

# CHEM3055: GREEN CHEMISTRY

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## Effective Term

Semester A 2025/26

## 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 DEC-A1 DEC-A2 DEC-A3 app.)			
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, fluorinated 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 ("- " for nil entry)	Allow Use of GenAI?
1	Group Presentations	1	10	-	Yes
2	Individual Presentations	1, 2, 3, 4	15	-	Yes
3	Written Report	5	25	-	Yes

**Continuous Assessment (%)**

50

**Examination (%)**

50

**Examination Duration (Hours)**

2

**Minimum Continuous Assessment Passing Requirement (%)**

40

**Minimum Examination Passing Requirement (%)**

40

**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.

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### 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.

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### 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.

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**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.

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**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, <a href="http://greenchem.uoregon.edu/">http://greenchem.uoregon.edu/</a>