DEPARTMENT OF

CHEMISTRY

CHEM UG Courses

UG Courses offered in Fall Term 2024-2025 but the courses outlines are not time-specific

Course Code	Course Title
CHEM 1008	Introductory Chemistry
CHEM 1011	General Chemistry A: Reactions, Thermodynamics, and Kinetics
CHEM 1012	General Chemistry B: Atomic Structure, Molecules, and Bonding Theories
CHEM 1051	Laboratory for General Chemistry A
CHEM 2110	Organic Chemistry I
CHEM 2111	Fundamentals of Organic Chemistry
CHEM 2210	Inorganic Chemistry I
CHEM 2310	Fundamentals of Analytical Chemistry
CHEM 2409	Mathematical Methods for Physical Chemistry
CHEM 2410	Physical Chemistry I: Equilibrium Thermodynamics and Statistical Mechanics
CHEM 2550	Synthetic Chemistry Laboratory I
CHEM 2555	Molecular Characterization Chemistry Laboratory I
CHEM 4120	Biomolecular Chemistry
CHEM 4140	Intermediate Organic Chemistry
CHEM 4150	Biomolecular Synthesis Laboratory
CHEM 4155	Biomolecular Characterization Laboratory
CHEM 4160	Cheminformatics
CHEM 4220	Materials Chemistry

CHEM 4250	Materials Preparation Laboratory
CHEM 4255	Materials Characterization Laboratory
CHEM 4350	Environmental Chemistry Laboratory
CHEM 4355	Instrumental Analytical Chemistry Laboratory
CHEM 4410	Physical Chemistry in Biological Applications
CHEM 4550	Advanced Synthetic Laboratory
CHEM 4555	Advanced Molecular Characterization Laboratory
CHEM 4680	Undergraduate Research
CHEM 4689	Capstone Project
CHEM 4691	Capstone Research I
CHEM 4692	Capstone Research II

The Hong Kong University of Science and Technology
Department of Chemistry

Instructor: Prof. Emily M. W. Tsang
Office: Rm 4536 (Lift 25/26)
E-mail: chetsang@ust.hk

CHEM 1008 – Introductory Chemistry (3-credits) Fall 2024 -2025

Course Description:
This course targets science or engineering students with very little to no chemistry background. It provides a general introduction to basic principles of chemistry. Key topics include state of matters, atoms and elements, molecules and compounds, atomic structures and periodicity, molecular structures, quantities in chemical reactions, bonding theories, acids and bases, and solution chemistry.

Exclusions: Level 3 or above in HKDSE 1/2x Chemistry OR HKDSE 1x Chemistry, a passing grade in AL/AS Chemistry, any CHEM courses at or above 1004-level

Lecture: Tues, Thurs, 13:30 – 14:50

Venue: LT-C

Instructor Office Hours: By email appointment

Course Content/Topics:

Chapter 1: Matter and Energy	Chapter 7: Electrons in Atom and the Periodic Table
Chapter 2: Atoms and Elements	Chapter 8: Chemical Bonding
Chapter 3: Molecules and Compounds	Chapter 9: Solids, Liquids, and Intermolecular Forces
Chapter 4: Chemical Composition	Chapter 10: Properties of Solutions
Chapter 5: Chemical Reactions	Chapter 11: Acids and Bases
Chapter 6: Reaction Stoichiometry	Chapter 12: Chemical Equilibrium

Intended Learning Outcomes:
Upon successful completion of this course, students are expected to be able to:

1. Develop a microscopic view of the worlds in terms of atoms and molecules
2. Recognize physical/chemical properties, physical/chemical changes
3. Apply knowledge of states of matter, chemical reactions, stoichiometry, atomic structure, chemical bonding, molecular structure, and intermolecular interactions.
4. Obtain a basic knowledge of solution chemistry, acid-base chemistry, chemical equilibrium.
5. Recognize and appreciate the impact and significance of chemistry to our society.

Course Grading Scheme

Online Quizzes (2 x 10% each)	20%
In-class Midterm Exam	40 %
In-class Final Exam	40 %

CHEM 1011 General Chemistry A: Reactions, Thermodynamics, and Reaction Kinetics (3:3-0-0)

Pre-requisite: Level 3 or above in HKDSE 1/2x OR level 3 or above in HKDSE 1x Chemistry
OR CHEM 1004 OR CHEM 1008

This course targets at students who have acquired prior knowledge in fundamental Chemistry in high school. Key topics include stoichiometry, chemical energy, properties of aqueous solutions, acids and bases, thermodynamics and equilibrium, reaction kinetics, and electrochemistry.

Fall 2024

Instructor:

Dr. Frederick Fu Kit SHEONG (1st half of the course)
(Room 4543; Tel. 3469 2098; Email: chemfksheong@ust.hk)

Prof. Zhenyang LIN (2nd half of the course)
(Room 4518; Tel. 2358 7379; Email: chzlin@ust.hk)

Instructional Assistant:

Dr. Tsz Kin NG (Room 4506; Tel. 2358 7404; Email: ngken@ust.hk)

Textbook: Chemistry – an atoms first approach (3e)
Authors: Steven S. Zumdahl, Susan A. Zumdahl and Donald J. Decoste

Chapter 10:	Properties of Solutions
Chapter 12:	Chemical Equilibrium
Chapter 13:	Acids and Bases
Chapter 14:	Acid-Base Equilibria
Chapter 15:	Solubility and Complex Ion Equilibria

Midterm Exam (Chapters 10, 12-15) 2pm – 4pm October 26 (Sat)

Chapter 16:	Spontaneity, Entropy, and Free Energy
Chapter 17:	Electrochemistry
Chapter 11:	Chemical Kinetics
Chapter 18:	The Nucleus: A Chemist's View
Chapter 21:	Organic and Biological Molecules

Final Exam (Chapters 11, 16-18, 21)

Learning Outcomes

On completion of the course, students will be able to

1. Analyze properties of solutions and determine stoichiometry of chemical transformations.
2. Describe different definitions of acids and bases theories and understand acid-base equilibrium.
3. Apply the laws of thermodynamics and account for the factors that lead to spontaneous physical and chemical changes.
4. Describe redox reactions, use electrochemical data to predict the spontaneity of redox reactions, and comprehend the structures of electrochemical cells.
5. Understand the fundamental chemical properties of organic and biological molecules at a molecular level, differentiate between synthetic and natural polymers while appreciating the diverse roles played by biological molecules such as starch, cellulose, proteins, DNA, and RNA in living systems.
6. Recognize the impact of chemistry to society.

Lecture Hours: Section L1: 9:00 am – 10:20 am; Tuesday, Thursday at LT-L
Section L2: 4:30 pm – 5:50 pm; Tuesday, Thursday at LT-C

Office Hours:
Thursday 12:30pm – 3:00pm: At Room 4507, or other time upon email request

Assessment:		
	Mid-term exam	**45%**
	Final exam	**45%**
	Assignments 1 & 2	**5% x 2**

Assessment Scheme:

Weight	Assessment	Course ILOs
5%	Assignment 1	1, 2
5%	Assignment 2	3, 4, 5
45%	Midterm exam	1, 2, 6
45%	Final exam	3, 4, 5, 6
	Participation	1, 2, 3, 4, 5, 6

Ungraded Problem Set will be given on Canvas for each chapter.

The Hong Kong University of Science and Technology
Department of Chemistry

Instructor: Prof. Emily M. W. Tsang
Office: Rm 4536 (Lift 25/26)
E-mail: chetsang@ust.hk

CHEM 1012 – General Chemistry B: Atomic Structure, Molecules, and Bonding Theories (3-credits)

Fall 2024 -2025

[Previous code: CHEM 1020]

Course Description:
This course targets students who have acquired prior knowledge in fundamental Chemistry in high school. Key topics include atomic structure and periodicity, molecules, bonding theories, and properties of gases, liquids and solids. Other topics such as transition metals and coordination compounds, and organic molecules will be briefly reviewed.

Pre-requsites: *Level 3 or above in HKDSE 1/2x Chemistry OR Level 3 or above in HKDSE 1x Chemistry CHEM 1004 or CHEM 1008*

Exclusions: *CHEM 1010*

Lecture: Wednesday and Friday, 16:30 – 17:50, LT-J

Instructor Office Hours: By email.

Textbook: *Chemistry: An Atoms First Approach*, 3rd Asian Ed. S.S. Zumdahl; S. A. Zumdahl; D. DeCoste © Cengage Learning. ISBN: 9789814896993

Course Content/Topics:

- ☐ Chapter 1: Chemical Foundations
- ☐ Chapter 2: Atomic Structure and Periodicity
- ☐ Chapter 3: Bonding: General Concepts
- ☐ Chapter 4: Molecular Structure and Orbitals
- ☐ Chapter 8: Gases
- ☐ Chapter 9: Liquids and Solids
- ☐ Chapter 19: The Representative Elements
- ☐ Chapter 20: Transition Metals and Coordination Chemistry (Guest Lecturer)

Intended Learning Outcomes:
Upon successful completion of this course, students are expected to be able to:

1. Describe and apply fundamental principles and terminologies of chemistry.
2. Develop a microscopic view of the world in terms of atoms and molecules and their change

3. Describe and apply concepts of mass conservation and energy conversation in chemical changes.
4. Describe the atoms and ions in terms of atomic structure, atomic orbitals, electron configuration, and periodicity of chemical properties
5. Describe molecules in terms of bonding theory, energy, molecular geometry and interactions.
6. Describe the physical states of matters: gases, liquids and solids.
7. Recognize and appreciate the impact of chemistry to our society.

Course Grading Scheme

Online Quizzes (2 x 10% each)	20%
In-class Midterm Exam	40 %
In-class Final Exam	40 %

CHEM 1051 Laboratory for General Chemistry A

2024–25 Fall

Course Outline

Instructor

Dr. CHEUNG Man Sing (Rm4535; Tel: 2358 7401; Email: sing@ust.hk)

Instructional Assistants (IAs)

Ms. MAK Angela P. Y. (Rm4501C; Tel: 2358 8450; Email: makpy@ust.hk)

Mr. MAN Tim T. P. (Rm4501C; Tel: 3469 2080; Email: takpm@ust.hk)

Technical Officer

Mr. TSE M. L. (Rm4531; Tel: 2358 7371; Email: mltse@ust.hk)

Class Schedule

Section	Date	Time	Venue
LA1	Tuesday	10:30AM – 01:20PM	UG001, CYT Building
LA2		01:30PM – 04:20PM	
LA3	Wednesday	10:30AM – 01:20PM	
LA4		01:30PM – 04:20PM	
LA5	Thursday	10:30AM – 01:20PM	
LA6		01:30PM – 04:20PM	

Course Information

Credit Units: 1

Pre-requisite: Nil

Co-requisite: CHEM 1011

Exclusion: Nil

Grade: P/F

Description:

This course is the laboratory class designed for students who are enrolled in CHEM 1011. With laboratory experience acquired in this course, students will be able to relate the physical and chemical principles and theories learned in the corresponding lecture course, perform basic chemical laboratory techniques, and develop their data analyzing skills.

Intended Learning Outcomes (ILOs)

Upon successful completion of this course, students should be able to:

Knowledge/Content Related:

1. recognize various kinds of equipment in chemistry laboratory
2. conduct standard laboratory procedures involved in basic chemistry experiments

Academic Skills/Competencies Related:

3. conduct risk assessments concerning the use of chemicals in basic chemistry experiments
4. keep records of experimental work in basic chemistry experiments
5. interpret experimental results for physical and chemical phenomena in basic chemistry experiments

Assessment Scheme

Assessment	Assessing Course ILOs
Pre-course Tests	1, 2, 3
Lab Attendance and Performance	1, 2, 3, 4, 5
Lab Reports	4, 5

To pass the course, students have to get satisfactory performances in all abovementioned assessment tasks/activities.

Student Learning Resources

- Reference Book: James Hall, *Experimental Chemistry: An Atoms First Approach*, Brooks/Cole, Cengage Learning, **2012**.
- Reference Book: J. A. Beran and Mark Lassiter, *Laboratory Manual for Principles of General Chemistry* (*11th edition*), Wiley, **2022**.
- Other learning resources can be accessed through Canvas.

Teaching and Learning Activities

Laboratory: focus on experiments related to co-requisite course

Course Schedule

Keyword Syllabus:

- Laboratory safety
- Common laboratory apparatus
- Basic techniques for measurements in chemistry laboratory
- Solution stoichiometry and volumetric titration
- Acids and bases
- Acid-base equilibria
- Solubility and complex ion equilibria
- Spontaneity, entropy, and free energy
- Electrochemistry

CHEM 2110 ORGANIC CHEMISTRY I
Syllabus- Fall 2024

1. **Instructor**

Name: Hugh NAKAMURA, Ph.D.
Contact Details: Room 6143, 6th floor, (Lift 22)
Email: hnakamura@ust.hk
Tel: 3469-2552

2. **TAs**

GU, Yangyi (ygubd@connect.ust.hk)
OGAWA, Hiroshige (hogawa@connect.ust.hk)
QIU, Huiying (hqiuag@connect.ust.hk)
ZHANG, Jie (jzhangin@connect.ust.hk)
ZHANG, Xinwei (xzhanghf@connect.ust.hk)
ZHOU, Yiqin (yzhoudp@connect.ust.hk)

3. **Lecture Time and Venue**

Date/Time: Monday (09:00-10:20) and Wednesday (09:00-10:20)
Venue: LT-J

4. **Course description**

This is the Part I of a two-semester, introductory level organic chemistry course designed for chemistry/biochemistry major undergraduates. Topics covered include: Structure and bonding; regio-, geometric, and stereoisomerism; polar and radical reactions of alkenes and alkynes; substitution and elimination reactions; synthesis and reactions of alcohols and epoxides.

5. **Intended Learning Outcomes**

Upon successful completion of this course, students should be able to:

No.	ILOs
1	Recognize fundamentals of organic chemistry including structures, reaction mechanisms, and transformations of carbon-derived compounds.
2	Explain the essential facts, principles, and theories of organic chemistry.
3	Demonstrate awareness of organic chemistry topics relevance to social and daily life.
4	Formulate and analyze mechanisms and products of organic transformations by applying organic chemistry principles.

6. **Assessment Scheme**

40% Midterm exam (mid of Oct)
60% Final exam (mid of Dec)

7. Student Learning Resources

Recommended Reading:

Text(s): John E. McMurry, "Organic Chemistry, 8th edition, international edition", Brooks/Cole, Cengage Learning

Francis A. Carey, Robert M. Giuliano, "Organic Chemistry, 9th edition, international edition", McGraw-Hill.

William H. Brown, Brent L. Iverson, Eric V. Anslyn, Christopher S. Foote, " Organic Chemistry, 7th edition, international edition" Brooks/Cole, Cengage Learning.

8. Course Schedule

Keyword Syllabus:

- Structure and bonding
- Polar covalent bonds and acids and bases
- Organic compounds: alkanes and their stereochemistry
- Organic compounds: cycloalkanes and their stereochemistry
- Stereochemistry at tetrahedral centers
- An overview of organic reactions
- Alkenes: structure and reactivity
- Alkenes: reactions and synthesis
- Alkynes: Organic synthesis
- Organohalides
- Reactions of alkyl halides: nucleophilic substitution and eliminations
- Alcohols and phenols
- Ethers and Epoxides: Thiols and Sulf

9. Schedule

2 Sep	LT-1: Introduction to Organic Chemistry, Structure
4 Sep	LT-2: Atomic Bonding
9 Sep	LT-3: Polar Covalent Bonds, Lewis Acids and bases
11 Sep	LT-4: Polar Covalent Bonds, Lewis Acids and bases
16 Sep	LT-5: Alkanes and their stereochemistry
23 Sep	LT-6: Cycloalkanes and their stereochemistry
25 Sep	LT-7: Stereochemistry at tetrahedral centers
30 Sep	LT-8: Stereochemistry at tetrahedral centers
2 Oct	LT-9: Overview of organic reaction
7 Oct	LT-10: Overview of organic reaction
9 Oct	LT-11: Alkenes—structure and reactivity
14 Oct	Tutorial (1) by TAs
16 Oct	**Mid-Term Exam, 09:00 – 10:20 am (LT-J), closed book**

21 Oct	LT-12: Alkenes—structure and reactivity
23 Oct	LT-13: Alkenes—reaction and synthesis
28 Oct	LT-14: Alkenes—reaction and synthesis
30 Oct	LT-15: Alkyne—Introduction to Organic Synthesis
4 Nov	LT-16: Alkyne—Introduction to Organic Synthesis
6 Nov	LT-17: Organic Halides
11 Nov	LT-18: Reactions of Alkyl halides
13 Nov	LT-19: Reactions of Alkyl halides
18 Nov	LT-20: Alcohol and Phenols
20 Nov	LT-21: Alcohol and Phenols
25 Nov	LT-22: Ethers and Epoxide, Thiol and sulfides
27 Nov	Tutorial (2) by TAs
17 Dec	**Final Exam, 16:30-19:30 (3 hours), closed book**

*Please note that the lecture schedule may change slightly depending on the typhoon or other circumstances. Please pay attention to our announcements.

