Paper Name : Analytical Chemistry (Theory)	Course Code : CH 404
Credits : 04	Learning Hours : 60

The objectives of standard operating procedures (SoP) for selective instruments are multifaceted. Firstly, they aim to ensure thorough comprehension and proficiency in the operation and calibration of a diverse array of analytical instruments, ranging from pH meters and conductometers to UV-Vis spectrophotometers and chromatography systems. This includes understanding the underlying principles of each instrument's operation and mastering calibration techniques to ensure accurate measurements. Secondly, the objectives involve providing comprehensive training in advanced analytical techniques such as thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and chromatography, enabling individuals to effectively analyse and characterize a wide range of materials. Additionally, the SoP aims to cultivate expertise in performing various chemical analyses, such as acid-base titrations and pH measurements, and understanding the principles behind these techniques, ensuring accurate and reliable results. Furthermore, the objectives encompass promoting adherence to quality control protocols and method validation procedures to maintain the integrity and reliability of analytical data. Ultimately, the SoP aims to equip individuals with the skills, knowledge, and best practices necessary to conduct precise and reliable analytical work across various scientific disciplines.

By the end of the course, the students will be able to:

- Understand proficiency in operating a diverse range of analytical instruments, including pH meters, conductometers, spectrophotometers, and chromatography systems, ensuring accurate measurements and reliable data collection.
- Acquire advanced skills in sophisticated analytical techniques such as thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and chromatography, enabling precise analysis and characterization of various materials with accuracy and reliability.
- Develop proficiency in performing chemical analyses such as acid-base titrations and pH measurements, understanding the underlying principles of these techniques and producing high-quality analytical results that meet rigorous standards of accuracy and reliability.
- Understand the quality control protocols and method validation procedures will ensure the integrity and validity of analytical data, enhancing the overall reliability and

trustworthiness of scientific findings.

- ❖ Understand the implementation of standard operating procedures (SoP) for selective instruments, individuals will be empowered to conduct precise, reliable, and impactful analytical work across a wide range of scientific disciplines, contributing to advancements in research, development, and innovation.

DETAILED SYLLABUS

Unit 1 **Standard Operating Procedures (SoP) of selective instruments (14 Marks)**

- pH meter
- Turbidometer
- Conductometer
- Potentiometer
- Flame Photometer
- Colourimeter
- UV-Vis Spectrophotometer
- Water bath
- Hot Air Oven
- M.P. Apparatus
- Magnetic Stirrer
- Centrigue
- Weighing Balance

Unit 2 **Basics of Electroanalytical Techniques (14 Marks)**

- **Polarography**
  - Principle, apparatus and electrodes systems, components of limiting current, residual current, migration current, diffusion current, catalytic current, convention current, adsorption current and kinetic current.

- Polarographic maxima, half-wave potential, derivation of relationship between half wave potential and diffusion coefficients, fractions governing diffusion current.
- Calibration curve method, standard addition method, effect of pH on polarography and applications.

- **Amperometry**
  - Principle, apparatus, and electrode system. Four different types of amperometric titrations, advantages, and disadvantages of amperometry.
  - Applications of amperometry.
- **pH metry**
  - Introduction, construction and working of different electrodes, Ion selective electrodes.
  - Applications of pH measurements, acid-base titrations, polybasic acid-base titrations, determination of dissociation constant of weak acids and weak bases.
  - Determination of hydrolysis constant and degree of hydrolysis.

Unit 3 **Thermal Methods** **(14 Marks)**

- Thermogravimetry analysis: Principle, construction and working of thermobalance, factors affecting TGA, Applications of TGA.
- Differential thermal analysis and differential scanning calorimetry: Principle,
- Instrumentation, factors affecting analysis and applications.
- Thermo mechanical analysis [TMA].
- Instrumentation and application, thermometric titrations.

Unit 4 **Chromatographic Methods** **(14 Marks)**

- Principles of chromatography, classification of chromatographic techniques based on mechanism of retention, configuration, mobile and stationary phase.

- Efficiency of separation- plate theory (theoretical plate concept) and rate theory (Van Deemter equation).
- Principles and applications of Paper chromatography, Gas chromatography, thin layer chromatography, HPTLC,
- Ion exchange chromatography. Counter-current chromatography for isolation of natural products.
- Detectors involved in chromatographic techniques.

References

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,

   W.H. Freeman and Company, New York, 2007.
4. "Modern Analytical Chemistry" by David Harvey, McGraw Hill, New York, 2001.