Course Code	Course Name	Credits
26CH101	GREEN CHEMISTRY	04

Course Objectives

- To understand the principles, need, and impact of green chemistry on environment and health.
- To apply green chemistry methods in synthesis, including microwave-assisted and eco-friendly reactions.
- To analyze green reaction techniques and sustainable approaches for chemical processes and products.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand the principles, scope, and environmental importance of green chemistry and pollution prevention.
- Explain health and environmental impacts of toxic metals and methods for their removal.
- Apply green chemistry techniques such as microwave-assisted, solvent-free, and phase-transfer catalyzed reactions.
- Evaluate sustainable synthetic methods including green synthesis, photochemical reactions, and supercritical fluid applications.

Unit 1 - Green Chemistry (12 Hrs.)

Introduction; need for green chemistry; environmental protection laws; eco-efficiency; challenges; pollution control and prevention; green methods; green products; recycling of waste; green cleaning; greenwashing.

Unit 2 – Green Chemistry and Environmental Health (12 Hrs.)

Principles of green chemistry; origin of green chemistry; awards for green chemistry; international organizations promoting green chemistry; health and environment; methods of removing heavy metals; health impacts of heavy metals including lead, manganese, cobalt, nickel, thallium, tellurium, and selenium; environmental toxins.

Unit 3 - Microwave-Assisted Green Reactions (12 Hrs.)

Microwave activation; advantages of microwave exposure; specific effects of microwaves; neat reactions; solid-support reactions; phase transfer catalysts; solvent-free ester saponification; reactions without support or catalyst with examples; microwave-assisted reactions in water; oxidation of toluene to benzoic acid.

Unit 4 – Green synthesis (12 Hrs.)

Designing green synthesis; choice of starting materials; choice of reagents; choice of catalysts including biocatalysts and polymer-supported catalysts; choice of solvent; synthesis involving the basic principles of green chemistry with examples; synthesis of ibuprofen, adipic acid, methyl methacrylate, and paracetamol.

Unit 5 - Green Reaction Methods (12 Hrs.)

Photoreduction of benzophenone to benzopinacol; photochemical alternative to Friedel–Crafts reaction; use of dimethyl carbonate as a methylating agent; reactions in water including furan and maleic acid reaction; supercritical liquids including water and CO_2; extraction of D-limonene from orange peel.

Reference Books:

1. An introduction to chemistry, V. Kumar, Vishal Publishing Co. Jalandhar, 2007
2. Environmental chemistry, B.K. Sharma, GOEL, Publishing House.
3. New trend in green chemistry by Ahluwalia and M. Kidwai.
4. Green Chemistry, Introductory Text, M Lancaster, Royal Society of Chemistry, London.
5. Introduction to green chemistry, M.A. Ryan, and M. Tinnesan, American Chemical Society, Washington.
6. Handbook of green chemistry and technology, J. Clark and D. Macquarrie, Black well Publication.
7. Solid-Phase Organic synthesis, K. Burgess, Wiley-Interscience.
8. Eco-Friendly synthesis in fine chemicals, F.M. Kerton, Royal Society of Chemistry, London.
9. Alternative solvents for green chemistry, F.M. Kerton, Royal Society of Chemistry, London.

Websites and eLearning Sources:

1. Advanced green synthesis: Solvent-free and catalyst-free reaction - ScienceDirect
2. https://youtu.be/Z0P2xDuWGrw?si=3dhHjUG1gkY2kLeb

COs and Bloom's Taxonomy Mapping – 26CH101		
Course Outcomes	**On completing U.G. program the students will be able to**	**BTL**
CO1	Understand and define the importance of green chemistry and environmental protection laws.	K1, K2
CO2	Apply green technique in preparation of different product.	K3
CO3	Examining their individual contributions to pollution prevention, resource efficiency, and health safety.	K4
CO4	Select and evaluate greener solvent for the ecofriendly synthetic pathway in synthesizing and application in drug development.	K5
CO5	Creating greener catalyst and solvents and making alternative for chemical reagent which profoundly affecting environment and human well-being.	K6

BTL K1 and K2 – remembering and understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6- Create

Relationship Matrix – 26CH101													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	2	1	1	1	3	2	1	1	1	1	1.58
CO2	3	3	2	2	1	1	3	2	2	1	1	2	1.91
CO3	3	3	3	2	2	1	3	3	2	2	1	3	2.33
CO4	3	3	3	2	2	1	3	3	2	2	2	3	2.41
CO5	3	3	3	3	2	2	3	3	3	2	1	3	2.58
												Total	2.16

Mean Score: 3- High, 2- Medium/Moderate, 1-Low