CHEM3055: GREEN CHEMISTRY

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Green Chemistry

Subject Code
CHEM - Chemistry
Course Number
3055

Academic Unit
Chemistry (CHEM)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
CHEM2006/BCH2006 Principles of Inorganic Chemistry
CHEM2007/BCH2007 Principles of Organic Chemistry
CHEM2008/BCH2008 Principles of Physical Chemistry

Precursors
Nil

Equivalent Courses
BCH3055 Green Chemistry

Exclusive Courses
Nil

Part II Course Details

Abstract

The rapidly increasing worldwide demand for environmentally friendly chemical products and processes requires the application of novel and cost-effective technologies for pollution prevention. Green Chemistry is an emerging new approach focusing on a simple principle that it is better to prevent waste than to treat or clean up waste after it is formed. The course will provide the basic knowledge to select greener solutions in the design and applications of chemicals and chemical processes.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the evolution of the concept of sustainability in general and the origin of the negative image of chemicals and the chemical and petrochemical industry, and describe the 12 principles of green chemistry and provide examples for each.	25	x		x
2	Compare and contrast the advantages and disadvantages of alternative media including water, fluorous and ionic liquids, supercritical media, and extended liquids.	20		x	
3	Evaluate the advantages and disadvantages of homogeneous and heterogeneous catalysis.	25		x	x
4	Discuss the chemistry of reusable chemicals and materials.	10			x
5	Design a list of criteria to evaluate the feasibility of a project / plan related to sustainable development for energy and carbon based chemicals.	20	x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will learn the major milestones of the evolution of the concept of sustainability and examples of the negative effect of chemicals.	1	

2	Lectures	Students will learn the 12 principles through several examples; they will also calculate E-factor and atom economy for the examples.	1	
3	Videos	Through the use of videos, students will learn the advantages and disadvantages of various solvents.	2	
4	Videos	Through the use of videos, students will learn the advantages and disadvantages of various solvents in different catalytic systems.	3	
5	Tutorials	In tutorials, students will learn from activities including debate, role play and online discussion.	4	
6	Group work	Students will join group work to compose a list of criteria for online discussion.	5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Group Presentations	1	10	
2	Individual Presentations	1, 2, 3, 4	15	
3	Written Report	5	25	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Starting from Semester A, 2015-16, students must satisfy the following minimum passing requirement for courses offered by CHEM: "A minimum of 40% in both coursework and examination components."

Assessment Rubrics (AR)

Assessment Task

Group Presentation

Criterion

ABILITY to EXPLAIN in DETAIL the principles of green chemistry and their use in the design of green technologies

Excellent (A+, A, A-)
Student is expected to give an excellent presentation demonstrating strong knowledge in the subject matter

Good (B+, B, B-)
Student is expected to give a good presentation showing satisfactory knowledge in the subject matter.

Fair (C+, C, C-)
Student is expected to give a presentation showing sufficient knowledge in the subject matter.

Marginal (D)
Student is expected to give a presentation showing limited knowledge in the subject matter.

Failure (F)
Student shows no preparation for the presentation and/or does not submit the written essay.

Assessment Task
Individual Presentation

Criterion
ABILITY to EXPLAIN in DETAIL the definition of sustainability and the principles of green chemistry and their combined use in the design of green technologies

Excellent (A+, A, A-)
Student is expected to give an excellent presentation demonstrating strong knowledge in the subject matter

Good (B+, B, B-)
Student is expected to give a good presentation showing satisfactory knowledge in the subject matter.

Fair (C+, C, C-)
Student is expected to give a presentation showing sufficient knowledge in the subject matter.

Marginal (D)
Student is expected to give a presentation showing limited knowledge in the subject matter.

Failure (F)
Student shows no preparation for the presentation and/or does not submit the written essay.

Assessment Task
Written Report

Criterion
CAPACITY for SELF-DIRECTED LEARNING to understand the principles of green chemistry
ABILITY to EXPLAIN the design and procedures

Excellent (A+, A, A-)
Student is expected to submit an excellent report demonstrating strong knowledge in the subject matter

Good (B+, B, B-)
Student is expected to submit a good report showing satisfactory knowledge in the subject matter.

Fair (C+, C, C-)
Student is expected to submit a report showing sufficient knowledge in the subject matter.

Marginal (D)
Student is expected to submit a report showing limited knowledge in the subject matter.

Failure (F)
Student fails to submit a report.

Assessment Task
Examination

Criterion
ABILITY to ANSWER QUESTIONS in DETAIL concerning the definition of sustainability and the principles of green chemistry, their use in the design of reaction environments including solvents, reagents, catalysts, efficient energy supply systems, in situ monitoring, renewable resource options, recycling and their integration to green and sustainable technologies.

Excellent (A+, A, A-)
Student is expected to show strong evidence of original thinking; good organization, capacity to analyse and synthesize the subject matter; superior grasp of knowledge is required.

Good (B+, B, B-)
Student is expected to demonstrate evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with knowledge.

Fair (C+, C, C-)
Student is expected to show sufficient evidence of the subject, little evidence of critical capacity and analytic ability; fair understanding of issues.

Marginal (D)
Student is expected to demonstrate little familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)
Student shows no evidence of familiarity with the subject matter; weakness in critical and analytic skills; limited, or irrelevant understanding of knowledge.

Part III Other Information

Keyword Syllabus
Accidents, Algae, Aqueous, Atom economy
Biodiesel, Bioethanol, Biofuels, Bio-inspired, Biomass
Catalysis, Chemicals, Chemofobia
Environmental factor, Enzymes, Extended liquids
Fluorous
Glass, Global warming, Green chemistry
Heterogeneous, Homogeneous
Ionic liquids
Metals, Microwave, MTBE
Organic, Ozone hole
Plastics, Pollution, Prevention, Principles

Real time monitoring, Recycling, Rubber
Sonocation, Super critical media, Sustainability, Sustainable developments
Toxicity
Unleaded gasoline
Zeolites

Reading List

Compulsory Readings

	Title
1	Anastas, P. T. and Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press, Oxford, 1998.
2	Anastas, P. T. Origins and Early History of Green Chemistry, Series on Chemistry, Energy and the Environment, Advanced Green Chemistry, Part 1: Greener Organic Reactions and Processes, Horváth, I. T.; Malacria, M. (Eds.) World Scientific: Singapore, 2018.
3	Horváth, I. T. Sustainable Chemistry, Chemical Reviews 2018, 118, 369.

Additional Readings

	Title
1	Mike Lancaster, Green Chemistry 3rd Edition: An Introductory Text, RSC Publishing, 2016.
2	Online Resources Green Chemistry at the University of Oregon, http://greenchem.uoregon.edu/