DEPARTMENT OF

CHEMISTERY

CHEM UG Courses

UG Courses offered in Spring Term 2021-22 but the courses outlines are not time-specific

Course Code	Course Title
CHEM 1004	Chemistry in Everyday Life
CHEM 1010	General Chemistry 1A
CHEM 1020	General Chemistry 1B
CHEM 1030	General Chemistry II
CHEM 1050	Laboratory for General Chemistry I
CHEM 1055	Laboratory for General Chemistry II
CHEM 2111	Fundamentals of Organic Chemistry
CHEM 2155	Fundamental Organic Chemistry Laboratory
CHEM 2311	Analytical Chemistry
CHEM 2355	Fundamental Analytical Chemistry Laboratory
CHEM 3120	Organic Chemistry II
CHEM 3220	Inorganic Chemistry II
CHEM 3320	Instrumental Analysis
CHEM 3420	Physical Chemistry II
CHEM 3550	Synthetic Chemistry Laboratory
CHEM 3555	Molecular Characterization Chemistry Laboratory
CHEM 4110	Structural Elucidation in Organic Chemistry
CHEM 4230	Materials Characterization Method

CHEM 4310	Environmental Chemistry
CHEM 4330	Separation Science
CHEM 4430	Symmetry in Chemistry and Spectroscopy
CHEM 4680	Undergraduate Research
CHEM 4689	Capstone Project
CHEM 4691	Capstone Research I
CHEM 4692	Capstone Research II

Updated 7 December 2021

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

CHEM1004 (L1) Chemistry in Everyday Life

Spring Semester 2020-21

3 credits

Lectures:	Zoom Meetings – Visit Canvas for meeting links (pw: **chem1004**) Mondays and Wednesdays 12:00 noon – 1:20 pm No lectures on 15 Feb, (public holiday) 31 Mar, 5 Apr (mid-term break)
Course Instructor:	**Prof. K. K. Jason CHAN** Assistant Professor of Science Education Department of Chemistry Email: **kkjchan@ust.hk** Office: Rm 4543, between Lifts 25/26 and 27/28
Course website:	**https://canvas.ust.hk**

Course Description

CHEM 1004 is an introductory course provided for students who have never taken a Chemistry course, but would like to learn what chemistry is and how it may affect the world we live in.

Course objectives are as follows:

1. Introduce basic concepts of Chemistry.
2. Connect Chemistry with everyday life and modern technology.
3. Explain the importance of Chemistry in the environment, medicine, and daily life.

Course Outline

The course is divided into six Chapters:

Chapter 1:	What is everything made of?
Chapter 2:	The Air.
Chapter 3:	The air and our environment.
Chapter 4:	The metals in our daily life.
Chapter 5:	Metals in the industry.
Chapter 6:	Fire and fuels.

Lectures

The lectures are critical to your understanding of course materials. You should try to attend all the lectures. Zoom meeting online lecture recordings will be available on Canvas after **each class**, so please catch up promptly when you missed a class.

Course Contents

Comprehensive **lecture notes** will be provided for this course. These notes should be very helpful to you as they provide more details of the lecture materials than power point slides. However, the version of the notes you receive is incomplete. You will need to fill in some important details or draw diagrams to complete the notes during the lectures.

You should print out hard copies of the lecture notes and bring them to the class. You can staple each chapter's notes into a booklet.
It would be advisable to print them single sided, so that you can use the blank page to drop down extra notes that the lecturer mentions but are not in the notes, or to write some references you obtained from other sources or your revision notes.

The **power point slides** will be mostly pictures or graphics. These will also be released on Canvas after the end of each lecture. Please note that while the slides may be available before the lectures, they are sometimes released after the lectures, so please make notes on the lecture notes instead.

The lecture notes will be released by chapter. New chapters will be released on Canvas towards the end of the current chapter. You can read through the notes before the lecture to familiarise yourself with the materials.

Textbooks/Reading List

You don't need a textbook for this course, and since we draw examples from many different areas of chemistry in everyday life, no one textbook is a perfect fit for the course. Therefore for each chapter, some reading materials will be suggested to you for optional reference.