CHEM 2111 Fundamental of Organic Chemistry

Fall Semester 2024 (Sept 2 – Nov 30)

Venue: G010, CYT Bldg
Lecture hours: Wednesday and Friday, 3:00 – 4:20 PM

Credits: 3
Pre-requisite: CHEM 1010 or CHEM 1012
Exclusion: CHEM 2110

INSTRUCTOR

Prof. Kenward VONG
Office: 4521 (lifts 25/26)
E-mail: kvong@ust.hk

COURSE DESCRIPTION

Various classes of organic compounds, emphasizing organic chemical reactions and mechanisms of major functionalities and their importance in the area of biological chemistry. For engineering students under the four-year degrees who prefer to learn organic chemistry in a single term.

The course will treat selected topics from a mechanistic viewpoint and illustrate their usefulness in the wider body of organic chemistry. Examples of concepts in organic synthesis will be given. The course does not aim to provide a comprehensive coverage of organic reactions, rather it will seek to encourage students to think about organic chemical reactions, and to apply key concepts to other reactions not covered in the course.

INTENDED LEARNING OUTCOMES

Upon successful completion of the course, students should be able to:

1. Recognize fundamentals of organic chemistry including structures, reaction mechanisms, and some transformations of carbon-derived compounds.
2. Explain the essential facts and principles of organic chemistry.
3. Demonstrate awareness of organic chemistry topics relevance to social and daily life.
4. Formulate and analyze mechanisms and products of some general organic transformations by applying organic chemistry principles.

ASSESSMENT SCHEME

Midterm 1 (open book): 20%
Midterm 2 (open book): 30%
Final Exam (one A4 size cheat sheet allowed): 50%

SCHEDULE

Week 1	Sept 4	Chemical Bonding (*chap 1*)
	Sept 6	Chemical Bonding (*chap 1*)
Week 2	Sept 11	Chemical reactions (*chap 2*)
	Sept 13	Chemical reactions (*chap 2*)
Week 3	Sept 18	Holiday
	Sept 20	Stereochemistry (*chap 3*)
Week 4	Sept 25	Alkanes and Cycloalkanes (*chap 4*)
	Sept 27	Alkanes and Cycloalkanes (*chap 4*)
Week 5	Oct 2	Alkenes and Alkynes I (*chap 5*)
	Oct 4	Review session
Week 6	Oct 9	**Midterm 1 (*open book*)**
	Oct 11	
Week 7	Oct 16	Alkenes + Alkynes II (*chap 6*)
	Oct 18	Aromatics (*chap 7*)
Week 8	Oct 23	Alkyl halides (*chap 8*)
	Oct 25	Nucleophilic substitution (*chap 9*)
Week 9	Oct 30	Alcohols (*chap 10*) and Amines (*chap 14*)
	Nov 1	Aldehydes and Ketones (*chap 11*)
Week 10	Nov 6	Carboxylic acids (*chap 12*)
	Nov 8	Carboxylic acid derivatives (*chap 13*)
Week 11	Nov 13	Review session
	Nov 15	**Midterm 2 (*open book*)**
Week 12	Nov 20	Retrosynthesis planning
	Nov 22	Retrosynthesis planning
Week 13	Nov 27	Free study
	Nov 29	Free study
Exam period	Dec 9 – Dec 20	**Final Exam (*closed book*)**

STUDENT LEARNING RESOURCES

Textbook:

"Organic Chemistry, A Brief Course" by Robert C. Atkins, Francis A. Carey, and Chi Wi Ong, McGraw-Hill Education (Asia), 2013

or

"Organic Chemistry, A Brief Course, 3rd Edition" by Robert C. Atkins and Francis A. Carey, McGraw-Hill Education, International Edition, 2007

Solutions Manual:

"Student Solutions Manual to accompany Organic Chemistry, A Brief Course, 3rd Edition" by Robert C. Atkins and Francis A. Carey, McGraw-Hill Education, International Edition, 2007

RESERVE ITEMS IN LIBRARY

CALL NUMBER	QD253.2 .A74 2002
AUTHOR	Atkins, Robert C. (Robert Charles)
TITLE	Organic chemistry, a brief course
EDITION	3rd ed.
IMPRINT	Boston : McGraw-Hill, c2002.
# Copies:	3 copies

CALL NUMBER	QD251.2 .A82 2002
AUTHOR	Atkins, Robert C. (Robert Charles)
TITLE	Organic chemistry, a brief course: student solutions manual
EDITION	3rd ed.
IMPRINT	Boston : McGraw-Hill, c2002.
# Copies:	2 copies

4. Intended Learning Outcomes

Upon successful completion of this course, students should be able to:

No.	ILOs
1	Demonstrate a comprehensive and well-founded knowledge of structure and bonding theories that are relevant to inorganic molecular compounds
2	Rationalize the stability of inorganic compounds using concepts of acids and bases.
3	Describe and rationalize structures of simple solids
4	Appreciate the importance of molecular symmetry in the field of chemistry and assign molecular point groups.
5	Understand structures of coordination compounds.

5. Assessment Scheme

a. Examination duration: 2 hours

b. Percentage of coursework, examination, etc.:

Assessment	Assessing Course ILOs
10% by assignment	1, 2, 3, 4
10% by quizzes,	1, 2, 3, 4
35% by mid-term test	1, 2, 3, 4, 5
45% by final exam	1, 2, 3, 4, 5

c. The grading is assigned based on students' performance in assessment tasks/activities.

6. Student Learning Resources

Recommended Reading:

Text(s):

"Inorganic Chemistry," international edition, by M. Weller et al., OUP (2018)

7. Teaching and Learning Activities

Scheduled activities: 3 hrs (lecture)

8. Course Schedule

Keyword Syllabus:

- Molecular orbital theory: bonding and antibonding molecular orbitals, bond order and energy, homo- and heteronuclear diatomic molecules, polynuclear molecules, ligand group orbitals, Walsh diagram.
- Acids and bases: definition and examples of Lewis acids, relative Lewis acidity, acid-base reactions hard-soft acid-base theory and its application.
- Structures of simple solids: unit cell and crystal structure description, close packing of spheres and holes, characteristic structures of ionic solids and their rationalization, energetics of ionic bonding and consequences of lattice enthalpies, electronic structures of solids, band formation, semiconductors
- Molecular symmetry: symmetry elements and operations, classification of point groups, applications of molecular symmetry
- Coordination chemistry: coordination geometry of metal complexes, classification of ligands, isomerism and chirality

CHEM 2210 Inorganic Chemistry I

Course Outline- Fall 2024

1. **Instructor(s)**

Name: Prof. Wa-Hung Leung

Contact Details: Rm 4538, ext. 7360, e-mail: chleung@ust.hk

Name: Prof. Guochen Jia

Contact Details: CYT 6009, ext. 7361, e-mail: chjiag@ust.hk

2. **Teaching Assistant(s)**

Miss JIANG, Xinxin email: xjiangbd@connect.ust.hk

Mr. HO, Chun Yin email: cyhobj@connect.ust.hk

Mr. ZHANG, Jiarong email: jzhangio@connect.ust.hk

Meeting Time and Venue

Lectures:

Date/Time: Monday (13:30-14:50), Friday (9:00-10:20)

Venue: LT-K

Tutorials:

Date/Time: N.A.

Venue: N.A.

3. **Course Description**

Credit Points: 3

Pre-requisite: CHEM 1030

Exclusion: NIL

Brief Information/synopsis:

This course is designed for students who have taken CHEM 1030 under the four-year degree. Key topics include molecular structure and bonding, physical techniques in inorganic chemistry, acids and bases, structure of inorganic solids, molecular symmetry, and introduction to coordination chemistry.

CHEM 2310 Fundamentals of Analytical Chemistry

Course Outline - Fall 2024

1. Instructor

Prof. Hongkai Wu

Email chhkwu@ust.hk, Rm 4516

Prof. Simon W. Chan

Email chanwan@ust.hk, Rm 4517

Office Hours: by appointment

2. Teaching Assistant(s)

Mr. CUI Binbin	bcuiaa@connect.ust.hk	Mr. LI Yuekang	ylipq@connect.ust.hk
Ms. LUK Wing Laam	wllukaa@connect.ust.hk	Ms. WANG Shuangshuang	swangfn@connect.ust.hk

3. Lecture Time and Venue

Date/Time: Wed & Fri (16:30 – 17:50); **Venue:** Rm 2404 (Lift 17-18)

4. Course Description

Credit Points: 3; Pre-requisite: CHEM 1030; Exclusion: CHEM 2311

Brief Information/synopsis:

Fundamental and practical aspects of chemical analysis, including titrimetric, electrical and spectroscopic methods, analytical separations by GLC and HPLC.

5. Assessment Scheme

3 x assignment (10% each; 30% total), and

1 x final exam (70%);

6. Intended Learning Outcomes

Upon successful completion of this course, students should be able to:

No.	**ILOs**
1	Able to recognize fundamentals of analytical chemistry including various concentration units, statistics for analytical chemistry, acid-base titrations, complexometric titrations, redox titrations, basics of optical spectroscopy, basics of chromatography and mass spectrometry.
2	Able to explain the essential facts, principles and theories for analytical chemistry.
3	Able to demonstrate awareness of topics of analytical chemistry relevant to social and daily life, such as environmental issues.
4	Formulate and analyze a wide range of analytical chemical problems by applying chemical principles.
5	Show appreciation of analytical chemistry and its interface with social and daily life such as environmental issues, and arouse audience's interest in chemistry.

7. Student Learning Resources

Textbook: Exploring Chemical Analysis (5th Edition), Daniel Harris, Freeman, 2013
Reference: Quantity Chemical Analysis, Daniel C. Harris, Freeman

8. Teaching and Learning Activities

Scheduled activities: 3 hrs (lecture)

9. Course Schedule

Keyword Syllabus:

Measurements and the tools of an analytical chemist	Polyprotic Acids and Bases
Math Tool-kit, Significant Figures and Errors	EDTA Titrations
Statistics	Introduction to Electrochemistry
Least Squares and Quality Assurance	Potentials and Potentiometry: Electrode Measurements
Gravimetry	Redox Titrations
Titrations	Instrumental Electrochemistry
Acids and Bases	Optical Spectroscopy and Applications
Buffers and Indicators	Chromatography
Acid-Base Titrations & N-Analysis	Mass Spectrometry

CHEM 2409
Mathematical Methods in Physical Chemistry
Fall 2024

Instructor:

Dr. Haibin Su (Associate Professor)
Room: 4540, Lift 25/26
Tel: 2358-7388
E-mail: haibinsu@ust.hk

Teaching Crew:

Yuzhou TAO	Rm 4207
Yingtong ZHU	Rm 4207
Japhert CHANG	Rm 4207
Chi Ming KAN	Rm 4207
Shan Qi YAP	Rm 4207
Imanual RAVA	Rm 4207
Wentao XU	Rm 4207
Yizhou WANG	Rm 4207

Lectures:

Tuesday	10:30 am – 11:50 am	4620 (Lift 32)
Thursday	10:30 am - 11:50 am	4620 (Lift 32)

Tutorials:

Friday	10:30 am - 11:50 pm	CYTG010

Office Hours:

Thursday	3:30 pm–4:30 pm	Rm 4540 (Lift 25/26)

Course Website:

https://canvas.ust.hk/courses/57932

COURSE DESCRIPTION

Chem2409: Mathematical Methods in Physical Chemistry covers numerical and mathematical methods for solving undergraduate-level problems in physical chemistry. The purpose of the course is to supplement the mathematical and computational background of chemistry students and build on skills learned in year-1 calculus courses by teaching them methods for quickly solving typical complex problems found in upper level chemistry courses. This course is a prerequisite to the *Physical Chemistry I and II* courses.

LEARNING OUTCOMES

Upon the study of this course, students are expected to understand how to interpret and classify integral/ordinary differential equations, to acquire basic skills to solve partial differential equations in quantum mechanics using computational, numeric and analytical methods, to have a skill set needed to learn theory of physical chemistry at a high level, and to be able to quickly and efficiently classify problems in physical chemistry and solve by any means.

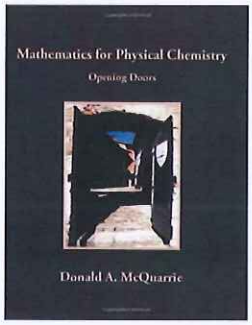
Upon successful completion of this course, students will be able to:

(1) Analyze and interpret experimental data, critically assess data from literature sources and extract and apply useful data from those sources.

(2) Communicate effectively both orally and in writing to a professional and/or lay audience.

(3) Demonstrate self-awareness and the ability to work independently and collaborate effectively with other people in a team.

TEXTBOOK



"Mathematics for Physical Chemistry – Opening Doors", by Donald A. McQuarrie, University Science Books

STUDENT REQUIREMENT

- Students need to be familiar with the syllabus and the class schedule and be aware of the course requirements and progress.
- Students need to check the course website (https://canvas.ust.hk/courses/38900) and their UST e-mails on regular basis. All assignments, slides and any other course materials will be posted on the course website. Furthermore, course announcements will also be made on the course website and/or via UST e-mail.
- Students are required to be familiar with HKUST Academic Integrity Policy (http://www.ust.hk/vpaao/integrity/). These policies will be strictly enforced in this course to keep academic honesty.
- Students need to follow proper classroom ethics, so that we can make a comfortable learning environment to each and every student in the class.

GRADING

Midterm Exam	40%
Final Exam	40%
Assignments	20%

Notes:

- Midterm Exam and Final Exam are in the mixed mode closed-book examinations.
- Assignments: There will be four sets of homework assignments in total.

