BACHELORS WITH CHEMISTRY AS MAJOR

8th SEMESTER

CHM822J3: CHEMISTRY _ INSTRUMENTAL METHODS IN CHEMISTRY

CREDITS: THEORY-4, TUTORIALS-2

THEORY (4 CREDITS: 60 HOURS)

COURSE OBJECTIVES:

- *To introduce students to some common instrumental methods used in analytical investigations in chemistry.*
- *To introduce the basic concepts of chromatography and various chromatographic methods used in chemistry laboratories.*
- *To introduce some basic construction and working of diffractometer.*
- *To introduce the basic concepts of various Thermal methods and microscopic techniques with their use in chemical investigations.*

LEARNING OUTCOMES:

- *Students shall learn the basic concepts of chromatography and various chromatographic techniques.*
- *Students shall learn how chromatography can be used for analytical investigations*
- *Students will learn the basic concepts of atomic/absorption spectroscopy and X-ray diffraction methods and their use for chemical analysis.*
- *Students shall learn about different microscopic and thermal techniques to appreciate the power of these techniques for material characterization.*

UNIT 1. CHROMATOGRAPHIC METHODS (15 HOURS)

Basic principles of chromatography, types of chromatography.

Gas-Liquid chromatography: Principle, columns and stationary phase, resolution and instrumentation.

HPLC: Theory, column efficiency, extra column and band broadening, temperature effects and diffusion. Chiral chromatography, chiral stationary phases. Applications of HPLC.

Ion exchange and size exclusion chromatography: Principle, mechanism of separation and applications. Elementary concepts of ion exchange chromatography, size exclusion chromatography, affinity chromatography, chiral chromatography, super-critical fluid chromatography, planer chromatography.

UNIT II. ATOMIC AND MOLECULAR ABSORPTION SPECTROSCOPY (15 HOURS)

Basic principles of atomic spectroscopy, origin of atomic spectroscopy, production of atoms and ions, atomic emission/absorption spectrometry, atomic fluorescence spectrometry, atomic mass spectrometry. Molecular absorption spectrometry, UV/Visible molecular absorption spectroscopy, IR -absorption spectroscopy, Molecular fluorescence spectroscopy, theory of molecular fluorescence, instrumentation, application of fluorescence methods. Instrumentation - single beam and double beam spectrophotometer; fluorimeter – construction, principle and working.

UNIT III.X-RAY DIFFRACTION METHODS (15 HOURS)

Generation of X-rays, X-ray diffraction (XRD), Laue method, Rotating crystal method and Powder method, Applications: determination of grain size/crystallite size using X-ray line broadening studies (Scherrer's formula), Determination of crystallite size distribution using X-ray line shape analysis, X-ray diffractometer (construction and working).

UNIT IV. THERMALAND MICROSCOPIC METHODS (15 HOURS)

Thermal methods: TGA, DTA and DSC – Principles and applications.

Electron Microscopic Techniques: Principles of electron microscopy, Scanning Electron Microscopy (SEM), Strengths and limitations of electron microscopy, Transmission Electron Microscopy (TEM), and Atomic Force Microscopy (AFM). General construction of the electron microscope.

SUGGESTED READINGS/ TEXT/REFERENCES

1. Fundamental of light microscopy and electronic imaging, D.B. Murphy, Wiley-Liss, 2001.
2. Microstructural Characterization of Materials – D. Brandon and W.D. Kaplan, John Wiley and Sons. 3. Scanning Electron Microscopy & X-Ray Microanalysis, J. Goldstein et.al, Springer, 2003.
3. Materials Characterisation Techniques, S. Zhang, Lin Li and Ashok Kumar, CRC Press, 2009.
4. X-ray Structure Determination- A Practical Guide by G. H. Stout and H. L. Jensen, MacMillan.
5. Contemporary Crystallography, M. J. Buerger, McGraw-Hill, N.Y. 1970.
6. Crystal Structure Analysis- A Primer J. P. Glusker and K. N. Trueblood, OUP, N.Y. 1985.
7. Instrumental methods of analysis Willard, Merrit and Dean.
8. Instrumental approach to chemical analysis: A. K. Srivastava and P. C. Jain: S. Chand
9. Fundamentals of Analytical Chemistry by Skoog, West, Holler and Crouch.

TUTORIALS (2 CREDITS: 60 HOURS)

1. Use given GC/MS data to identify drug metabolite in blood.
2. Utilize given IR, AAS, and fluorescence data to identify the organic functionalities and probes.
3. Use the given X-ray data to identify the crystallographic system.
4. Data interpretation of TEM micrograph.