COURSE CODE: CHM306
COURSE TITLE: **INSTRUMENTAL METHODS OF ANALYSIS**
TIME: **2 HOURS**
INSTRUCTION: Answer question one and any other three questions.

QUESTION ONE

1(a) (i) What is spectroscopy and what is the major difference between absorption and emission spectroscopy   (3 marks)

(ii)What are the three basic components of the internal energy of a body at a temperature below 1000 K?

                                                                                         (3 marks)

(iii)   State three consequences of interaction of radiation with matter that is related to changes in energy levels and those that are related to changes in bulk properties of a material

                                                                                         (3 marks)

(1b) State two objectives of studying fluorescence   (2 marks)

(1ci) Write short note on the operational procedure of an NMR spectrometer

                                                                                         (5 marks)

1cii) List two Application of NMR   (2 marks)

1d. What molecules are likely to possess the following given vibration and group frequency

   (i)   C-Hstretch (2800- 3000 cm^{-1})
   (ii)   O-Hstretch (3200-3600 cm^{-1})

(iii)   N-Hstretch (3300—3500 cm^{-1})

(iv)   C—Ostretch (1700—1725 cm^{-1})

(v)   C=Cstretch ($1620 – 1680$ cm^{-1})

(7marks)

QUESTION TWO

(2a) State beer's law of spectroscopy and derive the mathematical equation associated with the law. Define all terms in the derived equation hence, relate the expression to absorbance

(5 marks)

(2b) State Lambert's law of spectroscopy and derive the mathematical equation associated with the law. Define all terms in the derived equation hence, relate the expression to absorbance

(5 marks)

(2c) Derive expression for Beer-lambert's law and state the limitation of the two laws and how the limitations can be overcome. What is calibration curve.

(5 marks)

QUESTION THREE

(3ai)What is infra red spectroscopy   (2 marks)

(3aii) Highlight the three different kinetic energies every molecule possess. What is the total energy?

(3 marks)

(3b)   If a molecule contains N number of atom, derive an expression for calculating the theoretical number of fundamental vibrations for linear and nonlinear molecules

(3 marks)

(3ci)   Calculate the theoretical number of fundamental bands expected for ethyl methyl ketone (CH_3-CH_2-CO-CH_3) and carbon (IV) oxide (CO_2)

(5 marks)

(v) Why is it not possible to detect all theoretical fundamental bands in an experimental infra red spectrum   (2 marks)

QUESTION FOUR

(4a) What is X-ray and X-ray diffraction? Hence what is the condition for diffraction with respect to wave length ?

(5 marks)

(4b) Write the Bragg equation and hence calculate the spacing distance (for a first order reflection) when X-rays of wavelength 1.54×10^{-8} m passed through sodium chloride such that an intense cone is formed at $\theta = 15.87^0$.

(4 marks)

(4c)   State two major applications of X-ray diffraction techniques   **(2 marks)**

(4d)   Highlight the basic magnetic properties requirement underlining the application of nuclear magnetic resonance as an analytical method

(4 marks)

QUESTION FIVE

(5ai) What is spectrophotometry and spectrophotometer?   (3 marks)

(5aii) What are the different optical and electronic principles employed for different region of electromagnetic spectrum during spectrophometric study   (1 mark)

(5bi)Highlight five essential components of a spectrophotometer   (5 marks)

(5bii)   Draw a label schematic diagram of a typical spectrophotometer   (4 marks)

(5biii)   What are the sources of ultra violet and visible radiation in a spectrophotometer   (2 marks)