

Course Syllabus

offered by Department of Chemistry with effect from Semester A 2023/24

This form is for the completion by the <u>Course Leader</u>. The information provided on this form is the official record of the course. It will be used for the City University's database, various City University publications (including websites) and documentation for students and others as required.

Please refer to the Explanatory Notes on the various items of information required.

Prepared / Last Updated by:

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City University of Hong Kong Course Syllabus

offered by Department of Chemistry with effect from Semester A 2023/24

Part I Course Overview

Course Title:	Advanced Organic Chemistry
Course Code:	CHEM4031
Course Duration:	1 semester
Credit Units:	4 credits
Level:	B4
	Arts and Humanities
Proposed Area: (for GE courses only)	Study of Societies, Social and Business Organisations Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites : <i>(Course Code and Title)</i>	Nil
Precursors: (Course Code and Title)	CHEM2007/BCH2007 Principles of Organic Chemistry CHEM3015/BCH3015 Organic Chemistry
Equivalent Courses : <i>(Course Code and Title)</i>	BCH4031 Advanced Organic Chemistry
Exclusive Courses : (Course Code and Title)	Nil

Part II **Course Details**

1. Abstract

(A 150-word description about the course)

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; •
- explain how nature synthesizes organic molecules and compare biosynthetic reactions and synthetic • organic reactions.

2. **Course Intended Learning Outcomes (CILOs)**

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs#	Weighting* (if applicable)	Discov curricu learnin (please	very-en ilum rel ig outco e tick	riched lated omes where
				$\Delta 2$	43
1.	Understand the principles of advanced ¹ H/ ¹³ C NMR spectroscopies for molecular structural analysis.	25	$\sqrt{11}$	$\sqrt{\frac{112}{}}$	$\sqrt{10}$
2.	Develop general problem-solving strategy with a good understanding of the fundamentals of organic reaction mechanisms.	25	V	V	V
3.	Compare and contrast conformational, steric, and stereoelectronic effects of organic molecules; Pericyclic reactions.	20	V	V	V
4.	Apply the strategies, principles, and organic chemistry in natural products chemistry, bioorganic chemistry, and biosynthesis,.	30	V	V	V
* If we	righting is assigned to CILOs, they should add up to 100%.	100%			

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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 self-life problems.

Accomplishments A3:

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

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.			Hours/week	
		1	2	3	4	(if applicable)
Lectures and	Teaching and learning will be	\checkmark				
tutorials	primarily based on lectures and					
	tutorials explaining the concept of					
	advanced ¹ H/ ¹³ C NMR spectroscopies					
Lectures and	Teaching and learning will be		\checkmark			
tutorials	primarily based on lectures explaining					
	basic concepts and principles of					
	modern techniques used in studying					
	organic reaction mechanisms.					
Lectures and	Teaching and learning will be			\checkmark		
tutorials	primarily based on lectures and					
	tutorials explaining basic strategies of					
	multi-step organic syntheses, natural					
	product biosynthesis					
Lectures and	Teaching and learning will be				\checkmark	
tutorials	primarily based on lectures and					
	tutorials examining conformational,					
	steric, and stereoelectronic effects of					
	organic molecules.					

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	(CILO No.).	Weighting*	Remarks
	1	2	3	4		
Continuous Assessment: <u>30</u> %						
Short Quizzes/ Assignment	\checkmark	\checkmark	\checkmark	\checkmark	30%	
Examination: <u>70</u> % (duration: 3 hours)						
* The weightings should add up to 100%.					100%	

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."

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent	Good	Fair	Marginal	Failure
		(A+, A, A-)	(B+, B, B-)	(C+, C, C-)	(D)	(F)
 Short Quizzes/ Assignment 	Student completes the activity demonstrates grasp of the important concepts to the topic concerned	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Examination	Student demonstrates grasp of the important concepts to the topic concerned, and can apply these concepts to solve problems. Strong evidence of demonstrated use of concepts for rationalization, with some originality in thought and argument.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

- Aldol reactions and enolate anions: keto and enol tautomers, crossed aldol reaction, cyclization via aldol condensation, Michael addition, Robinson annulation
- Nuclear Magnetic Resonance spectroscopy, advanced 1D and 2D ¹H/¹³C NMR techniques
- 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
- Mechanistic and Physical Organic Chemistry: organic reaction mechanisms, kinetic vs thermodynamic control, substituent effect, isotope effect, solvent effect, catalysis
- Nucleophilic substitution reaction: S_N1 vs S_N2 reaction, carbocations, nucleophilicity, leaving group effects, neighboring-group participation, rearrangement
- Frontier molecular orbital interactions and their application to: electrocyclic reactions, cycloadditions, sigmatropic rearrangements. Woodward-Hoffmann rules for pericyclic reactions.
- Acetate pathway, mevalonate and methylerythritol phosphate (MEP) pathways, peptide biosynthesis.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	
2.	
3.	

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

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
3.	Medicinal Natural Products: A Biosynthetic Approach; Paul M. Dewick (John Wiley & Sons, Ltd, 3 rd Edition). The electronic version of the textbook is available from the CityU Library: <u>https://onlinelibrary.wiley.com/doi/book/10.1002/9780470742761</u>

A. Please specify the Gateway Education Programme Intended Learning Outcomes (PILOs) that the course is aligned to and relate them to the CILOs stated in Part II, Section 2 of this form:

GE PILO	Please indicate which CILO(s) is/are related to this PILO, if any (can be more than one CILOs in each PILO)
PILO 1: Demonstrate the capacity for self-directed learning	
PILO 2: Explain the basic methodologies and techniques of inquiry of the arts and humanities, social sciences, business, and science and technology	
PILO 3: Demonstrate critical thinking skills	
PILO 4: Interpret information and numerical data	
PILO 5: Produce structured, well-organised and fluent text	
PILO 6: Demonstrate effective oral communication skills	
PILO 7: Demonstrate an ability to work effectively in a team	
PILO 8: Recognise important characteristics of their own culture(s) and at least one other culture, and their impact on global issues	
PILO 9: Value ethical and socially responsible actions	
PILO 10: Demonstrate the attitude and/or ability to accomplish discovery and/or innovation	

GE course leaders should cover the mandatory PILOs for the GE area (Area 1: Arts and Humanities; Area 2: Study of Societies, Social and Business Organisations; Area 3: Science and Technology) for which they have classified their course; for quality assurance purposes, they are advised to carefully consider if it is beneficial to claim any coverage of additional PILOs. General advice would be to restrict PILOs to only the essential ones. (Please refer to the curricular mapping of GE programme: http://www.cityu.edu.hk/edge/ge/faculty/curricular_mapping.htm.)

B. Please select an assessment task for collecting evidence of student achievement for quality assurance purposes. Please retain at least one sample of student achievement across a period of three years.

Selected Assessment Task		