# CLUSTER UNIVERSITY, SRINAGAR

## SYLLABUS (FYUP UNDER NEP 2022)

## Offered by Department of Chemistry

## Semester 6th (Major Course)

## *Title: Selected Topics in Organic Chemistry*

**Course Code: UGCHM22J602** **Max. Marks:150**
**Credits: 6 (Theory: 4, Practical: 2)** **Theory External: 80; Min Marks: 32**
**Contact Hrs: 120 (Theory: 60, Practical: 60)** **Theory Internal (Continuous Assessment): 20 Marks, Min Marks: 08**
**Practical Experimental Basis = 30, Min. Marks: 12**
**Practical Experimental (Continuous assessment) = 20, Min. Marks: 08**

**Course Objectives:**

- Develop a comprehensive understanding of molecular rearrangements and their mechanisms.
- To understand the basics of the heterocyclic chemistry and at least one method of synthesis for each of the prominent heterocycles (Pyrrole, Furan, Thiophene, Pyridine and Quinones/Isoquinones)
- To develop the understanding of the spectroscopic techniques (Mass, UV-Vis, IR and NMR) used for the identification of organic compounds.

**Course Outcomes:** On completion of the course, the student should be able to:

- Understand the driving forces behind various types of rearrangements in organic reactions.
- Name monocyclic compounds containing one more (same or different) heteroatoms.
- Develop an understanding of the principles of various spectroscopic techniques used in organic chemistry
- Identify an unknown organic compound given it's spectroscopic data.

**Unit-I Molecular Rearrangements** **(15 Hrs.)**

Introduction, mechanism, stereochemical implications and applications of rearrangement reactions. Migration to Electron-Deficient Carbon: Wagner-Meerwein, Pinacol-Pinacolone and Semipinacol Rearrangements, Dienone-Phenol Rearrangements.
Migration to Electron-Deficient Nitrogen: Beckmann Rearrangement, Hofmann Degradation. Migration to Electron-Deficient Oxygen: The Baeyer-Villiger rearrangement Anionic Rearrangements: Benzil-Benzylic acid rearrangement.

**Unit-II Heterocyclic Compounds** **(15 Hrs.)**

Nomenclature of the monocyclic compounds with one and more than one heteroatom, handling the extra hydrogen. Structural features of pyrrolidine, pyrrole, furan, thiophene, pyridine, piperidine. Comparison of basicity and aromaticity of pyrrolidine, pyrrole, piperidine and pyridine Synthesis of Furan, Pyrrole and Thiophene (Pall-Knorr), Indole (Fischer), Pyridine (Hantzsch synthesis), Quinoline (Skraup synthesis) and Isoquinoline (Bischler-Napieralki).

**Unit-III UV-Visible and Infrared Spectroscopy** **(15 Hrs.)**

**UV-Vis Spectroscopy:** Introduction; types of electronic transitions. Chromophores and auxochromes; Bathochromic and Hypsochromic shifts; intensity of absorptions (Hyper-/Hypochromic effects). Application of Woodward's Rules for calculation of λmax for the following systems: conjugated diene, α,β-unsaturated aldehydes and ketones (alicyclic, homoannular and heteroannular); extended conjugated systems (dienes, aldehydes and ketones).
**IR Spectroscopy:** Introduction. Various modes of stretching and bending vibrations. Position of absorption bands: Hooke's law, force constant. Functional group and fingerprint region and their significance. Factors affecting stretching frequencies: effect of conjugation, electronic effects, bond multiplicity and H-bonding on IR absorptions. Characteristic absorptions of various functional groups

**Unit-IV NMR Spectroscopy** **(15 Hrs.)**

Introduction; nuclear spin; NMR active molecules; basic principles of Proton Magnetic Resonance; equivalent and non-equivalent protons. Chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons. Spin-spin coupling and coupling constant. Relative intensities of the

multiplets: Pascal's triangle. Chemical and magnetic equivalence in NMR. NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds (both aliphatic and benzenoid-aromatic compounds). Interpretation of NMR spectra of simple compounds (Ethanol, ethylacetate, acetone, acetaldehyde and toluene).

**Practical/LabCourse (2 Credits- 60 Hrs)**

*a)* Direct acylation method for the synthesis of paracetamol (involving the Beckman rearrangement).
*b)* Preparation of Aspirin.
*c)* Pinacol rearrangement involving benzaldehyde
*d)* Synthesis of Pyrrole using Pall-Knorr Synthesis.
*e)* A minimum of 04 exercises on the identification of an organic compound from its spectroscopic data.
*f)* A trip to a research institute for hands on training on handling the spectroscopic instruments.

**SUGGESTEDREADING:**


a) Basic principles of organic chemistry, 2nd Ed., 1977. John D. Roberts and M. C. Caserio
b) Organic chemistry, 2nd edition, Jonathan Clayden (OUP-2016).
c) Organic chemistry, Paula Y, Bruice (Pearson, New Age International Edition
d) Organic chemistry, 5 th Ed. Vol I & II, I.L.Finar (Persion, 2008)
e) Organic chemistry 8 th Ed. - F. A. Carey and Robert M. Giuliano (McGraw Hill-2012).
f) Organic chemistry, 5th Ed., John McMurry. (Brooks/Cole-2000).
g) Fundamentals of Organic Chemistry; Solomons and Fryhle ; 10th ed.; John-Wiley; 2012.
h) Reaction Mechanism in Organic Chemistry; Mukherji and Singh; 3rd ed.; Macmillan; 2007.
i) Introduction to spectroscopy, 4th or 5th Ed. Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James A. Vyvyan.
j) Organic spectroscopy by William Kemp
k) Spectrometric identification of organic compounds,7th Ed. R. M. Silverstein, F. X. Webster and D. J. Kiemle
l) Exercises should be devised on the data on the book by Silverstein or from SDBS (AIST Japan)
m) Fundamentals of Heterocyclic Chemistry, (2010) L. D Quin and J. A. Tyrell.
n) Heterocyclic chemistry, Malcolm Sansbury, RSC Publication.