Name of the Programme: M. Sc -I (Analytical Chemistry)

Course Code: CHA-501 **Title of the course:** Chemical methods of analysis

Number of Credits: 04

Effective from AY: 2022-23

Prerequisites for the course:	Students should have studied analytical chemistry courses at M.Sc. Chemistry in semester I	
Course Objectives:	1. Introduction to the various chemical method of analysis, details of underlying principle of chemical methods, advantages and limitations 2. Application of chemical methods for qualitative and quantitative analysis	
Content	**1. Acid-Base Titrations** a. Standard acids and Base solutions, b. Theory of acid-base indicators for Acid-Base titrations i. Colour change and range of indicator ii. Selection of proper indicator iii. Indicator errors c. Neutralization curves for strong acid-strong base; weak acid-strong base and weak base-strong acid weak acid-weak base titrations d. Polyfunctional acids and bases; titration curves for poly functional acids and bases; titration curves for amphiprotic species e. Determining the equivalence point; feasibility of acid - base titrations; magnitude of the equilibrium constant; effect of concentration f. Typical applications of acid-base titrations	No of hours 10
	2. Complexometric titrations a. The complex formation reactions; Stability of complexes; stepwise formation constants b. Organic complexing agents; amino carboxylic acid titration c. EDTA; acidic properties of EDTA; EDTA complexes with metal ions; equilibrium calculations involving EDTA in solution; condition of formation constants d. EDTA titration curves; effect of other complexing agents on EDTA; factors affecting the titration curves; completeness of reaction e. Indicators for EDTA titrations; Theory of common indicators f. Titration methods using EDTA- direct titration; back titration and displacement titration; indirect determinations; titration of mixtures; selectivity, masking and damasking agents g. Applications of EDTA titrations- hardness of water; magnesium and Al in antacids; magnesium, manganese and zinc in a mixture.	8
	3. Precipitation titrations	

	a. Introduction to precipitation titrations; feasibility of precipitation titrations b. Titration curves i. Effect of titrant and analyte concentration on titration curves ii. Effect of reaction completeness on titration curves iii. Titration curves for mixture of anions c. Indicators for precipitation titrations d. The Volhard, the Mohr's and the Fajan's methods e. Titration of sulfate with barium	6
	4. Basic concepts in Electrochemical Titrations a. Faradic and non-Faradic currents b. Reversible and irreversible cells c. EMF series; standard electrode potential; Nernst equation; calculation of cell potential; effect of current; ohmic potential; polarization; decomposition potential; over voltage; concentration polarization; mechanism of mass transport. d. Introduction to potentiometric methods	4
	5. Redox and potentiometric titrations a. Redox Titrations: Equilibrium constants for redox reactions- electrode potentials in equilibrium systems; calculation of equilibrium constants b. Redox titration curves- formal redox potentials; derivation of titration curves c. Factors affecting the shape of titration curves concentration; completeness of reaction; titration of mixtures- feasibility of redox titrations d. Detection of end point and redox indicators i. Structural aspect of redox indicators ii. Specific and nonspecific indicators iii. Choice of indicator iv. Potentiometric end point detection e. Sample preparation: pre-reduction and pre-oxidation f. Potentiometric titrations	8
	6. Gravimetric analysis a. Introduction to gravimetric method of analysis b. Properties of precipitates and precipitating reagents i. Completeness of precipitates ii. Super saturation and precipitate formation iii. Particle size and filterability of precipitates c. Colloidal precipitates and crystalline precipitates d. Purity of the precipitate; coprecipitation, post precipitation; conditions for precipitation. e. Fractional precipitation; precipitation from homogenous solution;	6

	f. Organic reagent as precipitants-dimethyl glyoxime, oxine, cupferron, salicylaldoxime g. Washing of precipitates; drying and ignition of precipitates; calculation of results from gravimetric data; h. Applications of gravimetric method	
	7. Clinical methods of analysis a. Composition of Blood; Collection and Preservation of Samples; b. Immunoassay: Radioimmunoassay; its principle and applications; instrumentation for radio bioassay c. Clinical application of the radioimmunoassay of insulin, estrogen and progesterone; receptor techniques of breast cancer d. Enzyme- linked immunosorbent assay; principles; practical aspects; applications e. Blood gas analyzer f. Trace elements in the body	10
	8. Environmental Sampling and Analysis a. Acquiring meaningful Sample b. Air Sample Collection and Analysis c. Water Sample Collection and Analysis d. Soil and Sediment Sampling e. Sample Preparation for Trace Organics f. Methods and Performance-Based Analyses	8
Pedagogy:	Mainly lectures and tutorials. Seminars / term papers /assignments / presentations / self-study or a combination of some of these can also be used. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.	
References / Readings:	1. G. D. Christian, Analytical Chemistry, 6th Ed., John Wiley, New York, 2004. 2. D. A. Skoog, D. M. West & F. J. Holler, Fundamentals of Analytical Chemistry, 9th Ed., Sounders College publishing, 2014. 3. J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, Vogel's Textbook of Quantitative Inorganic Analysis, 6th Ed., Pearson Education Asia, 2000. 4. D. Harvey, Modern analytical chemistry, 1st Ed., The McGraw-Hill, 2000. 5. G. H. Jeffery, J. Bassett, J. Mendham, R C. Denney, Vogel's Text Book of Quantitative Chemical Analysis, 5th Ed., John Wiley, New York, 1989.	
Course outcomes:	1. Students will be able to explain the basic principle and chemistry behind different conventional method of analysis. 2. Students will know the limitation of method of analysis and will be in a position to choose an appropriate chemical method for particular analysis. 3. Students will understand the various types of titration techniques. 4. Students will understand and will be able to apply various sampling techniques.	