

CHE410 ANALYTICAL CHEMISTRY**Credits: 4****COURSE OUTCOMES**

- CO1:** Demonstrate understanding of sampling and sample preparation techniques in chemical analysis, including methods such as liquid-liquid extraction and solvent extraction.
- CO2:** Apply spectrophotometric principles, including calibration and operation of spectrophotometers, for accurate quantitative analysis.
- CO3:** Explain the principles of fluorescence and phosphorescence and their applications in chemical and biochemical analysis.
- CO4:** Utilize various methods to measure equilibrium constants and analyze complex mixtures, enhancing problem-solving skills in quantitative analysis.
- CO5:** Understand the principles of environmental chemistry, focusing on water and soil chemistry, and evaluate the toxicity and impact of pollutants.
- CO6:** Integrate analytical techniques with environmental monitoring to assess and address chemical contamination and pollution control.

Unit: 1 Sampling and Sample Preparation Techniques

- Sampling and sample preparation, general steps in chemical analysis, Liquid-liquid extraction/solvent extraction-partition coefficient, distribution ratio and percent extraction.
- Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter current distribution, Cloud point extraction, Accelerated and Microwave assisted extraction, protein precipitation and solid phase extraction (SPE), Hybrid SPE and solid phase micro extraction (SPME)

Unit 2 Spectrophotometry

- Properties of light, absorption of light, interaction of light with matter and origin of spectra, The spectrophotometer- calibration, sources of light, monochromators and detectors.
- Beer's law in chemical analysis, photometric accuracy- Ringbom Plot, derivative spectrophotometry (first and second order), optical rotatory dispersion and circular dichroism.
- Analysis of mixture resolved and unresolved spectra, measurement of equilibrium constant: Scatchard Plot; Stoichiometry-method of continuous variation- the Jobs plot, Photometric titrations.

Unit 3 Fluorescence and Phosphorescence Spectrometry

- Introduction, physical and chemical principles, relaxation processes, Jablonski diagram, fluorescence, phosphorescence and structure, quantum yield, effect of structural rigidity, temperature, concentration and solvents, instrumentation, interferences (additive and multiplicative) and application for quantitative measurements.

Unit 4 Environmental Analytical Chemistry

- Chemical Speciation and toxicity of particulate, gaseous and soluble pollutants, remedial measures, and methods to control industrial air pollution.

- **Water Chemistry:** Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation and filtration.
- **Soil Chemistry:** Inorganic and organic components of soil, Nitrogen pathways and NPK in soils.
- **Toxic Chemicals in the environment:** Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, PAN Pesticides and Insecticides

Reference Books

1. Analytical Chemistry, Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.
2. Principles of Instrumental Analysis, Douglas A. Skoog, 3rd Edition, Holt-Saunders International Edition
3. Introductory 1. "Quantitative Chemical Analysis" by Daniel C. Harris, 7th Edition,
4. W.H. Freeman and Company, New York, 2007.
5. "Modern Analytical Chemistry" by David Harvey, McGraw Hill, New York, 2001.