# IV SEMESTER

## OC H 561: ORGANIC SYNTHETIC METHODS AND GREEN TECHNIQUES

**Course Outcomes**

Enable the students:

- To understand the synthetic design with diverse chemical reactions, planning of organic synthesis and functionality.
- To learn the principles and technologies used in disconnection approach, the utility of protecting group strategy in organic synthesis and retrosynthetic analysis.
- Students will acquire the knowledge of utilization of principles of green chemistry by the use of phase transfer catalysts, crown ethers and ionic liquids in organic synthesis.
- Students will gain knowledge on Sonochemical and Microwave induced organic reactions.
- Students will also learn to understand the preparation, properties and uses of polymer supported reagents in organic synthesis and mechanistic aspects of some multicomponent reactions.

**UNIT- I** **[12 Hours]**

**Synthetic Design:** Classification of carbon-carbon single bond and double bond forming reaction and their use in carbon skeleton ring formation. Ring forming and ring cleaving reactions, use of Thorpe condensation, Carbene insertion reaction, 1,3-dipolar addition and Ene reaction in ring formation.

**Planning of Organic Synthesis:** Selection of starting materials and key intermediates during the synthesis. Use of Robinson annulation, Dieckmann cyclisation, Arndt-Eistert synthesis, Diel's-Alder reaction in organic synthesis. Synthesis of Cubane and Iswarane.

**Functionality:** Synthesis of 6 and 7-methoxytetralones, biotin and penicillin-V with special reference to the introduction of functional groups.

**UNIT- II** **[12 Hours]**

General introduction to disconnection approach. Synthons and synthetic equivalents. Interconversion of functional groups. One group C-X and two group C-X disconnections. Use of C-C one group and C-C two group disconnections in the synthesis of 1,2; 1,3 and 1,5-difunctionalised compounds.

**Protecting groups:** Protection of hydroxyl, amino, carboxylic and carbonyl groups.

**Retrosynthetic analysis:** Analysis of alcohols, carbonyl compounds, benzocaine, *p*-methoxyacetophenone, 2-methyl-6-methoxy-indole-3-acetic acid, & 1-phenyl-4-*p*-methoxyphenyl-1,3-butadiene. Illustrative synthesis of Limonene, Benziodarone, Nitrofurazone, Warfarin, Juvabione and Longifolene.

**UNIT-III** **[12 Hours]**

**Green Chemistry:** Principles, planning a green synthesis in a chemical laboratory, Green preparation-Aqueous phase reactions, solid state (solventless) reactions, Phase transfer catalyst catalysed reactions-Quaternary ammonium salts-synthesis and applications in the alkylations, substitution reactions, esterifications, eliminations, condensations, oxidations and reductions; Crown ethers-Synthesis, applications in the alkylations, esterifications, saponifications, elimination reactions, superoxide anion and generation of carbenes.

**Sonochemistry:** Introduction, Phenomenon of cavitation, Sonochemical esterification, substitution, addition, oxidation, reduction and coupling reactions.

**Microwave induced organic synthesis:** Introduction, reaction vessel and reaction medium, atom efficiency, % atom utilisation, advantages, limitations and precautions. Applications in alkylation of active methylene compounds, N-alkylation, condensation of active methylene compounds with aldehydes, Diels-Alder reaction, Leuckardt reductive amination of ketones, ortho ester Claisen rearrangement.

**Ionic Liquids:** Introduction, properties, types, preparation, applications like Epoxidation, Alkene Metathesis, Oxidation, Reduction and Enzyme catalysed synthesis.

**UNIT-IV** **[12 Hours]**

**Polymer supported reagents in organic synthesis**: Introduction, properties of polymer support, advantages of polymer supported reagents and choice of polymers. Applications: Substrate covalently bound to the support, Synthesis of oligosachcharides, Dieckmann cyclisation. Preparation of polymer bound aldehyde and application in aldol and Wittig reactions. Synthesis of polystyryl boronic acid and use in diol protection reaction. Reagent linked to a polymeric material: Preparation of sulfonazide polymer and application in diazo transfer reaction. Synthesis of polymer bound per acid and its applications. Polymer supported catalytic reactions: Preparation of polymer supported $AlCl_3$ and application in etherification and acetal formation reactions.

**Multicomponent Reactions:** Studies on the mechanistic aspects and use of theUgi, Passerini,Biginelli, Hantzsch, Doebner-Miller, Jacobson, Barbier, Baylis-Hilmann and Mannich reactions.

**References**


1. Art in Organic Synthesis, Anand, Bindra & Ranganath, Wiley, (1970).
2. Organic Synthesis - A Disconnection Approach, S. Warren, P. Wyatt., Wiley (2008)
3. Advanced Organic Chemistry, Part A & B, F. A. Carrey & R. J. Sundberg, Plenum Press, (1990).
4. Modern Methods of Organic Synthesis, N. Carruthers, Cambridge University, (1996).
5. Selected Organic Synthesis, I. Fleming, John Wiley & Sons, (1973).
6. Organic Synthesis: Special Techniques, V. K. Ahluwalia and R. Aggarwal, Narosa,(2003).
7. Polymers as aids in Organic synthesis, N. K. Mathur, C. K. Narang and R. E. Williams, Academic Press, (1980).