City University of Hong Kong
Course Syllabus

offered by Department of Chemistry
with effect from Semester A 2022/23

Part I Course Overview

Course Title:	Frontiers in Chemical Biology
Course Code:	CHEM6119
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)*	BCH6119 Frontiers in Chemical Biology
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to enable students to gain knowledge and training in chemical biology and to understand how to use chemical approaches to study biological systems. Building from fundamental knowledge in both chemistry and biology aspects, the course will cover different topics in chemical biology including the fundamentals of chemical biology, metal-based drugs, drug delivery, combinatorial synthesis, high-throughput screening, DNA-based self-assembly, biomolecular sensing and bioimaging, and other advanced topics in chemical biology. The skills and understanding accumulated during this course will prepare students for more advanced and specialized research projects at the interface of chemistry and biology.

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.	Describe the basic concepts in chemical biology including central dogma of biology, peptides and proteins, nucleic acids, carbohydrates, etc.	10%	✓		
2.	Explain nucleic acids as drug targets and the mechanism of metal-based drugs as well as other DNA-damaging anticancer drugs	15%		✓	
3.	Describe the basic principle and the recent progress in drug delivery using marketed nanomedicines as examples	15%			✓
4.	Explain enzymes as drug targets, the design of enzyme inhibitors and antibiotics as well as their industrial applications	15%	✓	✓	
5.	Describe the basic concepts of peptide structure and synthesis, and introduce peptide-based drugs	15%	✓	✓	
6.	Describe the basic concepts in nucleic acid structure and synthesis (nucleosides, nucleotides and analogues, protecting groups, concept of solid-phase synthesis, mechanism of DNA and/or RNA synthesis)	20%	✓	✓	
7.	Discover the interactive role of oligonucleotides in the area of nanotechnology	10%			✓
		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 fundamental principles of chemical biology, metal-based drugs, and drug delivery.	✓	✓						
Lectures	Students will be introduced to peptide structure, peptide synthesis and design of peptide-based drugs.			✓					
Lectures	Students will be introduced to enzyme classification and applications, catalytic mechanism, and different types of inhibitors.				✓				
Lectures	Students will be introduced to the concepts in nucleic acid structure and synthesis including protecting groups, solid-phase synthesis, mechanism of DNA and/or RNA synthesis.					✓			
Lectures	Students will be introduced to the interactive role of oligonucleotides in the area of nanotechnology.						✓	✓	
Tutorials	Tutorials to provide students with training on the topics relevant to basic concepts, anticancer drugs, peptide synthesis, nucleic acid synthesis and structure.	✓	✓		✓	✓	✓		
Assignments	Assignments will be arranged for students to demonstrate extensive knowledge and skills, information searching ability, and problem-solving ability relevant to the DNA-damaging agents, drug delivery, combinatorial synthesis, high-throughput screening, oligonucleotide synthesis, peptide synthesis, enzyme inhibitors, DNA-based self-assembly, biomolecular sensing and bioimaging, and other advanced topics in chemical biology.	✓	✓	✓	✓	✓	✓	✓	

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: 30%									
Written assignments One assignment on oligonucleotide soli-phase synthesis and DNA-based self-assembly; one assignment on peptide synthesis and peptide-based drugs; one assignment on anticancer drugs; and one assignment on DNA sequencing.	✓	✓	✓	✓	✓	✓	✓	30%	
Examination: 70% (duration: 3 hours)									
Examination	✓	✓	✓	✓	✓	✓	✓	70%	
								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.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Assignments	Ability to analyze and solve problems relevant to the DNA-damaging agents, drug delivery, combinatorial synthesis, high-throughput screening, oligonucleotide synthesis, peptide synthesis, enzyme inhibitors, DNA-based self-assembly, biomolecular sensing and bioimaging, and other advanced topics in chemical biology.	Very high ability to analyze and solve problems.	Good analysis and problem-solving skills.	Basic ability to analyze and solve problems.	Not even reaching marginal levels.
2. Examination	Ability to describe the major concepts and chemical processes related to chemical biology; ability to describe the nucleic acid structure and synthesis and compare the synthesis and mechanism of action of different types of DNA-damaging anticancer drugs; ability to describe the drug delivery processes and propose strategies against the potential issues; ability to describe the peptide structure and synthesis; ability to differentiate different kinds of inhibitors.	High ability to describe the concepts, processes, chemical structures, and to differentiate the differences.	Good ability to describe the concepts, processes, chemical structures, and to differentiate the differences.	Basic ability to describe the concepts, processes, chemical structures, and to differentiate the differences.	Not even reaching marginal levels.

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignments	Ability to analyze and solve problems relevant to the DNA-damaging agents, drug delivery, combinatorial synthesis, high-throughput screening, oligonucleotide synthesis, peptide synthesis, enzyme inhibitors, DNA-based self-assembly, biomolecular sensing and bioimaging, and other advanced topics in chemical biology.	Very high ability to analyze and solve problems.	Good analysis and problem-solving skills.	Moderate ability to analyze and solve problems.	Basic ability to analyze and solve problems.	Not even reaching marginal levels.
2. Examination	Ability to describe the major concepts and chemical processes related to chemical biology; ability to describe the nucleic acid structure and synthesis and compare the synthesis and mechanism of action of different types of DNA-damaging anticancer drugs; ability to describe the drug delivery processes and propose strategies against the potential issues; ability to describe the peptide structure and synthesis; ability to differentiate different kinds of inhibitors.	High ability to describe the concepts, processes, chemical structures, and to differentiate the differences.	Good ability to describe the concepts, processes, chemical structures, and to differentiate the differences.	Moderate ability to describe the concepts, processes, chemical structures, and to differentiate the differences.	Basic ability to describe the concepts, processes, chemical structures, and to differentiate the differences.	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.)

Basic Concepts
Chemical biology. Central dogma of biology. Peptides and proteins. Nucleic acids. Carbohydrates.

Metal-Based Drugs
DNA-damaging anticancer drugs. Cisplatin. Mechanism of action of platinum-based drugs. DNA repair. Other metal-based drugs.

Drug Delivery
Basic principles of drug delivery. Endocytosis. Enhanced permeability and retention effect. Nanomedicine.

Enzymes and Inhibitors
Enzyme classification and catalytic mechanism. Different mechanism of enzyme inhibition. Industrial applications of enzymes.

Peptide and Combinatorial Chemistry
Basic structure and chemical synthesis of peptides. The concept of combinatorial chemistry library. Design of peptide-based drugs.

Nucleic Acids
Basic chemical structure and synthesis (nucleoside, nucleotides and analogues, protecting groups, concept of solid-phase synthesis and mechanism of DNA/RNA synthesis).

Phosphorus Compounds
Structure, nomenclature, phosphates: mechanism of hydrolysis, chemical cleavage of DNA & RNA.

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.)

Nil

2.2 Additional Readings

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

1.	Vranken, D. V. and Weiss, G. A. (2013) *Introduction to Bioorganic Chemistry and Chemical Biology*. New York: Garland Science