**Department of Chemistry and Chemical Sciences**
**CENTRAL UNIVERSITY OF JAMMU**
**Rahya-Suchani (Bagla), District-Samba,**
**Jammu-181143, (J&K) India**

## Five-year Integrated M.Sc. Chemistry
## Teaching Plan (July 2019-Dec 2019)

Semester: VII
Course: Organic Reaction Mechanism and Stereochemistry (ICCHM7C002T)
Course Teacher: Dr. V. Sridharan

| Week | Lecture No./Day | Topic to be Taught | No of Hours | Suggested Readings |
|---|---|---|---|---|
| 1st Week | I | **Structure and bonding**: Bonding, Atomic and molecular orbitals | 1 | 1-5 |
| | II | Hybridization, Electronic structure of molecules | 1 | 1-5 |
| | III | Electronegativity, Dipole moment, Inductive and field effects | 1 | 1-5 |
| | IV | Bond distance, angle and energies, Cross conjugation, Resonance | 1 | 1-5 |
| 2nd Week | I | Hyperconjugation, Steric inhibition of resonance | 1 | 1-5 |
| | II | Tautomerism, Hydrogen bonding | 1 | 1-5 |
| | III | Acids and Bases, Factors affecting the strength of acids and bases | 1 | 1-5 |
| | IV | **Aromaticity**: Huckel's theory of aromaticity, Aromatic, antiaromatic and homoaromatic systems | 1 | 1-5 |
| 3rd Week | I | Cyclopentadienyl anion and cation, MO description | 1 | 1-5 |
| | II | Mobius twist and aromaticity, Heterocyclic aromatic systems | 1 | 1-5 |
| | III | Aromaticity of annulenes and heteroannulenes | 1 | 1-5 |
| | IV | Fullerenes and fused ring systems | 1 | 1-5 |
| 4th Week | I | **Reactive intermediates**: Carbocation, carbanion, radicals, carbenes and nitrenes: Generation, geometry, stability and reactivity | 1 | 2,3,10-12 |
| | II | Contd. | 1 | 2,3,10-12 |
| | III | Nucleophilicity, Heteroatom nucleophiles, Solvent effects | 1 | 2,3,10-12 |
| | IV | Alkene nucleophiles, α-Effect | 1 | 2,3,10-12 |
| 5th Week | I | Ambident nucleophiles: Thiocyanate, cyanide, nitrite and nitronium ions, Enolate ions, Allyl anions | 1 | 2,3 |
| | II | Electrophilicity: Trigonal electrophiles, Tetrahedral electrophiles, Hard and soft electrophiles | 1 | 2,3 |
| | III | Ambient electrophiles: Aromatic and aliphatic electrophiles | 1 | 2,3 |
| | IV | **Mechanistic aspects**: Transition state theory, Intermediate, Transition state, Reaction coordinate diagram | 1 | 1-3 |
| 6th Week | I | Linear free energy relationships, Quantitative correlation of substituent effects on reactivity, | 1 | 1-3 |

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| | | Hammett and Taft equations | | |
| | II | Microscopic reversibility, Kinetic versus thermodynamic control | 1 | 1-3 |
| | III | Hammond postulate, Curtin-Hammett principle | 1 | 1-3 |
| | IV | Isotope effects, Cross over experiments | 1 | 1-3 |
| 7th Week | I | **Stereochemistry:** Optical activity and chirality | 1 | 13-15 |
| | II | Stereochemistry of molecules with more than one asymmetric carbon (up to five) | 1 | 13-15 |
| | III | Homotopic and heterotopic ligands and faces, Heterotopicity, Enantiotopic and diastereotopic atoms, groups and faces | 1 | 13-15 |
| | IV | Contd. | 1 | 13-15 |
| 8th Week | I | Contd. | 1 | 13-15 |
| | II | Stereotopic ligands and NMR spectroscopy | 1 | 13-15 |
| | III | Prochiral centers: Chiral methyl, phosphate, sulphate and thiophosphate groups | 1 | 13-15 |
| | IV | Contd. | 1 | 13-15 |
| 9th Week | I | Contd. | 1 | 13-15 |
| | II | Chirality of molecules devoid of chiral centers: Biphenyls | 1 | 13-15 |
| | III | Allenes and spiranes | 1 | 13-15 |
| | IV | Molecules with planar chirality | 1 | 13-15 |
| 10th Week | I | **Conformational analysis:** Conformational analysis of acyclic and cyclic compounds | 1 | 13-15 |
| | II | Contd. | 1 | 13-15 |
| | III | Effect of conformation on reactivity in acyclic compounds and cyclohexanes: Stereoelectronic and steric factors | 1 | 13-15 |
| | IV | Contd. | 1 | 13-15 |
| 11th Week | I | Oxidation of cyclohexanol, Esterification of cyclohexane carboxylic acid | 1 | 13-15 |
| | II | Solvolysis of tosylates, E2 and *cis* eliminations | 1 | 13-15 |
| | III | Formation and cleavage of epoxide ring, Neighboring group participation | 1 | 13-15 |
| | IV | Molecular rearrangements | 1 | 13-15 |
| 12th Week | I | Conformation of cyclohexene and cyclohexanone | 1 | 13-15 |
| | II | Conformation and stereochemistry of *cis*- and *trans*-decalins and 9-methyl decalin | 1 | 13-15 |
| | III | Conformation of perhydrophenanthrene and perhydroanthracene | 1 | 13-15 |
| | IV | Contd. | 1 | 13-15 |
| 13th Week | I | **Asymmetric synthesis:** Principles of asymmetric synthesis | 1 | 13,14,16-21 |
| | II | Stereospecific and stereoselective reactions, Enantioselectivity and diastereoselectivity | 1 | 13,14,16-21 |
| | III | Strategies for asymmetric synthesis | 1 | 13,14,16- |

