

KU3DSCCHE202: ORGANIC CHEMISTRY- I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200	KU3DSCCHE202	4	60

Learning Approach (Hours/ Week)		Marks Distribution			Duration of ESE (Hours)
Lecture/ Tutorial	Practical/ Internship	CE	ESE	Total	
4	-	30	70	100	2

Course Description: The course comprises of modules on hydrocarbons, hydroxy compounds and halogen compounds, stereochemistry, organic reaction mechanism and a teacher specific module

Course Prerequisite: Basic knowledge about reaction intermediates, electron displacement in molecules, types of reagents, electrophiles, nucleophiles and bond fission. Basic idea regarding the classification of organic compounds based on functional groups.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Examine the chemical properties of different classes of organic compounds.	U
2	Understand various named reactions and their applications in the synthesis of organic compounds.	U
3	Propose the stereochemistry of organic molecules and predict the stability of conformers.	A

4	Analyse different reaction mechanisms and suggest a mechanism for a particular reaction.	An
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**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	0	0	0	0	0	0
CO 2	0	3	0	0	0	0	1
CO 3	0	0	3	0	0	0	0
CO 4	0	0	0	3	0	0	1

Course Contents for Classroom Transaction:

M O D U L E	U N I T	DESCRIPTION	HOURS
1	HYDROCARBONS		12
	1	Alkanes: Preparation by Reduction of alkyl halides and Wurtz reaction and Kolbe's electrolytic method-Alkenes: Preparation by dehydration of alcohols, de-hydrohalogenation of alkyl halides, dehalogenation of vic-dihalides and by Kolbe's electrolytic method	
	2	Reactions of alkenes- Hydrogenation, addition of water-Oxidation with KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$ and Osmium Tetroxide-Ozonolysis and polymerization	

	3	Alkynes: Preparation by de-hydrohalogenation of vic-dihalides and gem dihalides-Kolbe's electrolytic method-Reactions of alkynes- Addition of Hydrogen, Halogen, Halogen acid and water-Oxidation using alkaline KMnO_4 , Acidic $\text{K}_2\text{Cr}_2\text{O}_7$ and Selenium dioxide- Ozonolysis, hydroboration- oxidation and polymerization reactions specific to alkynes.	
	4	Dienes: Conjugated, cumulated and isolated dienes with examples- preparation of 1, 3 butadiene by dehydration of diols- Reactions of 1, 3 butadiene: 1,2 and 1,4 additions, polymerization- Polynuclear Hydrocarbons- Haworth Synthesis of naphthalene-synthesis of Anthracene from benzyl chloride	
	5	Cycloalkane –Methods of formation-chemical reactions- Baeyer's strain theory and its limitations- Ring strain in small rings (cyclopropane and cyclobutane)	

	HYDROXY COMPOUNDS AND HALOGEN COMPOUNDS		10
2	1	Alcohols – Preparation of monohydric alcohols from carbonyl compounds using Grignard reagents - Preparation with hydro-boration reaction-Ascent and Descent in alcohol series- Methods to distinguish 1° , 2° and 3° alcohols: Lucas method, Victor Meyer's method and oxidation method.	
	2	Glycerol- Isolation from fats and oils- Preparation from Propene- Reactions: Oxidation, Reduction with HI, Dehydration, Nitration, Acetylation	
	3	Phenols - Acidic character of phenol - Preparation of phenol from diazonium salt, aryl sulphonates, cumene-Important reactions of Phenol: Bromination, Kolbe-Schmidt reaction, Riemeier-Tiemann reaction, Hauben-Hoesch reaction, Gattermann-Koch reaction, FeCl_3 reaction, azo coupling-Naphthols- Preparation of Alpha and Beta Naphthol-	

