

Course Syllabus

**offered by Department of Chemistry
with effect from Semester A 2021/22**

This form is for the completion by the *Course Leader*. 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 2021/22**

Part I Course Overview

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

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) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) | | |
|-----|---|-------------------------------|---|----|----|
| | | | A1 | A2 | A3 |
| 1. | Advanced ¹ H/ ¹³ C NMR spectroscopies. | 25 | √ | √ | √ |
| 2. | Mechanistic and Physical Organic Chemistry for organic reaction mechanisms. | 20 | √ | √ | √ |
| 3. | Compare and contrast conformational, steric, and stereoelectronic effects of organic molecules; Pericyclic reactions. | 20 | √ | √ | √ |
| 4. | Apply the strategies, principles, and organometallic chemistry in multi-step organic syntheses, and natural product biosynthesis. | 35 | √ | √ | √ |
| | | 100% | | | |

* If weighting is assigned to CILOs, they should add up to 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.

A3: Accomplishments

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 (if applicable) |
|------------------------|---|----------|---|---|---|-------------------------------|
| | | 1 | 2 | 3 | 4 | |
| Lectures and tutorials | Teaching and learning will be primarily based on lectures and tutorials explaining the concept of advanced $^1\text{H}/^{13}\text{C}$ NMR spectroscopies | ✓ | | | | |
| Lectures and tutorials | Teaching and learning will be primarily based on lectures explaining basic concepts and principles of modern techniques used in studying organic reaction mechanisms. | | ✓ | | | |
| Lectures and tutorials | Teaching and learning will be primarily based on lectures and tutorials explaining basic strategies of multi-step organic syntheses, natural product biosynthesis | | | ✓ | | |
| Lectures and tutorials | Teaching and learning will be 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 | ✓ | ✓ | ✓ | ✓ | 30% | |
| Examination: <u>70%</u> (duration: 3 hours) | | | | | | |
| | | | | | 100% | |

* The weightings should add up to 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 (A+, A, A-) | Good (B+, B, B-) | Fair (C+, C, C-) | Marginal (D) | Failure (F) |
|---------------------------------|--|--------------------------|---------------------|---------------------|-----------------|-----------------------------------|
| 1. 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 $^1\text{H}/^{13}\text{C}$ 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: $\text{S}_{\text{N}}1$ vs $\text{S}_{\text{N}}2$ 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.

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, 7 th or 8 th edition) |
| 2. | Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg |

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 |
|---------------------------------|
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