

ELECTIVE PAPER-A: MODERN SYNTHETIC STRATEGIES AND RENEWABLE ENERGY RESOURCES

Semester	Subject Code	Category	Instruction Hours						Credits
			Lecture		Theory		Practical		
			Per Week	Per Semester	Per Week	Per Semester	Per Week	Per Semester	
II	21CPCH2D	Elective	3	45	3	45	0	0	3

COURSE OBJECTIVES:

- ❖ To understand the basic aspects of organic reactions in terms of acceptor, donor synthons, retrosynthetic analysis and various types of organic syntheses involved in accessing natural products.
- ❖ To understand the mechanism, synthetic utility of transition metal catalyzed organic reactions, concept of asymmetric synthesis, various types of total synthesis involved in natural products, advantages of green reactions and their utility.

COURSE OUTCOMES:

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

CO Number	CO statement	Knowledge level
CO1	Use retrosynthetic method for the logical dissection of complex organic molecules and devise synthetic methods	K3 & K2
CO2	Learn various organic reactions and reagents used in them as tools applied in the art of organic synthesis	K3 & K2
CO3	Gain knowledge about structural elucidation of steroids, synthesis of various natural products	K2 & K4
CO4	Learn the importance of minimizing waste, saving power and doing organic synthesis according to the principles of green chemistry	K2 & K3
CO5	Acquire knowledge about the applications of various types of renewable energy sources and biofuel cells	K3 & K4

* CO-Course Outcomes

Knowledge level K1-Remember; K2-Understand; K3-Apply; K4-Analyze

MAPPING WITH PROGRAM OUTCOMES

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

UNIT-I: SYNTHETIC METHODOLOGY

9 hours

Synthons (acceptor and donor) – Synthetic equivalent – Target molecule – Retrosynthetic analysis – Functional group interconversion – Disconnection approach – One group disconnection – Disconnection of alcohols, olefins and ketones – Logical and illogical disconnections, Two group disconnection – 1,2 – 1,3 – 1,4 – 1,5 – and 1,6 – deoxygenated skeletons and dicarbonyls – Umpolung, antithesis, 1,3 – Dipolar cycloaddition methodologies (Azide, nitrile oxide, azomethine ylides and carbonyl ylides) – Concept of Tandem, cascade and domino reactions in organic synthesis – Various types of cyclization and ring formation reaction – anionic, cationic, radical and transition metal mediated cyclizations.

UNIT-II: NOVEL REAGENTS AND ASYMMETRIC SYNTHESIS

9 hours

Protection and deprotection of functional groups (R-OH, R-CHO, RCOR, R-NH₂ and R-COOH) – Role of palladium and nickel catalysts in organic reactions including Pd(0), Ni(0), Pd(II) and Ni(II) complexes – Typical reactions involving Heck, Negishi, Suzuki – Miyaura, Kumada, Sonogashira, Stille and Hiyama coupling for carbon-carbon bond formation reactions – Buchwald – Hartwig coupling for the carbon – heteroatom bond formation reactions.

Selectivity – Resolution – Kinetic resolution reactions – Desymmetrization – Asymmetric induction – Chiral auxiliary – Generation of Asymmetric synthesis – Substrate – Auxiliary – Reagent and Catalyst control. Auxiliary controlled alkylation of chiral enolates – Evans oxazolidones, chiral hydrazones and chiral imines – Enders RAMP/SAMP and chiral sulfoxide – Asymmetric oxidation [dihydroxylation, epoxidation Sharpless, Jacobsen, Shi] and Asymmetric reduction (Noyori, Corey, Pfaltz) – Boranes reduction.

UNIT-III: STEROIDS AND TOTAL SYNTHESIS OF NATURAL PRODUCTS

9 hours

Structural elucidation of cholesterol, stigmasterol and ergosterol – synthesis of cholesterol – conversion of cholesterol to progesterone, oestrone and testosterone – Biosynthesis of cholesterol and bile acids.

Classification of Organic Synthesis. Demonstration of various types of total syntheses using alkaloid (Epibatidine and Ibogamine), Prostaglandin (PGE₁) and Terpenes (longifolene and cedrene). Total synthesis of quinine, morphine, reserpine, cocaine and papaverine.

