

## CH-832 Advanced Techniques in Chemistry

**Credit Hours**                      3-0

**Prerequisites**                      Nil

### **Course Objectives:**

This course aims to familiarize students with the working principles and interpretation of results from a range of advanced analytical techniques, including UPLC, ICP-MS, XPS, Raman spectroscopy, XRD (powder and single crystal), fluorescence spectroscopy, TGA, impedance spectroscopy, cyclic voltammetry, and SEM-EDX. Students will develop a foundational understanding of how these techniques function and learn to analyze the data they produce critically. Emphasis will be placed on the practical applications of these tools in materials characterization, forensic investigations, and drug analysis. By the end of the course, students will be able to select and apply appropriate analytical techniques to specific research problems and interpret their outcomes with scientific accuracy.

### **Course Contents**

Brief introduction of working principle and results interpretation of Ultra-performance liquid chromatography, Inductively coupled plasma mass spectrometry, X-Ray Photoelectron Spectroscopy, High Throughput screening, Raman Spectroscopy, Powder and Single X-Ray Diffraction, Fluorescence Spectroscopy, Thermogravimetric Analysis, Impedance Spectroscopy, Cyclic Voltammetry, Scanning Electron Microscopy and Energy-dispersive X-ray spectroscopy (SEM-EDX). Their applications in Materials Science, Forensic and Drugs analysis.

### **Course Outcomes**

Upon successful completion of this course, students will be able to explain the fundamental working principles of a range of advanced analytical techniques such as UPLC, ICP-MS, XPS, Raman spectroscopy, XRD, SEM-EDX, and others. They will gain the ability to interpret experimental results accurately and understand the strengths and limitations of each method. Students will be equipped to select suitable analytical tools for specific applications in materials science, forensic investigations, and pharmaceutical analysis.

Additionally, they will develop the competence to critically evaluate analytical data and apply these techniques effectively in research and industrial settings.

### **Recommended Books**

1. Williams, D. B. & Carter C. B. (2009), *Transmission electron Microscopy: a textbook for materials science*, (2<sup>nd</sup> ed.). ISBN 9780387765006.
2. Girão, A. V., Caputo, G., Ferro. M. C. (2017). *Chapter 6 - Application of Scanning Electron Microscopy–Energy Dispersive X-Ray Spectroscopy (SEM-EDS)*, *Comprehensive Analytical Chemistry*, 153-168.
3. Stuart, B. H. (2013). *Forensic Analytical Techniques*, John Wiley & Sons Ltd. ISBN: 9780470687284.
4. Heid, P. V. D. (2012). *X-ray Photoelectron Spectroscopy: An Introduction to Principles and Practices*. John Wiley & Sons. ISBN 978-1-118-06253-1.
5. Monk, P. (2001). *Fundamentals of Electroanalytical Chemistry*. (1<sup>st</sup> ed.) John-Wiley & Sons Ltd, England. ISBN: 9780470511329.
6. Clegg. W. (2015) *X-Ray Crystallography*, (2<sup>nd</sup> ed.) Oxford primer series, ISBN: 9780198700975.
7. Smith. E. & Dent. Geoffrey. (2005) *Modern Raman Spectroscopy-A Practical Approach*, John Wiley & Sons Ltd. ISBN 0-471-49794-0.
8. Current Literature and Reviews.