COURSE SCHEDULE

wk 1	Tues. 03 Sep	Lecture 1	Introduction & Functions of a Single Variable: Differentiation *Textbook: Chapters 1*
	Thurs. 05 Sep	Lecture 2	Functions of a Single Variable: Integration *(cont'd.)* *Textbook: Chapters 2*
wk 2	Mon. 10 Sep	Lecture 3	Functions of a Single Variable: Integration *(cont'd.)* *Textbook: Chapters 2*
	Thurs. 12 Sept	Lecture 4	Functions of a Single Variable: Integration *(cont'd.)* *Textbook: Chapters 2*
wk 3	Tues. 17 Sep	Lecture 5	Ordinary Differential Equations *Textbook: Chapters 6*
	Thurs. 19 Sep	Lecture 6	Ordinary Differential Equations (cont'd.) *Textbook: Chapters 6*
wk 4	Tues. 24 Sep	Lecture 7	Ordinary Differential Equations (cont'd.) *Textbook: Chapters 6*
	Thurs. 26 Sep	Lecture 8	Ordinary Differential Equations (cont'd.) *Textbook: Chapter 6*
wk 5	Tues. 01 Oct	No Class	
	Thurs. 03 Oct	Lecture 9	Ordinary Differential Equations (cont'd.) *Textbook: Chapter 6*
wk 6	Tues. 08 Oct	Lecture 10	Series *Textbook: Chapter 3*

	Thurs. 10 Oct		Series (cont'd) + Review for Midterm Exam *Textbook: Chapter 3*
wk 7	Tues. 15 Oct	**Exam**	**Midterm Exam** (covering Lecture 1 to 10) Time: 10:30am – 11:50 am **Location: To be announced**
	Thurs. 17 Oct	Lecture 11	Functions of Several Variables *Textbook: Chapter 12*
wk 8	Tues. 22 Oct	Lecture 12	Functions of Several Variables (cont'd) *Textbook: Chapter 12*
	Thurs. 24 Oct	Lecture 13	Functions of Several Variables (cont'd) *Textbook: Chapter 12*
wk 9	Tues. 29 Oct	Lecture 14	Operators/Vectors *Textbook: Chapter 11 & 13*
	Thurs. 31 Oct	Lecture 15.	Operators/Vectors (cont'd) *Textbook: Chapter 11 & 13*
wk 10	Tues. 05 Nov	Lecture 16	Plane Polar & Spherical Coordinates *Textbook: Chapter 14*
	Thurs. 07 Nov	Lecture 17	Plane Polar & Spherical Coordinates (cont'd) *Textbook: Chapter 14*
wk 11	Tues. 12 Nov	Lecture 18	Plane Polar & Spherical Coordinates (cont'd) *Textbook: Chapter 14*
	Thurs. 14 Nov	Lecture 19	Matrix *Textbook: Chapter 18*
wk 12	Tues. 19 Nov	Lecture 20	Matrix (cont'd) *Textbook: Chapter 18*
	Thurs. 21 Nov	Lecture 21	Matrix (cont'd) *Textbook: Chapter 18*
wk 13	Tues. 28 Nov		Review for Final Exam
Exam Weeks			**Final Exam** (covering Lecture 11 to 21) Arranged by the university

Updated in September 2024

Instructor: *Prof. Jonathan HALPERT* Fall, 2024

Chem2410: Physical Chemistry I
(home: https://canvas.ust.hk/courses/57937)

Description:
This 3-credit course is the Part-I of "Physical Chemistry" sub-curriculum for students majoring in chemistry. It covers:
(a) The basic principles and applications of equilibrium thermodynamics; and
(b) The equilibrium statistical thermodynamics

Textbook: "*Physical Chemistry*", P. Atkins, J. de Paula & J. Keeler **11th Edition** (Oxford, 2018)
https://www.amazon.com/Atkins-Physical-Chemistry-Revised-Paperback/dp/B00RWU5W1I/ref=sr_1_fkmr0_1?
Coverage: Fundamentals and Part I: Equilibrium (Chap 1R, 2 – 6, 12) *(11th Ed. Chap 12 = 9th Ed. Chap 15/16)*

Prerequisites:
CHEM1030 and CHEM2409

Schedule/Venue:
(a) Lectures: Tuesday (4:30 – 5:50 pm), Rm 6573 &
Thursday (4:30 – 5:50 pm), Rm 6573
(b) Instructors' Office Hours: Friday: 11:00 am – 12:00 pm (on Zoom, by appointment only)
(c) TAs' Tutorial: **Tuesday evening 7:30-8:30**

(d) Examinations:
Midterm Exam: October 31, 7:30 pm-9:30 pm [LT-J]
Final Exam: December 11, 4:30-7:30 pm [Atrium, TST Art Hall]

Teaching Assistants and Assignments [# L's]:

CHEUNG, Hiu Yeung "John"	(hycheungbd@connect.ust.hk)	Chap. 6, 12
GE, Jianchao	(jgeae@connect.ust.hk)	Chap. 1R, 2, 3
KUMAR, Nitish	(nkumaraa@connect.ust.hk)	Chap. 4, 5

Credit/Grading :

Midterm:	50 % (Chapters 2, 3, 4)
Homework:	10 % (*avg of the best 3 out of 4*)
Final Exam:	40 % (Chapters 5, 6, 12)

The HW questions must be handed in and this will contribute directly to your final grade!

(i) HWs (provided on CANVAS) will be completed and handed in to TA **via the CANVAS portal.**
(ii) Questions will be marked by the TAs: 50 % completeness, 50 % correctness
(iii) **Exam** questions: ~30% of Q's are directly from HW or in-class Q's
(iv) Tutorials are **about the HW**: the TAs will present model answers and answer questions
(v) ***Don't wait until exam time!*** By then it is too late to learn everything.

MAIN REFERENCES:

Atkins, P.; de Paula, J. "*Physical Chemistry*" 9th Ed., Oxford University Press, 2011. **[previous main text]**

Atkins, P.; de Paula, J. "*Physical Chemistry*" 10th Ed., Oxford University Press, 2014. **[previous main text]**

Adamson, A.W. *"A Textbook of Physical Chemistry*" 3rd Ed., Academic Press, 1986. (QD453.2.A3 1986)

Klotz, I. M. and Rosenberg, R. M. *"Chemical Thermodynamics: basic theory and methods"* 6th Ed, John Wiley, 2000. (QD 504.K55 2000)

DeVoe, H. *"Thermodynamics and Chemistry"* Prentice Hall, 2001. (QD504.D48 2001)

Ott, J.B. *"Chemical Thermodynamics"* Academic Press, 2000. (QD504.O87, 2000)

Smith, J.M. "*Introduction to Chemical Engineering Thermodynamics"* 6th Ed, McGraw-Hill, 2001. (TP155.T45.S58, 2001)

Chang, R. *"Physical Chemistry for the Chemical and Biological Sciences"* 3rd Ed., Univ. Sci. Press, 2000. (with Solutions Manual by Leung, H.O. and Marchall, M.D.) (QD453.2.C48 2000)

Alberty, R.A. (2003) *"Thermodynamics of Biological Reactions"* Wiley 2003.

MATHEMATICAL TOOLS:

McQuarrie, D. A. "*Mathematics for Physical Chemistry*", 2008, Univ. Science Books

Yates, P. **"***Chemical Calculations – Mathematics for Chemistry*", 2007, CRC Press.

Mortimer, R.G. *"Mathematics for Physical Chemistry*" 2nd Ed., Academic Press, 1999. (QD455.3.M3.M67.1999)

Hecht, H.G. *"Mathematics in Chemistry"* Prentice Hall, 1990.(QD39.3.M3.H43.1990)

Starzak, M.E. *"Mathematical Methods in Chemistry and Physics*" Plenum,1989. (QD39.3.M3.S73.1989)

PHYSICS :

G. A. D. Ritchie and D. S. Sivia**, "***Foundations of Physics for Chemists*", 2000, Oxford

HOMEWORK ASSIGNMENTS

(from < *Atkins' Physical Chemistry* > ***10th Ed., 2014*** by P. W. Atkins and J. de Paula)

There will be four homework assignments corresponding to Chapters 1R+2, 3+4, 5+6, 12.

Assignments will be transcribed and released on CANVAS a few days or so before the start of the chapter lectures. Students who have the 10th Edition will be able to find them in that book, but it is not necessary to acquire it, we will provide all HW questions and answers.

Model solutions to the homework will be released a few days AFTER they are due. Due dates will be announced but are subject to change, depending on our progress. HW is due by 11:59 pm HKT on the due date and will be submitted in the CANVAS portal. If you have trouble with the CANVAS portal, just email it, on time, to the TA (and cc me) so there is a timestamp showing you did it on time.

Late HW will be accepted without penalty up to 2 days late. *It is officially due, usually, on Friday.*

Assignments will be handed in via CANVAS and will be marked by the TAs for:

50%: completeness, attempted all parts of all problems (must be a serious attempt)
50%: correctness, answered all parts of all problems correctly (partial credit does apply)

You can then check your own answers online against the model solutions 2 days after the assignment. The TAs will also answer questions in tutorial.

Moreover, some portion of the test and exam questions WILL be drawn (almost) directly from the homework. The reason for this is that is necessary to solve the problems in order to understand the course fully. There are no shortcuts to doing well in this course. *Revising old exams will not be enough preparation to succeed.*

Here's the HW schedule (*tentative*). Check the ASSIGNMENTS page on CANVAS for due dates.

HW	**Chapters**	**Due** (+2 days w/o penalty)
#1	2+1R	**Sep 17**
#2	3+4	**Oct 25**
#3	5+6	**Nov 22**
#4	12	**Nov 30**

Extra Credit:
Extra credit will be awarded for:

1. correctly solving problems in class
2. participating in class discussion
3. attending class regularly

This may add up to +2 pts to your final grade.

CHEM 2410 Syllabus

WEEK (roughly)	CONTENTS (Textbook Sections)	ASSIGNMENT
	Chap. 1 : Review of Gas Laws (Chapter 1)	**Homework-1**
1	(a) State variables and the gas laws ➢ Pressure, volume, moles, R constant ➢ The Gas Law and changes in variable of state ➢ Temperature in thermodynamics ➢ Solving problems in pchem ➢ Real Gases	
2-4	**Chap. 2 :** The First Law (§2.1 - §2.9)	**Homework-1**
	(a) The Basic Concepts and Terminology in Thermodynamics ➢ System and Its Surroundings ➢ Open, Closed, and Isolated Systems ➢ State and Process ➢ Work, Heat, Internal Energy (U) and Its Change (ΔU)	
	(b) The First Law: The basic statement(s)	
	(c) More on Work: Expansion Work and Reversibility	
	(d) More on Heat ➢ Heat Capacity (C_v) ➢ Heat Capacity (C_p) and Enthalpy (H)	
	(e) Thermochemistry ➢ Standard Enthalpy Changes(ΔH°) ➢ Standard Enthalpy of Formation($\Delta_f H^{\circ}$) ➢ *T*-dependence of ΔH (Kirchhoff's law)	
	(f) Mathematics and Machinery for Thermodynamics (§2.10 –§2.12) ➢ Math Background: Two-variable Calculus ➢ State Functions and Exact Differentials vs. and Non-State variables / Inexact Differentials ➢ The Change of State Functions : dU and dH ➢ The Relationship between Cv and Cp ➢ Expansion coefficient α and isothermal compressibility	

4-6 **Chap. 3 :** The Second Law (§3.1 –§3.6) **Homework-2**

(a) The Basic Concepts
- The Direction of Spontaneous Change
- The Second Law: Clausius Statement and Kelvin Statement
- Reversible and Irreversible Processes

(b) The Second Law: The Formal Statement
- The Change of the System Entropy (ΔS) and that of the Environment (ΔS_{surr})
- The Clausius Inequality

(c) The Entropy (S)
- Physical Meaning
- Thermodynamic Definition
- Statistical View of Entropy (Boltzmann Formula)

(c) Evaluate ΔS and/or ΔS_{surr} for Some Specific Processes

(d) The Third Law : The Standard Entropy ($S^{\ominus}$)

(e) Helmholtz Energy (A) and Gibbs Energy (G) and Remarks
- Evaluate ΔG and/or ΔA for Some Specific Processes
- Standard Molar Gibbs Energy ($\Delta_r G^{\ominus}$).

6-7 **Chap. 4 :** Physical Transformations of Pure Substances (§4.1 –§4.6) **Homework-2**

(a) Phase Diagrams: Phases and Their Stability;
(b) Phase Diagrams: Phase Boundary and The Phase Transition Temperature;
(c) Phase Transition: Thermodynamic Criterion for Phase Equilibrium;
(d) Phase Transition: The Dependence of Phase Stability on the Conditions;
(e) Phase Transition: The Location of Phase Boundaries;

MIDTERM (week 8 or 9)

7-9 **Chap. 5:** Simple Mixtures (§5.1-§5.13) **Homework-3**

(a) Thermodynamic description of mixture and mixing process
(b) The properties of solutions: Chemical Potentials of Ideal Solutions
(c) The properties of dilute solutions: Colligative Properties
(d) Phase diagrams of binary systems
(e) The Raoult's Law versus the Henry's Law
(e) The Activities (α): solvent, solute, molecule versus ions

9-10 **Chap. 6 :** Chemical Equilibrium (§6.1 –§6.9) **Homework-3**

(a) The Direction of Spontaneous Chemical Reactions: The Criterion;
(b) Reaction Quotient (Q) and Equilibrium Constant (K);
(c) The Response of Equilibrium to P and T ;
(d) Several Examples of Applications of Chemical Equilibrium.

(e) Equilibrium Electrochemistry (§6.5 –§6.9)
- Ions in Solution: ΔG, ΔS, and activity α
- Electrochemical Cells : Half-reactions and Electrodes
- Electrochemical Cells : Cell Reactions and Cell Potentials
- The Nernst Equation and Standard Potentials
- The Electrochemical Series
- Measurement of pH and pK and Standard Thermodynamics Functions

11-13 **Chap. 12 :** Statistical Thermodynamics

- Statistical Thermodynamics 1 (formerly Ch 15) : **Homework-4**
  The concepts, the Boltzmann distribution
  The microcanonical ensemble and the canonical ensemble
  The partition functions and the thermodynamics relations
- Statistical Thermodynamics 2 (formerly Ch 16):
  Boltzmann statistics and molecular partition functions
  Applications to thermodynamic properties of non-interacting molecular systems

Dec **FINAL EXAM**
Exam period (December)

GENERAL ADVICE:

(a) NEVER ACCUMULATE PROBLEMS TO THE END OF SEMESTER! Should you have any confusion/questions/problems about the lectures/text/assignments, do not hesitate to ask for help from the TAs or instructor. The accumulation of problems would only create more trouble for you to follow the new lectures.

(b) TEAM-WORK IS STRONGLY ENCOURAGED! Do homework in groups! Discuss with each other (after the class)! Teamwork has proven to be highly efficient means to enhance the understanding of difficult concepts in this course.

(c) NEVER ACCUMULATE DIFFICULTIES TO THE END OF SEMESTER
Should you have any confusions/questions/problems about the lectures/text/assignments, do not hesitate to ask for help from the instructor or TAs. The accumulation of problems would only create more trouble for you to follow the new lectures. Reading textbook and notes before and after lectures/tutorials.

(d) TEAM-WORK IS STRONGLY ENCOURAGED
Discuss the course materials and homework problems with your peers after the class! The team-study has been proven to be highly efficient means to enhance the understanding of difficult concepts and mathematical skills in this course.

(e) Math and science are not spectator sports…the **only** way to learn the material is to solve problems.

CHEM 2410: Physical Chemistry I

"Equilibrium Thermodynamics and Statistical Mechanics"

The Intended Learning Outcomes

Upon the study of this course, students are expected to establish a recognition of the fundamentally important role of *Physical Chemistry* in molecular science, to gain a better understanding of the relationship between *Physical Chemistry* and other sub-areas of chemistry (such as Organic, Inorganic, Analytical, Biological, Environmental and Materials Chemistry), to develop an appreciation of the relationship between Chemistry, Physics and Mathematics and other disciplines in science, and to be able to assess and judge some of the pressing societal issues in health, environment, and new technologies from the point of view of Physical Chemistry.

Specifically, students are expected to gain the following knowledge and skills.

A. Basic Knowledge in Science and Basic Skills in Mathematics

1) To grasp the principles of thermodynamics in terms of four basic thermodynamic laws, and be able to use the thermodynamic functions, such as Gibbs energy, enthalpy, entropy, chemical potential, to judge the direction of spontaneous change and to study various physical and chemical equilibrium problems
2) To grasp the basic principles of equilibrium statistical mechanics, the concepts and skills of statistical ensembles and the partition functions and their relations to thermodynamics functions
3) To be able to use the molecular partition functions and Boltzmann statistical mechanics to study the equilibrium thermodynamics properties and fluctuations of noninteracting molecular systems

B. Intellectual Skills in Chemistry

4) To be able to apply the principles of equilibrium thermodynamics to analyze and interpret a wide range of chemical problems from other sub-areas and interdisciplinary areas of chemistry
5) Able to analyze and judge the relevant issues and topics from daily life by employing the principles of thermodynamics and chemical equilibrium

C. Chemistry-Related Practical Skills

6) To gain a qualitative impression of the common physical techniques and experimentally measurables employed in the study of various physical and chemical equilibrium problems

D. Transferable Skills

7) To establish an effective scientific communication skill, in both oral and writing, in terms of equilibrium thermodynamics, chemical equilibria, and equilibrium statistical mechanics
8) To demonstrate information technology skills, especially in the areas of information retrieval, literature searching and library databases relevant to thermodynamics and equilibrium statistical mechanics
9) To enhance self-awareness and the ability of both team work and independent work.

CHEM 2550 Synthetic Chemistry Laboratory I

2024 Fall

Course Outline

1. Instructor

Name: Prof. CHAN, Ho-Wai Dennis (email: chanhw@ust.hk)
Contact Details: Room 4528 (office); Tel: 3469-2099 (office)

Name: Dr. TSE, Wai Pui Veronica (email: chvaipui@ust.hk)
Contact Details: Room 4537 (office); Tel: 2358-7364 (office)

2. Technical support staff / Teaching Assistant:

Technical support staff:

Name: LAU, Chun Tak Disney (email: disney@ust.hk)
CHAN, Ka Lok Kelvin (email: chkelvin@ust.hk)
CHOI Chai Yu, Edwin (email: edwinchoi@ust.hk)
Contact Details: CYT-1003 & CYT-1004; Tel: 34692611 & 34692612

Teaching Assistant:

Name: [to be provided in a separate file]

3. Meeting Time and Venue:

Date/Time:	LA1 Tuesday	/	12:30 – 16:20
	LA2 Wednesday	/	12:30 – 16:20
Venue:	CYT-1003 and CYT-1004 (Cheng Yu Tung building)		

4. Course Description

Credit Points: 2
Pre-requisite: CHEM 1050 or CHEM 1052
Corequisite: CHEM 2110 and CHEM 2210
Exclusion: CHEM 2155, CHEM 2150 and CHEM 2250
Brief Information/synopsis:

This is the laboratory course designed for students who enrolled in CHEM 2110 Organic Chemistry I and CHEM 2210 Inorganic Chemistry I. It includes a series of organic and inorganic experiments related to the theory learnt in the lecture courses. Students will be trained to perform a wide range of basic synthetic chemistry laboratory techniques, operate chemical instruments in laboratory, relate the physical and chemical principles and theory in practice and develop their data interpretation and analyzing skills. For CHEM students only.

5. Intended Learning Outcomes (ILOs)

Upon completion of this course, students are expected to be able to:

1	Describe the fundamentals of organic and inorganic chemistry.
2	Assess and manage the risks of organic and inorganic chemical substances and laboratory procedures.
3	Conduct analysis and interpretation of experimental data of synthetic chemistry.
4	Conduct standard laboratory procedures involved in fundamental chemical synthesis and instrumental work.
5	Operate a range of chemical instrumentation.
6	Work independently and collaborate in team work.

6. Assessment Scheme

In lab reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

#	Assessment items	Weighting	ILO(s) to be assessed
1	Risk Assessment	5%	2
2	Lab Quizzes†	25%	1, 2
3	Performance in laboratory	20%	2, 3, 4, 5, 6
4	Product /Results	10%	4
5	Lab Reports	40%	1, 3, 5

† *There will be a short lab quiz before each experiment begins.*

7. Student Learning Resources

Reference books:

(a) Kenneth L. Williamson, Katherine M. Masters, *Macroscale and Microscale Organic Experiments 7th edition*, Australia: Cengage ©2017. (or the *6th edition* ©2011)

(b) Dana W. Mayo; Ronald M. Pike; David C. Forbes, "*Microscale Organic Laboratory: with Multistep and Multiscale Syntheses*" *6th Edition*, Wiley Global Education, ©2013. (or the *5th edition* ©2011)

(c) Addison Ault, "*Techniques and Experiments for Organic Chemistry*" *6th Edition,* Sausalito, CA: University Science Books ©1998.

(d) Catherine E. Housecroft and Alan G. Sharpe, *Inorganic Chemistry 5th edition,* Harlow: Pearson Education ©2018. (or the *3rd edition* ©2008 [QD151.2 .H68 2008])

(e) James E. House, *Inorganic Chemistry 2nd edition*, Amsterdam: Academic Press/Elsevier ©2013. [QD151.5 .H68 2013eb]

(f) J. Derek Woollins, *Inorganic Experiments 3rd edition*, Weinheim: Wiley © 2010. [QD155.I54 2010]

* *Other course materials can be accessed from Canvas (https://canvas.ust.hk). Please login to Canvas using your ITSC username and password.*

8. Teaching and Learning Activities

Scheduled activities: 3 hr. 50 min. (tutorial, laboratory work, demonstrations, etc.)

9. Course Schedule

Keyword syllabus:

- Thin Layer Chromatography (TLC)
- Recrystallization of Organic and Simple Inorganic Compounds
- Liquid-Liquid Extraction of Organic Components from a Mixture
- Organic Synthesis
- Nucleophilic Substitution
- Melting Point Measurement
- Infrared Spectroscopy of Organic Compounds
- Synthesis of Transition Metal Complexes with Multi-dentate Ligands
- Spectrochemical Series
- UV-visible Spectroscopy of Inorganic Compounds

10. **Regarding score assignment**: *TAs and Technical Supports would discuss before deciding the final score (such as lab performance score)*

The Hong Kong University of Science and Technology

UG Course Syllabus

Molecular Characterization Chemistry Laboratory I

CHEM 2555

2 Credits

Pre-requisites: CHEM 1050 Laboratory for General Chemistry I, and [CHEM 2409 Mathematical Methods for Physical Chemistry, or MATH 2351 Introduction to Differential Equations]

Corequisite: CHEM 2410 Physical Chemistry I: Equilibrium Thermodynamics and Statistical Mechanics, and CHEM2310 Fundamentals of Analytical Chemistry

Name: Dr Joanne W T Tung

Email: jwttung@ust.hk

Office: Rm 4541

Course Description

This is a practical course designed for students who are taking the lectures of Physical Chemistry I and Fundamentals of Analytical Chemistry, in which it provides students some hands-on experience, with the use of analytical instruments or physical equipment, to apply what they learned in lectures in practical term. The main topics include electrochemical equilibrium, GC-FID analysis, etc.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the essential facts, principles and theories across the areas of chemistry, i.e. analytical and physical.
2. Formulate and analyze a wide range of chemical problems by applying relevant chemical principles.
3. Analyze and interpret experimental data, critically assess and extract useful data from it.
4. Conduct standard laboratory procedures involved in instrumental and experimental work.
5. Operate a range of chemical instrumentation with adequate hands-on experiences.
6. Assess and manage the risks of chemical substances and laboratory procedures by evaluating their potential impact on the environment.
7. Demonstrate self-awareness, work independently and collaborate effectively with other people in a team.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed mapping for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Lab Reports	45%	According to the individual experiment deadline
Lab Quizzes	35%	According to the individual experiment deadline
Lab Performance	20%	According to the individual experiment deadline

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab Reports	ILO1, ILO2, ILO3, ILO4, ILO7.	This task assesses students' ability to explain and apply analytical and physical chemistry principles and theories (ILO 1); evaluate their ability to apply the relevant chemical principles to analyze a wide range of analytical and physical chemistry problems (ILO 2), and interpret and critically assess and explain experimental data obtained from the experiments and be able to explain from the obtained experimental results (ILO 3); assess their understanding of the experimental or instrumental works in order to obtain experimental data for their reports (ILO 4), and work independently (ILO 7).
Lab Quizzes	ILO1, ILO2, ILO3, ILO4.	The quizzes assess students' knowledge to explain and apply analytical and physical chemistry principles and theories (ILO 1); evaluate their ability to apply analytical and physical chemistry principles to solve a wide range of analytical chemical problems (ILO 2); and their understanding of the meaning of experimental results (ILO 3) and understanding of the experimental procedure or instrumental works (ILO 4).
Lab Performance	ILO4, ILO5, ILO6, ILO7	Lab performance assess students' ability to conduct instrumental and experimental works correctly according to the given laboratory

		procedure (ILO4), operate a range of chemical instruments correctly (ILO 5), evaluate the risks of chemicals and can safely dispose chemicals (ILO 6), work independently and collaborate with other fellow students in laboratory (ILO 7).

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of the analytical and physical experiments. Exhibits a high capacity of understanding, analyzing and critically assessing the experimental and instrumental works, going beyond the requirements of the learning goals. Displays high motivation to learn and the ability to work effectively with others.
B	Good Performance	Shows good knowledge and understanding of the analytical and physical experiments, and demonstrate ability in analyzing and evaluating the experimental and instrumental works.
C	Satisfactory Performance	Possesses adequate knowledge of the analytical and physical experiments, and shows understanding of the core concept of the experimental works.
D	Marginal Pass	Has threshold knowledge of the analytical and physical experiments, and has potential to achieve the skills to make basic judgments.
F	Fail	Demonstrates insufficient understanding of the analytical and physical experiments, and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

There is no restriction on the use of generative AI in this course. Nevertheless, if students choose to use these tools, please use them ethically. Your submitted reports will be checked by Turnitin on canvas for detecting copying works. If you are found directly copy the answers generated by these tools, or cross copying from one another for these same answers, this falls in to plagiarism and dishonesty, the whole report will be zero mark.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within 10 working days of submission. Feedback on assignments will included. Students who have questions about the feedback including marks should raise during the data handling session or the next lab session.

Late Submission Policy

To ensure fairness for students who submit reports on time, a penalty for late submission is listed as follows:

- Late submission for every 12 hours, 10% of total marks deduction will be applied.
- Late penalty will be compounded at 10% mark deduction for every 12 hours lateness.
- For lateness that is less than 12 hours, it will be counted as one 12 hours.

Recommended Texts and Materials

- Peter Atkins, Julio de Paula, James Keeler, *Atkins' Physical Chemistry*, 11th Ed, Oxford University Press, 2018.
- Daniel C. Harris, Charles A. Lucy, *Quantitative Chemical Analysis*, 10th Ed, Macmillan Learning, 2020

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

CHEM 4120 Biomolecular Chemistry

Fall semester, 2024

INSTRUCTOR:

Dr. Zhihong Guo
Rm. 4519, Tel. 2358-7352
Email: chguo@ust.hk
Office hour: By appointment

TEACHING ASSISTANT:

Mr. Lingfeng Zhang
Rm. 7133, Tel. 2358-7380
Email: lzhangdl@connect.ust.hk

COURSE SUMMARY:

This course will introduce the fundamental chemical principles underlying the structure, properties, and functions of biologically important molecules. Using the chemical concepts of bonding, structure, and structure-reactivity relationships developed in organic chemistry, this course will cover topics on the stereochemistry, structural diversity, physicochemical properties, and reactivity of amino acids, peptides, proteins, nucleic acids, carbohydrates, and lipids to understand the molecular basis of their biological functions. Another major topic of this course is the preparation of these important biological molecules for understanding of their functions and exploitation of their biotechnological and medicinal values, using available organic chemistry methods. *Prerequisite*: CHEM3120, Organic Chemistry II.

Lecture Time: Tuesday and Thursday 9:00-10:20 pm

Venue: Rm. 6591, Lift 31-32.

Course Website: http://canvas.ust.hk/, use ITSC user name and password.

Course Materials: From selective textbooks, research reviews, and research papers.

1. "*Organic Chemistry*" 8th edition by J. McMurry; Brooks/Cole, Cengage Learning. 7th edition, QD251.3 .M364 2008, 4 copies.
2. "*Peptide chemistry: a practical textbook*" 2nd edition, Miklos Bodanszky, Springer-Verlag, c1988. Call number: QP552.P4 B629 1988.
3. "Introducing Proteomics" Josip Lovrić, Wiley-Blackwell, 2011. Call number: QP551.L68 2011.
4. *"Biochemistry of Lipids, Lipoproteins and Membranes"* 4th and 5th editions, D.E. Vance and J.E. Vance (Eds.), Elsevier 2002 and 2008. 4th Ed: QP 751.B55.2002; 5th Ed: QP751.B55.2008eb, online access: http://catalog.ust.hk/catalog/archives/769210.

5. "*Carbohydrates: synthesis, mechanisms, and stereoelectronic effects*" by Momčilo Miljković , Springer c2009. Call number: QD321 .M55 2009eb. Online access through SpringerLink: http://www.springerlink.com/content/gm7201/?MUD=MP.
6. "*Carbohydrates: the sweet molecules of life*" by Robert V. Stick, Academic Press, c2001. Call number: QD321 .S84 2001.
7. "*Nucleic acids in chemistry and biology*" 3rd ed. / edited by G. Michael Blackburn et al., RSC Pub., c2006. Call number: QD433.N83 2006.
8. "*Principles of nucleic acid structure*" by Stephen Neidle, 1st ed. Elsevier: Academic Press, 2008. Call number: QD433 .N43 2008. Online access through Elsevier: http://www.sciencedirect.com/science/book/9780123695079.

EXAMS AND GRADING SCHEME:

1. Midterm exam: 50%.
2. Final exam: 50%

COURSE OBJECTIVES AND INTENDED LEARNING OUTCOMES:

This course is dedicated to fundamental principles governing the structure, properties, and functions of biologically important molecules. It is designed to better prepare chemistry majors and other students for careers related to biologically important molecules in industry, government agencies, or academic institutions. Upon the end of the course, students should be able to:

1 To understand and recognize the fundamental chemical principles underlying the structure, properties, and functions of biologically important molecules.

2 To explain the essential facts, principles, and theories of the behaviours and properties of molecules in biological processes.

3 To understand the favourable and unfavourable interactions of living organisms with nature and environment to better appreciate the significance of regulation of food safety and environmental pollution.

4 To use the biologically important molecules in elucidation of their biological functions.

5 To formulate synthetic strategy for preparation of biological molecules for biotechnological and medicinal purposes.

Syllabus

	Dates	Subjects
Week 1	Sept. 3	Introduction and Amino acids, peptides and proteins (1)
	Sept. 5	Introduction and Amino acids, peptides and proteins (2)
Week 2	Sept. 10	Synthesis of amino acids and peptides
	Sept. 12	Solid-state synthesis of peptides
Week 3	Sept. 17	Synthesis of proteins
	Sept. 19	Analysis of amino acids and proteins: Mass spectroscopy
Week 4	Sept. 24	Peptide fingerprinting of proteins
	Sept. 26	Proteomics
Week 5	Oct. 1	***No class, The National Day***
	Oct. 3	Lipids—Fatty acids, wax, and triacylglycerols
Week 6	Oct. 8	Lipids—Components and structure of cell membranes (1)
	Oct. 10	Lipids—Components and structure of cell membranes (2)
Week 7	Oct. 15	Biosynthesis of lipids and drug development
	Oct. 17	Carbohydrates—Stereochemistry and hemiacetal forms
Week 8	Oct. 22	**Mid-term exam, in class.**
	Oct. 24	Carbohydrates—Reactions of monosaccharides
Week 9	Oct. 29	Carbohydrates—Di-, oligo- and polysaccharides
	Oct. 31	Carbohydrates—Synthesis of oligosaccharides
Week 10	Nov. 5	DNA structure, properties, and reactivity (1)
	Nov. 7	DNA structure, properties, and reactivity (2)
Week 11	Nov. 12	DNA replication and amplification
	Nov. 14	DNA chemical synthesis
Week 12	Nov. 19	DNA sequencing (1)
	Nov. 21	DNA sequencing (2)
Week 13	Nov. 26	RNA structure and properties
	Nov. 28	RNA functions
Week 14	Dec. 1-7	**Study Break**
Final exam	Dec.9-20	To be arranged.

CHEM 4140 Intermediate Organic Chemistry: Fall Semester (1 Sept – 30 Nov 2024)

INSTRUCTOR	Prof. HUANG, Yong
	Office: 4530
	Telephone: 3469 2625
	E-mail: yonghuang@ust.hk
TEACHING ASSISTANTS	ZHU, Ruiqi, rzhuaj@connect.ust.hk

LECTURE TIME	Mon. 1:30 PM - 2:50 PM
	Fri. 9:00 AM - 10:20 PM
CLASS VENUE	Rm 1409, Lift 25/26

COURSE DESCRIPTION:

Provides further training in the multistep organic synthesis of natural and unnatural products, and will focus on the retrosynthetic analysis, control of stereochemistry, carbonyl group chemistry, and pericyclic reactions with a brief coverage on new synthetic methodologies for efficient synthesis of compound libraries. A prerequisite for students wishing to take CHEM 5110/5120 as part of their undergraduate program. Prerequisite(s): CHEM 3120.

REFERENCE BOOKS:

1. "Advanced Organic Chemistry, Part A & Part B; 5th Ed", by Francis A. Carey and Richard J. Sundberg; New York: Springer, 2007.
2. "Organic Chemistry: an intermediate text; 2nd Ed", by Robert V. Hoffman; Hoboken, N.J.: Wiley-Interscience, 2004.
3. "Organic Synthesis; 4th Ed", by Michael B. Smith; Irvine, CA: Academic Press, 2017.
4. "Organic Synthesis: strategy and control", by Paul Wyatt and Stuart Warren; Chichester, England: John Wiley, 2007.
5. "Organic Synthesis: the disconnection approach; 2nd Ed", by Stuart Warren and Paul Wyatt; Chichester, UK : John Wiley & Sons Ltd., 2008.
6. "Molecules That Changed The World", by K. C. Nicolaou and T. Montagnon; Weinheim: Wiley-VCH, 2008.

