



ARSD College, University of Delhi

Model Course Handout/Lesson Plan

Course Name : B.Sc. (H) Chemistry						
Semester	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
IV	Skill Enhancement Course	Green Methods in Chemistry	2			2
Teacher/Instructor(s)		Dr. Anil Kumar				
Session		2021-2022				

Course Objective:

- To inspire the students about the chemistry which is good for human health and environment.
- To evaluate suitable technologies for the remediation of hazardous substances.
- To make students aware of how chemical processes can be designed, developed and run in a sustainable way.
- To acquire the knowledge of the twelve principles of green chemistry and how to apply in green synthesis.
- To make students aware about the benefits of using green chemistry.
- To have the idea of Biocatalytic Process—Conversion of Biomass into chemicals.

Learning Outcomes:

By the end of this course, students will be able to:

- Get idea of toxicology, environmental law, energy and the environment
- Think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry.
- Think of chemical methods for recovering metals from used electronics materials.
- Get ideas of innovative approaches to environmental and societal challenges.
- Know how chemicals can have an adverse/potentially damaging effect on human and vegetation.
- Critically analyse the existing traditional chemical pathways and processes and creatively think about bringing environmentally benign reformations in these protocols.
- Convert biomass into valuable chemicals through green technologies.

Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	Introduction	1	Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry
		2	Need of green chemistry
		3	Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each).
		4	A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards).
2.	Twelve Principles of Green Chemistry	5	Prevention of waste / byproducts, pollution prevention hierarchy
		6	Green metrics to assess greenness of a reaction: environmental impact factor, atom economy and calculation of atom economy
		7	Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources.
		8	Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
		9	Green energy and sustainability.
		10	Real-time analysis for pollution prevention.
		11	Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD “What you don’t have cannot harm you”, greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.
3.	Application	12	Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO ₂ for precision cleaning and dry cleaning of garments.
		13	Designing of environmentally safe marine antifoulant.
		14	Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments

		15	An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.
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Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment		12
	• Quiz		
	• Class Test		
	• Attendance		
	• Assignment		
2.	End Semester Examination	3 hr	38

Details of the Course		
Unit	Contents	Contact Hours
1. Introduction	<ul style="list-style-type: none"> · Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry. · Need of green chemistry · Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each). · A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards). 	8
2. Twelve Principles of Green Chemistry	<p>The twelve principles of the Green Chemistry with their explanations Special emphasis on the following:</p> <ul style="list-style-type: none"> · Prevention of waste / byproducts, pollution prevention hierarchy. · Green metrics to assess greenness of a reaction: environmental impact factor, atom economy and calculation of atom economy. · Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources. · Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. · Green energy and sustainability. · Real-time analysis for pollution prevention. · Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD “What you don’t have cannot harm you”, greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation. 	14
3.	The following Real-world Cases in green chemistry should be discussed:	8

Applications	Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO ₂ for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.	
	Total	30
Suggested Books:		
Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Re print
1	Anastas, P.T.; Warner, J.C. Green Chemistry, Theory and Practice , Oxford University Press.	(1998)
2	Lancaster, M, Green Chemistry an Introductory Text .2nd Edition, RSC Publishing.	(2008)
3	Cann ,M. C.; Umile, T.P., Real world cases in Green chemistry Vol 11, American chemical Society, Washington.	(2005)
4	Matlack, A.S., Introduction to Green Chemistry , Marcel Dekker.	(2001)
Mode of Evaluation:	Internal Assessment / End Semester Exam	



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