	4	Halogen compounds: Nomenclature of Alkyl and Aryl Halides- Classes of alkyl halides- Methods of formation and chemical reactions of Geminal and Vicinal dihalides- Polyhalogen compounds-Methods of formation of Carbon tetrachloride and Chloroform	
	5	Aryl Halides-Preparation of Chloro, bromo and iodo-benzene from phenol- Sandmeyer & Gattermann reactions- Relative reactivity of alkyl, allyl /benzyl, vinyl and aryl halides towards nucleophilic substitution reactions-Nucleophilic aromatic substitution-SNAr and Benzyne mechanism.	
	STEREOCHEMISTRY		14
3	1	Isomerism: Geometrical isomerism: cis-trans and, syn-anti isomerism. Optical Isomerism-Optical Activity-Definition-wave nature of light-plane polarised light-optical rotation and specific rotation-chiral centres. Chiral molecules: definition and criteria - absence of plane, centre and Sn axis of symmetry – asymmetric and dissymmetric molecules.	
	2	Fischer Projection, Newman and Sawhorse Projection formulae and their inter-conversions - Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans-1,2-dichlorocyclopropane). optical isomerism in compounds without any stereo centres (allenes, biphenyls)	
	3	Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3-dibromopentane)-D, L &, R, S configuration, Cahn-Ingold-Prelog rules. Racemic mixture, Racemisation and Resolution techniques. Geometrical isomerism with reference to alkenes and cyclo alkanes– cis, trans and E, Z configuration	
	4	Conformational analysis: Definition and examples of conformational and configurational isomers. Difference between configuration and	

		conformation- Types of cycloalkanes and their relative stability, Baeyer strain theory. Conformation analysis of alkanes- Conformational analysis of ethane, n-butane, 1,2-dichloroethane, 2-chloroethanol	
	5	Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams., Inter-conversion of axial and equatorial bonds in chair conformation of cyclohexane, conformation of mono and di-substituted cyclohexane derivatives.	
	ORGANIC REACTION MECHANISM		12
4	1	Aliphatic nucleophilic substitutions: Mechanism of S_N1 and S_N2 . Stereo Chemistry of S_N1 and S_N2 reaction- Walden Inversion- Effect of nucleophile, leaving group, and solvent on the relative rates of S_N1 versus S_N2 reactions.	
	2	Aromatic Electrophilic Substitution: Mechanism of halogenation, nitration and sulphonation – Friedel-Crafts alkylation and acylation- Orientation and reactivity in mono-substituted benzene rings – ortho/para ratio-	
	3	Elimination: $E1$ and $E2$ mechanism - mechanism of dehydrohalogenation of alkyl halides - Saytzeff rule and Hofmann's rule- Effect of nucleophile, leaving group, and solvent on the relative rates of $E1$ versus $E2$ reactions- $E1CB$ mechanism- Thermal elimination reactions- Chugaev and Cope elimination	
	4	Addition reactions: Mechanism of Electrophilic addition of Hydrogen halides to Carbon- Carbon double bond-Markownikoff's rule - Kharasch effect (Free radical addition of HBr on unsymmetrical double bond)- Method for determination of reaction mechanism: product analysis, intermediates, isotope effect, kinetic and stereochemical studies	
5	TEACHER SPECIFIC MODULE		12

	<i>Directions: A module on polymers or any other topic relevant to the course according to the teacher can be proposed.</i>	
	Polymers: Introduction and classification of polymers; Number average molecular weight, Weight average molecular weight, Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics - thermosetting (phenol-formaldehyde, Polyurethanes) and thermo softening (PVC, polythene –LDPE and HDPE) – polyamides, Polycarbonates, and silicone polymers. Rubbers - natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.	

Essential Readings:

1. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry' 3rd Edition, Visal Publishing Company Co.
2. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House
3. B. S. Bahl 'Advanced organic Chemistry', S. Chand.
4. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India.
5. I. L. Finar 'Organic Chemistry', Vol.- 1, Pearson Education
6. P. S. Kalsi 'Organic Reactions and their Mechanisms' New Age International Publishers
7. Peter Sykes, 'A Guidebook to Mechanism in Organic Chemistry', Pearson Education
8. V.R. Gowariker, N.V Viswanathan and Jayader Sreedhar, 'Polymer Science', Wiley Eastern Ltd., New Delhi.
9. F. W. Billmeyer, Textbook of Polymer Science, John Wiley & Sons.

Suggested Readings:

1. P. Y. Bruice, 'Organic Chemistry', Pearson Education.
2. J. March, 'Advanced Organic Chemistry', 4th Edn., John Wiley & Sons, NY
3. S. H. Pine 'Organic Chemistry', McGraw Hill
4. J. Clayden, N. Greeves, S. Warren and P. Wothers, 'Organic Chemistry', Oxford University Press

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		70
Continuous Evaluation		30
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		100

* Average mark of the best two written tests may be considered for internal mark.