Course Code	Course Name	Credits
26CH603	SUSTAINABLE CHEMISTRY	04

Course Objectives

- This course on sustainable chemistry intends to make the students appreciate the interdisciplinary nature of the concept of development and bring together a holistic perspective in students to function successfully in the development sector.

Learning Outcomes

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

- Understand the principles, goals, and tools of green chemistry for sustainable and eco-friendly chemical processes.
- Apply microwave-assisted, ionic liquid, and phase-transfer catalyzed methods in green organic synthesis.
- Explain the role of supported catalysts and biocatalysts in environmentally benign chemical transformations.
- Evaluate concepts of sustainable development and emerging trends in green and sustainable chemistry practices.

Unit 1 - Green chemistry (12 Hrs.)

Relevance and Goals of Green Chemistry; Anastas' Twelve Principles of Green Chemistry; Tools of Green Chemistry; Environmental Production Laws; Eco-efficiency; Challenges in Green Chemistry; Pollution Control and Prevention; Green Methods; Alternative Starting Materials; Green Reagents; Green Catalysts; Green Solvents; Green Processes (with Suitable Examples).

Unit 2 – Microwave mediated organic synthesis (MAOS) (12 Hrs.)

Microwave Activation; Advantages of Microwave Exposure; Specific Effects of Microwave Irradiation; Neat Reactions; Reactions on Solid Supports; Ionic Liquids – Introduction; Synthesis of Ionic Liquids; Applications of Ionic Liquids (Alkylation, Hydroformylation, Epoxidation); Phase Transfer Catalysis (PTC).

Unit 3 - Supported catalysts and bio-catalysts for Green chemistry (12 Hrs.)

Introduction to Green Chemistry Concepts; Atom Economy; Supported Metal Catalysts; Mesoporous Silicas; Biocatalysts in Green Chemistry; Modified Biocatalysts; Fermentations and Biotransformations; Fine Chemicals by Microbial Fermentations; Production of Vitamins and Amino Acids; Baker's Yeast Mediated Biotransformations; Biocatalyst Mediated Baeyer–Villiger Reactions; Microbial Polyester Synthesis.

Unit 4 – Future Trends in Green Chemistry Oxidation reagents and catalysts (12 Hrs.)

Biomimetic Multifunctional Reagents; Combinatorial Green Chemistry; Proliferation of Solventless Reactions; Covalent Derivatization; Green Chemistry in Sustainable Development.

Unit 5 - Principles of Sustainable Development (12 Hrs.)

History and Emergence of Sustainable Development; Definitions of Sustainable Development; Environmental Issues and Crisis; Socio-Economic Sustainable Development Systems; Socio-Economic Policies for Sustainable Development; Strategies for Implementing Eco-Development Programmes; Role of Developed Countries in the Sustainable Development of Developing Countries.

Reference Books:

1. V. K. Ahluwalia, Green Chemistry–Environmentally benign reactions, 2006, Ane Books India.
2. Paul T. Anastas & Tracy C. Williamson, Green Chemistry–Designing Chemistry for the Environment, 2nd Edn, 1998.
3. Paul T. Anastas & Tracy C. Williamson, Green Chemistry–Frontiers in benign chemical synthesis and processes, 1998, Oxford University Press.
4. M.P. Todaro, and S.C. Smith, Economic Development, 2003, Pearson Education.
5. R.Andres, The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, 2005, New Society Publishers.
6. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.

Websites and eLearning Sources:

1. https://nptel.ac.in/courses/102105087
2. https://www.youtube.com/watch?v=6856okxSZV0

COs and Bloom's Taxonomy Mapping – 26CH603		
Course Outcomes	**On completing P.G. program the students will be able to**	**BTL**
CO1	Recall and explain green chemistry principles, sustainable development, and emerging trends like microwave synthesis and atom economy.	K1, K2
CO2	Apply green chemistry principles to analyze processes and impacts, and assess environmental issues for their influence on sustainability and policy.	K3
CO3	Analyze green chemistry tools and technologies for their impact on sustainability and environmental practices.	K4
CO4	Evaluate green chemistry approaches and global efforts supporting sustainable development.	K5
CO5	Design green chemistry solutions using innovative materials and analyze sustainable development case studies.	K6

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

Relationship Matrix – 26CH603												
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	1	1	3	2	1	2	1	1.81
CO2	2	3	2	2	1	1	3	3	3	3	2	2.27
CO3	3	3	2	1	1	1	3	3	2	2	1	2
CO4	2	2	1	2	1	1	3	3	3	3	1	2
CO5	3	3	3	1	1	1	3	3	3	3	1	2.27
											Total	2.07

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