End of Chapter Exercises and Tutorial Sessions

To help you prepare for the examination, each chapter will finish with a short **exercise**. These exercises will require you to work through a set of problems, using some knowledge from the lectures and also to teach you some new knowledge through the exercise.

These exercises will not be formally graded, but they will be examinable.

Videos of detailed solutions to the exercises will be released by chapter. In the videos, the instructor will go through the answers to the exercises. If you have questions on these exercises please feel free to contact the instructor or the TAs to ask.

Office Hours of the Instructor and TAs

Please feel free to approach the instructor, Dr Jason Chan to ask questions or to discuss any chemistry or course-related issues. You may approach him after the lectures, or you may email him to arrange an appointment. There is no fixed office hour schedule: if you need one, feel free to email and book a time.

In addition, our TAs are all postgraduate research students working in the forefront of chemistry research. They are here to help you also if you want to ask any questions or if you want to find out more about their research. You should email them directly to arrange an appointment.

Online Graded Quizzes (15 % of the course)

There will be two online graded quizzes in addition to the end-of-chapter exercises, the first quiz is after Chapter 4 (covering chapters 1 – 4), and the second quiz is at the end of the course (covering mainly Chapters 4-6). You should complete them within the given time (around 1 week). The accumulated points from the online quizzes will carry 10 % to the course grade, but the main purpose is to help you further understand the course materials and have a chance to practice and receive answers immediately after submission. When these quizzes are available, you will receive email notification as well as instructions during the lectures.

Study-project (35 % of the course)

This course will have a study project component for you to learn more about a particular area of everyday chemistry that interests you. The project period will commence about 2 weeks into the course. In view of the time needed for this project, **there will be no mid-term examination** for this course.

For this semester, in view of the online teaching mode, most students will undertake an individual written study project. At the end of the project, each student should submit:

- An individual study report

For those students who are residing in the HKUST campus this semester, it is also possible to carry out a written group project. In order to prevent the spread of COVID-19, students who are not living in student halls on campus will not be offered this option. The group size will also be limited to a maximum of 4 students per group. At the end of the project, each group should submit:

- A small group study report

Individual projects

Individual projects will be a piece of written original research. You will choose a topic yourself that is about any chemistry phenomenon or chemicals that is in your everyday life. Be creative and explore interesting topics!

You are expected to read widely, using resources available to you, not limited to the internet – you also have access to books, journal articles and other multimedia resources. You may report also real experiences yourself and report them. Photographs would be needed to demonstrate that your topic is truly something you can connect to in the real world.

The article should bring together many ideas to draw up an original story. Originality checks will be performed so you must do the writing yourself.

More information will be announced during a lecture around week 3.

Small Group projects (only for students residing on HKUST campus)

2 - 4 students may form a group. Each group will work on a specific topic together. The group projects can involve some simple experimental investigation using materials that can be obtained from the supermarkets.

If the COVID-19 situation allows, it may be possible to provide some simple reagents/equipment for small groups to complete simple projects. These should be discussed with the instructor. However, if the COVID-19 situation worsen, the group project option may be cancelled for safety concerns.

More information will be announced during a lecture around week 3.

Final Examination (50 %)

On-campus proctored examination: This course will end with a *close-book* final examination (2 hours). This will cover all the lecture materials and exercises that were taught in the course. You will mainly be tested on your understanding and ability to solve problems rather than on the memorisation of facts, but you should also be familiar with some key chemical details – some of these will inevitably require some memorisation.

The date, time and venue for the final exam will be announced later.

Online mode assessment: If the final exam will be offered in an online mode, an *open-book* final examination on Canvas will be carried out. It will be proctored through Zoom Meeting (webcam monitoring).

Grades

The final grade for the course will be consisted of:
15 % from the Online Quizzes
35 % from the Study Project
50 % from the Final Examination
The course is graded from A+ to F. An F grade will not earn you credits for the course.

