

## Course Syllabus

**offered by Department of Chemistry  
with effect from Semester A 2020/21**

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:**

|              |  |                |                                |
|--------------|--|----------------|--------------------------------|
| Name:        | <u>Dr. Guangyu Zhu</u>                       | Academic Unit: | <u>Department of Chemistry</u> |
| Phone/email: | <u>3442 6857 /<br/>guangzhu@cityu.edu.hk</u> | Date:          | <u>18 November 2019</u>        |

**City University of Hong Kong  
Course Syllabus**

**offered by Department of Chemistry  
with effect from Semester A 2020/21**

---

---

**Part I Course Overview**

|  |   |
|--|---|
| <b>Course Title:</b>   | Frontiers in Chemical Biology   |
| <b>Course Code:</b>  | CHEM6119  |
| <b>Course Duration:</b>                                      | 1 semester  |
| <b>Credit Units:</b>   | 3 credits   |
| <b>Level:</b>  | P6  |
| <b>Proposed Area:</b><br><i>(for GE courses only)</i>        | <input type="checkbox"/> Arts and Humanities<br><input type="checkbox"/> Study of Societies, Social and Business Organisations<br><input type="checkbox"/> Science and Technology |
| <b>Medium of Instruction:</b>                                | English   |
| <b>Medium of Assessment:</b>                                 | English   |
| <b>Prerequisites:</b><br><i>(Course Code and Title)</i>      | Nil   |
| <b>Precursors:</b><br><i>(Course Code and Title)</i>         | Nil   |
| <b>Equivalent Courses:</b><br><i>(Course Code and Title)</i> | BCH6119 Frontiers in Chemical Biology   |
| <b>Exclusive Courses:</b><br><i>(Course Code and Title)</i>  | Nil   |

## Part II Course Details

### 1. Abstract

(A 150-word description about the course)

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 <sup>#</sup>   | Weighting*<br>(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%                          |   |    |    |

\* If weighting is assigned to CILOs, they should add up to 100%.

<sup>#</sup> 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 | 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<br>* | Remarks |
|---|----------|---|---|---|---|---|---|----------------|---------|
|   | 1        | 2 | 3 | 4 | 5 | 6 | 7 |                |         |
| Continuous Assessment: <u>30%</u>   |          |   |   |   |   |   |   |                |         |
| Written assignments<br>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: <u>70%</u> (duration: 3 hours)   |          |   |   |   |   |   |   |                |         |
| Examination   | ✓        | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 70%            |         |

\* 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<br>(A+, A, A-)   | Good<br>(B+, B, B-)  | Fair<br>(C+, C, C-)  | Marginal<br>(D)   | Failure<br>(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.)

|     |  |
|-----|--|
| 1.  |  |
| 2.  |  |
| 3.  |  |
| ... |  |

##### 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) <i>Introduction to Bioorganic Chemistry and Chemical Biology</i> . New York: Garland Science |
| 2.  |   |
| 3.  |   |
| ... |   |

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:

| <b>GE PILO</b>  | <b>Please indicate which CILO(s) is/are related to this PILO, if any<br/>(can be more than one CILOs in each PILO)</b> |
|---|--|
| 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](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.

| <b>Selected Assessment Task</b> |
|---------------------------------|
|                                 |