CRAWFORD UNIVERSITY
COLLEGE OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF PHYSICAL AND EARTH SCIENCES
(INDUSTRIAL CHEMISTRY UNIT)
HARMATTAN SEMESTER EXAMINATIONS 2016/2017 SESSION

COURSE CODE: CHM 449
COURSE TITLE: INSTRUMENTAL METHODS OF ANALYSIS **UNITS: 3**
TIME ALLOWED: 2 ½ HOURS
DATE: FEBRUARY, 2017

INSTRUCTION: ATTEMPT ONLY FOUR QUESTIONS

1. (a) Differentiate between classical and instrumental methods of analysis.
   (b) Distinguish between the terms 'precision and accuracy' as applied in chemical analysis.
   (c) (i) Show that for a radioactive decay of an isotope that is a first order process,

$$\ln \frac{[A_o]}{[A]} = \lambda t$$

   (ii) If the half-life of element $^{210}_{84}Pb$ with activity 0.25 mCi is 13.5 years, calculate its activity after 25 years of disintegration.

2. (a) (i) State Lambert's law as applied to colorimetry and visible spectroscopy.
   (ii) Mention the deviation from the Beer-Lambert's law with reason(s).
   (b) Explain briefly the following colorimetric methods:
   (i) Dilution method
   (ii) Balancing method
   (iii) Photoelectric photometer method
   (iv) Spectrophotometric method
   (c) List two applications of Visible Spectroscopy.

3. (a) The modern High-Performance Liquid Chromatography (HPLC) enables liquid chromatography to be more transformed into a versatile technique, which in some respects proved to be more versatile than Gas Chromatography (GC). List seven (7) features of HPLC that enhance its versatility.
   (b) (i) Write briefly on the choice of mobile phase in HPLC.
   (ii) If HPLC is coupled with graphite furnace atomic absorption spectroscopy (GFAAS), mention the sample the instrument can be used to analyze.

(c) State four (4) factors on which the partition ratio depends in Gas Chromatography (GC).

4. (a) Draw a schematic lay-out of a single beam Infrared Spectroscopy.
   (b) List at least eight (8) applications of Ultraviolet Spectroscopy.
   (c) Enumerate five factors that affect thermal method of analysis.

5. (a) Distinguish between Atomic Absorption Spectrophotometry (AAS) and Flame Emission Spectrophotometry (FES).
   (b) In the determination of sodium ion in potato chips using a sodium ion selective electrode, potassium ion is usually present in the sample:
      (i) State what potassium ion is called in the sample to be analyzed and the effects of its presence on such analysis.
      (ii) Mention with reasons the appropriate method that can be used to determine the concentration of sodium ion in the chips in the presence of potassium ion.
   (c) List four methods for monitoring enzymatic reactions.

6. (a) (i) State the most important parameter to be controlled to ensure precision when using Flow Injection Analyzer.
      (ii) One of the major benefits of continuous flow analysis as compared with other types of automated chemical system is its capability of performing online sample pretreatment. List five most important treatments that can be performed in such a way.
   (b) (i) Draw the diagram of a Coolidge Tube used in X-ray analysis.
      (ii) Mention three techniques used in X-ray methods of analysis.