NCY-202: MODERN ANALYTICAL TECHNIQUES

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OBJECTIVE:
The objective of this course is to make the students aware of the modern instrumental techniques, the principles underlying them and their applications in the characterization of materials.

Course outcome

On the successful completion of the course, students will be able to

CO1	Interpret Raman and IR–Spectra for characterization of materials.	Understand, Apply, Analyze
CO2	Interpret NMR, Mass and ESR–Spectra for characterization of materials.	Understand, Apply, Analyze
CO3	To analyze the conductivity to determine the concentration of solution and i-E characteristics of the samples.	Understand, Apply
CO4	Analytical separation carried out by Chromatography in a multi-component system.	Remember, Apply, Analyze
CO5	Elucidation of the Thermal Stability of different molecules and their Characterization on the basis oftheir thermal stability and Glass Transition Temperatureof Polymers. Determine the specific heat, heat ofreaction, Melting point & boiling point. Check thepurity of drugs, crystallization and fusion of polymeric materials.Basic Understanding of electron microscopy and X-ray methods.	Understand, Apply, Evaluate,Create
CO6	To develop experimental skills to perform, monitor and manipulate the reactions.	Understand, Evaluate, Analyze

Chemistry												
BCY252	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	-	1	-	-	-	-	3
CO2	3	3	2	3	2	-	1	-	-	-	-	3
CO3	3	3	2	3	2	-	1	-	-	-	-	3
CO4	3	3	2	3	2	-	1	-	-	-	-	3
CO5	3	3	2	3	2	-	1	-	-	-	-	3
CO6	3	3	3	3	2	2	2	2	1	2	-	3
Average	3	3	2.17	3	2	0.33	1.17	0.33	0.17	0.33	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

SYLLABUS

Module I

(i) ***Infrared Spectroscopy*****:** Principle, mechanics of measurements, Selection rules, fundamental vibration modes, Factors influencing the band position and intensities, some characteristic frequencies and co-relation of IR spectra with molecular structures (applications), effect of Hydrogen Bonding on vibrational frequencies.

(Lectures: 5-6)

(ii) ***Raman Spectroscopy*****:** Introduction theory of Raman Spectroscopy, Mechanism of Raman and Rayleigh scattering, Rule of Mutual Exclusion, correlation with the molecular structure, difference between Raman and IR spectra, Resonance Raman effect, Application of Raman Spectroscopy.

(Lecture 2-3)

(iii) ***Inductively coupled plasma-*** Introduction, Principle and applications of ICP-AES or OES.

(Lectures: 2-3)

Module II

(i) ***Nuclear Magnetic Resonance Spectroscopy*****:** Introduction, basic principles, mechanics of measurements, chemical shift, band multiplets, spin-spin splitting, shielding and deshielding effect, spin-spin coupling and coupling constant (J), some characteristics of NMR positions, Application in elucidation of molecular structure, , Elementary idea of NOE, DEPT NMR, C^{13} NMR, P^{31}NMR, F^{19}NMR.

(Lectures: 4-5)

(ii) ***Mass Spectroscopy*****:** Introduction, basic principles, instrumentation, fragmentation patterns, nitrogen rule, Mc Lafferty Rearrangement, interpretation of mass spectra and applications.

(Lectures: 3-4)

(iii) ***ESR* (*Electron Spin Resonance*) -** Basic Principles, Instrumentation and Applications.

(Lectures: 2-3)

Module III

(i) ***Potentiometry and Conductometry*****:** General principles, reference and indicator electrodes, potentiometric and conductometric titrations.

(Lectures: 3-4)

Polarography**:** Basic principle, dropping mercury electrode (DME), half wave potential, polarographic currents and applications.

(Lectures: 3-4)

Module IV

(i) ***Chromatographic methods***: Introduction to chromatographic methods: Paper, TLC, Column and Gas chromatography, Principles, Instrumentation, GC column, Detectors and stationary phases and applications, Hyphenated techniques (GC-MS). (Lectures: 4-5)

Liquid Chromatography LC/HPLC, Column efficiency in LC, Detectors, Instrumentation, Partition/Adsorption/Ion Exchange Chromatography and applications.

(Lectures: 4-5)

Module V

(i) ***Thermal Methods of Analysis*****:** Thermogravimetric analysis, differential thermal analysis and differential scanning calorimetry and applications. (Lectures: 4-5)

(ii)***Electron Microscopy:*** Introduction and Applications of Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM). (Lectures: 2-3)

(iii) ***X-ray methods:*** Introduction and applications of XRD. (Lectures: 2-3)

CHEMISTRY LAB

List of Experiments:

1. Estimation of vitamin C in commercial soft drink / Glucon D.
2. Determine the strength of oxalic acid conductometrically using sodium hydroxide solution.
3. Separation of amino acids by thin layer chromatography.
4. Determination of R_f value of Methyl Orange and Phenolphthalein using paper/ thin layer chromatography.
5. Separation of metal ions by paper chromatography.
6. Determine the adsorption isotherm of oxalic acid/acetic acid on activated charcoal and verify the Freundlich adsorption isotherm.
7. Determine the rate constant (K) of hydrolysis of ethyl acetate catalyzed by HCl.
8. Synthesis of p-nitro acetanilide from acetanilide and find its percentage yield.
9. Determine the viscosity and percentage composition of the given liquid using Ostwald's viscometer.
10. Determine the strength of given glucose solution by titration against Fehling's solution.
11. Determination of dissociation constant k for a weak acid using conductometry.
12. Separation of mixtures using column chromatography.
13. Estimation of Phosphoric acid from coca cola.
14. Preparation of picric acid (2,4,6-trinitrophenol) from phenol.

Reference Books:

1. Instrumental Analysis by Douglas A. Skoog, F. James Holler & Stanley R. Crouch.
2. Instrumental Methods Analysis, by B. K. Sharma.
3. Text book of Quantitative Inorganic Analysis, A. I. Vogel.
4. Elementary Organic Spectroscopy by Y.R. Sharma.
5. Engineering Chemistry by Shashi Chawla

Evaluation Scheme:

S. No.	Course Type	Subject Code	Course title	Credits	L T P	Sessional Marks				ESM	Total Marks
						MSE	TA	Lab	Total		
1	BSC	NCY 202	Modern Analytical Techniques	4	3 0 3	15	20	15	50	50	100