UNIT-IV: ESSENTIALS OF GREEN CHEMISTRY

9 hours

Introduction to green chemistry – definition, origin, history, needs, goals, twelve principles of green chemistry – Usage of Conventional and Green solvents – Advantages, Limitations and drawbacks – Green Synthesis – Designing, Choice of starting materials, choice of reagents, choice of catalysts – biocatalysts, polymer supported catalysts – choice of solvents – Synthesis involving basic principles of green chemistry – Examples: synthesis of adipic acid, methyl methacrylate, paracetamol – Microwave, Ultrasonication and Ultrasound assisted reactions – esterification, reduction and coupling reactions.

UNIT-V: RENEWABLE ENERGY RESOURCES**9 hours**

Renewable energy sources – types of renewable energy sources – Solar cells – basic principles, types and their applications – Fuel cells – basic principles, types and their applications. Working principle and applications of Biofuel cells – brief introduction about hydroelectric, biomass, wind power and geothermal power and their applications and limitations – energy from some other natural source.

Distribution of hours: Theory-100%; Problems-Nil

TEXT BOOKS

S.No	Authors	Title	Publishers	Year of publication
1	Jiro Tsuji	Palladium Reagents and Catalysts	Wiley & Sons	1995
2	M. B. Smith and Jerry March	Advanced Organic Chemistry	John Wiley & Sons, 5 th Ed	2001
3	W. Carruthers	Some Modern Methods of Organic Synthesis	Cambridge University Press, 3 rd Ed, Reprint	1998
4	R. O. C. Norman and J. M. Coxon	Principles of Organic Synthesis	Chapman & Hall, 3 rd Ed	1993
5	Louis S. Hegedus	Transition Metals in the Synthesis of Complex Organic Molecules	University Science Books, 2 nd Ed	1999
6	L. Brandsma, S. F. Vasilevsky and H. D. Verkruisje	Applications of Transition Metal Catalysts in Organic Synthesis	Springer-Verlag	1999
7	R. E. Gawley & J Aube	Principles of Asymmetric Synthesis	Elsevier, 2 nd Ed	2012
8	Noyori, R	Asymmetric Catalysis in Organic synthesis	Wiley	2001
9	I. L. Finar, t	Organic Chemistry Vol 2, Stereochemistry and the Chemistry of Natural Produc	Dorling Kindersley India (P) Ltd	2009
10	Corey and Cheng	The Logics of Chemical Synthesis	John Wiley & Sons	1989
11	K.C. Nicolau and Sorenson	Classics in Total Synthesis	Wiley	1996
12	P. T. Anastas and T. C. Williamson	Frontiers in Benign Chemical Syntheses	Oxford University Press, Oxford	1998

		and Processes, Green Chemistry		
13	V. K. Ahluwalia	Methods and Reagents of Green Chemistry: An Introduction by Green Chemistry	Kluwer Academic Publisher & Anamaya Publishers	2004
14.	R. A, Sheldon, I. Arends and Ulf. Hanefeld	Green Chemistry and Catalysis	John Wiley & Sons	2007
15.	<u>Gadi Rothenberg</u>	Catalysis: Concepts and Green Applications	John Wiley & Sons	2015

REFERENCE BOOKS

S.No	Authors	Title	Publishers	Year of publication
1	W. Carruther and Jain Coldham	Modern Methods of organic synthesis	Cambridge University Press, 4th edition	2015
2.	Micheal B. Smith	Organic Synthesis	McGraw Hill, 2 nd edition	2002
3.	Stuart Warren	organic synthesis, the disconnection approach	John Wiley and sons (Asia) Pvt. Ltd.	2008
4.	R.E. Ireland	Organic synthesis	Prentice hall of India, Pvt. Ltd New Delhi	1975
5.	V.K. Ahluwalia	Green Chemistry: Environmentally Benign Reactions	CRC press	2008

TEACHING METHODOLOGY:

- Board and chalk
- PowerPoint presentation
- Group discussion
- Seminar and Assignments
- Animated videos
- Board and chalk

SYLLABUS DESIGNERS:

1. Dr. T. Gomathi, Assistant Professor, Department of Chemistry
2. Mrs. J. Saranya, Assistant Professor, Department of Chemistry
3. Dr. D. Shakila, Assistant Professor, Department of Chemistry