BACHELORS WITH CHEMISTRY AS MAJOR
4th SEMESTER
CHM422J1 CHEMISTRY _ CONCEPTS IN ANALYTICAL CHEMISTRY

CREDITS: THEORY-3, PRACTICAL-1

Theory (3 credits: 45 Hours) **Max. Marks**: 75, **Min Marks:** 27

Course Objectives:

As the course is introductory the students will study and appreciate the new methods of separation and analyses, besides learning about reporting the data with accuracy and precision. The students will also learn about quantitative methods (gravimetery, titrimetry and column chromatography) and qualitative methods (paper and thin layer chromatography) of estimation.

Learning outcomes:

After completing this course, the student is expected to learn the following

- *Analytical chemistry and its significance and scope.*
- *About significant figures and errors, essential for reporting data/results in scientifically correct way.*
- *Different types of separation methods and their scope and limitations.*
- *Theory of gravimetry and titrimetry, which are important component of their laboratory courses*
- *Different methods of chromatography, its working and scope.*

Unit-I: Basic Concepts of Chemical Analysis (15 Hours)

Analytical Chemistry: Introduction. Qualitative and quantitative analyses. Stages and methods of analyses.

Chemometrics*:* Errors, Accuracy, Precision, Significant Figures, Mean and Standard Deviation, Tests of significance (t-test and F-test)

Separation methods*:* Precipitation: Fractional Precipitation, Effect of Acids, Temperature and Solvent on Precipitate Solubility. Partition Coefficient, Solvent Extraction.

Complexation as a Separation Method. Electrophoresis, Dialysis, Electrodialysis and Crystallization (theory and significance).

Unit-II Gravimetric and Titrimetric Analysis (15 Hours)

Gravimetry: Introduction and Principle. Precipitation Reagents and Methods. Essence of Essential Steps: Concentration, Super-saturation, Precipitation, Co-precipitation, Post-precipitation, Digestion, Washing and Filtration. Gravimetric calculations.

Complexometric Titrations. Introduction, EDTA: Structure, Standardization and Solution Chemistry and its Speciation Diagram. Metal ion Indicators: Structures and Working. Titration Curves. Mixture Titrations: Masking and Demasking. Back Titration.

Precipitation Titrations. Principle and applications.

Unit-III Chromatography-Analytical Aspects. (15 Hours)

Chromatography: Introduction, Classification, Types and Principles. Stationary Phases and Mobile Phases.

Liquid Chromatography: Differential Migration, Nature of Partition Forces, Partition, Resolution (R_f factor), Column: Packing, Length and Diameter. Band Broadening and Tailing. Column Efficiency. Plate Theory: Theoretical Plates and Height of Plates.

Thin Layer, Paper and Gas Chromatography: Principle and applications.

Practical (1 credits: 30 Hours) **Max. Marks**: 25, **Min Marks:** 9

Part A. Volumetric Analyses

1. Determination of Hardness of water by EDTA titration method.
2. Determination of acetic acid concentrations in commercial vinegar using NaOH.

Part B: Gravimetric estimations

1. Estimation of Nickel as $[Ni(dmg)_2]$.
2. Estimation of Barium as $BaSO_4$

Part B: Chromatography

1. Identification of components of binary mixture of organic compounds using TLC.
2. Comparative mobile phase composition for binary mixture analysis of cations using ascending paper chromatography.

Books Recommended:

1. Vogel's text book of Quantitative Inorganic Analysis (revised); Bassett, J., Denney, R.C., Jeffery, G. H and Mendham, J.; 6th ed.; ELBS; 2007.
2. Experimental Inorganic Chemistry; Palmer, W.G.; Cambridge.
3. Analytical Chemistry; Gary D-Christian; 6th ed.; Wiley; 2008.
4. *Vogel's Qualitative Inorganic Analysis;* Svehla, G.; Pearson Education; 2012.
5. *Vogel's Quantitative Chemical Analysis;* Mendham, J.; Pearson; 2009.
6. Vogel's book of Practical Organic Chemistry; Furniss, B.S., Hannaford, A.J.; Rogers, V.; Smith P.W.G.; 5th ed.; ELBS; 2009.
7. Molecular Spectroscopy; 2ndedn; J L. McHale; CRC Press 2015.
8. Introduction of Spectroscopy; 4thedn.; D.L. Pavia, G. M. Lampman, G. S. Kriz, J. Vyvan; Cengage Learning, 2008
9. Physical Methods for Chemists; R. S. Drago; 2nd edn; Saunders; 1992. 7. Fundamentals of Molecular Spectroscopy; C. N. Banwell, E. M. Mc Cash; 4th edn; Tata Mc Graw Hill; 1994.
10. Fundamentals of Analytical Chemistry; 6 th Indian Reprint; D. A. Skoog and D.M. West; Cenage Learning; 2012.