GREEN CHEMISTRY

Semester	Subject Code	Category	Lecture hours		Theory hours		Practical Hours		Credits
			Per week	Per sem.	Per week	Per sem.	Per week	Per sem.	
V	21CCH5Da	Elective-I (Option-2)	3	45	3	45	-	-	3

COURSE OBJECTIVES:

The students will be able to

- Gain knowledge about Green Solvents, Green Techniques, Green Catalysts, Biocatalytic reactions and Future trends in Green Chemistry.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Gain knowledge about the principles of green chemistry and green synthesis.	K2
CO2	Gain knowledge about various green solvents and solid supported synthesis**.**	K3
CO3	Gain knowledge about Microwave and Ultrasound Assisted Green Synthesis and Green catalysis.	K2
CO4	Gain knowledge about biocatalytic reactions.	K2
CO5	Know about the various analytical green methods which bring about ecofriendly green products.	K3

*CO – course Outcomes

Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze.

MAPPING WITH PROGRAMME OUTCOMES:

COS	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	S	S	S
CO2	S	S	M	M	M	S
CO3	S	M	M	S	S	S
CO4	S	M	M	M	S	S
CO5	S	M	M	S	M	S

(S – Strong; M – Medium; L – Low)

UNIT-I: Principles of Green Chemistry **9 Hours**

1.1 Introduction– Need for Green Chemistry – Principles of Green Chemistry – Limitations in the pursuit of the goals of Green Chemistry – Atom economy – Definition with example – Ibuprofen synthesis – Green oxidants – Hydrogen peroxide.

1.2 Green synthesis – Evaluation of the type of the reaction – Rearrangements (100 % Atom economic) – Addition reaction (100 % Atom economic).

UNIT-II: Green Solvents **9 Hours**

2.1 Selection of solvents – Aqueous Phase Reactions – Diels-Alder Reaction in water – Catalysis in water – Aerobic oxidation of alcohols catalysed by Pd (II)/ Bathophenanthroline – Extraction of D- Limonene from orange peel using liquid CO_2 prepared from dry ice.

2.2 Mechanochemical solvent-free, solid state synthesis of azomethine using p-toluidine and o-vanillin – Solid supported synthesis – Supercritical CO_2 – Preparation, properties and applications – Decaffeination – Dry cleaning – Environmental impact.

UNIT-III: Green Techniques and Green Catalysis **9 Hours**

3.1 Microwave and Ultrasound assisted Green Synthesis – Apparatus required – Examples of MAOS – Synthesis of fused anthroquinones – Leukart reductive amination of ketones – Advantages and disadvantages of MAOS – Aldol condensation – Cannizzaro condensation – Diel's-Alder reaction – Strecker's synthesis – Reformatsky reaction – Coupling reactions.

3.2 Green Catalysis – Heterogeneous catalysis – Uses of zeolites, Silica, Alumina, Clay supported catalysis – Biocatalysis – Introduction to Biocatalysis – Enzymes and microbes.

UNIT-IV: Biocatalytic Reactions **9 Hours**

4.1 Green Chemistry using biocatalytic reactions – Introduction – Fermentation and biotransformations – Production of bulk and fine chemicals by microbial fermentation – Photoreducion of benzophenone to benzopinacol in the presence of sun light – Solvent free microwave assisted one pot synthesis of phthalocyanine complex of copper(II).

4.2 Antibiotics – Vitamins – Biocatalysis synthesis of industrial chemicals by bacterial constructs – Importance of biocatalysts in Green chemistry and chemical industries – Examples.

UNIT- V: Future Trends in Green Chemistry **9 Hours**

5.1 Future Trends in Green Chemistry – Green analytical methods – Redox reagents – Green catalysts – Green nanosynthesis – Green Polymer Chemistry – Exploring Nature.

5.2 Biomimetic – Proliferation of solventless reactions – non-covalent derivatisation – Biomass conversion – Emission control – Green Chemistry in sustainable development.

TEXT BOOKS:

S. No.	Authors	Title	Publishers	Year of publication
1.	V. K. Ahluwalia	Green Chemistry	Narosa Publishing House, New Delhi	2011
2.	R. Sanghi and M. M. Srinivatava	Green Chemistry: Environmental Friendly Alternatives	Narosa Publishing House, New Delhi	2003
3.	V. Kumar	An Introduction to Green Chemistry	Vishal Publishing Co. Reprint Edition	2010

REFERENCE BOOKS:

S. No.	Authors	Title	Publishers	Year of publication
1.	P. Tundo, A. Perosa and F. Zechini	Methods and Reagents for Green Chemistry	John Wiley and Sons Inc., New Jercy	2007
2.	V.K. Ahluwalia	Green Chemistry: Greener Alternatives to Synthetic Organic Transformations	Alpha Science International Limited	2011
3.	C. Suresh, Ameta and Rakshit Ameta	Green Chemistry: Fundamentals and Applications	CRC Press	2013
4.	Paul T. Anastas and John C. Warner	Green Chemistry: Theory and Practice	Oxford University Press, New York	1998

TEACHING METHODOLOGY:

- Power Point Presentations
- Assignments
- Animated videos
- Chalk and Board
- Group discussion

SYLLABUS DESIGNER:

- Dr. R. Arunadevi, Assistant Professor of Chemistry