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| | IV | Analytical methods for determining enantiomeric excess | 1 | 13,14,16-21 |
| 14th Week | I | Resolving agents and resolution of racemic compounds having common functional groups such as alcohol, amine and acid | 1 | 13,14,16-21 |
| | II | Contd. | 1 | 13,14,16-21 |
| | III | Sharpless epoxidation, symmetric dihydroxylation | 1 | 13,14,16-21 |
| | IV | Asymmetric Diels-Alder reactions | 1 | 13,14,16-21 |
| 15th Week | I | Chiral borane reagents | 1 | 13,14,16-21 |
| | II | Asymmetric reductions of prochiral carbonyl compounds and olefins | 1 | 13,14,16-21 |
| | III | Contd. | 1 | 13,14,16-21 |
| | IV | Revision of Units I and II | 1 | |
| 16th Week | I | Revision of Units III and IV | 1 | |
| | II | Revision of Unit V | 1 | |
| | III | Discussion of model question papers | 1 | |
| | IV | Discussion of model question papers | 1 | |

**REFERENCES**

1. M. B. Smith and J. March, *March's Advanced Organic Chemistry*, 6th Ed., Wiley, New Jersey, 2007.
2. F. A. Carey and R. J. Sundberg, *Advanced Organic Chemistry: Part A: Structure and Mechanisms*, 5th Ed., Springer, New York, 2007.
3. F. A. Carey and R. J. Sundberg, *Advanced Organic Chemistry: Part B: Reactions and Syntheses*: 5th Ed., Springer, New York, 2007.
4. R. Bruckner, *Organic Mechanisms*, Ed., M. Harmata, Springer, Berlin, 2010.
5. J. Clayden, N. Greeves, S. Warren and P. Wothers, *Organic Chemistry*, Oxford University Press, Oxford, 2001.
6. M. B. Smith, *Organic Synthesis*, 2nd Ed., McGraw-Hill, New Delhi, 2004.
7. F. A. Carey, *Organic Chemistry*, McGraw-Hill, New Delhi, 2000.
8. J. McMurry, *Organic Chemistry*, 5th Ed., Brooks/Cole, New York, 2000.
9. J. J. Li, Ed., *Name Reactions for Homologations*, Part II, Wiley, New Jersey, 2009.
10. C. J. Moody and G. H. Whitham, *Reactive intermediates*, Oxford Chemistry Primers, 1992.
11. R. O. C. Norman and J. M. Coxon, *Principles of Organic Synthesis*, 3rd Ed. CRC press, New York, 2012.
12. P. Sykes, *A guidebook to Mechanism in Organic Chemistry*, 6th Ed. Lingman Scientific & Technical, New York, 1986.
13. E. L. Eliel and S. H. Wilen, *Stereochemistry of Organic Compounds*, Wiley, New York, 2008.

14. D. Nasipuri, *Stereochemistry of Organic Compounds: Principles and Applications*, 2nd Ed., New Age International, 2002.
15. P. S. Kalsi, *Stereochemistry: Conformation and Mechanism*, 9th Ed., New Age International, 2009.
16. J. D. Morrison, *Asymmetric Synthesis*, Vol 1-5, Academic press, 1983.
17. *Comprehensive Asymmetric Catalysis,* E. N. Jacobsen, A. Pfaltz, H. Yamamoto, Eds., Springer, 2000.
18. R. Noyori, *Asymmetric Catalysis in Organic synthesis*, Wiley-New York, 1994.
19. I. Ojima, *Catalytic Asymmetric Synthesis*, VCH-NY, Pergamon, 1998.
20. *Methods for the Asymmetric Synthesis of Complex Organic Molecules*, D. J. O'Leary, Lecture Notes 2001.
21. H. B. Kagan, *Aymmetric Synthesis*, 1st Ed., Thieme Medical Publishers, 2003.