**COURSE TITLE: INSTRUMENTAL ANALYSIS II**

**COURSE CODE:** Chem2052

**CREDIT HOURS: 3**

**CONTACT HOURS: 3 LEC. HR/WEEK**

**PREREQUISITE:** Chem2051

**Course Description**

Introduction to the subject matter; analytical methods based on the interaction of electromagnetic radiation with matter; atomic absorption and emission spectroscopy; instrumentation for spectroscopy; ultraviolet and visible spectroscopy; infrared; nuclear magnetic resonance; fluorescence; phosphorescence.

**Learning Outcomes**

By the end of this course students should be able to:

* + Describe the theory behind techniques of spectrochemical analysis.
	+ Describe different types of analysis for the estimation of the concentration of an unknown solution
	+ Identify different parts of selected instruments, draw block diagrams for different instruments and describe their respective functions.
	+ Define Possible terms used in the analysis such as resolution, spectroscopy, absorption and emission of EMR;
	+ Describe the underlying principles of pectral analysis.
	+ Discuss the qualitative and quantitative applications of different spectral analysis
	+ Elucidate structure of compounds from spectra by using data from joint spectroscopic techniques;

**Course outline:**

1. Introduction to Spectroscopy

 1.1 Electromagnetic Radiation and its interaction with matter

 1.2 Electromagnetic radiation and its quantum mechanical property

 1.3 Absorption and Emission of Radiation

 1.4 The electromagnetic spectrum

2. Absorption Laws (Quantitative Analysis)

 2.1 Lambert-Beer's Law

 2.2 Deviation from Beer's Law

 2.3 Errors associated with Beer's Law

3. Instruments for optical spectroscopy

 3.1 Components of optical instruments

 3.1.1 Source of Radiation

 3.1.2 Wave-length selectors

 3.1.3 Sample containers

 3.1.4 Radiation Detectors

 3.1.5 Read out detectors and signal amplification systems

 3.2 Optical systems used in spectroscopy: Single beam versus double beam

4. Atomic Absorption and emission spectroscopy

 4.1 Principles

 4.2 Instrumentation

 4.3 Analytical Applications

5. Ultraviolet and Visible (UV-Vis) Spectroscopy

 5.1 Introduction

 5.2 Basic Principles

 5.3 Absorption characteristics of some chromopores

 5.4 Instrumentation

 5.5 Application

6. Infrared Spectroscopy

 6.1 Introduction

 6.2 Energy levels in vibrating and rotating molecules

 6.3 Characteristic vibrational frequencies

 6.4 Factors affecting group frequencies

 6.5 Instrumentation

 6.6 Interpretation of some spectra

7. Nuclear Magnetic Resonance Spectroscopy (NMR)

 7.1 Basic principle of NMR

 7.2 NMR spectrometers

 7.3 Proton NMR

 7.4 C–13 NMR

 7.5 Interpretation of NMR spectra

8. Mass Spectrometry

* 1. Basic principle of MS
	2. Instrumentation- the mass spectrometer
	3. Interpretation of mass spectra

9. Structure elucidations by joint application of different spectroscopic methods: UV, IR, NMR

 and mass spectrometry.

**Reference materials:**

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Principles of Instrumental Analysis, 7 th Ed. Cengage Learning, 2018.
2. J.W. Robinson, Undergraduate Instrumental Analysis, 5th ed, Marcel Dekkers Inc. 1995
3. D.A. F. Rouessac and A. Rouessac, Chemical Analysis; Modern Instrumentation Methods and Techniques, 6th Edition, John Willey & sons Ltd, 2007
4. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, McGraw Hill, 1994.
5. R.M. Silverstein, G.C. Bassler and T.C. Morril, Spectrometric Identification of Organic Compounds, 5th ed., John Willey and sons, 1991.
6. J. Hollas, Modern Spectroscopy, 3rd Ed. John Willey and sons, 1996.
7. L.D. Field, S. Sternhell and S. Kalman, Organic structure from spectra, 2nd ed., John Willey and sons, 1995.
8. D.H. Williams and I. Fleming, Spectroscopic method in organic chemistry, 5th ed. McGraw Hill, 1995.
9. H. Gunter, NMR Spectroscopy, 2nd ed., John Willey and sons, 1995.
10. J.R. Chapman, Organic Mass Spectrometry, 2nd ed.; John Willey and Sons, 1993.