COURSE OBJECTIVES AND INTENDED LEARNING OUTCOMES:

The course will treat selected topics in synthetic organic chemistry from a mechanistic viewpoint and illustrate their usefulness in the synthesis of designed organic molecules and natural

products. The course aims to provide an introduction to multistep organic synthesis and new development in synthetic methodologies essential for pharmaceutical research and application. It also seeks to encourage students to raise interest in a career in chemical research and development, either within a university or in industry.

Upon the end of the course, students should be able to:

1. Recognize and explain the essential facts, principles, and theories of organic chemistry including structures, stereochemistry, reaction mechanisms, and main transformations of carbon-derived compounds.
2. Demonstrate awareness and appreciation of synthetic organic chemistry topics relevant to advancement in social and daily life.
3. Formulate and analyze synthetic planning and products of multistep organic transformations by applying principles of retrosynthetic analysis.
4. Communicate effectively in the community of synthetic organic chemistry both orally and in writing.

SYLLABUS

Module 1: Introduction to Organic Chemistry

- Brief revision of atomic theory and the periodic table

- The impact of organic molecules on life

- Importance of chemical synthesis, including total synthesis of natural products

Module 2: Stereochemistry Part I

- Molecular chirality and stereoisomerism

- Fischer convention and CIP convention

- Chiral centers and axes

- Chirality, symmetry, and optical activity

- Physical properties of enantiomers

- Prochiral relationship, stereochemical drawing techniques, and analysis

- Conformations of acyclic alkanes, alkenes, aldehydes, and ketones

- Conformations of cyclohexanes, cyclohexenes, and cyclohexanones

- A values, 1,3-allylic strain, stereoelectronic effect, and anomeric effect

Module 3: Stereochemistry Part II: Stereochemistry of Reactions

- Chemoselectivity, regioselectivity, and stereoselectivity in reactions

- Heterogeneous and homogeneous catalytic hydrogenation
- Polar group directing effects
- Hydride reduction of acyclic ketones and cyclohexanones
- Nucleophilic addition to acyclic carbonyl groups
- Cram's rule and Felkin-Ahn model
- 1,3-asymmetric induction on reduction of β-hydroxyketones
- Chelation control in reduction and Grignard addition
- Houk conformation for reactions of alkenes
- Sharpless asymmetric epoxidation (AE) and asymmetric dihydroxylation (AD)

Module 4: Retrosynthetic Analysis & Synthetic Strategy

- Bond disconnection and retrosynthetic steps
- Convergent synthesis
- Normal and umpolung synthons
- Functional group interconversion (FGI) and functional group addition (FGA)
- Selected strategies for reaction control

Module 5: Functional Group Interconversion

- Mitsunobu reaction
- Conversion of alcohols
- Formation of esters from alcohols
- Formation of amides
- Cleavage of ethers and esters using TMSI
- Reduction carbonyl compounds
- Reductive amination
- CBS reduction
- Swern oxidation
- Dess–Martin periodinane reagents

Module 6: Carbonyl Group Chemistry I

- Grignard and organolithium reagents
- Addition reactions with carbonyls
- Wittig olefination and its variations
- Horner-Wadsworth-Emmons (HWE)
- Schlosser modifications
- Peterson olefination
- Julia olefination

Module 7: Carbonyl Group Chemistry II

- Chemo- and regio-selectivity in enol and enolate formation
- Regio-, stereoselective aldol reactions
- The Zimmermann–Traxler transition state
- Open transition state
- Controlling selectivity in aldol reactions
- Mukaiyama aldol reactions
- Chiral enolates of Evans auxiliaries
- Proline-catalyzed asymmetric aldol
- Robinson annulation
- Organo-Cu reagents

Module 8: Pericyclic Reactions

- Diels-Alder reactions
- Stereoselectivity in DA reactions
- Catalyzed DA reactions

Module 9: Case Study - Total synthesis of amphidinolides

- Olefin Metathesis
- Fürstner's total synthesis of T1, T3 and T4
- Ghosh's total synthesis of T1
- Jamison's total synthesis of T1

- Dai's total synthesis of T2

Module 10: Cross-Coupling Reactions

- Introduction to cross-coupling reactions

- The catalytic cycle of Pd-catalyzed coupling

- Various Palladium-catalyzed cross-coupling reactions (Suzuki, Stille, Negishi, Sonogashira, Heck)

Module 11: Diversity-Oriented Synthesis and Multicomponent Reactions

- Principles of diversity-oriented synthesis

- Multicomponent reactions

- Passerini reaction (P-3CR)

- Ugi reaction (U-4CR)

CLASS SCHEDULE

Week 1	Sept. 2	*1-Introduction*
	Sept. 6	*2-Molecular chirality, stereoisomers, Fischer and CIP*
Week 2	Sept. 9	*3-chiral centers, axis chirality, symmetry*
	Sept. 13	*4-optical activity, enantiomers, prochirality, drawings*
Week 3	Sept. 16	*5-Conformations, A values, $A^{1,3}$ strain, anomeric effect*
	Sept. 20	*6-Selectivity, hydrogenation, hydride addition*
Week 4	Sept. 23	*7-Nucleophilic addition, Cram and Felkin-Ahn models*
	Sept. 27	*8-Chelation control, the Houk conformation*

Week 5	Sept. 30	*No class, public holiday (the day following National Day)*
	Oct. 4	*9-Sharpless epoxidation and dihydroxylation*
Week 6	Oct. 7	*10-Retrosynthetic Analysis, synthons, umpolung*
	Oct. 11	*No Class (Chung Yeung Festival)*
Week 7	Oct. 14	*11-FGI: Mitsunobu, conversion of alcohols*
	Oct. 18	*Mid-term Examination (Normal Classroom)*
Week 8	Oct. 21	*12-FGI: Interconversion among carboxylic derivatives*
	Oct. 25	*13-FGI: Reduction and oxidation*
Week 9	Oct. 28	*14-Carbonyls I: Grignard, Li-exchange, Nu addition*
	Nov. 1	*15-Carbonyls I: Olefination: Wittig, HWE, etc.*
Week 10	Nov. 4	*16-Carbonyls II: Enolates, Aldol, Zimmermann-Traxler*
	Nov. 8	*17-Carbonyls II: Aldol continued, Mukaiyama aldol, Evans auxiliary*
Week 11	Nov. 11	*18-Carbonyls II: Proline-catalyzed aldol, organo-Cu reagents*
	Nov. 15	*19-Pericyclic Reactions: Diels-Alder, stereoselectivity*
Week 12	Nov. 18	*20-Cross-Coupling Reactions: mechanisms, variant and application*

Nov. 22 *21- Total Synthesis Case Study – Amphidinolide*

Week 13 Nov. 25 *22-DOS: multicomponent reactions, Passerini, Ugi*

Nov. 29 *23-Tutorial*

Dec. 2-7 *Study Break*

Dec. 9-20 *Final Examination (TBD)*

EXAMS AND GRADING SCHEME:

1. Mid-term Examination (45%)
2. Final Examination (55%)

SUPPORTING READING MATERIALS AND SOLUTION MANUAL:

Call Number QD251.2 .C36 2007eb

TITLE: Advanced Organic Chemistry, 5th ed.

AUTHOR: Francis A. Carey and Richard J. Sundberg

IMPRINT New York: Springer, c2007

Online access to the 4th ed. can be found at: https://chemistlibrary.files.wordpress.com/2015/07/advanced-organic-chemistry-4ed-2000-part-a-structure-and-mechanisms-carey-sundberg.pdf

Call Number QD251.2 .H58 2004

TITLE: Organic Chemistry: an intermediate text, 2nd ed.

AUTHOR: Hoffman, Robert V

IMPRINT Hoboken, N.J.: Wiley-Interscience, c2004

Call Number QD262 .W284 2008

TITLE: Organic Synthesis: the disconnection approach, 2nd ed.

AUTHOR: Warren, Stuart G

IMPRINT Chichester, UK: John Wiley & Sons Ltd., 2008

Call Number QD262 .W89 2007

TITLE: Organic Synthesis: strategy and control

AUTHOR: Paul Wyatt and Stuart Warren

IMPRINT Chichester, England: John Wiley, c2007

Call Number QD262 .S65 2017

TITLE: Organic Synthesis, 4th ed.

AUTHOR: Smith, Michael

IMPRINT Amsterdam: Academic Press, c2017

Call Number QD262 .S65 2010

TITLE: Organic Synthesis, 3rd ed.

AUTHOR: Smith, Michael

IMPRINT [Irvine, CA]: Wavefunction, Inc., [2010]

Call Number QD262 .N53 2008

TITLE: Molecules That Changed The World

AUTHOR: Nicolaou, K. C

IMPRINT Weinheim : Wiley-VCH, c2008

CHEM 4150 Biomolecular Synthesis Laboratory

2024 Fall semester

Course Outline

1. Instructors

Name: Dr. TSE. Wai Pui Veronica (chvaipui@ust.hk)
Contact: Office Room 4537; Tel: 2358-7364
Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099

2. Technician/ Instructional Assistant/ Teaching Assistant:

Technical support:
Name: CHOI, Chai Yu Edwin (edwinchoi@ust.hk)
Contact: Laboratory CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details will be provided in a separate file.]

3. Meeting Time and Venue:

Date/Time: CHEM 4150 Thu (10:30 – 13:20)
Venue: CYT-1004 and CYT-1003

4. Course Description

CHEM 4150 [1 Credit]
Pre-requisite: CHEM 3550
Co-requisite: CHEM 4155
Exclusion: nil
Brief Information/synopsis:
This course provides hands-on experience for students in the biomolecular chemistry option. It focuses on preparation/synthesis of molecules of biological relevance.

5. Intended Learning Outcomes

Upon completion of this course, students are expected to be able to:

1	Recognize fundamentals of chemistry including structure, reativity and properties of chemical substances, and the states of matter.
2	Explain the essential facts, principles and theories across organic and inorganic chemistry related to biomolecular chemistry.
3	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
4	Conduct standard laboratory procedures involved in synthetic work related to biomolecular chemistry.
5	Conduct analysis and interpretation of experimental data related to biomolecular chemistry.
6	Work independently and collaborate effectively in team work.

6. Assessment Scheme

In lab reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

#	Assessment items	Weighting	ILO(s) to be assessed
1	Risk assessment	5%	3
2	Laboratory Quiz†	25%	1, 2
3	Laboratory Performance	20%	3, 4, 5, 6
4	Product/Result	10%	4
5	Laboratory Reports	40%	1, 2, 5

†*There will be a short lab quiz before each experiment.*

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments*" *7th edition*, Kenneth L. Williamson and Katherine M. Masters, Australia: Cengage ©2017.

(b) "*Vogel's Textbook of Practical Organic Chemistry*" *5th edition*, A. I. Vogel, (editor), London : Longman Scientific & Technical ©1989.

* *Course materials can be downloaded by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).*

8. Teaching and Learning Activities

Tutorial + Laboratory work related to preparative chemistry related to biomolecular chemistry area.

9. Keyword Syllabus

- Synthesis of Platelet Aggregation Inhibitor
- Acylation reactions and Chemoselectivity
- Preparation of Poly-Arcylamide Gel
- Radical Chain-Growth Polymerization
- Extraction of Nucleic Acid from Plant Material
- Extraction of Nucleic Acid from Bacteria Sample
- Protection of Hydroxyl Groups for Carbohydrates
- Regioselective Substitution Reactions
- Diastereoselectivity Control in Substitution Reactions
- Glycosidation Reactions

CHEM 4155 Biomolecular Characterization Laboratory

2024 Fall semester

Course Outline

1. Instructors

Name: Dr. TSE, Wai Pui Veronica (chvaipui@ust.hk)
Contact: Office Room 4537; Tel: 2358-7364
Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099

2. Technical support / Teaching Assistant:

Name: CHOI, Chai Yu Edwin (edwinchoi@ust.hk)
Contact: Laboratory CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details to be provided in a separate file.]

3. Meeting Time and Venue:

Date/Time: CHEM 4155 Thu (13:30 – 16:20)
Venue: CYT-1004 and CYT-1003

4. Course Description

CHEM 4155 [1 Credit]
Pre-requisite: CHEM 3555
Co-requisite: CHEM 4150
Exclusion: nil
Brief Information/synopsis:
This course provides hands-on experience for students in the biomolecular chemistry option. It focuses on characterization of biologically relevant molecules.

5. Intended Learning Outcomes

Upon completion of this course, students are expected to be able to:

1	Recognize fundamentals of chemistry including structure, reativity and properties of chemical substances, and the states of matter.
2	Explain the essential facts, principles and theories across organic and inorganic chemistry related to biomolecular chemistry.
3	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
4	Conduct standard laboratory procedures involved in instrumental work related to biomolecular chemistry.
5	Conduct analysis and interpretation of experimental data related to biomolecular chemistry.
6	Work independently and collaborate effectively in team work.

6. Assessment Scheme

In lab reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

#	Assessment items	Weighting	ILO(s) to be assessed
1	Risk assessment	5%	3
2	Laboratory Quiz†	25%	1, 2
3	Laboratory Performance	20%	3, 4, 5, 6
4	Product/Result	10%	4
5	Laboratory Reports	40%	1, 2, 5

†*There will be a short lab quiz before each experiment.*

7. Student Learning Resources

Reference books:

(a) *"Macroscale and Microscale Organic Experiments" 7th edition*, by Kenneth L. Williamson and Katherine M. Masters, Australia: Cengage ©2017.

(b) *"Principles of Instrumental Analysis" 7th edition*, by D. A. Skoog, F. J. Holler, S. R. Crouch. Australia: Cengage Learning ©2007 [2018]. E-Book in HKUST Library: https://ebookcentral.proquest.com/lib/hkust-ebooks/detail.action?pq-origsite=primo&docID=6351262

(c) *"Gel electrophoresis of proteins: a practical approach" 3rd edition*, by B.D. Hames (editor), New York: Oxford University Press, ©1998.

* *Course materials can be downloaded by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).*

8. Teaching and Learning Activities

Tutorial + Laboratory work related to preparative chemistry and chemical analysis.

9. Keyword Syllabus

- Spectrophotometric Assay for Protein Concentration
- Characterization by FT-IR spectroscopy
- Characterization by ^{1}H-NMR spectroscopy
- Analysis of Protein by Electrophoretic Method - SDS PAGE
- Analysis of Nucleic Acid by Agaorse gel Electrophoresis
- Characterization by MALDI-Tof MS
- Characterization by UV spectroscopy
- Chemical analysis by GC-FID
- Determining Diastereoselectivity by High Resolution ^{1}H-NMR Spectroscopy

The Hong Kong University of Science and Technology
Department of Chemistry
CHEM 4160: Cheminformatics

INSTRUCTOR

- Dr. SHEONG Fu Kit

LECTURE

- Monday, 03:00PM - 04:20PM
- Friday, 10:30PM - 11:50PM

VENUE

- Room 5508, Lift 25/26

COURSE DESCRIPTION

- The course provides a general introduction to the field of cheminformatics, covering the conceptualization, classification and codification of chemical information and data, structures and reactions. Students will learn the terminology, methods and the practical workflow of cheminformatics. Students will then apply these principles working in a project, which involves definition of problem, data mining and analysis, modelling including use of AI, prediction of properties, problem outcomes, and proposing future directions for experimental work.

PREREQUISITE

- CHEM 2110 AND (CHEM 2409 OR MATH 2351 OR DASC 2010)

INTENDED LEARNING OUTCOMES

- To recognise the scope, methods and terminology of Cheminformatics.
- To describe classification and encoding of chemical information, data, structures and reactions.
- To demonstrate the skills of retrieving and analyzing information relevant to a particular problem through data mining and database searching.
- To select the correct cheminformatics techniques for a given goal.
- To assemble various cheminformatics methods to solve a chemical problem as a project.

SUGGESTED READING

- An Introduction to Chemoinformatics – Leach & Gillet, Springer, 2007.
- Chemometrics: Statistics & Computer Application in Analytical Chemistry – Otto, Wiley Online Library, 2016.