Intended Learning Outcomes (ILOs)

At the end of the course, the students will have:

1. An ability to recognize physical/chemical properties, physical/chemical changes.
2. An ability to apply knowledge of chemical reactions, stoichiometry, atomic structure, chemical bonding, molecular structure, states of matter, acid-base chemistry, and redox reactions.
3. A basic knowledge of organic chemistry, polymer chemistry, biochemistry, and food chemistry.
4. An ability to link chemistry to modern technology, environment, and daily life.

Assessment Scheme

Weight	Assessment	Course ILOs	CHEM Program ILOs
15%	Online Revision Quiz	1, 2, 3, 4	1, 2, 3
35%	Study Project	1, 2, 3, 4	3, 6, 11, 12, 13
50%	Final Exam	1, 2, 3, 4	1, 2, 3

Teaching and Learning Activities (Non-assessed)

Activities	Course ILOs	CHEM Program ILOs
Lecture	1, 2, 3, 4	1, 2, 3
End of chapter exercises and Tutorials	1, 2, 3, 4	1, 2, 3

Topics by Chapter

Chapter 1: What is everything made of?	**2 Lectures**	Introduction of the course Discovery of the atomic structure Elements; relative atomic mass relative molecular mass The mole Chemical calculations Relationship between mole and mass, mole and concentration, mole and gas volume Calculations, Common elements
Chapter 2: The Air	**3 Lectures**	Gases in the Air, Electronic configuration Forming covalent bonds States of matter, separation of gases in air, Intermolecular forces: London dispersion force Electronegativity, Polar and non-polar molecules, Intermolecular forces: dipole-dipole interactions
Chapter 3: The air and our environment	**5 Lectures**	Electromagnetic waves Greenhouse gases, Greenhouse effect, Global Warming, Carbon cycle, Reducing CO_2 emission Acids and Bases Air Pollution: Acid Rain and other air pollutants Reading organic chemical structures Air Pollution: VOCs, smog, PMs Controlling air pollution Ozone and ozone depletion
Chapter 4: The metals in our daily life	**5 Lectures**	Different groups of metals in the periodic table: Alkali metals, Alkaline earth metals, Transition metals, Lanthanides, metals in Group 13-15, Radioactivity and the Actinide elements Structure of Metals, Metallic bonding Metal lattice systems

		Physical properties of typical metals; Alloys Alloys: types and applications Compounds of metals: Ionic bonding Name and Formula of ionic compounds Structure of complex ions Solid structure of ionic compounds Ionic lattice systems Physical properties of ionic compounds Reaction of metals with oxygen Reaction of metals with water Reaction of metals with acids
Chapter 5: Metals in the industry	**6 Lectures**	Metal extraction industry Calculate %mass of metal in a compound Redox Oxidation number Metal displacement reactions Metal displacement reactions Extraction of Metals by heating with carbon: Copper, Iron (Blast Furnace, Basic Oxygen Converter) Electrolysis of molten ionic compounds: Extraction of sodium Electrolysis of molten ionic compounds: Extraction of aluminium Electrolysis of aqueous solution The chloroalkali industry The refining of copper metal Electroplating Anodising aluminium Half cells and standard electrode potentials Electrochemical cells Fruit batteries, zinc-carbon batteries

		Alkaline batteries Silver oxide cells Rechargeable batteries: Ni-MH batteries Lithium metal batteries Lithium-ion batteries
Chapter 6: Fire and fuels	**4 Lectures**	Fire and combustion, Fire triangle How to fight a fire Fire extinguishers Introduction to fossil fuels: coal, natural gas and crude oil Alkanes: naming and isomers Fractional distillation of crude oil Fractions from crude oil Cracking Alkenes Polymers Calculating energy from combustion reactions Starting a fire Fireworks Explosives

Updated 7 December 2021

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
化學系
DEPARTMENT OF CHEMISTRY

