CHE-371-VSC-P: APPLIED ANALYTICAL CHEMISTRY

Course Type: VSC **Credits: 2**

A. Course Objectives:

1. To introduce the principles and applications of spectroscopic, colorimetric, and electrochemical analytical techniques.
2. To develop skills in qualitative and quantitative chemical analysis used in pharmaceutical, forensic, food, and environmental laboratories.
3. To provide hands-on training in method development, validation, and instrumental analysis for chemical investigations.
4. To familiarize students with forensic chemistry techniques for identification and analysis of toxic substances and evidence materials.
5. To enhance practical knowledge of analytical methods used in agricultural, pharmaceutical, and industrial sample analysis.
6. To inculcate scientific reasoning, laboratory safety, data interpretation, and analytical report writing skills.

B. Course Outcomes (COs):

CO No.	Course Outcome Statement (COs) *After learning the course, the students are able to -*
CO-1	Recall principles and procedures of analytical techniques.
CO-2	Explain the working and applications of analytical methods.
CO-3	Apply analytical and instrumental techniques for sample analysis.
CO-4	Analyze experimental and instrumental data for interpretation of results.
CO-5	Evaluate accuracy and applicability of analytical methods.
CO-6	Design and perform analytical procedures using suitable techniques.

C. Contents:

Prerequisites
Students should have basic knowledge of analytical chemistry, qualitative and quantitative chemical analysis, stoichiometry, and laboratory safety practices. Familiarity with handling laboratory instruments, preparation of standard solutions, titration techniques, and basic spectroscopic concepts is desirable.
A minimum of 12 experiments are to be completed.
Part-I: Investigative Approach in Colorimetry

Experiment-1 and 2: Colorimetry: Development of green chemistry method of estimation of Fe(III) using tea extract / salicylic acid / 5-sulfosalicylic acid. a) determine best pH for estimation b) linearity range c) Molar absorbance d) detection limit e) estimation of iron from blade sample using developed method. [J. of Chemical Education: https://pubs.acs.org/doi/10.1021/acs.jchemed.9b00530]
[http://www.kinetics.nsc.ru/comp/comp2016/Pozdnyakov4.pdf;

Experiment-3 and 4: Development of method for estimation of Mn(II) using form-aldoxime method. a) determine best pH for estimation b) linearity range c) Molar absorbance d) detection limit e) estimation of Mn from Mn-steel sample using developed method. (https://pdf.benchchem.com/1209/Application_Notes_Formaldoxime_Colorimetric_Method_for_Manganese_Determination_in_Water.pdf); 10.1016/S0003-2670(00)88510-4

Part-II: Application of Qualitative Analysis in Forensic and Pharmaceutical Industry

Experiment-5-6: Identification tests and Limit test of iron, heavy metal, barium, carbonate, chloride, sulfate and nitrate in Dibasic calcium phosphate / Dextrose (glucose) or any other pharmaceutical as raw material in pharmaceutical industry. (Ref-1)

Experiment-7: Forensic Investigation - Qualitative and Confirmatory Tests for poisons (any ***four compounds*** from the least given in book): Test for aniline / para aminophenol, Test for antimony (No C.T.), Test for Borate (use talcum powder), Chlorate, Dinitrophenol pesticides, Ethanol / methanol, Formaldehyde, peroxides, Hypochlorites, Iodates, Nitrate / nitrite, Nitrobenzene, Oxalates; Paracetamol, Phenol, Salicylic acid its derivatives, Thiocynates (**Note:** Sample in the form of aqueous solutions shall be given containing slightly higher conc. of poison than prescribed conc. in monograph of the substance). (Ref-2). For the substance tested student should write toxicity effects. (Ref-2)

Experiment-8: Identification by IR spectroscopy a**) Pharmaceutical:** Use of IR spectroscopy for identification of pharmaceutical substance as per IP any of any four active pharmaceutical ingredients **b) Forensic Investigation**: Identification of fiber (Nylon, polyester, cotton) by IR spectroscopy for forensic investigation. (Ref.-1 and 3).

Part-III: Quantitative Analysis

Experiment-9: Determination of soil organic matter a) Determination of soil organic matter by loss on ignition b) Determination of easily oxidizable organic-C by Tinsley's wet combustion. (Ref-5).

Experiment-10: **Forensic quantitative analysis of nitrate**: Qualitative test of nitrate and its quantitative analysis by colorimetry. (Ref-2)

Experiment-11: **Quantitative separation and Analysis**: Analysis of Fe and Cr from blade sample (Fe-Gravimetric method Cr-volumetric method).

Experiment-12: Determination of Dextrose content DNA saline by Polarimetry and NaCl by Argentometric titration. (Ref-1)

Experiment-13: Determination of glucose content in three different glucose supplements by Volumetric method (Fehling Solution Method). (https://blamp.sites.truman.edu/files/2016/01/Fehling-final.pdf) (https://egyankosh.ac.in/bitstream/123456789/15896/1/Experiment-11)

Experiment-14: Determination of caffeine content in three different brands of tea powder by solvent extraction. (Ref-4)

Experiment-15: Determination of moisture (Loss on Drying), ash and sulfated ash in aspirin / instant coffee sample. (Ref-1 and 4)

Experiment-16: Determination of organic nitrogen by Kjeldahl's Method (ref-1) or Determination of organic plus ammonium-N by digestion and distillation

Experiment-17: Determination of effective cation exchange capacity (ECEC) (Ref-5)

Experiment-18: Visit to Forensic Laboratory or Pharmaceutical industry / Food Industry

References:

1. Basics of Analytical Toxicology, World Health Organization, Geneva, 1995.
2. Basic Principles of Forensic Chemistry, JaVed I. Khan • Thomas J. Kennedy Donnell R. Christian, Jr., Humana Press
3. FSSAI Manual for analysis of Coffee/Chicori/etc.
4. Methods in Agricultural Chemical Analysis A Practical Handbook; N.T. Faithfull, CABI Publishin