ and $n - \pi^*$ transition (2 marks)
   e. How can 1,3 pentadiene and 1,4 pentadiene be distinguished by UV spectroscopy (2 marks)
   f. Using a well labelled block diagram, discuss in detail the various components of a typical HPLC instrument. (10 marks)