22CH4D1 : GREEN CHEMISTRY

Course Code	22CH4D1	I A Marks	30
No. of Lecture Hours / Week	4	End Exam Marks	70
Total Number of Lecture Hours	60	Total Marks	100
Seminar	-	Exam Hours	03

Course:GREEN CHEMISTRY		
S.No	COURSE OUTCOMES	PO`S
	The student will be able to	
1	Memorize the principles of green chemistry and concepts related to green organic synthesis.	2,7
2	Understand the role and significance of green organic synthesis.	1,2,7
3	Exercise the basic and advanced knowledge gained in green organic synthesis in chosen job role.	1, 6
4	Analyse how far green methods are environmentally benign over conventional methods of synthesis.	1, 7
5	Evaluate the principles of green chemistry in organic synthesis.	1, 7

CO-PO MATRIX								
COURSE CODE 22CH4D1	CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	CO1		H					M
	CO2	M	M					L
	CO3	H					H	
	CO4	H						M
	CO5	H						M

Unit-I

Principles of Green Chemistry: Prevention of waste / by-products, atom economy, Hazardous products-Designing of safer chemicals-energy requirements Selection of appropriate solvents and starting materials-Use of protecting groups and catalysis-Designing of biodegradable products. green organic synthesis of paracetamol, catechol, adipic acid, urethane and ibuprofen.

Unit-II

Microwave assisted reactions: Theory ofMicrowave, advantages, disadvantages, applications-water as solvent: Hoffmann elimination, hydrolysis, oxidation of Toluene, oxidation of alcohols, hydrolysis of methyl benzoate to benzoic acid.

Organic solvents: Esterification reactions, Fries rearrangement, Ortho ester Claisen rearrangement, DielsAlder reactions, synthesis of chalcones, decarboxylation.

Solid state reactions (solvent free): De acetylation, deprotection, saponification of esters, synthesis of anhydrides from dicarboxylic acid, synthesis of nitriles from aldehydes.

Unit-III

Phase Transfer Catalysis: Definition, Mechanism, Types, advantages and applications of PTC – C-alkylation, N-alkylation, Darzen's reaction, Wittig reaction, Benzoyl cyanides from benzoyl chloride, alcohols from alkyl halides, Crown ethers – Introduction,synthetic applications: esterfication, saponification, Anhydride formation, $KMnO_4$ oxidation, aromatic substitution, elimination.

Unit-IV

Ultrasound assisted green synthesis: Introduction, instrumentation, types of sono chemical reactions – Homogeneous reactions – Curtius rearrangement of Benzoyl azide to phenyl isocyanate. Heterogeneous Liquid-Liquid reactions - Esterification, saponification, Hydrolysis, substitutions, additions. Heterogeneous Solid – Liquid Reactions–oxidation, reduction, hydroboration, coupling, Bouveault reaction, Strecker reaction.

Unit-V

Ionic liquids: Definition-Types of Ionic Liquids- properties- Application in organic synthesis-alkylation, allylation, oxidation, hydrogenation, hydroformylation, alkoxycarbonylation, carbon-carbon bond forming reactions-suzuki coupling, Heck reaction, stille coupling.

Textbooks/Referencebooks:

1. New Trends in Green Chemistry by V.K.Ahluwalia, M.Kidwai.

2. Green Chemistry: Environment Friendly Alternatives by Rashmi Sanghi, M.M.Srivastava

3. Green Solvents for Organic Synthesis by V.K.Ahluwalia, RajenderS.Varma.

4. Organic synthesis – special Techniques, V.K.Ahluwalia, Renu Aggarwal.

5.Green Chemistry - V.K.Ahluwalia, Ane Books Pvt. Ltd.,

9) (a) 2D INADEQUATE technique is useful to establish C – C mapping. Justify. (CO–2,L2)

(b) NOESY technique is useful to establish spatial interaction. Justify. (CO-4,L-4)

UNIT – V

10) (a) Deduce the structure of the compound consistent with the following data elemental analysis: C=32.14%H 5.35% and Cl 62.5% UV: No absorption above 210 nm, IR (CCl_4), 2941,2265 and 1460cm-1PMR δ 2.72(septet,J=6.7,1H),1.33 (doublet J=6.7,6H). State whether data is consistent to deduce the structure. (CO–5,L-5)

(OR)

(b) Deduce the structure of the compound consistent with the following data elemental analysis:C=32.14%H 5.35% and Cl 62.5% UV: No absorption above 210 nm IR (CCl_4)940,1265 and 690cm-1 and PMR δ3.5(2H,D),3.3(1H,m) and 1.25(3H,d). State whether data is consistent to deduce the structure. (CO-5,L-5)

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M.Sc. DEGREE EXAMINATION

FOURTH SEMESTER

22CH4D1 :: GREEN CHEMISTRY

Time: 3 hours **Maximum Marks: 70**

SECTION – A

Answer all the questions 5X4=20M

1. (a). Write the green synthesis of urethane. (CO-2,L-2)

(OR)

(b). Define atom economy. Explain atom economy in rearrangement reaction with a suitable example. (CO-2,L-2)

2) (a). Discuss esterification reactions in organic solvents. (CO-2,L-2)

(OR)

(b). Explain the synthesis of nitriles from aldehydes. (CO-2,L-2)

3) (a). Give the disadvantages of microwave assisted organic synthesis. (CO-2,L-2)

(OR)

(b).Discuss the various types of phase transfer catalysts. (CO-2,L-2)

4) (a) Write the mechanism of phase transfer catalysis. (CO-2,L-2)

(OR)

(b) Write notes on ultrasound assisted homogeneous reactions. (CO-2,L-2)

5) (a) Write notes on ultrasound assisted strecker reaction. (CO-3,L-3)

(OR)

(b) Write notes on hydroformylation. (CO-3,L-3)

SECTION – B **(5x10=50M)**

UNIT – I

6) (a) Write a brief account of twelve principles of green chemistry. (CO-2,L-2)

(OR)

(b) Out line the green synthesis of the following compounds:
(i) Ibuprofen (ii) paracetamol (iii) catechol. (CO-3,L-3)

UNIT – II

7)(a) Discuss microwave assisted reactions in organic solvents. (CO-3,L-3)

(OR)

(b) Discuss the theory, advantages and disadvantages of microwave. (CO-2,L-2)

UNIT – III

8) (a) Define phase transfer catalyst. Write notes on C – alkylation and N – alkylation using PTC. (CO-3,L-3)

(OR)

(b) Discuss the synthetic applications of crown ethers. (CO-3,L-3)

UNIT – IV