

CHE-353-MJ-T: ORGANIC CHEMISTRY III

Course Type: Major Theory

Credits: 2

A. Course Objectives:

1. To introduce fundamental principles and techniques of organic spectroscopy.
2. To develop understanding of UV, IR, and NMR spectroscopy for structural analysis.
3. To enable interpretation of spectral data for identification of organic compounds.
4. To study structure, synthesis, and significance of natural products.
5. To enhance analytical and problem-solving skills in organic chemistry

B. Course Outcomes (COs):

CO No.	Course Outcome Statement (COs) <i>After learning the course, the students are able to -</i>
CO-1	Recall the basic concepts of UV, IR, NMR spectroscopy and natural products.
CO-2	Explain principles of UV, IR, NMR spectroscopy and natural products.
CO-3	Solve problems based on UV, IR, and NMR spectral data.
CO-4	Analyze spectral data for structure determination of organic compounds.
CO-5	Justify structures of organic molecules using combined spectral evidence.
CO-6	Derive structures of organic compounds from spectral data.

C. Contents:

Prerequisites	
Basic knowledge of organic chemistry, functional groups, and chemical bonding is required. Familiarity with molecular structure will aid in understanding spectroscopy and natural products.	
Chapter 1: Introduction to Spectroscopy	02 Hours
Introduction and meaning of spectroscopy; types of spectroscopy; nature of electromagnetic radiation and regions of the electromagnetic spectrum; basic terms used in spectroscopy: wavelength, frequency, amplitude, wavenumber and energy; relationship between these terms and numerical conversions.	
Chapter 2: Ultraviolet and Visible Spectroscopy	04 Hours
Introduction; electromagnetic radiation; electronic transitions; λ_{max} and ϵ_{max} ; chromophores and auxochromes; bathochromic and hypsochromic shifts; applications of UV-Visible spectroscopy in organic molecules; Woodward-Fieser rules for calculation of λ_{max} of conjugated dienes and α,β -unsaturated compounds.	

Chapter 3: Infrared Spectroscopy	05 Hours
Introduction; types of molecular vibrations; functional group region and fingerprint region; application of IR spectroscopy in organic molecules; IR spectra of alkanes, alkenes and alcohols (intermolecular and intramolecular hydrogen bonding); aldehydes, ketones, carboxylic acids and their derivatives; factors affecting IR stretching frequencies, basic structural problems based on IR.	
Chapter 4: Proton Magnetic Resonance Spectroscopy	08 Hours
Introduction; principle of NMR; magnetic and non-magnetic nuclei; nuclear magnetic resonance; chemical shift; TMS as reference and its advantages; shielding and deshielding effects; peak area and integration; spin–spin coupling; coupling constant and J-value; basic structural problems based on PMR.	
Chapter 5: Combined Problems Based on UV, IR and PMR Spectroscopy	05 Hours
Interpretation of combined spectral data; structural elucidation of organic compounds using UV, IR and ^1H NMR spectra; practice problems.	
Chapter 6: Natural Products	06 Hours
Terpenoids: Isolation, Classification. Citral - structure determination using chemical and spectral methods, Synthesis of Citral by Barbier and Bouveault Synthesis. Alkaloids: Extraction, Purification, Some examples of alkaloids and their natural resources. Ephedrine - structure determination using chemical methods. Synthesis of Ephedrine by Nagai Synthesis	
References: 1. Spectroscopic Methods in Organic Chemistry – D. H. Williams & Ian Fleming, McGraw-Hill Education, 6th Edition, 2013. 2. Introduction to Spectroscopy – Donald L. Pavia, Gary M. Lampman, George S. Kriz & James R. Vyvyan, Cengage Learning, 5th Edition, 2015. 3. Organic Chemistry Through Spectroscopy – P. S. Kalsi, New Age International Publishers, 2nd Edition, 2007. 4. Organic Chemistry – R. T. Morrison & R. N. Boyd, Pearson Education, 7th Edition, 2010. 5. Organic Chemistry – T. W. Graham Solomons, Craig B. Fryhle & Scott A. Snyder, John Wiley & Sons, 12th Edition, 2016. 6. A Textbook of Organic Chemistry (Vol. I) – I. L. Finar, Pearson Education, 6th Edition, 2002.	

7. Natural Products: Their Chemistry and Biological Significance – J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe & J. B. Harborne, Longman Scientific & Technical, 2nd Edition, 1994.
8. Organic Chemistry of Natural Products – Gurdeep R. Chatwal, Himalaya Publishing House, Revised Edition, 2011.
9. Natural Products – O. P. Verma & Ashok Kumar, Vishal Publishing, Revised Edition, 2010.