CHEM 1010: General Chemistry IA

Spring 2020/21

Department of Chemistry, HKUST

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

Department of Chemistry

Course Instructors

Prof. Emily M.W. Tsang

- Office: **Rm 4536 (Lift 25/26)**
- E-mail: **chetsang@ust.hk**

Lectures: Feb 1 – Feb 24

**Maternity Leave from March - June*

Prof. Jonathan Halpert

- Office: **Rm 4545 (Lift 25/26)**
- E-mail: **jhalpert@ust.hk**

Lectures: Mar 1 – Mar 29

Prof. Jinqing Huang

- Office: **Rm 4544 (Lift 25/26)**
- E-mail: **jqhuang@ust.hk**

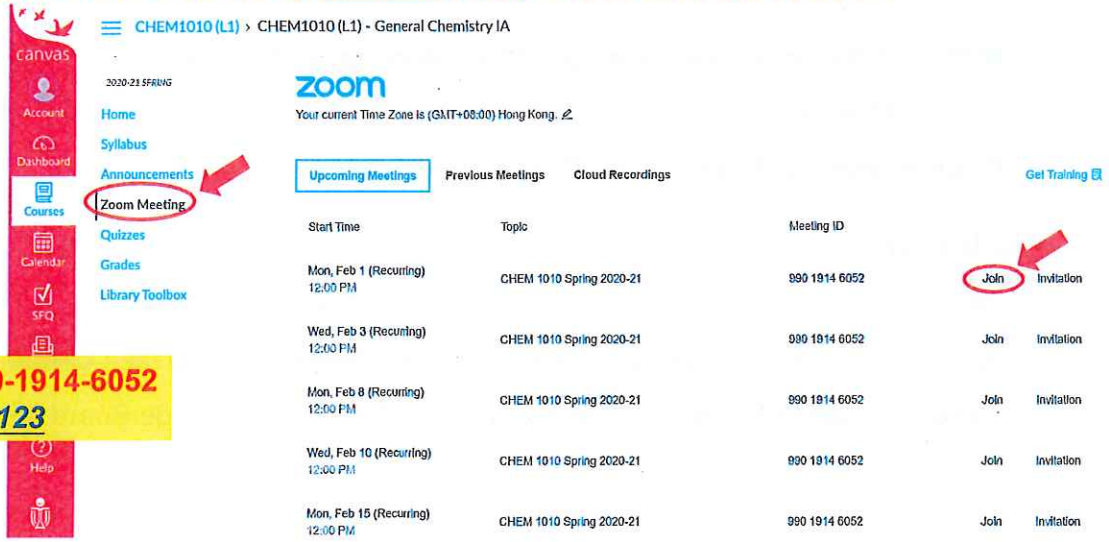
Lectures: Apr 7 – May 5

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

Department of Chemistry

Course Description and Pre-requisite

- Lectures: 12:00 – 13:20, Every Monday and Wednesday
- Venue: Interactive Online Lecture by ***Zoom Meeting***, access through CANVAS



Meeting ID: 990-1914-6052
Password: *9874123*

Course Description and Pre-requisite

Pre-requisites:

- **HKDSE *0.5*x Combined Science - Chemistry** (take **THIS** course)
- **Or CHEM 1004**
- **Or equivalent (HKCEE, GCE AS-level, IB-SL, etc)**

Exclusions:

- **HKDSE 1.0x Chemistry (or *equivalence)*** (should take **CHEM 1020**)
- Have **NOT** taken any Chemistry Subject in High School (should take **CHEM 1004**)
- Eligible for **credit transfer**: HKALE CHEM, IB CHEM HL, College Board AP, etc

Course Description and Pre-requisite

- **Course Description**:

  This course targets students who have learnt the basic knowledge of Chemistry in high school and is **Part I** of a **two-semester course** "General Chemistry".

