CHEM8131: ADVANCED ORGANIC CHEMISTRY

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Advanced Organic Chemistry

Subject Code
CHEM - Chemistry
Course Number
8131

Academic Unit
Chemistry (CHEM)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
4

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
BCH8131 Advanced Organic Chemistry

Exclusive Courses
Nil

Part II Course Details

Abstract
This course aims to:
- introduce organic chemistry of aldol reactions and enolate anions;

- explain the structures and reactions of carbohydrates and lipids;
- introduce basic strategies of multi-step organic syntheses;
- explain conformational, steric, and stereoelectronic effects of organic molecules;
- critically evaluate organic reaction mechanisms;
- develop knowledge of nucleophilic substitution reaction.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the concepts and basic principles of aldol reactions and enolate anions; describe the principles of chemistry in carbohydrates and lipids.		x	x	
2	Apply the strategies and principles in multi-step organic syntheses.		x	x	x
3	Compare and contrast conformational, steric, and stereoelectronic effects of organic molecules.		x	x	
4	Apply various techniques in studying organic reaction mechanisms.		x	x	x
5	Explain various factors affecting nucleophilic substitution reactions.		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 and tutorials	Students will learn the concept of enolate, the principles of aldol reaction, and the structures and reactions of carbohydrates and lipids through discovery-based teaching and learning activities in lectures and tutorials.	1	

2	Lectures and tutorials	Students will learn basic strategies of multi-step organic syntheses through discovery-based teaching and learning activities in lectures and tutorials.	2	
3	Lectures and tutorials	Students will learn the conformational, steric, and stereoelectronic effects of organic molecules through discovery-based teaching and learning activities in lectures and tutorials.	3	
4	Lectures and tutorials	Students will learn basic concepts and principles of modern techniques used in studying organic reaction mechanisms through discovery-based teaching and learning activities in lectures and tutorials.	4	
5	Lectures and tutorials	Students will learn various factors affecting nucleophilic substitution reactions through discovery-based teaching and learning activities in lectures and tutorials.	5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Short Quizzes	1, 2, 3, 4, 5	30	-	Yes

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

Minimum Continuous Assessment Passing Requirement (%)

40

Minimum Examination Passing Requirement (%)

40

Assessment Rubrics (AR)

Assessment Task

Short Quizzes (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Ability to explain chemical reaction/reactivity based on the knowledge of organic chemistry listed in section 3.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Ability to propose practical solutions/methods to new organic chemical transformation; ability to explain the mechanism of organic chemical reaction.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Short Quizzes (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Ability to explain chemical reaction/reactivity based on the knowledge of organic chemistry listed in section 3.

Excellent
(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Ability to propose practical solutions/methods to new organic chemical transformation; ability to explain the mechanism of organic chemical reaction.

Excellent

(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- aldol reactions and enolate anions: keto and enol tautomers, crossed aldol reaction, cyclization via aldol condensation, Michael addition, Robinson annulation
- carbohydrates and lipids: mutarotation, monosaccharide, alditol, osazone, disaccharide, polysaccharide, reducing sugar vs non-reducing sugar, fatty acids and triacylglycerols, terpenes and terpenoids, steroids, prostagladins, phospholipids and cell membranes, waxes
- multi-step organic syntheses: protective group, synthetic analysis and planning, retrosynthetic analysis, control of stereochemistry, convergent and linear synthesis
- conformational, steric, and stereoelectronic effects: steric strain, heteroatom, angle strain, conformational analysis, axial vs equatorial
- organic reaction mechanisms: kinetic vs thermodynamic control, substituent effect, isotope effect, solvent effect, catalysis

- nucleophilic substitution reaction: Sn1 vs Sn2 reaction, carbocations, nucleophilicity, leaving group effects, neighboring-group participation, rearrangement

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Organic Chemistry, T.W.G. Solomons (John Wiley and Sons, 7th or 8th edition)
2	Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg