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:	Advanced Chemical Instrumentation for Research
Course Code:	CHEM8008
Course Duration:	1 semester
Credit Units:	3 credits
Level:	R8
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)*	BCH8008 Advanced Chemical Instrumentation for Research
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The course aims to provide the student with concepts and principles of some advanced and widely used research techniques and instrumental methods in chemistry. The course will introduce to the students the basic concepts, working principles and specific capabilities of different chemical instrumentations.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain and apply the basic concepts and working principles of electronic spectroscopy (UV-VIS absorption and fluorescence) and vibrational spectroscopy (Raman and IR), review the latest developments in laser based time-resolved electronic and vibrational spectroscopies, and evaluate their capabilities for researches.		√	√	
2.	Explain and apply the basic concepts and working principles of mass spectrometry, characterize the capabilities of commonly used ion sources and mass analyzers for chemical analyses, and evaluate their usages for researches.		√	√	
3.	Explain and apply the basic concepts and working principles of *in situ* IR and NMR spectroscopies, and analyze their usages in chemical analyses.		√	√	
4.	Demonstrate critical thinking skills in proposing possible applications of UV-VIS, fluorescence, IR, Raman, NMR spectroscopies, and mass spectrometry for modern chemical researches and justify the selection of the most appropriate instrumental methods or their combination to perform a given research task.		√	√	√
		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)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lectures	Basic concepts, working principles, and latest instrumental developments in time-resolved electronic and vibrational spectroscopies with some recent applications will be discussed and reviewed.	✓				
Lectures	Basic concepts, working principles, and the capabilities of commonly used ion sources and mass analyzers in mass spectrometry with some recent applications will be discussed and reviewed.		✓			
Lectures	Basic concepts and working principles of *in situ* IR and NMR with some recent applications will be discussed and reviewed.			✓		
Assignment: literature reviews	Through literature search of latest publications, students will propose possible applications of UV-VIS, fluorescence, IR, Raman, NMR spectroscopies, and mass spectrometry for modern chemical researches.				✓	

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.				Weighting *	Remarks
	1	2	3	4		
Continuous Assessment: 30%						
Literature reviews, group discussions and oral presentation	✓	✓	✓	✓	30%	
Examination: 70% (duration: 3 hours)						
					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

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. Literature reviews, group discussions and oral presentation	Capacity for self-directed learning to understand the principles of advanced chemical instrumentation	High	Significant	Basic	Not even reaching marginal levels
	Ability to critically evaluate some selected literature on the usage of advanced instrumentation for modern chemical researches	High	Significant	Basic	Not even reaching marginal levels
	Ability to propose with detail explanation possible applications of advanced instrumentation for modern chemical researches	High	Significant	Basic	Not even reaching marginal levels
2. Examination	Ability to explain in detail and with accuracy the principles of advanced chemical instrumentation and their applications for modern chemical researches	High	Significant	Basic	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. Literature reviews, group discussions and oral presentation	Capacity for self-directed learning to understand the principles of advanced chemical instrumentation	High	Significant	Moderate	Basic	Not even reaching marginal levels
	Ability to critically evaluate some selected literature on the usage of advanced instrumentation for modern chemical researches	High	Significant	Moderate	Basic	Not even reaching marginal levels
	Ability to propose with detail explanation possible applications of advanced instrumentation for modern chemical researches	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Examination	Ability to explain in detail and with accuracy the principles of advanced chemical instrumentation and their applications for modern chemical researches	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information

1. Keyword Syllabus

UV-Vis absorption, fluorescence spectroscopy, Raman spectroscopy, Infrared (IR) spectroscopy, Fourier Transfer IR spectroscopy, time domain and frequency domain spectra, continuous wave laser, pulsed laser, time-resolved spectroscopy with time window ranging from femtosecond to millisecond, time-resolved fluorescence, transient absorption, time-resolved resonance Raman, fluorescence photocounting, laser flash photolysis, mass spectrometry, electron ionization, fast atom bombardment, chemical ionization, electrospray, laser desorption, quadrupole mass analyzer, quadrupole ion trap, time-of-flight, Fourier transform ion cyclotron resonance, hybrid instruments, tandem mass spectrometry, *in situ* IR and NMR.

2. Reading List

2.1 Compulsory Readings

1.	
2.	
3.	
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2.2 Additional Readings

1.	Principles of Instrumental Analysis; D. A. Skoog, F. J. Holler, S. R. Crouch; (Cengage Learning, 2018, 7th Ed.)
2.	Mass Spectrometry - A Textbook; J. H. Gross; (Springer-Verlag, 2017, 3rd Ed.)
3.	Mass Spectrometry: Principles and Applications; E. de Hoffmann, V. Stroobant; (John Wiley & Sons Ltd., 3rd Ed., Reprinted 2012)