Semester V

# CHEMISTRY-BCHC-51:GROUP –B (theory-ORGANIC CHEMISTRY) (3 Credits)

Credit 2 + 1 (Tutorial) : Lecture 30 +15

## Organic Spectroscopy: 20 Lectures

General principles Introduction to absorption and emission spectroscopy.

*UV Spectroscopy:* Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

*IR Spectroscopy:* Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

*NMR Spectroscopy:* Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.

Applications of IR, UV and NMR for identification of simple organic molecules.

Elementary idea on mass spectrometry.

## Dyes: 5 Lectures

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

## Polymers: 5 Lectures

Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index.

Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene);

Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

# Learning objectives

1. To make the students familiar with the basic principles of various spectroscopic techniques (UV,IR, NMR, and MS).

1. How to analyze NMR pulse sequences using this basic NMR theory
2. How to execute basic 1-dimentional proton and carbon experiments on a standard NMR spectrometer
3. How to interpret 1-dimentional NMR spectra from simple organic compounds
4. How to apply these spectroscopic techniques in the structure elucidation of organic compounds.
5. How to analyze experimental NMR, IR, UV, and MS spectra
6. To gain knowledge on the chemistry of dyes and synthetic polymers.

# Learning outcomes

At the end of the course, the students will be able to gain knowledge of how various spectroscopic techniques are used in Organic Chemistry. Students will be well conversant with the applications of spectroscopic techniques towards the determination of molecular structures. In summary, they will learn about how to solve chemical and structural problems in a systematic manner by applying these spectroscopic techniques. In addition they will get knowledge on dyes and polymers.

# Recommended Textbook

1. Pavia, D.L., Lampman, G.M., and Kriz, G.S., "Introduction to Spectroscopy"

2. Silverstein, R.M., and Webster, F.X., "Spectrometric Identification of Organic Compounds"

1. Kemp, W. "Organic Spectroscopy"
2. Kalsi, P.S., "Spectroscopy of Organic Compounds"