



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

**A. M. E. C. E. A**

**MAIN EXAMINATION**

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**JANUARY – APRIL 2014 TRIMESTER**

**FACULTY OF SCIENCE**

**DEPARTMENT OF NATURAL SCIENCE**

**REGULAR PROGRAMME**

**CHEM 408: ANALYTICAL CHEMISTRY II**

**Date: APRIL 2014**

**Duration: 2 Hours**

**INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions**

- Q1. a) An instrument is a device that communicates to the analyst.
- i) Name any **TWO** spectroscopic instruments.
  - ii) List and describe the role of each of the four fundamental components of an instrument. **(10 marks)**
- b) Separation of sample components by chromatograph is enabled depending on the kind of mode. Support this statement using partition and exclusion modes of chromatography. **(8 marks)**
- c) Describe the following terms or processes as used in analytical chemistry:
- i) Chemical analysis
  - ii) Isotope dilution analysis
  - iii) Physical interferences
  - iv) Elution
  - v) Spin lattice relaxation
  - vi) Photoelectric effect **(12 marks)**
- Q2. a) For each of the following, state any **TWO**:
- i) Features of capillary columns
  - ii) Information that is obtained from a chromatogram

- iii) Factors affecting thermal analysis
- iv) Disadvantages of a photocell
- v) Types of interferences in spectroscopic instruments
- vi) Ionization sources in mass spectroscopy (MS)
- vii) Safety precautions of handling a cell. **(14 marks)**

b) Why would an analyst perform the following:

- i) Choose a suitable solvent for UV-Vis analysis.
- ii) Expose the nuclei to a magnetic field in NMR.
- iii) Aspirate a solution in an AAS machine. **(6 marks)**

Q3. a) Explain the working principle of the following detectors or devices:

- i) Electron capture detector
- ii) UV detector
- iii) Monochromator **(9 marks)**

b) Sketch and clearly label the parts of the following detectors or devices:

- i) Flame ionization detector
- ii) Splitless injector port
- iii) Nebulizer **(9 marks)**

c) Name **TWO** techniques that would be used in measuring the physical properties of a compound as a function of temperature. **(2 marks)**

Q4. a) What is the main difference between the following:

- i) Spectrum in IR and UV spectroscopy.
- ii) Source of radiation in absorption and emission techniques
- iii) Instrumental components of MS and other spectroscopic techniques.
- iv) Gradient and isocratic elution.
- v) Line and a continuous source. **(10 mark)**

b) HPLC is a useful separation technique:

- i) Outline the instrumental components of this machine (use a block diagram).
- ii) Name **TWO** factors that would be considered during method development in HPLC analysis

- iii) State **ONE** advantage of HPLC over GLC.
- iv) List an application of this technique. **(10 marks)**

Q5. a) List any **TWO** for each of the following:

- i) Conditions that would cause excitation of molecules.
- ii) Advantages of gratings.
- iii) Factors that determine the variability of components of instruments.
- iv) Advantages of a photomultiplier tube.
- v) Steps that lead to production of atoms in a flame. **(10 marks)**

b) Discuss the timing of beams in both single and double beam designs of instruments (use diagrams where appropriate). **(10 marks)**

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