GRADING SCHEME

- Written Proposal of a Cheminformatics Project (40%)
  - Submission deadline: 10th November, 2024
- Proposal Defense OR Completed Project (60%)
  - [Defense] 29th November, 2024
  - [Project] 8th December, 2024

COURSE SCHEDULE

Week 1	2nd Sept	Topic 01	Course Intro and the Mindset of Cheminformatics
	6th Sept	-	*Class cancelled due to typhoon*
Week 2	9th Sept	Topic 02	Workflow of Cheminformatics
	13th Sept	Topic 03	Understanding Representation
Week 3	16th Sept	Topic 04	Representing Molecular Topology
	20th Sept	Topic 05	Representing Molecular Properties
Week 4	23rd Sept	Topic 06	Chemical Data Acquisition
	27th Sept	Topic 07	Quantifying Dissimilarities
Week 5	30th Sept	Topic 08	Quantifying Similarities
	4th Oct	Topic 09	Visualizing Chemical Data
Week 6	7th Oct	Topic 10	Dimensionality Reduction I
	11th Oct	-	*Chung Yeung Festival*
Week 7	14th Oct	Topic 11	Dimensionality Reduction II
	18th Oct	Special Topic	The Nobel Prize in Chemistry 2024
Week 8	21st Oct	Topic 12	Cluster Analysis in Cheminformatics
	25th Oct	Topic 13	Regression Analysis in Cheminformatics
Week 9	28th Oct	Topic 14	Tree-based Methods in Cheminformatics
	1st Nov	Topic 15	Neural Networks in Cheminformatics I
Week 10	4th Nov	Topic 16	Neural Networks in Cheminformatics II
	8th Nov	Topic 17	Model Validation
Week 11	11th Nov	Topic 18	Case Studies: Catalyst Design
	15th Nov	Topic 19	Case Studies: Drug Discovery
Week 12	18th Nov	Topic 20	Case Studies: Energy Functions
	22nd Nov	Topic 21	Case Studies: Material Design
Week 13	25th Nov	Topic 22	Reflections on Cheminformatics
	29th Nov	Assessment	Oral Defense of Project Proposals

CHEM 4220
Materials Chemistry
Fall 2024

Instructors:
Dr. Haipeng Lu (Assistant Professor)
Room: 4533, Lift 25/26
Tel: 3469-2097
E-mail: haipenglu@ust.hk

Teaching Assistants:
CHOW, Chi Wa (Ivan), Email: cwchowae@connect.ust.hk

Lectures:

Mon, Wed	9:00-10:20	Rm 1409 (Lift 25/26)

Course Website:
Canvas: https://canvas.ust.hk/courses/57979

COURSE DESCRIPTION

An introductory upper level UG course in materials chemistry for students interested in the fundamental principles governing inorganic and organic materials. Crystalline solids, polymers, nanomaterials, preparative methods, characterization techniques, and properties.

THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Calendar Dates in the 2024-25 Academic Year
(Provisional)

Week	S	M	T	W	T	F	S	Events		General Holidays
	August, 2024									
					1	2	3			
	4	5	6	7	8	9	(10)	10	Last day of Summer Term, 2023-24	
	11	12	13	14	15	16	17			
	18	19	20	21	22	23	24			
	25	26	27	28	29	30	31			
	September									
1	1	(2)	3	4	5	6	7	2	Commencement of the 2024-25 Academic Year	
2	8	9	10	11	12	13	14	2	Fall Term commences	
3	15	16	17	18	19	20	21			*18 The day following the Chinese Mid-Autumn Festival*
4	22	23	24	25	26	27	28			
5	29	30								
	October									
5			1	2	3	4	5			*1 The National Day*
6	6	7	8	9	10	11	12			*11 Chung Yeung Festival*
7	13	14	15	16	17	18	19			
8	20	21	22	23	24	25	26			
9	27	28	29	30	31					
	November									
9						1	2			
10	3	4	5	6	7	8	9			
11	10	11	12	13	14	15	16			
12	17	18	19	20	21	22	23			
13	24	25	26	27	28	29	(30)	30	Last day of Fall Term classes	
	December									
	1	**2**	**3**	**4**	**5**	**6**	**7**	2-7	Study Break	
	8	**9**	**10**	**11**	**12**	**13**	**14**	9-20	Fall Term Examinations	
	15	**16**	**17**	**18**	**19**	**20**	21	20	Last day of Fall Term	
	22	23	24	25	26	27	28			*25 Christmas Day*
	29	30	31							*26 The first weekday after Christmas Day*

Public holiday — (○) First/Last day of Term classes

Examination Period/Break — **Boldtype** Important dates for students to note

Objectives:

Upon successful completion of this course, students should be able to:

No.	Objectives
1	Obtain key fundamental knowledge about materials chemistry, including structure, synthesis, characterization, properties, and applications of different functional materials.
2	Able to understand the key structural-property relationship of materials from the fundamental chemistry principles (crystal structure, bonding etc).
3	Able to understand the synthetic methods of functional materials from a perspective of chemistry.
4	Able to present key knowledge and principles learned in this course to a broad audience. Intrigue those students who are interested in materials chemistry to pursue further research.

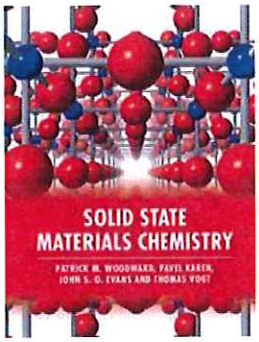
Intended LEARNING OUTCOMES

Upon successful completion of this course, students will be able to:

1) Learn the basic knowledge related with materials including organic, inorganic, hybrid, polymer, and nanomaterials
2) Obtain basic crystallographic knowledge and able to understand the structures of complex crystals;
3) Able to understand the chemical bonding from molecular orbitals to extended solids;
4) Learn important synthetic methods for functional inorganic materials and nanomaterials;
5) Obtain basic knowledge of important material characterization methods;
6) Able to understand and predict materials' properties from the fundamental chemistry principles (elemental composition, bonding, and crystal structure) learned in this course;
7) Able to present the most important knowledge and principles learned in this course in a clear and simple presentation.

TEXTBOOK

Solid State Materials Chemistry, 1st Edition, Student Edition
Patrick M. Woodward
ISBN: 9780521873253 May 2021



The instructor will also provide additional notes.

REQUIREMENTS

- Students need to be familiar with the syllabus and the class schedule and be aware of the course requirements and progress.
- Students need to check the course website and their UST e-mails on regular basis. All assignments, slides and any other course materials will be posted on the course website. Furthermore, course announcements will also be made on the course website and/or via UST e-mail.
- Students are required to be familiar with HKUST Academic Integrity Policy (http://www.ust.hk/vpaao/integrity/). These policies will be strictly enforced in this course to keep academic honesty.
- Students need to follow proper classroom ethics, so that we can make a comfortable learning environment to each student in the class.
- Discussions with fellow students and teaching crew are strongly encouraged, but work which is submitted for grading must be your own understanding, expressed in your own words.
- Student should have taken Inorganic chemistry (CHEM 2210)

GRADING

Assessment

- 20% assignments
- 60% final
- 20% presentation

Notes:

Number of assignments: **3**

Final Presentation: topics will be provided

COURSE SCHEDULE

Week 1	09/02	Lecture 1	Introduction & different materials types
	09/04	Lecture 2	Molecular materials 1
Week 2	09/09	Lecture 3	Carbon materials
	09/11	Lecture 4	Coordination materials 1
Week 3	09/16	Lecture 5	Coordination materials 2
	09/18	Holiday	
Week 4	09/23	Lecture 6	Polymer materials 1
	09/25	Lecture 7	Polymer materials 2 **Assignment #1**
Week 5	09/30	Lecture 8	Crystalline solids 1
	10/03	Lecture 9	Crystalline solids 2
Week 6	10/07	Lecture 10	Battery materials
	10/09	Lecture 11	Nanomaterials 1
Week 7	10/14	Lecture 12	Nanomaterials 2
	10/16	Lecture 13	Synthesis of materials
Week 8	10/21	Lecture 14	Materials characterization: structural characterization **Assignment #2**
	10/23	Lecture 15	Special topic: Carbon Nanomaterials: 1
Week 9	10/28	Lecture 16	Special topic: Carbon Nanomaterials: 2
	10/30	Lecture 17	Optical materials 1
Week 10	11/04	Lecture 18	Optical materials 2
	11/06	Lecture 19	Light-emitting diodes 1
Week 11	11/11	Lecture 20	Light-emitting diodes 2
	11/13	Lecture 21	Semiconducting materials
Week 12	11/18	Lecture 22	Different PV techniques **Assignment #3**
	11/20		Final presentation 1
Week 13	11/25		Final presentation 2
	11/27		Final Presentation 3

Date & location of Final Exam will be arranged by ARO.

CHEM 4250 Materials Preparation Laboratory
2024 Fall semester
Course Outline

1. Instructor

Name: Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099

2. Technical Support / Teaching Assistant:

Name: CHAN, Ka Lok Kelvin (chkelvin@ust.hk)
Contact: Laboratory CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details will be provided in a separate file.]

3. Meeting Time and Venue:

Date/Time: CHEM 4250 Thu (10:30 – 13:20)
Venue: CYT-1003 and CYT-1004

4. Course Description

CHEM 4250 [1 Credit]
Pre-requisite: CHEM 3550
Co-requisite: CHEM 4255 Exclusion: nil
Brief Information/synopsis:
This is a laboratory course for students to gain hands-on experiences in the preparation of modern materials. Students will have the opportunity to practice the synthesis of materials such as organic polymers, nanoparticles and solid materials.

5. Intended Learning Outcomes

Upon completion of this course, students are expected to be able to:

1	Recognize fundamentals of chemistry including structure, reativity and properties of chemical substances, and the states of matter.
2	Explain the essential facts, principles and theories across organic and inorganic chemistry related to solid state materials
3	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
4	Conduct standard laboratory procedures involved in synthetic work related to organic polymers and solid state materials.
5	Conduct analysis and interpretation of experimental data related to solid state materials
6	Work independently and collaborate effectively in team work.

6. Assessment Scheme

In lab reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

#	**Assessment items**	**Weighting**	**ILO(s) to be assessed**
1	Risk assessment	5%	3
2	Laboratory Quiz†	25%	1, 2
3	Laboratory Performance	20%	3, 4, 5, 6
4	Product/Result	10%	4
5	Laboratory Reports	40%	1, 2, 5

†*There will be a short lab quiz before each experiment.*

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments*" *7th edition*, Kenneth L. Williamson and Katherine M. Masters, Australia: Cengage ©2017.

(b) "*Vogel's Textbook of Practical Organic Chemistry*" *5th edition* A. I. Vogel, (editor), London : Longman Scientific & Technical ©1989.

* *Course materials can be downloaded by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).*

8. Teaching and Learning Activities

Tutorial + Laboratory work related to preparative chemistry related to materials chemistry area.

9. Keyword Syllabus

- Preparation of Fluorescent Organic Materials for pH Sensing
- Organic Synthesis by Condensation of Amines with Aldehydes
- Synthesis of Light Emitting Metal Complex with Multidentate Ligands
- Construction of Organic Light-Emitting Device
- Synthesis of Conjugated Aromatics by Suzuki Cross-coupling
- Transition Metal Catalyzed Organic Synthesis
- Synthesis of Mixed-Valence Metal Oxides Solid-State Material by Partial Oxdiation
- Sonochemical Synthesis of Metal Organic Framework

CHEM 4255 Materials Characterization Laboratory
2024 Fall semester
Course Outline

1. Instructor

Name: Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099

2. Technical support / Teaching Assistant:

Name: CHAN, Kelvin Ka Lok (chkelvin@ust.hk)
Contact: Laboratory CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details to be provided in a separate file.]

3. Meeting Time and Venue:

Date/Time: CHEM 4255 Thu (13:30 – 16:20)
Venue: CYT-1003 and CYT-1004

4. Course Description

CHEM 4255 [1 Credit]
Pre-requisite: CHEM 3555 Co-requisite: CHEM 4250 Exclusion: nil
Brief Information/synopsis: This is a laboratory course for students to gain hands-on experiences in the characterization of modern materials.

5. Intended Learning Outcomes

Upon completion of this course, students are expected to be able to:

1	Recognize fundamentals of chemistry including structure, reativity and properties of chemical substances, and the states of matter.
2	Explain the essential facts, principles and theories across organic and inorganic chemistry related to solid state materials
3	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
4	Conduct standard laboratory procedures involved in instrumental work related to organic polymers and solid state materials.
5	Conduct analysis and interpretation of experimental data related to solid state materials
6	Work independently and collaborate effectively in team work.

6. Assessment Scheme

In lab reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

#	Assessment items	Weighting	ILO(s) to be assessed
1	Risk assessment	5%	3
2	Laboratory Quiz†	25%	1, 2
3	Laboratory Performance	20%	3, 4, 5, 6
4	Product	10%	4
5	Laboratory Reports	40%	1, 2, 5

†*There will be a short lab quiz before each experiment.*

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments" 7th edition*, Kenneth L. Williamson and Katherine M. Masters, Australia: Cengage ©2017.

(b) "*Principles of Instrumental Analysis" 7th edition*, by D. A. Skoog, F. J. Holler, S. R. Crouch. Australia: Cengage Learning ©2007 [2018]. E-Book in HKUST Library: https://ebookcentral.proquest.com/lib/hkust-ebooks/detail.action?pq-origsite=primo&docID=6351262

** Course materials can be downloaded by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).*

8. Teaching and Learning Activities

Tutorial + Laboratory work related to chemical analysis related to materials chemistry area.

9. Keyword Syllabus

- Characterization of Fluorescent Materials - Fluorescence spectroscopy
- Characterization of Fluorescent Materials – Nuclear Overhauser Effect
- Spectrometric Measurement of pH-Dependent Fluorescence
- Materials Characterization by Thermal Analytical Method – DSC
- Materials Characterization by Thermogravimetric Analytical Method – TGA
- Materials Characterization by Transmission FT-IR and ATR FT-IR
- Characterization of Molecular Materials by Fluorescence Spectroscopy
- Characterization of Molecular Materials by UV-Visible Spectroscopy
- Characterization of Solid-state Materials by Powder X-ray Diffraction (pXRD)
- Characterization of Solid-state Materials by Scanning Electron Microscopy (SEM)
- Characterization of Molecular Materials by High-Resolution ^{1}H-NMR Spectroscopy
- Characterization of Molecular Materials by 2D NMR Spectroscopy – Homonuclear Correlation Spectrosopy (COSY)

The Hong Kong University of Science and Technology

UG Course Syllabus

Environmental Chemistry Laboratory

CHEM 4350

1 Credit

Pre-requisite: [CHEM2310 Fundamentals of Analytical Chemistry or CHEM2311 Analytical Chemistry] AND [CHEM2555 Molecular Characterisation Laboratory I or CHEM2355 Fundamental Analytical Chemistry Laboratory]

Co-requisite: CHEM4355 Instrumental Analytical Chemistry Laboratory

Name: Dr Joanne W T Tung

Email: jwttung@ust.hk

Office: Rm 4541

Course Description

This is a laboratory course for students to gain hands-on experience in collection and handling environmental samples. Analyses particularly for determining analytes in environmental samples using specific instruments and methods will be covered, such as TOC analyser, air collection using DNPH-sorbent cartridge, etc. Experiments covered in this course will be closely connected with the topics covered in the lecture courses of CHEM4310 and CHEM4320, including preparation of environmental samples for analytical analysis.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the essential facts, principles and theories across the areas of chemistry, i.e. analytical and environmental chemistry.
2. Formulate and analyze a wide range of environmental analytical chemical problems by applying relevant chemical principles.
3. Analyze and interpret experimental data, critically assess and extract useful data from it.
4. Conduct standard laboratory procedures involved in instrumental and experimental work.
5. Operate a range of chemical instrumentation with adequate hands-on experiences.
6. Assess and manage the risks of chemical substances and laboratory procedures by evaluating their potential impact on the environment.
7. Demonstrate self-awareness, work independently and collaborate effectively with other people in a team.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed mapping for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Lab Reports	45%	According to the individual experiment deadline
Lab Quizzes	35%	According to the individual experiment deadline
Lab Performance	20%	According to the individual experiment deadline

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab Reports	ILO1, ILO2, ILO3, ILO4, ILO7.	This task assesses students' ability to explain and apply environmental analytical chemistry principles and theories (ILO 1); evaluate their ability to apply the relevant chemical principles to analyze a wide range of environmental analytical chemical problems (ILO 2), and interpret and critically assess experimental data obtained from the experiments and be able to extract useful information from the obtained experimental results (ILO 3); assess their understanding of the experimental or instrumental works in order to obtain experimental data for their reports (ILO 4), and work independently (ILO 7).
Lab Quizzes	ILO1, ILO2, ILO3, ILO4.	The quizzes assess students' knowledge to explain and apply environmental analytical chemistry principles and theories (ILO 1); evaluate their ability to apply environmental chemistry and analytical chemistry principles to solve a wide range of analytical chemical problems (ILO 2); and their understanding of the meaning of experimental results (ILO 3), and their understanding of the experimental procedure or instrumental works (ILO 4).