  [Part II (CHEM 1030) is offered every Spring term]

- **Key Topics**: *atoms, atomic structures, chemical bonds, molecules, molecular structures, substances, chemical kinetics, energy*

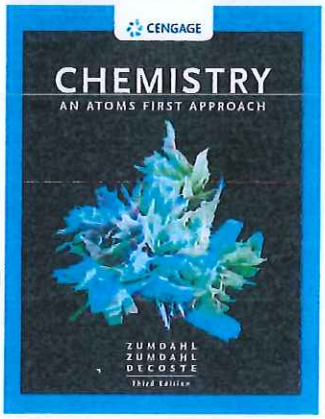
- **Supplementary Lab Course**: **CHEM 1050** **[0-0-3:1]**

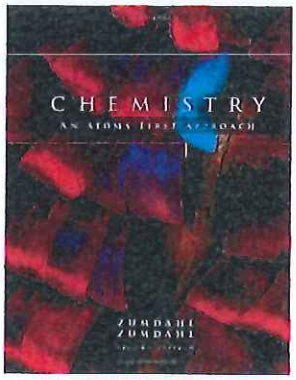
香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Course Outline and Textbook

- **Chapter 1:** Chemical Foundations
- **Chapter 2*:** Atomic Structure and Periodicity
- **Chapter 3:** Bonding - General Concepts
- **Chapter 4:*** Molecular Structure and Orbitals
- **Chapter 5:** Stoichiometry
- **Chapter 6:** Types of Chemical Reactions and Solution Stoichiometry
- **Chapter 7:** Chemical Energy
- **Chapter 8:** Gases

**Key Chapters!!!*





(The 2nd Edition textbook can also be used.)

Chemistry: An Atoms First Approach,
3rd Edition (Asian Edition)
S.S. Zumdahl; S. A. Zumdahl; D. DeCoste
© Cengage Learning
ISBN: 9789814896993 **(Hardcopy Textbook, $423.7)**
ISBN: 9780357560938 **(e-Book, $330)**
E-book ordering link: **https://w5.ab.ust.hk/cgi-bin/std_cgi.sh/WService=broker_ba_p/prg/ba_stdt_main.r**

Course Grading (*tentative*)

- Midterm Exam 50%
- Final Exam 50%

NOTE:

- exams **cannot** be waived under any circumstances
- ***Exam questions will be similar to:***
  - ***End-of-chapter exercises.***

How to do well in this Course?

- **Attend Lectures**
- **Pre-read, Read, and Review** textbooks & lecture notes
- Do the **Recommended End-of-Chapter Exercises**
  - **Hint:** *exam questions will be similar to these!!!*
- **Email instructor for course help**

Lecture Notes

- Lecture Notes are posted on **CANVAS system:**
  - http://canvas.ust.hk
  - Login: **ITSC username** and **password**

Intended Learning Outcomes

At the end of this course, you will 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 a chemical reaction from a **thermodynamic** point of views.
7. Describe the **physical states and properties of gases**
8. Recognize and appreciate the **impact of chemistry to our society**.

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DEPARTMENT OF CHEMISTRY

Updated 7 December 2021

CHEM 1020: General Chemistry IB

Spring 2020/21

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

Department of Chemistry

Course Instructors

Prof. Emily M.W. Tsang

- Office: **Rm 4536 (Lift 25/26)**
- E-mail: chetsang@ust.hk

Lectures: Feb 1 – Feb 24

**Maternity Leave from March - June*

Prof. Jonathan Halpert

- Office: **Rm 4545 (Lift 25/26)**
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Lectures: Mar 1 – Mar 29

Prof. Jinqing Huang

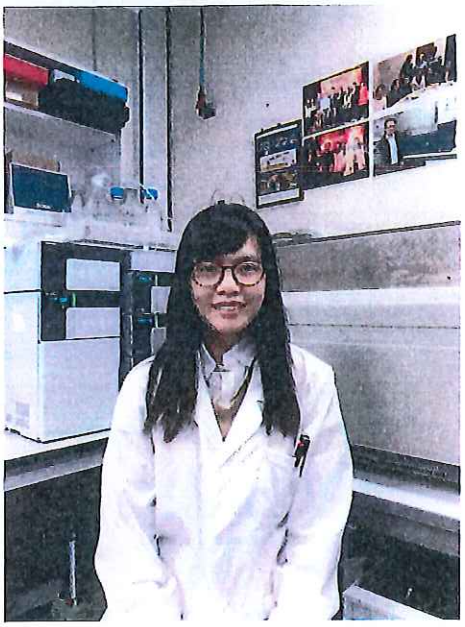
- Office: **Rm 4544 (Lift 25/26)**
- E-mail: jqhuang@ust.hk

