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University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK4DSCCHE202**				
Course Title	**ORGANIC CHEMISTRY II**				
Type of Course	**DSC**				
Semester	4				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higer secondary level chemistry 2. UK2DSCCHE100 (preferable)				
Course Summary	The course covers aromaticity for understanding the reactivity and stability of benzene and its derivatives. Organic reaction mechanisms delve into nucleophilic and electrophilic substitutions, eliminations, and rearrangements, providing insights into the behaviour of organic compounds. Practical applications in quantitative analysis and organic preparations enhance understanding and application of theoretical concepts in real-world scenarios.				

Detailed Syllabus:

Module	Unit	Content ORGANIC CHEMISTRY II	Theory 75 Hrs
I	**ARENES AND AROMATICITY**		**12**
	1	Concept of aromaticity – heat of hydrogenation and combustion of benzene – structure of benzene: Kekule structure – resonance structure – molecular orbital structure. Nomenclature of aromatic compounds	2
	2	Theories of aromaticity: Aromatic sextet theory – Huckel's rule. Benzenoid aromatics – benzene, naphthalene, anthracene and pyrene. Non-benzenoid aromatics – charged rings, fulvenes and azulene and annulenes. Aromaticity of furan, pyrrole and thiophene. Anti-aromaticity and non-aromaticity. Frost circle diagram – benzene and cyclobutadiene.	2

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	3	Mechanism of aromatic electrophilic substitution – energy profile diagram – nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation.	3
	4	Directive influence of functional group in mono-substituted benzene with ring activating and deactivating groups (-OH, -NH_2, -CH_3, -CHO, -COOH and -Cl) Directive influence in disubstituted benzenes – o-cresol, m-chloro nitrobenzene and p-bromotoluene.	4
	5	Carcinogenicity and toxicity of aromatic hydrocarbons.	1
II		**INTRODUCTION TO PHYSICAL ORGANIC CHEMISTRY**	**9**
	6	Reaction coordinates- difference between transition state and intermediates, Energy profiles	3
	7	Thermodynamic and kinetic control of reaction. The Hammond postulate (qualitative treatment). Primary, secondary and inverse kinetic isotopic effects	3
	8	Methods of determining mechanism, identification of products, detection of intermediates, catalytic study, isotopic labelling, stereochemical evidence, kinetic evidence	3
III	**ORGANIC REACTION MECHANISM II**		**12**
	9	Aliphatic nucleophilic substitutions: Mechanism of SN1, SN2 and SNi reactions, energy profile diagram for SN1 and SN2 reactions. Stereochemistry of SN1 and SN2 reactions. Effect of the substrate structure, solvent and nucleophilicity in substitution reactions.	3
	10	Neighbouring group participation (anchimeric assistance): examples involving acetoxonium and phenonium ions, participation of lone pair of electrons in substitutions reaction	3
	11	Aromatic nucleophilic substitution – Uni and bimolecular displacement mechanism SNAr and ArSN1 reactions. Benzyne mechanism with evidence.	3
	12	Elimination – addition (Benzyne) mechanism with evidence, regiochemistry of addition of nucleophiles to substituted benzynes	3
IV	**ORGANIC REACTION MECHANISM III**		**12**
	13	Elimination reaction: 1,1 and 1,2 eliminations, mechanisms of E1, E1CB and E2 reactions, Regioselectivity in elimination reactions (Hoffmann and Saytzeff rule and Bredt's rule). Stereochemistry of E1, and E2 reactions.	3
	14	Substitution vs Elimination	1
	15	Electrophilic addition to carbon-carbon double bonds: mechanism of addition of bromine, hydrogen, H_2O, oxymercuration, and hydroboration (followed by oxidation only), regioselectivity in addition reactions (Markownikoff's rule and peroxide effect), stereo aspects, effect of substituents on the rate of additions, cis and trans hydroxylation of alkenes and cycloalkenes.	2