Lab Performance	ILO4, ILO5, ILO6, ILO7	Lab performance assess students' ability to conduct instrumental and experimental works correctly according to the given laboratory procedure (ILO4), operate a range of chemical instruments correctly (ILO 5), evaluate the risks of chemicals and can safely dispose chemicals (ILO 6), work independently and collaborate with other fellow students in laboratory (ILO 7).

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of the environmental analytical experiments. Exhibits a high capacity of understanding, analyzing and critically assessing the experimental and instrumental works, going beyond the requirements of the learning goals. Displays high motivation to learn and the ability to work effectively with others.
B	Good Performance	Shows good knowledge and understanding of the environmental analytical experiments, and demonstrate ability in analyzing and evaluating the experimental and instrumental works.
C	Satisfactory Performance	Possesses adequate knowledge of the environmental analytical experiments, and shows understanding of the core concept of the experimental works.
D	Marginal Pass	Has threshold knowledge of the environmental analytical experiments, and has potential to achieve the skills to make basic judgments.
F	Fail	Demonstrates insufficient understanding of the environmental analytical experiments, and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

There is no restriction on the use of generative AI in this course. Nevertheless, if students choose to use these tools, please use them ethically. Your submitted reports will be checked by Turnitin on canvas for detecting copying works. If you are found directly copy the answers generated by these tools, or cross copying from one another for these same answers, this falls in to plagiarism and dishonesty, the whole report will be zero mark.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within 10 working days of submission. Feedback on assignments will included. Students who have questions about the feedback including marks should raise during the data handling session or the next lab session.

Late Submission Policy

To ensure fairness for students who submit reports on time, a penalty for late submission is listed as follows:

- Late submission for every 12 hours, 10% of total marks deduction will be applied.
- Late penalty will be compounded at 10% mark deduction for every 12 hours lateness.
- For lateness that is less than 12 hours, it will be counted as one 12 hours.

Recommended Texts and Materials

- Daniel C. Harris, Charles A. Lucy, *Quantitative Chemical Analysis*, 10th Ed., Macmillian Learning, 2020.
- Skoog D. A., Holler F. J. and Crouch S. R., *Principles of Instrumental Analysis*, 6th Ed., Thomson Brooks/Cole, Thomson Corporation, 2007.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

The Hong Kong University of Science and Technology

UG Course Syllabus

Instrumental Analytical Chemistry Laboratory

CHEM 4355

1 Credit

Pre-requisite: [CHEM2310 Fundamentals of Analytical Chemistry, or CHEM2311 Analytical Chemistry] AND [CHEM2555 Molecular Characterisation Laboratory I, or CHEM2355 Fundamental Analytical Chemistry Laboratory]

Co-requisite: CHEM4350 Environmental Chemistry Laboratory

Name: Dr Joanne W T Tung

Email: jwttung@ust.hk

Office: Rm 4541

Course Description

This is a laboratory course for students to gain hands-on experiences in operation of the modern instruments. The instruments include liquid chromatography, gas chromatography, LC-MS/MS, ICP-OES, etc. The experiments covered in this course will be closely connected with the topics covered in CHEM4320 and CHEM4330.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the essential facts, principles and theories across the areas of chemistry, i.e. instrumental analytical chemistry.
2. Formulate and analyze a wide range of instrumental analytical chemical problems by applying relevant chemical principles.
3. Analyze and interpret experimental data, critically assess and extract useful data from it.
4. Conduct standard laboratory procedures involved in instrumental and experimental work.
5. Operate a range of chemical instrumentation with adequate hands-on experiences.
6. Assess and manage the risks of chemical substances and laboratory procedures by evaluating their potential impact on the environment.
7. Demonstrate self-awareness, work independently and collaborate effectively with other people in a team.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed mapping for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Lab Reports	45%	According to the individual experiment deadline
Lab Quizzes	35%	According to the individual experiment deadline
Lab Performance	20%	According to the individual experiment deadline

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab Reports	ILO1, ILO2, ILO3, ILO4, ILO7.	This task assesses students' ability to explain and apply instrumental analytical chemistry principles and theories (ILO 1); evaluate their ability to apply the relevant chemical principles to analyze a wide range of instrumental analytical chemical problems (ILO 2), and interpret and critically assess and explain experimental data obtained from the experiments and be able to extract useful information from the obtained experimental results (ILO 3); assess their understanding of the experimental or instrumental works in order to obtain experimental data for their reports (ILO 4), and work independently (ILO 7).
Lab Quizzes	ILO1, ILO2, ILO3, ILO4.	The quizzes assess students' knowledge to explain and apply instrumental analytical chemistry principles and theories (ILO 1); evaluate their ability to apply instrumental analytical chemistry principles to solve a wide range of analytical chemical problems (ILO 2); and their understanding of the meaning of experimental results (ILO 3), and their understanding of the experimental procedure or instrumental works (ILO 4).
Lab Performance	ILO4, ILO5, ILO6, ILO7	Lab performance assess students' ability to conduct instrumental and experimental works correctly according to the given laboratory

		procedure (ILO4), operate a range of chemical instruments correctly (ILO 5), evaluate the risks of chemicals and can safely dispose chemicals (ILO 6), work independently and collaborate with other fellow students in laboratory (ILO 7).

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of the instrumental analytical experiments. Exhibits a high capacity of understanding, analyzing and critically assessing the experimental and instrumental works, going beyond the requirements of the learning goals. Displays high motivation to learn and the ability to work effectively with others.
B	Good Performance	Shows good knowledge and understanding of the instrumental analytical experiments, and demonstrate ability in analyzing and evaluating the experimental and instrumental works.
C	Satisfactory Performance	Possesses adequate knowledge of the instrumental analytical experiments, and shows understanding of the core concept of the experimental works.
D	Marginal Pass	Has threshold knowledge of the instrumental analytical experiments, and has potential to achieve the skills to make basic judgments.
F	Fail	Demonstrates insufficient understanding of the instrumental analytical experiments, and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

There is no restriction on the use of generative AI in this course. Nevertheless, if students choose to use these tools, please use them ethically. Your submitted reports will be checked by Turnitin on canvas for detecting copying works. If you are found directly copy the answers generated by these tools, or cross copying from one another for these same answers, this falls in to plagiarism and dishonesty, the whole report will be zero mark.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within 10 working days of submission. Feedback on assignments will included. Students who have questions about the feedback including marks should raise during the data handling session or the next lab session.

Late Submission Policy

To ensure fairness for students who submit reports on time, a penalty for late submission is listed as follows:

- Late submission for every 12 hours, 10% of total marks deduction will be applied.
- Late penalty will be compounded at 10% mark deduction for every 12 hours lateness.
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Recommended Texts and Materials

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- Skoog D. A., Holler F. J. and Crouch S. R., *Principles of Instrumental Analysis*, 6th Ed., Thomson Brooks/Cole, Thomson Corporation, 2007.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

CHEM 4410 - Physical Chemistry in Biological Applications

Fall 2024/25

1. Instructor:

Name: Prof. Jinqing Huang
Office: 4544
Email: jqhuang@ust.hk
Extension: 2627

2. Meeting Time and Venue

Lectures:

2 Sessions (1.5 hour each) every week
Wed, Fri: 15:00-16:20 am Room 2126D

Office Hours:

	Time	Venue
Instructor	Mon. 15:00 – 17:00	4544

3. Course description:

Credit Points: 3
Pre-requisite: CHEM 3420 Physical Chemistry II
Exclusion: NIL
Brief Information/synopsis:

This course covers the applications of physical chemistry in biological science and emphasizes the capability in using the fundamental knowledge in physical chemistry to solve the latest research problems in the interdisciplinary areas. Topics include molecular interpretations of the laws of thermodynamics, free energy and physical equilibria in membranes, photochemistry and photobiology, enzyme kinetics, binding and conformation transitions, spectroscopy of biomolecular structures and interactions. For CHEM students only. Students with Minor in CHEM or other Major may seek instructor's approval for enrollment in the course.

4. Intended Learning Outcomes

At the end of the course, the student will be able to:

1. Understand how to interpret fundamental concept from physical chemistry in the application of biological science
2. Have the skill set to do literature review to gather information for the development of the industry and the academia in biological science.
3. Be able to apply the knowledge from physical chemistry to solve the problems in the application of biological science.
4. Be able to present and criticize the knowledge from physical chemistry in the application of biological science.

5. Assessment Scheme

Reading Assignments	20%	ILOs 1, 2
Midterm Presentation	40%	ILOs 3, 4
Final Project Report	40%	ILOs 2, 3

6. Student Learning Resources

Recommended Reading:
"*Physical Chemistry: Principles and Applications in Biological Sciences*" Tinoco, Sauer, Wang, Puglisi, Harbison, and Rovnyak, Prentice Hall, 5th Edition

7. Additional Teaching and Learning Activities

After lecture discussions

8. Course Topics and Schedule

Chapter 1: Molecular Interpretations of the Laws of Thermodynamics
Chapter 2: Free Energy and Physical Equilibria in Membranes
Chapter 3: Photochemistry and Photobiology
Chapter 4: Enzyme Kinetics
Chapter 5: Binding and Conformation Transitions
Chapter 6: Spectroscopy of Biomolecular Structures and Interactions

CHEM 4550 Advanced Synthetic Laboratory
2024 Fall semester
Course Outline

1. Instructor

Name: Dr. TSE, Wai Pui Veronica (chvaipui@ust.hk)
Contact: Office Room 4537; Tel: 2358-7364
Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099

2. Technical support / Teaching Assistant:

Name: LAU, Chun Tak Disney (disney@ust.hk)
Contact: Laboratory Room CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details will be provided in a separate file.]

3. Meeting Time and Venue:

Date/Time: CHEM 4550 Thu (10:30 – 13:20)
Venue: CYT-1003 and CYT-1004

4. Course Description

CHEM 4550 [1 Credit]
Pre-requisite: CHEM 3550
Co-requisite: CHEM 4555
Exclusion: nil
Brief Information/synopsis:
This course provides hands-on experience for students in the pure chemistry option. It emphasizes on the advanced lab techniques. Experiment of different areas like metal catalyzed cross coupling, regiospecific synthesis and preparation of a mimic model of natural catalyst will be included.

5. Intended Learning Outcomes

Upon completion of this course, students are expected to be able to:

1	Recognize fundamentals of chemistry including structure, reativity and properties of chemical substances, and the states of matter.
2	Explain the essential facts, principles and theories across organic and inorganic chemistry.
3	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
4	Conduct standard laboratory procedures involved in synthetic work.
5	Conduct analysis and interpretation of experimental data.
6	Work independently and collaborate effectively in team work.

6. Assessment Scheme

In lab reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

#	Assessment items	Weighting	ILO(s) to be assessed
1	Risk assessment	5%	3
2	Laboratory Quiz†	25%	1, 2
3	Laboratory Performance	20%	3, 4, 5, 6
4	Product/Result	10%	4
5	Laboratory Reports	40%	1, 2, 5

†*There will be a short lab quiz before each experiment.*

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments*" *7th edition,* by Kenneth L. Williamson and Katherine M. Masters, Australia: Cengage ©2017.

(b) "*Vogel's Textbook of Practical Organic Chemistry*" *5th edition,* by A. I. Vogel, (editor), London : Longman Scientific & Technical ©1989.

* *Course materials can be downloaded by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).*

8. Teaching and Learning Activities

Tutorial + Laboratory work related to preparative methods in both organic and inorganic chemistry.

9. Key word Syllabus

- Synthesis of Organometallic Compounds and its Light-sensitive Derivatives
- Substitution of Aromatic Ligand in Sandwich Organometallic Compounds
- Synthesis of Metallo-Organic Chelate Complex
- Wittig-Horner Synthesis for Olefins
- Use of Organophosphorus Reagent
- Synthesis of Conjugated Aromatics by Suzuki Cross-Coupling
- Transition Metal Catalyzed Organic Synthesis
- Protection of Hydroxyl Groups for Carbohydrates
- Regioselective Substitution Reaction
- Control of Distereoseletivity in Substitution Reactions
- Glycosidation Reaction

CHEM 4555 Advanced Molecular Characterization Lab
2024 Fall semester
Course Outline

1. Instructor

Name: Dr. TSE, Wai Pui Veronica (chvaipui@ust.hk)
Contact: Office Room 4537; Tel: 2358-7364
Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099

2. Technical support / Teaching Assistant:

Name: LAU, Chun Tak Disney (disney@ust.hk)
Contact: Laboratory Room CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details will be provided in a separate file.]

3. Meeting Time and Venue:

Date/Time: CHEM 4555 Thu (13:30 – 16:20)
Venue: CYT-1003 and CYT-1004

4. Course Description

CHEM 4555 [1 Credit]
Pre-requisite: CHEM 3555
Co-requisite: CHEM 4550
Exclusion: nil
Brief Information/synopsis:
This course is designed for chemistry major students who are enrolling in Pure Chemistry option. It provides students hands-on experience in the operation of different instruments for characterization of organic products.

5. Intended Learning Outcomes

Upon completion of this course, students are expected to be able to:

1	Recognize fundamentals of chemistry including structure, reativity and properties of chemical substances, and the states of matter.
2	Explain the essential facts, principles and theories across organic and inorganic chemistry.
3	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
4	Conduct standard laboratory procedures involved in instrumental work.
5	Conduct analysis and interpretation of experimental data.
6	Work independently and collaborate effectively in team work.

6. Assessment Scheme

In lab reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

#	Assessment items	Weighting	ILO(s) to be assessed
1	Risk assessment	5%	3
2	Laboratory Quiz†	25%	1, 2
3	Laboratory Performance	20%	3, 4, 5, 6
4	Product/Result	10%	4
5	Laboratory Reports	40%	1, 2, 5

†*There will be a short lab quiz before each experiment.*

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments*" *7th edition,* by Kenneth L. Williamson and Katherine M. Masters, Australia: Cengage ©2017.

(b) "*Principles of Instrumental Analysis*" *7th edition,* by D. A. Skoog, F. J. Holler, S. R. Crouch. Australia: Cengage Learning ©2007 [2018]. E-Book in HKUST Library: https://ebookcentral.proquest.com/lib/hkust-ebooks/detail.action?pq-origsite=primo&docID=6351262

* *Course materials can be downloaded by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).*

8. Teaching and Learning Activities

Tutorial + Laboratory work related to chemical analysis and instrumental method of analysis.

9. Key word Syllabus

- Characterization by 1D NMR Spectroscopies: ^{1}H-NMR, ^{13}C-NMR and DEPT135
- Characterization by 2D NMR Spectroscopies: Homonuclear Correlation Spectroscopy (COSY) and Heteronuclear Multiple Bond Coherence Spectroscopy (HMBC)
- Experimental Determination of Rate Constants and Activation Energy of a Reaction
- Computational Study using MMFF and Time-dependent DFT
- Prediction of Electronic Absorption Maxima using Computational Methods
- Thermogravimetric Analysis of Molecular Materials
- Characterization and Analysis by MALDI-Tof Mass Spectroscopy
- Optical Characterization by UV-vis Spectroscopy
- Optical Characterization by FT-IR Spectroscopy
- Chromatographic Analysis by GC-FID
- Chromatographic Analysis by HPLC-PDA
- Determination of Diastereoselectivity by High-Resolution ^{1}H-NMR Spectroscopy

The Hong Kong University of Science and Technology
Department of Chemistry

CHEM 4680 Undergraduate Research
Course Outline

1. Course Description

Credit Points: 3
Pre-requisite: CHEM 2550
Instructor(s): Research Faculties of Chemistry Department

Brief Information/synopsis:

Students conduct original research in accordance with their ability and background, and under the supervision of a research faculty. The final course grade is determined based on an oral presentation and a written report to be submitted to a judging committee, which includes the faculty supervisor plus at least one other faculty. Enrollment in the course requires approval of the faculty supervisor.

