CHEM6119: FRONTIERS IN CHEMICAL BIOLOGY

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Frontiers in Chemical Biology

Subject Code
CHEM - Chemistry
Course Number
6119

Academic Unit
Chemistry (CHEM)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
BCH6119 Frontiers in Chemical Biology

Exclusive Courses
Nil

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the basic concepts in chemical biology including the central dogma of biology, peptides and proteins, nucleic acids, carbohydrates, etc.	20	x		
2	Explain nucleic acids as drug targets and the mechanism of metal-based drugs as well as other DNA-damaging anticancer drugs	15		x	
3	Explain enzymes as drug targets, the design of enzyme inhibitors and antibiotics as well as drug resistance; explain structure-activity relationships	15	x	x	
4	Describe the basic concepts in nucleic acid structure and synthesis (nucleosides, nucleotides and analogues, protecting groups, the concept of solid-phase synthesis, mechanism of DNA and/or RNA synthesis); describe the chemistry of DNA sequencing	30	x	x	
5	Discover the interactive role of oligonucleotides in the area of nanotechnology; describe the basic principle and the recent progress in drug delivery	20			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	Students will learn the fundamental principles of chemical biology, metal-based drugs, and drug discovery.	1, 2, 3	

2	Lectures	Students will learn the concepts in nucleic acid structure and synthesis including protecting groups, solid-phase synthesis, mechanism of DNA and/or RNA synthesis.	4	
3	Lectures	Students will learn the interactive role of oligonucleotides in the area of nanotechnology.	4, 5	
4	Tutorials	Students will obtain training on topics relevant to basic concepts, anticancer drugs, peptide synthesis, nucleic acid synthesis, and structure.	1, 2, 3, 4	
5	Assignments	Students will demonstrate extensive knowledge and skills, information-searching ability, and problem-solving ability relevant to the DNA-damaging agents, drug discovery 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.	1, 2, 3, 4, 5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Written assignments One assignment on oligonucleotide soli-phase synthesis and DNA-based self-assembly; one assignment on anticancer drugs; and one assignment on DNA sequencing.	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
1. Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Ability to analyze and solve problems relevant to the DNA- damaging agents, drug discovery 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.

Excellent
(A+, A, A-) Very high ability to analyze and solve problems.

Good
(B+, B, B-) Good analysis and problem-solving skills.

Fair
(C+, C, C-) Moderate ability to analyze and solve problems.

Marginal
(D) Basic ability to analyze and solve problems.

Failure
(F) Not even reaching marginal levels.

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

Criterion
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 discovery processes and propose strategies against the potential issues; ability to describe the peptide structure and synthesis; ability to differentiate different kinds of inhibitors.

Excellent
(A+, A, A-) High ability to describe the concepts, processes, chemical structures, and to differentiate the differences.

Good
(B+, B, B-) Good ability to describe the concepts, processes, chemical structures, and to differentiate the differences.

Fair

(C+, C, C-) Moderate ability to describe the concepts, processes, chemical structures, and to differentiate the differences.

Marginal

(D) Basic ability to describe the concepts, processes, chemical structures, and to differentiate the differences.

Failure

(F) Not even reaching marginal levels.

Part III Other Information

Keyword Syllabus

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.

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.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

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