

INSTITUTE	FACULTY OF SCIENCE
PROGRAM	BACHELOR OF SCIENCE (CHEMISTRY)
SEMESTER	6
COURSE TITLE	ANALYTICAL SPECTROSCOPIC TECHNIQUES
COURSE CODE	02CY0354
COURSE CREDITS	6

Objective:

- 1 To study the characterization technique i.e. UV spectroscopy.
- 2 To make students capable of understanding IR spectroscopy.
- 3 To study the introduction, and principle of NMR spectroscopy.
- 4 To study the mass spectrometry.

Course Outcomes: After completion of this course, student will be able to:

- 1 Understand the concepts of analytical technique UV spectroscopy.
- 2 Obtain the information regarding the IR spectroscopy.
- 3 Be aware of the basics of NMR spectroscopy.
- 4 Understand the basic of Mass spectrometry and their uses in construction of the molecules.

Pre-requisite of course: Understand characterization of compounds

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
5	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	UV spectroscopy Introduction, Absorption law: Lambert's law and Beer's law, Lambert – Beer's law. Electromagnetic radiation, Wave length, Wave number, Frequency, Energy, Distribution of energy in atoms and molecules, Translational energy, Nuclear energy, Rotational energy, Vibrational energy, Electronic energy, Interaction of radiation with matter, Types of spectra, UV-Visible spectroscopy, Theory, Absorption bands, Types of electronic transition, Absorption shifts and intensity effects, UV absorption by some organic molecules, Applications, Numericals.	

Contents : Unit	Topics	Contact Hours
2	IR spectroscopy Introduction, Various types of energies (Translational energy, Rotational energy, Vibrational and electronic energy), Instrumentation of IR spectrophotometer, Normal modes of vibration (Stretching and bending vibrations), Coupled vibrations and Fermi resonance, Electronic effect, Intramolecular hydrogen bonding, intermolecular hydrogen bonding, Selection rule, Theory of IR absorption spectroscopy, Theory of vibrational rotational spectra, P-Q-R bands, Force constant, Franck-Condon principle, Vibrational coupling, Fermi resonance, Finger print region, Relation between frequency and bond in IR spectra, Numericals.	
3	NMR Spectroscopy Introduction, Principle, Nuclear quantum number, equivalence and nonequivalent protons with illustrations, Enantiomeric and Diastereomeric protons, shielding and de shielding proton, Chemical Shift, Paramagnetic anisotropic effect, Relative intensity of signals, Spin-spin coupling and coupling constant, Deuterium labelling, Numericals.	
4	Mass Spectrometry Introduction, Classification of spectroscopy origin and basic principles, Instrumentation, General Fragmentation modes, important features for mass spectra of alkanes. Numericals based on UV, IR, NMR and Mass spectral data for structure elucidation of organic molecules.	
Total Hours		

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiments Experiment - 1, Experiment - 2, Experiment - 3, Experiment - 4, Experiment - 5, Experiment - 6, Experiment - 7, Experiment - 8	
Total Hours		

Textbook :

- 1 A Textbook of Spectroscopy, M.S. Yadav, Anmol Publications Pvt Ltd, 2003
- 2 Spectra of atoms and molecules, Peter F. Bernath, Taylor & Francis, 2017

References:

- 1 Spectroscopy: Principles and instrumentation, Spectroscopy: Principles and instrumentation, Vitha, M. F., John Wiley & Sons, 2018
- 2 Chemical spectroscopy, Chemical spectroscopy, Brode, W. R., John Wiley & Sons, 1939
- 3 Introduction to spectroscopy, Introduction to spectroscopy, Pavia, D. L., Lampman, G. M., Kriz, G. S., & Vyvyan, J. A., Cengage learning, 2014

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

- 1 The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory
- 5 Use of hazardous/toxic chemicals should be avoided as far as possible in laboratory.
- 6 All students in the laboratory must wear safety goggles and lab coats during lab session.

Supplementary Resources:

- 1 <http://vlab.amrita.edu/index.php?sub=2>
- 2 <http://nptel.ac.in/course.php?disciplineId=104>
- 3 <http://ocw.mit.edu/courses/chemistry/>
- 4 http://www.vlab.co.in/ba_labs_all.php?id=9
- 5 <https://www.youtube.com/user/TMPChem>
- 6 <https://www.youtube.com/playlist?list=PL166048DD75B05C0D>
- 7 <https://www.youtube.com/channel/UCqk-dmk3AOfikaFDpsZorg>
- 8 <https://www.youtube.com/user/PradeepKshetrapal>