2. Intended Learning Outcomes

Upon successful completion of this course, students are expected to be able to:

1	Work independently, to handle and use appropriate instrumentation, interpret data, and complete given tasks in a research setting, and to prepare a written report.
2	Communicate more effectively in speaking and writting, both about their newly acquired knowledge and knowledge in general.
3	Recognize deficiencies in knowledge existing in chemistry, and to plan and mount a research study to address these deficiencies.
4	More critically assess data presented in textbooks, the primary literature or other sources, e.g. electronic data bases, patents.
5	In general, to appreciate the importance of research in relation to science, the definition of problems in research, and how the corpus of scientific knowledge is able to expand through the overall reserach effort for the betterment of humankind.

3. Course Requirements and Grading

At the end of the course, **students are required to give an oral presentation and submit a written report to document their project work**. Course grades will be determined by a faculty panel consisting of their research supervisor and at least one other faculty member. Students will be evaluated based on their research performance, oral presentation (including the Q&A session), and written report.

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

CHEM 4689 Capstone Project
Course Outline (Fall 2024-2025)

1. Course Coordinator:

Prof. Emily M. W. Tsang (chetsang@ust.hk) Rm 4536; Tel: 3469-2100

Faculty Supervisors: (You will be assigned under one supervisor)

Prof. Dennis H.W. CHAN	(chanhw@ust.hk)
Prof. Tengteng CHEN	(tengtengchen@ust.hk)
Prof. Jonathan HALPERT	(jhalpert@ust.hk)
Prof. Jinqing HUANG	(jqhuang@ust.hk)
Prof. Yong HUANG	(yonghuang@ust.hk)
Prof. Zhenyang LIN	(chzlin@ust.hk)
Prof. Hugh NAKAMURA	(hnakamura@ust.hk)
Prof. Yangjian QUAN	(chyjquan@ust.hk)
Prof. Haibin SU	(haibinsu@ust.hk)
Prof. Rongbiao TONG	(rtong@ust.hk)
Prof. Emily M.W. TSANG	(chetsang@ust.hk)
Prof. Hongkai WU	(chhkwu@ust.hk)
Dr. Yi CHEN	(atmoschenyi@ust.hk)
Dr. Ryan T. K. KWOK	(chryan@ust.hk)
Dr. Jacky W.Y. LAM	(chjacky@ust.hk)
Dr. Frederick F.K. SHEONG	(chemfksheong@ust.hk)
Dr. Chaoshen ZHANG	(zhangcs@ust.hk)

Library Referencing Advisors: (You will be assigned under one advisor)

Mr. Samson CHOI, Librarian (Learning Support)	(lbsamson@ust.hk)
Mr. Ernest LAM, Librarian (Learning Support)	(lbernest@ust.hk)

2. Class Time and Venue:

Date/Time: 9:30 – 10:20 am, **Fridays** (*please refer to the class schedule*)
Venues: Room 5566 (Lift 27/28) OR Library Computer Barn
(*please refer to class schedule*)

3. Course Description:

Credit Points: 3 Pre-requisite: CHEM 3550 and CHEM3555

Brief Information/synopsis:
Under the supervision of a faculty member or teaching staff, students will complete a capstone project which requires the integration of the chemical knowledge learnt from their previous courses. Students will carry out a literature review on a mutually agreed topic. A written report and an oral presentation are required to document their learning experiences.

4. Intended Learning Outcomes:

1	Demonstrate awareness of chemical topics relevant to social and daily life
2	Analyze and interpret experimental data, critically assess data in literature and extract useful data from it.
3	Carry out directed research by selecting appropriate topics and procedures, and presenting the results
4	Communicate effectively both orally and in writing with professionals and/or lay audience
5	Demonstrate information technology skills, especially in the areas of information retrieval, literature searching and use of library database.
6	Show self awareness, work independently and collaborate effectively with other people in a team

5. Assessment Scheme:

Weight	*Assessment*	*Course ILOs*
10%	Participation	1, 2, 3, 4, 5, 6
20%	Submission of a Scientific Poster and Library Training	2, 4, 5
40%	Literature Research Presentation	1, 4, 5, 6
30%	Literature Research Report	1, 2, 3, 4, 5

6. Student Learning Resources (Reference books):

- Catherine E. Housecroft and Alan G. Sharpe, *Inorganic Chemistry* 3rd edition, Harlow: Pearson Prentice Hall ©2008. [QD151.2 .H68 2008] ♠
- Douglas A. Skoog, F. James Holler, Stanley R. Crouch, *Principles of Instrumental Analysis* 6th edition, Thomson Brooks/Cole, ©2007. [QD79.I5 S58 2007]
- Jonathan Clayden, Nick Greeves and Stuart Warren, *Organic Chemistry* 2nd edition: Oxford University Press ©2012 [QD251.3 .O64 2012]
- T.D.H. Bugg, *Introduction to Enzyme and Coenzyme Chemistry* 3rd edition, Wiley ©2012. [QP601.B955 2012eb] ♠

♠ *Free access online via HKUST Library*

^ *other course materials can be downloaded from Canvas website by logging in using your ITSC username and password (http://canvas.ust.hk).*

7. Teaching and Learning Activities:

Tutorials/Workshops:
1. Literature Search Training
2. SciFinder Workshop
3. Chemical Structure Drawing Training
4. Literature Referencing Training
5. Poster Design Workshop

Consultations: With your faculty supervisor (**at least 3 times**)

Individual Coaching: With your library referencing advisor (**at least once**)

Oral presentation: 10 minutes + 5 minutes Q&A

Poster Mini-Conference: 3 hours session at the end of semester

8. Course Schedule:

Week	Date/Time	Activities [† *denotes follow-up work required*]	Venue/Instructor
1	Sept 6 (Fri) 9:30-10:20 *before 20 Sept*	**Course Introduction** [† ***meet your supervisor for topic assignment***] [† ***upload topic to Canvas after assignment***]	**Room 5566 (Lift 27/28)** Prof. Emily Tsang
2	Sept 13 (Fri) 9:30-10:20	**Literature Search Training**	**Library LG1 Computer Room A** Mr. Samson Choi/Mr. Ernest Lam
3	Sept 20 (Fri) 9:30-10:20 *before Sept 20* ***between Sept 23 – Oct 11***	**SciFinder Workshop** [† ***submit Weekly Timetable to Canvas for scheduling Oral Presentation Time***] **Individual Coaching Session on Literature Search** [***Compulsory***] (with your Referencing Advisor during Weeks 4 – 6)	**Zoom Meeting** SciFinder vendor (based in Singapore) (by appointment with your referencing advisor)
4	Sept 27 (Fri) 9:30-10:20	**Chemical Structure Drawing Training**	**Library LG1 Computer Room B** Prof. Emily Tsang
5	During this week (Sept 30 – Oct 4)	**1st Consultation with supervisor**	(by appointment with your supervisor)
6	Oct 7 – 11 *before Oct 14*	*Work on your project* [† ***submit Research Plan***]	
7	Oct 18 (Fri) 9:30-10:20	**Referencing Training**	**Library LG1 Computer Room B** Mr. Samson Choi/Mr. Ernest Lam
8	During this week (Oct 21 – 25)	**2nd Consultation with supervisor**	(by appointment with your supervisor)
9	Nov 1	**Poster Design Workshop**	**Room 5566 (Lift 27/28)** Prof. Emily Tsang
10	Nov 4 – 8 ***between Nov 4 – 22***	*Work on your project* **Individual Coaching Session on Referencing** [***Optional***] (with your Referencing Advisor during Weeks 10 – 12)	(by appointment with your referencing advisor)
11	During this week (Nov 11 – 15)	**3rd Consultation with supervisor**	(by appointment with your supervisor)
12	Nov 18 – 22	*Work on your project*	
13	Nov 29 (Fri) *before Nov 24 (Sun)*	**Oral Presentations** [† ***submit Poster file to Canvas***]	TBA
Study break	Dec 2 (Mon) 14:00-17:00	**Poster Mini-Conference**	**Library LG4** **Multi-function Room**
	Dec 15 (Sun)	† ***Deadline for Literature Research Report***	

9. Supervisor Arrangements:

Student Name	Supervisor
AU-YEUNG, Lam Judy lauyeungaa@connect.ust.hk	Dr. Ryan T. K. KWOK chryan@ust.hk
BAE, Sion sbaeae@connect.ust.hk	Prof. Rongbiao TONG (rtong@ust.hk
CHAU, Tsz Long Timothy tltchau@connect.ust.hk	Prof. Zhenyang LIN chzlin@ust.hk
CHEUNG, Chun Kit ckcheungax@connect.ust.hk	Prof. Tengteng CHEN tengtengchen@ust.hk
CHING, Chun Lam clching@connect.ust.hk	Dr. Yi CHEN atmoschenyi@ust.hk
CHOW, Hau Yin Remy hychowax@connect.ust.hk	Dr. Frederick F. K. SHEONG chemfksheong@ust.hk
CHU, Hang Laam Simone hlchuac@connect.ust.hk	Dr. Chaoshen ZHANG zhangcs@ust.hk
CHUNG, Chi Kuen ckchungai@connect.ust.hk	Prof. Yangjian QUAN chyjquan@ust.hk
HO, Chun Wa cwhoam@connect.ust.hk	Prof. Hugh NAKAMURA hnakamura@ust.hk
HO, Chun Wing cwhoan@connect.ust.hk	Prof. Hugh NAKAMURA hnakamura@ust.hk
KIM, Seulgi skimbb@connect.ust.hk	Prof. Hongkai WU chhkwu@ust.hk
KWONG, Wing Lam wlkwong@connect.ust.hk	Dr. Jacky W. Y. LAM chjacky@ust.hk
LAM, Cherry clamam@connect.ust.hk	Prof. Emily M. W. TSANG chetsang@ust.hk
LEE, Ka Chun Antony kcaleeab@connect.ust.hk	Prof. Yong HUANG yonghuang@ust.hk
LEUNG, Chun Wa cwleungav@connect.ust.hk	Dr. Frederick F. K. SHEONG chemfksheong@ust.hk
LEUNG, Ho Kuen Alvina hkleungap@connect.ust.hk	Prof. Dennis H. W. CHAN chanhw@ust.hk
LI, Changwen clidd@connect.ust.hk	Prof. Haibin SU haibinsu@ust.hk
LOK, Hoi Yuen hylok@connect.ust.hk	Prof. Joanathan HALPERT jhalpert@ust.hk

NG, Shing Kwan skngag@connect.ust.hk	Prof. Tengteng CHEN tengtengchen@ust.hk
WONG, Ka Hei khwongcn@connect.ust.hk	Prof. Rongbiao TONG rtong@ust.hk
YU, Ka Wai kwyuaf@connect.ust.hk	Prof. Dennis H. W. CHAN chanhw@ust.hk
WONG, Ching Hin Jessie chjwongac@connect.ust.hk	Prof. Jinqing HUANG jqhuang@ust.hk
WONG, Jemson Jun Peng jjpwong@connect.ust.hk	Prof. Haibin SU haibinsu@ust.hk

10. Library Referencing Advisor Arrangements

Advisor: Mr. Samson Choi Librarian (Learning Support) (lbsamson@ust.hk)	**Advisor: Mr. Ernest Lam** Librarian (Learning Support) (lbernest@ust.hk)
AU-YEUNG, Lam Judy lauyeungaa@connect.ust.hk	LAM, Cherry clamam@connect.ust.hk
BAE, Sion sbaeae@connect.ust.hk	LEE, Ka Chun Antony kcaleeab@connect.ust.hk
CHAU, Tsz Long Timothy tltchau@connect.ust.hk	LEUNG, Chun Wa cwleungav@connect.ust.hk
CHEUNG, Chun Kit ckcheungax@connect.ust.hk	LEUNG, Ho Kuen Alvina hkleungap@connect.ust.hk
CHING, Chun Lam clching@connect.ust.hk	LI, Changwen clidd@connect.ust.hk
CHOW, Hau Yin Remy hychowax@connect.ust.hk	LOK, Hoi Yuen hylok@connect.ust.hk
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CHUNG, Chi Kuen ckchungai@connect.ust.hk	WONG, Ka Hei khwongcn@connect.ust.hk
HO, Chun Wa cwhoam@connect.ust.hk	YU, Ka Wai kwyuaf@connect.ust.hk
HO, Chun Wing cwhoan@connect.ust.hk	WONG, Ching Hin Jessie chjwongac@connect.ust.hk
KIM, Seulgi skimbb@connect.ust.hk	WONG, Jemson Jun Peng jjpwong@connect.ust.hk
KWONG, Wing Lam wlkwong@connect.ust.hk	

CHEM 4691 Capstone Research I

Course Outline (Fall 2024/25)

1. Course Description

Pre-requisite: CHEM 3550 and CHEM 3555

Exclusion: CHEM 4689

Instructor(s)/Project Supervisor(s): Research Faculties of Chemistry Department

Course Coordinator: Prof. Emily M.W. Tsang

Reference Librarians:

Mr. Samson CHOI (lbsamson@ust.hk)

Mr. Ernest LAM (lbernest@ust.hk)

Brief Information/synopsis:

This is a project-based course that provides students an opportunity to integrate and apply their chemical knowledge learnt in regular lecture and lab courses. Students will carry out a research project under the supervision of a faculty member/teaching staff. At the end of the course, students are required to submit a written report and deliver an oral presentation to document their learning experiences. Students should seek instructor's approval prior to enrollment in the course.

2. Intended Learning Outcomes

Upon successful completion of this course, students are expected to be able to:

1	Demonstrate awareness of chemical topics relevant to social and daily life.
2	Analyze and interpret experimental data, critically assess data in literature and extract useful data from it.
3	Carry out directed research by selecting appropriate topics and procedures, and presenting the results.
4	Communicate effectively both orally and in writing with professionals and/or lay audience.
5	Demonstrate information technology skills, especially in the areas of information retrieval, literature searching and use of library database.
6	Show self-awareness, work independently and collaborate effectively with other people in a team.

3. Grading

Weight	Assessment	Course ILOs
50%	Lab Performance and Participation	1,2,3,4,5,6
30%	Written Research Thesis	1,2,3,4,5
20%	Oral Presentation	4,5,6

4. **<u>Mandatory</u> Library Trainings Schedule:**

The following library training workshops are ***mandatory***. Attendances will be taken and counted towards your course participation scores.

Date	Activity	Venue
Sept 13 (Fri), 9:30 – 10:20	**Library Workshop I: Literature Search Training**	Computer Room **A** (Library LG1) (Mr. Samson Choi/Mr. Ernest Lam)
Sept 20 (Fri), 9:30 – 10:20	**SciFinder-n Workshop**	Zoom Meeting (meeting link to be provided)
Sept 27 (Fri), 9:30 – 10:20	**Chemical Structure Drawing Training**	Computer Room **B** (Library LG1) (Prof. Emily Tsang)
Oct 18 (Fri), 9:30 – 10:20	**Library Workshop II - Referencing Training**	Computer Room **B** (Library LG1) (Mr. Samson Choi/Mr. Ernest Lam)

CHEM 4692 Capstone Research II
Course Outline

1. Course Description

Credit Points: 3
Pre-requisite: CHEM 4691
Instructor(s): Research Faculties of Chemistry Department

Brief Information/synopsis:

Continuation of research project started in CHEM 4691 and to be conducted under the supervision of a faculty member/teaching staff. A written report and oral presentation are required to document their learning experiences. Students should seek instructor's approval prior to enrollment in the course.

2. Intended Learning Outcomes

Upon successful completion of this course, students are expected to be able to:

1	Demonstrate awareness of chemical topics relevant to social and daily life
2	Analyze and interpret experimental data, critically assess data in literature and extract useful data from it.
3	Carry out directed research by selecting appropriate topics and procedures, and presenting the results
4	Communicate effectively both orally and in writing with professionals and/or lay audience
5	Demonstrate information technology skills, especially in the areas of information retrieval, literature searching and use of library database.
6	Show self awareness, work independently and collaborate effectively with other people in a team

3. Grading

Weight	Assessment	Course ILOs
50%	Lab Performance and Participation	1,2,3,4,5,6
20%	Oral Presentation	4,5,6
30%	Written Research Thesis	1,2,3,4,5