Programme: M. Sc. Part-I (Chemistry)

Course Code: ACO-401 **Title of the Course: Analytical Techniques**
Number of Credits: 03 **Effective from AY: 2018-19**

Prerequisites for the course:	Should have knowledge of basic analytical techniques such as chromatography, electro-analytical techniques and data handling.	
Course Objectives:	1. Introduction of various statistical approach used in analytical data handling 2. Introduction of different analytical techniques used for qualitative, quantitative estimation	
Course Outcomes:	3. Students should be in a position to understand principle behind different analytical techniques 4. With the knowledge basic techniques used for qualitative and quantitative estimation students should be in a position to choose for appropriate technique for particular analysis 5. Students should be in a position to select the separation techniques for purification of analytes.	
Content:	**Section A** **1 Analytical Objectives, Data Handling and Good Laboratory Practice (GLP)** Scope of analytical science and its literature, qualitative and quantitative analysis, ways to express accuracy and precision, types of errors and their causes; significant figures, control charts, confidence limit, test of significance, rejection of a result- the Q-test. Introduction to significant analytical procedure such as GLP- standard operating procedures, quality assurance, quality control and analytical method validation. **2 Sampling and Calibration Methods** Sampling and sample preparation, general steps in chemical analysis, calibration of glass wares. Finding the best straight line-least square regression, correlation coefficient; Calibration curves, standard addition technique and internal standards. Chemical concentrations. **3 Electroanalytical techniques** Introduction to electroanalytical techniques, electrochemical cells, electrode potentials, voltametry and polarography, cyclic voltametry, coulometry, controlled potential coulomety and coulometric titrations, Stripping voltammetry, ion-selective electrodes and sensors; Evaluation and Calculation; Application to Inorganic and Organic Trace analysis **Section B** **1. Extraction Techniques** ***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; Introduction to green analytical extraction methods:Supercritical Fluid Extraction (SFE); Pressurized Liquid Extraction (PLE); Ultrasound Assisted Extraction (UAE); Microwave Assisted Extraction (MAE);	7 hr 5 hr 6 hr 4 hr

	Enzyme Assisted Extraction (EAE); Solid Phase Microextraction (SPME); Solid Phase Extraction (SPE) **2. Basic Principles in Chromatographic Methods** 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, thin layer chromatography, HPTLC, Size exclusion and Ion exchange chromatography. Counter-current chromatography for isolation of natural products. **3. Gas and Liquid Chromatography** Introduction; Instrumental Modules; The Separation System; Choice of Conditions of Analysis; Sample Inlet Systems; Detectors; Practical Considerations in Qualitative and Quantitative Analysis; Coupled Systems-introduction to GCMS, LCMS; Applicability-interpretation and numerical problems; Recent and Future Developments **4.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.	4 hr 6 hr 4 hr
Pedagogy:	Mainly lectures & tutorials. Seminars / term papers /assignments / presentations/ self-study or a combination of some of these can also be used to some extent. Sessions shall be interactive in nature to enable peer group learning.	
References/ Readings	1. G.D. Christian, *Analytical Chemistry*, John Wiley New York (2004) 6th Edition 2. D.A. Skoog, D. M. West and F. J. Holler, *Fundamentals of Analytical Chemistry*, Sounders College publishing (2014), 9th Ed. 3. F. J. Holler, D. A. Skoog, S. R. Crouch, *Priniciples of Instrumental Analysis*, Thomson Books/Cole , 6thEd. 4. J. Mendham, R.C. Denney, J.D. Barnes and M. Thomas,*Vogel's Text Book of Quantitative Inorganic Analysis*, Pearson Education Asia 2000, 6th Ed. 6. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, *Instrumental Methods of Analysis*, CBS Publishing New Delhi, 7th Ed. 7. J.H. Kennedy, *Analytical Chemistry:Principles*, Saunders College Publishing 2ndEd. 8. G.W. Ewing, *Instrumental Methods of Chemical Analysis*, McGraw-Hill (Singapore), 5th Ed. 9. L.G.Hargis, *Analytical Chemistry: Principles and Techniques*, Prentice Hall, New Jersey (1988) 10. R. A. Day, Jr. and A. L. Underwood, *Quantitative Analysis*, Prentice Hall, 2001., 6thEd. 11. T. Rocha-Santos, A.C. Duarte, *Comprehensive Analytical Chemistry*, Elsevier, 2014, 1st Ed.	