Lectures: Apr 7 – May 5

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

Department of Chemistry

Instructional Assistant (IA)



Miss Elaine YL Wong

- Office: **Rm 4524 (Lift 25/26)**
- E-mail: **wylelaine@ust.hk**
- Office Tel: **2358 7243**

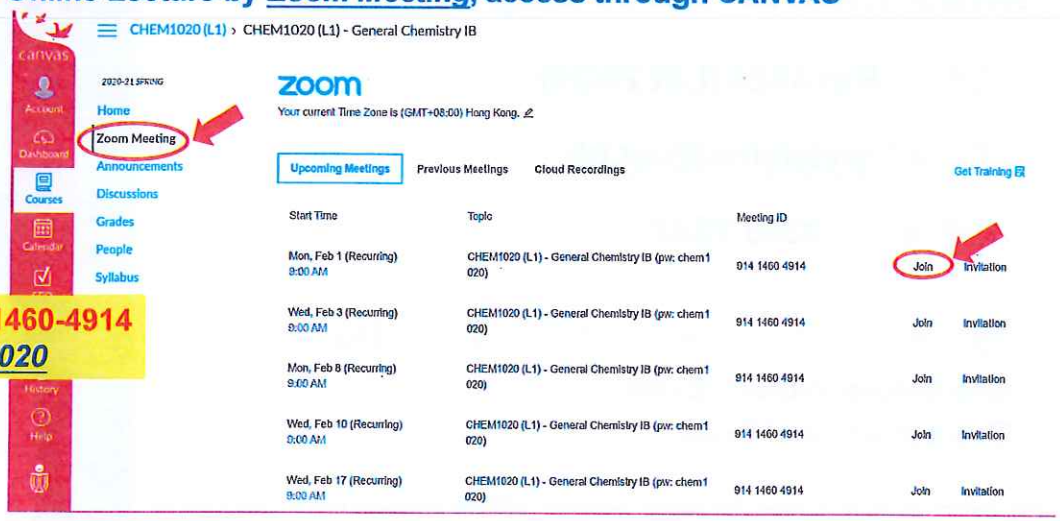
Two Tutorial Sessions instructed by IA:

- One before Midterm Exam
- One before Final Exam

The exact date and time for these tutorials will be announced in due course

Course Description and Pre-requisite

- Lectures: **9:00 – 10:20 am, Every Monday and Wednesday**
- Venue: **Interactive Online Lecture by *Zoom Meeting*, access through CANVAS**



Meeting ID: 914-1460-4914
Password: *chem1020*

Course Description and Pre-requisite

Pre-requisites:

- HKDSE *1.0*x Chemistry
- Or equivalent (Mainland JEE, Taiwan GSAT, IB Chem HL, SAT Chem, College Board AP, etc)

Course Description and Pre-requisite

- **Course Description**:

  This course targets students who have acquired more advanced knowledge in fundamental Chemistry in high school and is **Part I** of a **two-semester course** "General Chemistry".

  [Part II (CHEM 1030) is offered every Spring term]

- **Key Topics**: *atoms, atomic structures, chemical bonds, molecules, molecular structures, substances, chemical kinetics, energy*

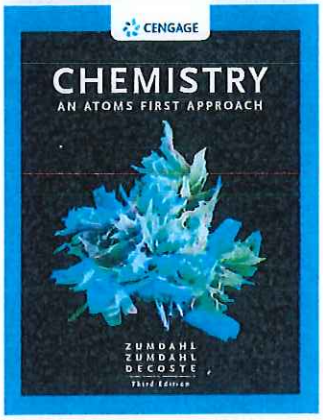
- **Supplementary Lab Course**: **CHEM 1050 [0-0-3:1]**

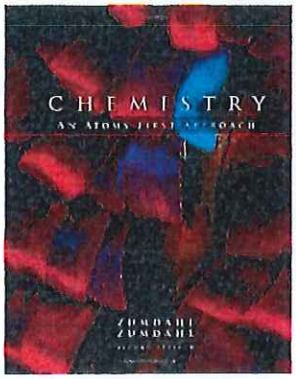
香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Course Outline and Textbook