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	16	Molecular rearrangement reactions- General mechanistic considerations – nucleophilic rearrangement, electrophilic rearrangement and carbene rearrangement	3
	17	Wagner–Meerwein rearrangement, Schmidt rearrangement and Lossen rearrangement, Stevens rearrangement, Fries rearrangement (with mechanism)	3
V	**ORGANIC CHEMISTRY PRACTICAL- Organic Quantitative Analysis, Determination of Physical constants, Preparations and separation techniques**		**30**
	19	**Quantitative Analysis**	
		a) Estimation of phenol	3
		b) Estimation of Aniline	3
		c) Determination of physical constants; i) Determination of melting point of an organic compound; ii) Determination of boiling point of an organic compound;	3
	20	**Organic Preparations and separations**	
		a) Halogenation: Bromination of acetanilide	3
		b) Nitration of Acetanilide or nitrobenzene	3
		c) Oxidation of benzaldehyde/Toluene/Benzyl chloride	2
		d) Acetylation of salicylic acid or aniline	2
		e) Benzoylation of phenol or aniline	2
		f) Hydrolysis of ethyl acetate and benzamide	2
		g) Preparation of Soap (Demonstration only)	2
		d) Steam distillation –Extraction of essential oil from citrus fruits/eucalyptus leaves (demonstration only)	2
		e) Chromatography (demonstration only): i) TLC of simple organic compounds (using TLC sheets); ii) *Paper chromatographic separation of mixture of inks and sugars; iii) Column chromatographic separation of a mixture of dyes	2
		f) Recrystallisation of any five different classes of organic compounds	1

References

For Theory

1. A.Bahl and B.S.Bahl, Advanced Organic Chemistry, S.Chand & Company, New Delhi.
2. L.G.Wade Jr, Organic Chemistry, Pearson Education, New Delhi.
3. K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemisty, Vikas Publishing House (Pvt) Ltd., New Delhi.

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4. S.C.Sharma and M.K.Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi.
5. D.Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, New Age International Publizhers, New Delhi.
6. J.Clayden, N.Greeves and S.Warren, Organic Chemistry, Oxford University Press, New York.
7. I L Finar, "Organic Chemistry" Vol – 1, 5th Edition, Pearson Education, NewDelhi
8. Physical Organic Chemistry, Neil Isaacs, 2nd Edition PHI, ELBS
9. P.S.Kalsi, Organic Reactions, Stereochemistry, and Mechanism, New Age International Publishers, New Delhi
10. R.T.Morrison, R.N.Boyd. Organic Chemistry, Pearson Education, New Delhi.
11. P.Y.Bruice, Essential Organic Chemisty, Pearson Education, New Delhi.
12. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, Pearson Education, New Delhi.
13. G.M. Louden, Organic Chemistry, Oxford University Press, New York.
14. E.L.Eliel, Stereochemistry of Carbon compounds, Tata McGraw Hill Publishing House, New Delhi.
15. J.March, Advanced Organic Chemistry, John Wiley & Sons., NY.
16. S.M.Mukerji and S.P.Singh, Reaction Mechanism in Organic Chemistry, McMillan Publishers.
17. R.O.C. Norman and J.M.Coxon, Principles of Organic Synthesis, CRC Press.

For Practicals

1. A.I.Vogel, "A text book of Qualitative Analysis including semi micro methods" Longmans.
2. V.V.Ramanujam, "Semi micro–Qualitative Analysis"
3. E.S.Gilreath "Qualitative Analysis using semi micro method" Mc Graw Hill
4. A.I.Vogel, "Elementary Practical Organic Chemistry" Longmans
5. Day and Raman, "Laboratory Manual of Organic Chemistry".
6. F.G Mann and B.C Saunders, "Practical Organic Chemistry" 4th Edn, Orient Longmann
7. N.K.,Vishnu, "Advanced practical organic chemistry" Vikas publishing house, New Delhi

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the concept of aromaticity, orientation effects in aromatic systems and toxicity of aromatic hydrocarbons	Ap	PSO-1,2,3,4

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CO-2	Identify aliphatic and aromatic nucleophilic substitution, elimination reactions and effects of NGP.	An	PSO-1,2
CO-3	Identify various aspects of thermodynamic and kinetic control of reactions and various methods of determination of reaction mechanism.	E	PSO-1,2
CO-4	Predict favourable reaction pathways for substitution/elimination reactions and identify rearrangement reactions.	C	PSO-1,2
CO-5	Practice systematic scientific procedure for quantitative analysis, preparation and separation methods of organic compounds.	C	PSO-1,2,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ORGANIC CHEMISTRY II

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PSO-1,2,3,4	Ap	F	L	-
2	CO-2	PSO-1,2	An	F	L	-
3	CO-3	PSO-1,2	E	C	L	-
4	CO-4	PSO-1,2	C	F, C	L	-
5	CO-5	PSO-1,2,4,5	C	P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	2	1	2	3	-	2	-	-	-	-	-	-	-
CO 2	2	3	-	-	-	2	2	-	-	-	-	-	-
CO 3	3	2	-	-	-	2	2	-	-	-	-	-	-
CO 4	2	3	-	-	-	2	2	-	-	-	-	-	-

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CO 5	2	2	-	3	3	2	2	3	-	-	3	2	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓	-	✓
CO 2	✓	✓	-	✓
CO 3	✓	✓	-	✓
CO 4	✓	✓	-	✓
CO 5	✓	✓	✓	✓

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