DEPARTMENT OF CHEMISTRY
SHRI G. S. INSTITUTE OF TECHNOLOGY AND SCIENCE, INDORE
COURSE COMPLETION UNIT PLAN
Course: M.Sc. (Applied Chemistry) Semester II
Paper: CH91206 Modern Analytical Methods
Name of Faculty: Dr. Urmila Raghuvanshi

Lecture No.	Brief description of Topic to be taught	Reference/Remarks
	Unit I **IR Spectroscopy and Raman Spectroscopy**	**Books** (1) Willard Merritt Dean & Settle, Instrumental Methods Of Chemical Analysis. (2) Banwell C.N., Mc Cash E.M., Fundamentals of Molecular Spectroscopy (McGraw Hill Education) (3) B.K. Sharma, Instrumental Methods of Chemical Analysis. (4)Vogel A.I., Quantitative Chemical Analysis. etc. (5)Silverstein R.M., Spectrometric Identification of Organic Compounds (J. Wiley & Sons, New York). (6) Kalsi P.S., Spectroscopy of Organic Compounds
1	Introduction and theory/principle of IR spectroscopy, Theory of molecular vibrations, types of vibrations,	
2	Theoretical and observed number of modes of fundamental vibrations, Numerical, Selection Rule, intensity of absorption bands, group frequencies.	
3	Instrumentation, sampling techniques, finger print regions, factors affecting group frequencies and band shapes, Vibrational & Rotational fine structures. Applications of IR spectroscopy	
4.	Spectral features of various classes of organic compounds, Introduction to Fourier transform IR spectroscopy.	
5.	Introduction, Quantum theory of Raman effect, theory of Raman spectra, Advantages of Raman spectroscopy over IR spectroscopy. Correlation between IR and Raman Spectra.	
6	Conditions for Raman spectroscopy, Characterstic parameters of Raman spectroscopy, Raman spectra of diatomic molecules and polyatomic molecules.	
7	Rotational-Vibrational Raman spectra, Rule of mutual exclusion principle, Structure elucidation by Raman spectroscopy.	
8	Factors affecting the choice between IR and Raman spectra. Instrumentation and Applications of Raman Spectroscopy.	
	Unit-II **NMR Spectroscopy**	
9	Introduction, theory of magnetic and nuclear resonance, Relaxation Process, Number of Signals in NMR,	
10	Instrumentation, sample handling, Internal Standards, Position of Signals, Chemical Shift.	
11	Shielding and deshielding effects, Factors influencing chemical shift, Peak area and proton counting.	
12	Coupling, spin-spin interactions, coupling constants, Geminal coupling, Vicinal coupling, lomg range coupling, splitting pattern, nature of coupling.	

13	Spin Decoupling, rules for predicting band multiplicities, Nuclear overhauser effect, shift reagents.	(7) Ewing G.W., Instrumental Methods of Chemical Analysis (8) Sharma Y.R., Elementary Organic Spectroscopy **Journals** 1. Concepts in Magnetic Resonance Part B: Magnetic Resonance Engineering 2. International Journal of Mass Spectrometry 3. Journal of Electron Spectroscopy and Related Phenomena 4. Journal of Molecular Spectroscopy **5.** Journal of Applied Spectroscopy
14	Important features of NMR , Applications-structure elucidation, qualitative and quantitative analysis, kinetic studies, property studies.	
15	NMR spectra of nuclei other than protons, ^{13}C, ^{31}P, and their applications.	
16	NMR spectra of nuclei other than protons ^{19}F &^{14}N, and their applications.	
	Unit III **Mass Spectroscopy and ESR Spectroscopy**	
17	Introduction, Basic principles involved in Mass spectroscopy, Theory of mass spectrometry.	
18	Parent ion or molecular ion, daughter ions, Instrumentation: Ion source, Mass analyser, Ion Detector.	
19	Mass spectrum, Important features of the parent ion peak, Determination of molecular formula.	
20	McLafferty Rearrangement, Metastable ions or peak and their formation, Nitrogen rule.	
21	General fragmentation modes: 1.Simple cleavage- Homolytic cleavage and Hetrolytic cleavage. 2. Retro Diel's-Alder reaction	
22	General fragmentation modes: 3. Hydrogen transfer rearrangements 4. McLafferty Rearrangement.	
23	Important features of mass spectroscopy, Study of Mass spectra of some molecules.	
24	Applications of mass spectrometry (EI- MAS, FAB, ESI)	
	Unit IV **ESR Spectroscopy and Laser Spectroscopy**	
25	Introduction, theory, Origin of ESR signals, intensity and width, position and multiplet structure of spectral lines.	
26	Hyperfine splitting, Selection rule, Hyerfine intearction,	
27	g value, factors affecting g value, Super hyperfine splitting, Zero field splitting and Kremer degeneracy.	
28	Instrumentation and applications of ESR.	
29	Introduction, Basic principle of LASER, Characterics of LASER.	
30	LASER and MASER compare and contrast, Stimulated absorption.	

31	Sponteous Emission and Stimulated Emission, Population inversion, Meta stable states.	
32	Instrumentation and applications of LASER.	
	Unit V **Atomic Spectroscopy**	
33	Introduction, Theory of atomic absorption spectroscopy (AAS)	
34	Instrumentation, general methodology of AAS, Preparation of samples,	
35	Applications of AAS in environmental science and engineering, analytical chemistry.	
36	Demonstration and partial hands on on AAS.	
37	Flame photometry: Introduction, Principle of flame photometry, Chemistry involves in flames	
38	Limitations of Flame photometry, Instrumentation, Effect of solvent in flame photometry.	
39	Flame photometry and AAS comparison. Interferences in Flame photometry.	
40	Applications of flame photometry.	