- **Chapter 1:** Chemical Foundations
- **Chapter 2*:** Atomic Structure and Periodicity
- **Chapter 3:** Bonding - General Concepts
- **Chapter 4:*** Molecular Structure and Orbitals
- **Chapter 5:** Stoichiometry
- **Chapter 6:** Types of Chemical Reactions and Solution Stoichiometry
- **Chapter 7:** Chemical Energy
- **Chapter 8:** Gases

**Key Chapters!!!*





(The 2nd Edition textbook can also be used.)

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E-book ordering link: **https://w5.ab.ust.hk/cgi-bin/std_cgi.sh/WService=broker_ba_p/prg/ba_stdt_main.r**

Course Grading

- Midterm Exam (Tentative Time: Week 9) 50%
- Final Exam 50%

NOTE:

- exams **cannot** be waived under any circumstances
- ***Exam questions will be similar to:***
  - ***End-of-chapter exercises.***

How to do well in this Course?

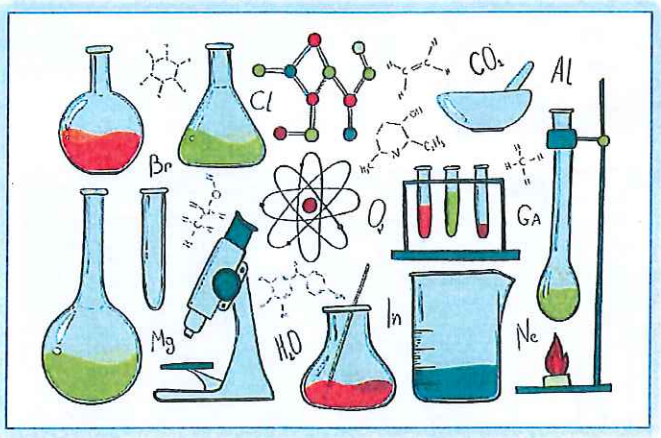
- **Attend Lectures**
- **Pre-read, Read, and Review** textbooks & lecture notes
- Do the **Recommended End-of-Chapter Exercises**
  - **Hint:** *exam questions will be similar to these!!!*
- **Email instructor for course help**

Lecture Notes and Lecture Videos

- **Lecture Notes and Lecture Videos are posted on CANVAS system:**
  - http://canvas.ust.hk
  - Login: **ITSC username** and **password**

Course Objectives

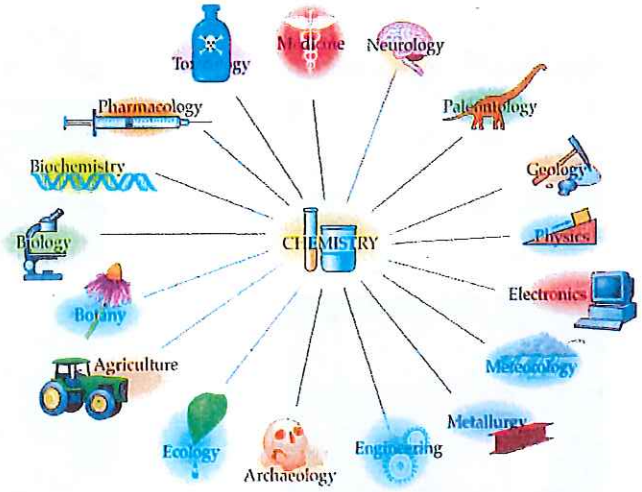
- **Chemistry** is a science that studies composition, structure, properties, and the changes (reactions) of matter.



Chemistry in our Daily Life

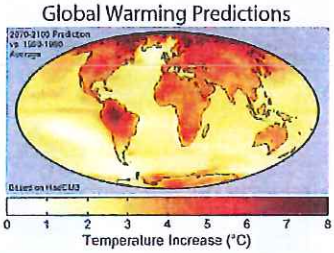
We encounter and use chemicals every days.

