SYL-TPG (Interim)

香港城市大學
City University of Hong Kong

Course Syllabus

offered by Department of Chemistry with effect from Semester A 2024/25

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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Part I Course Overview

Course Title:	Frontiers in Modern Synthetic Chemistry
Course Code:	CHEM6131
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

(A 150-word description about the course)

This course aims to explore the cutting edge of synthetic technologies and methodologies for the synthesis of functional molecules, advanced materials, and pharmaceuticals. Synthetic chemistry is of vital significance in multiple disciplines, such as medicinal chemistry, material science, chemical biology, and many other areas. In this course, different areas of synthetic chemistry, including asymmetric catalysis, electrochemical synthesis, photoredox catalysis, flow chemistry, main group element chemistry, and other relevant technologies will be introduced. Upon completion of this course, students will attain a comprehensive view of advanced synthetic chemistry, which will endow them with the ability to enter different research areas in their future careers.

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.	Introduce the asymmetric synthesis based on organic and organometallic catalytic methods, the catalytic system design, mechanism studies as well as their applications in pharmaceutical synthesis.	10		√	√
2.	Demonstrate the utilization and advantages of advanced approaches of molecule synthesis, including photo- and electro-chemical techniques.	10	√	√	
3.	Describe the basic concepts of continuous flow chemistry and its application in modern organic synthesis.	10	√	√	
4.	Describe the equipment and technique used in modern synthetic chemistry.	10		√	√
5.	Introduce the synthesis and structure of reactive main-group compounds.	10	√	√	√
6.	Describe the application of main-group compounds in small-molecule activation, catalysis, and organic synthesis.	10		√	√
7.	Show the ability to search references, identify scientific problems, propose solutions, and give presentations in class.	40	√	√	√
** If weighting is assigned to CILOs, they should add up to 100%.*		100%			

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	5	6	7	
Lectures	Students will be introduced to the importance of chirality, the designing principle of asymmetric catalysis, advanced photo-/electrochemical synthetic technologies, mechanistic understanding, and practical applications in industrial production.	√	√						
Lectures	Students will be introduced to the fundamental principles of continuous flow chemistry, working principles of flow equipment, recent examples of continuous flow synthesis, and the development of continuous flow systems.			√	√				
Lectures	Teaching and learning will be based on a combination of lectures and tutorials to explain the synthesis, structure, and reactivity of main-group compounds.					√	√		
Quizzes	Quizzes will be included in each lecture class to reinforce the understanding of learning contents and set it as one of the assessments of students' competence.	√	√	√	√	√	√		
Assignments	Assignments will be arranged to consolidate the classroom learning and in-depth understanding of related knowledge, including asymmetric organic catalysts, organometallic catalysts, mechanism of chiral induction, mechanism of photo- and electrochemical processes, principles of continuous flow chemistry, the main group chemistry.	√	√	√	√	√	√		
Presentation	A presentation of relevant synthetic topics will be conducted to enhance students' self-learning ability, expression skills, literature-searching ability, and teamwork spirit.							√	

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	5	6	7		
Continuous Assessment: 100%									
In-class tutorials and quizzes Tutorials and quizzes will be arranged in each lecture class to test the learning quality.	√	√	√	√	√	√		30%	
Out-class assignments One assignment on asymmetric catalysis, photochemistry, and electrochemical synthesis; one assignment on continuous flow technology; one assignment on main group chemistry.	√	√	√	√	√	√		30%	
Presentation A selected topic, either given by teachers or chosen by students themselves, related to advanced synthetic technology will be assigned to individuals or groups for presentation.							√	40%	2 assessors will be arranged to give an objective and comprehensive evaluation.
Examination: 0%									
** The weightings should add up to 100%.*								100%	

Starting from Semester A, 2015-16, students must satisfy the following minimum passing requirement for CHEM courses:

"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)	Marginal (B-, C+, C)	Failure (F)
1. Quizzes	The extent of mastery of class learning outcome, ability to solve practice problems, including the design of synthetic routes for target molecules, reaction mechanisms, flow system design, structure, and reactivity of main group chemistry.	Very proficient and high ability to analyze and solve practice problems.	Good analysis and problem-solving skills.	Basic ability to analyze and solve problems.	Not even reaching marginal levels.
2. Assignments	Ability to periodically summarize and recall the in-class learning knowledge; the depth and width of understanding and memory of various synthetic methods and technologies; ability to apply in-class learning concepts for rationalization and to solve chemical problems.	High ability and excellent performance in solving practice problems.	Good ability to solve practice problems.	Basic ability to solve practice problems.	Not even reaching marginal levels.
3. Presentation	Ability to search reference, extract, and summarize scientific ideas; capability of self-learning and analysis of critical problems; skills of expression and convincing others.	Very fluent expression and articulate, audience been well convinced.	Good expression, critical problems, and ideas are well-received by the audience.	Basic complement.	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.)

Synthetic Chemistry
Material science. Physical science. Medicinal chemistry.

Asymmetric Synthesis
Chirality. Asymmetric catalysis. Organic catalyst. Organometallic catalyst. Chiral pharmaceuticals.

Photo-/Electrochemical Synthesis
Sustainable chemistry. Photoredox reaction. Electrochemical oxidation. Electrochemical reduction.

Continuous Flow Chemistry
Working principles of flow equipment. Establishment of continuous flow system. Advantages of continuous flow chemistry.

Main Group Chemistry
Small molecular activation. Metal-free catalysis. Main-group compounds.

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.	Mukherjee, S.; Yang, J. W.; Hoffmann, S.; List, B., Asymmetric Enamine Catalysis. *Chem. Rev.* **2007,** *107*, 5471-5569.
2.	Yan, M.; Kawamata, Y.; Baran, P. S., Synthetic Organic Electrochemical Methods Since 2000: On the Verge of a Renaissance. *Chem. Rev.* **2017,** *117*, 13230-13319.
3.	Chan, A. Y.; MacMillan, D. W. C., *et.al.* Metallaphotoredox: The Merger of Photoredox and Transition Metal Catalysis. *Chem. Rev.* **2022,** *122*, 1485-1542.
4.	Plutschack, M. B.; Pieber, B.; Gilmore, K.; Seeberger, P. H., The Hitchhiker's Guide to Flow Chemistry. *Chem. Rev.* **2017,** *117*, 11796-11893.
5.	Stephan, D. W.; Erker, G., Frustrated Lewis Pair Chemistry: Development and Perspectives. *Angew. Chem. Int. Ed.* **2015,** *54*, 6400-6441.

2.2 Additional Readings

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

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2.	
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