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

Course Code: CHA-502 **Title of the course:** Techniques in Analytical Chemistry - II

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 Objective:	1. Provide understanding of the principle of optical analytical techniques like Nephelometry, Turbidimetry, and Polarimetry. 2. Introduce the principles and applications of Absorption and Emission spectroscopic techniques. 3. Develop concepts in various Electroanalytical techniques such as pH-metry, conductometry and Karl Fischer titration. 4. Acquaint the students to the basic principles of Radioanalytical techniques and solvent extraction techniques.	
Content:	**1. Optical analytical techniques** a. Nephelometry and Turbidimetry: Introduction to principle, instrumentation and application of nephelometry, turbidimetry. Factors affecting measurement; comparison between nephelometry, turbidimetry, colorimetry and fluorimetry; applications of nephelometry and turbidimetry. b. Polarimetry: Introduction, principle and Instrumentation of Polarimetry; application of optical rotation method in rate constant determination; acid- catalysed mutarotation of glucose; inversion of cane sugar. Introduction to terms such as optical rotatory dispersion (ORD), cotton effect curves, circular dichroism, octant rule for ketones.	No of hours 15
	2. Introduction to Absorption and Emission Techniques Introduction, principles and applications of atomic absorption Spectroscopy (AAS) Atomic Emission spectroscopy (AES), and Flame Emission spectroscopy (FES). Excitation techniques, electrodes and their shapes, Quantitative and qualitative application, brief introduction to ICP-MS, ICP-OES	5
	3. Electroanalytical techniques a. Brief introduction to electroanalytical techniques. Voltammetry and polarography, cyclic voltammetry, coulometry, controlled potential coulometry and coulometric titrations, Stripping voltammetry, ion-selective electrodes and sensors; Evaluation and Calculation; Application to Inorganic and Organic Trace analysis b. Introduction to Ion selective electrodes; construction, application and selectivity coefficient of Ion selective	15

	electrode; pH measurement; buffer solution; glass electrode; instrument for pH measurement. c. Basic aspects of conductometric titration; types of conductometric titration; advantages and disadvantages of conductometric titration; Introduction; theory; instrumentation; advantages, disadvantages and applications of High frequency titrations.	
	4. Karl Fischer Titration Introduction, theory, instrumentation, advantages and disadvantages Karl Fischer reagent, determination of water content in industrial samples.	5
	5. Radioanalytical techniques Theory and principles of radio analytical technique, detection of nuclear radiation, radiation detectors, pulse height analysis, counting error, analytical application of radioisotopes, neutron activation analysis and isotope dilution analysis.	8
	6. Introduction to Extraction Techniques a. Liquid-liquid extraction/solvent extraction: partition coefficient, distribution ratio and percent extraction, choice of solvents, Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution. b. Introduction to green analytical extraction methods: Supercritical Fluid Extraction, Pressurized Liquid Extraction, Ultrasound assisted Extraction, Microwave assisted Extraction, Enzyme assisted Extraction, Solid phase microextraction, Solid Phase Extraction.	12
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.; Wiley, 2004. 2. D. A. Skoog, D. M. West, F. J. Hollar, S. R. Crouch; Fundamentals of Analytical Chemistry, 9th Ed.; Cengage Learning, 2014. 3. F. J. Holler, D. A. Skoog, S. R. Crouch, Principles of Instrumental Analysis, 6th Ed.; Thomson Books, 2007. 4. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, B. Sivasankar, Vogel's Text Book of Quantitative Chemical Analysis, 6th Ed.; Pearson, 2009. 5. H. H. Willard, L. L. Merritt, J. A. Dean, F.A. Settle, Instrumental Methods of Analysis, 7th Ed.; CBS Publishing, 1988. 6. J. H. Kennedy, Analytical Chemistry: Principles, 2nd Ed.; Saunders College Publishing, 1990. 7. G. W. Ewing, Instrumental Methods of Chemical Analysis, 5th Ed.; McGraw-Hill, 1985.	

	8. R. A. Day, A. L. Underwood, Quantitative Analysis, 6th Ed.; Prentice Hall, 2001. 9. B. K. Sharma, Instrumental methods of chemical analysis, Goel Publishing House, Meerut, 2004. 10. R. D. Braun, Introduction to Instrumental analysis, Pharma Med Press, 2012. 11. G. R. Chatwal, S. K. Anand, Instrumental Methods of Chemical Analysis, 5th Ed.; Himalaya publishing House, 2019. 12. H. Gunzler, A. Williams, Handbook of Analytical Techniques, 1st Ed.; Wiley, 2001 13. M. A. Rostagno, J. M. Prado, Natural Product Extraction: Principles and Applications, RSC, 2013. 14. E. Scholz, Karl Fischer Titration: Determination of Water, Springer, 2011.
Course outcomes:	1. Students will be able to explain the principle of Nephelometry, Turbidimetry, and Polarimetry. 2. Students will be able to describe and differentiate between the absorption and emission techniques such as AAS, AES. 3. Students will be able to illustrate the principle of Electroanalytical techniques such as voltammetry, conductometry and Karl Fischer titration. 4. Students will be able to explain and apply the principles of Radioanalytical techniques and solvent extraction methods.