Name of the Programme: M. Sc -I (Organic Chemistry)

Course Code: CHO-504 **Title of the course:** Stereochemistry and Organic Transformations

Number of Credits: 04

Effective from AY: 2022-23

Prerequisites for the course:	Students should have studied organic chemistry courses at M.Sc. Chemistry in semester I	
Course Objective:	1. To study various principles of stereochemistry 2. To understand the importance of chirality in organic syntheses 3. To learn stereoselective reactions and toplan oxidation, reduction reactions	
Content	1. **Stereochemistry** a. Stereoselectivity in cyclic compounds: Introduction, stereochemical control in six membered rings, reactions on small rings, regiochemical control in cyclohexene epoxides, Stereoselectivity in bicyclic compounds b. Conformations, stability and reactivity of fused ring compounds: Fused bicyclic systems with small and medium rings: cis- and trans- decalones and decalols, Octahydronaphthalins (octalins), Bicyclo [4.3.0] nonane (cis- and trans-hydrindanes) c. Fused polycyclic systems: Perhydrophenanthrenes, Perhydroanthracenes, Perhydrocyclopentenophenanthrene system (steroids, triterpenoids and hormones). Conformations and reactivity towards esterification, hydrolysis, chromium trioxide oxidation, ionic additions of halogen (X_2) to double bonds, formation and opening of epoxide ring, epoxidation by peroxy acids. d. Spirocyclic compounds e. Reactions with cyclic intermediates or cyclic transition state f. Stereoisomerism due to axial chirality, planar chirality and helicity. *g.* Stereochemistry and configurational (*R/S*) nomenclature in appropriately substituted allenes, alkylidenecycloalkenes, spiranes, adamantoids, biaryls, trans-cycloalkenes, cyclophanes and ansa compounds. *h.* Atropisomerism in biphenyls and bridged biphenyls	No of hours 20
	2. Conformation of bridged ring compounds a. Bicyclo [2.2.1] heptane (norbornane): Geometry and topic relationship of hydrogens, solvolysis of bicycle [2.2.1]heptyl systems, formation, stability and reactivity of norbornylcation, relative stability and the rate of formation of endo and exo isomers in both bornane and norbornane systems. b. Bicyclo [2.2.2] octane system: Geometry and topic relationship of hydrogens, solvolysis of bicycle [2.2.2]octyl system. c. Other bridged ring systems: starting from bicycle [1.1.1]pentane to bicycle [3.3.3] undecane	10

	d. Bicyclo system with heteroatom: the relative stabilities of tropine, pseudotropine and benzoyl derivatives of norpseudotropine.	
	3. Dynamic Stereochemistry: Stereoselective Reactions a. Stereoselectivity: classification, terminology and principle. Selectivity in chemistry– substrate and product selectivity. b. Stereoselective reaction of cyclic compounds: Introduction, reactions of four, five and six-membered rings. Conformational control in the formation of six-membered ring. c. Diastereoselectivity: Introduction, making single diastereoisomers using stereospecific reactions of alkenes. d. 1,2-Addition to carbonyl compounds: Predicting various addition outcomes using different predictive models such as, Cram Chelate, Cornforth, Felkin-Anh. Specific reactions: allylation/crotylation by Brown, Roush, BINOL catalyzed. e. Stereoselective reaction of acyclic alkenes: The Houk model	14
	4. Oxidation and reduction reactions *a.* Oxidation reactions: Oxidation of organic compounds using Oppenauer oxidation, Swern oxidation. Other methods of oxidation such as selenium dioxide, $Pb(OAc)_4$, HIO_4, OsO_4, RuO_4, DMSO (Swern) sodium bromate / CAN &NaOCl, DDQ, Prevost's reagent and Woodward Conditions; Catalytic oxidation over Pt, Photosensitised oxidation of alkenes, oxidation with molecular oxygen, aromatization, silver based reagents. *b.* Reduction reactions: Reduction of organic compounds using hydride-transfer reagents and related reactions: MPV reduction, Trialkylborohydrides, LAH, mixed LAH-$AlCl_3$ reagents, enzymatic reduction involving liver alcohol dehydrogenase/NADH & Bakers' yeast, catalytic hydrogenation, dissolving metal reductions including acyloin condensation, other methods of reduction: Raney Ni desulphurisation, di-imide.	16
Pedagogy	Lectures & tutorials. Seminars / assignments / presentations / self-study or a combination of some of these could also be used to some extent. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.	
References / Readings	1. M. B. Smith, J. March, Advanced Organic Chemistry- 50 Reaction, Mechanism and Structure, Wiley, 2006, 6th Ed. 2. D. Nasipuri, Stereochemistry of Organic compounds, Principles and applications, New Age International Pvt. Ltd., 1994, 2nd Ed. 3. E.L. Eliel, Stereochemistry of Carbon Compound, Tata McGraw Hill, 1975. 4. W. Caruthers, I. Colddham, Modern Methods of Organic Synthesis, Cambridge University Press, 2016, 4th Ed. 5. J. Clayden, N. Greeves, S. Warren, Oxford, 2016.	

	6. I. L. Finar, Stereochemistry and the Chemistry of Natural Products, ELBS, Vol. 2, Longman Edn, 1975. 5th Ed. 7. E.S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Reinhart and Winston, 1965. 8. F. A. Carey, R. J. Sundberg, Advanced Organic Chemistry: Part A and B, Springer India Private Limited, 2007, 5th Ed. 9. R. O. Norman J, M. Coxon, Principles of Organic Syntheses, CRC Press Inc, 1993, 3rd Ed. 10. V.M. Potapov, A. Beknazarov, Stereochemistry, Central Books Ltd., 1980. 11. D. G. Morris, Stereochemistry, Wiley-RSC, 2002, 1st Ed. 12. C., Greeves, W., Wothers, Organic Chemistry, Oxford University Press, 2002, 2nd Ed. 13. M. Nogradi, Stereoselective Synthesis, VCH Publishers, Inc., 1994, Revised and Enlarged Ed.
Course outcomes:	1. Students will be in a position to explain stereochemistry and organic transformations. 2. Students will be in a position to apply knowledge of various reactions in functional group manipulations. 3. Students will be in a position to apply stereoselective reactions for the synthesis of chiral organic molecules. 4. Students will understand conformations of bridged ring compounds.