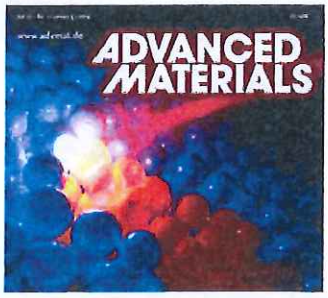
Chemistry: Its Central Role



Chemistry is a central science. It is related to many modern technologies and industries.

Chemistry and Future





New medicines

Intended Learning Outcomes

At the end of this course, you will 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 a chemical reaction from a **thermodynamic** point of views.
7. Describe the **physical states and properties of gases**
8. Recognize and appreciate the **impact of chemistry to our society**.

CHEM 1030 General Chemistry II

Instructor:
Zhenyang Lin 林振陽 (Room 4511; Tel no. x-7379; Email: chzlin@ust.hk)

Instructional Assistant:
Elaine Y L Wong (Room 4524; Tel: 23587243; Email: wylelaine@ust.hk)

Teaching Assistants:

Miss	LEI, Siqi	sleiab@connect.ust.hk
Mr.	HASAN, Muhammad	mhasanaa@connect.ust.hk
Mr.	LUO, Siwei	sluoak@connect.ust.hk
Mr.	PAN, Mingao	mpanac@connect.ust.hk
Mr.	Wilwin	wilwin@connect.ust.hk
Mr.	XU, Xin	xxube@connect.ust.hk
Mr.	YIN, Junli	jyinah@connect.ust.hk
Mr.	YU, Eric Yan Hung	eyhyu@connect.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 11:	Chemical Kinetics
Chapter 12:	Chemical Equlibrium
Chapter 13:	Acids and Bases
Chapter 14:	Acid-Base Equilibria
Chapter 15:	Solubility and Complex Ion Equilibria

Midterm Exam (Chapters 10-15)

Chapter 16:	Spontaneity, Entropy, and Free Energy
Chapter 17:	Electrochemistry
Chapter 18:	The Nucleus: A Chemist's View
Chapter 19:	The Representative Elements
Chapter 20:	Transition Metals and Coordination Chemistry

Final Exam (Chapters 16-20)

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. Describe and explain the trends and patterns of structures, physical properties and reactivities of selected main group compounds, transition metal compounds.
6. Recognize the impact of chemistry to society.

Lecture Hours: 4:30 pm – 5:50 pm; Tuesday, Thursday

Instructor's Office Hours:
Wednesday Mornings: via Zoom or face-to-face Meetings (upon email request)

Instructional Assistant's Office Hours:
Email Elaine (wylelaine@ust.hk) when you want to discuss with her.

Assessment:

Mid-term exam (4:30-6:30pm Tuesday 30 March 2021)	45%
Final exam	45%
Assignments 1 & 2	5% × 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 homework/quizzes will be given via Canvas for each chapter.

Updated 7 December 2021

The Hong Kong University of Science and Technology

CHEM 1050 Laboratory for General Chemistry I

Spring 2020–21

Course Outline

Instructor

Prof. TSANG Emily Ming Wai (Rm 4536; Tel: 3469-2100; Email: chetsang@ust.hk)

Instructional Assistants (IAs)

Ms. CHEUNG Ruby S. W. (Rm 4522; Tel: 2358-8450; Email: rubycheung@ust.hk)

Ms. WONG Cherry C. T. (Rm 4523; Tel: 3469-2080; Email: cctwong@ust.hk)

Technical Officers

Mr. SEETO K. (Rm 4531; Tel: 2358-7371; Email: chkseeto@ust.hk)

Mr. TSE M. L. (Rm 4531; Tel: 2358-7371; Email: mltse@ust.hk)

Class Schedule

Section	Date	Time	Online Platform
LA1	Friday	03:00 – 05:50 PM	Canvas & Zoom

Course Information

Credit Units:	1
Pre-requisite:	Level 3 or above in HKDSE 1/2× Chemistry OR level 3 or above in HKDSE 1× Chemistry OR CHEM 1004
Co-requisite:	CHEM 1010 OR CHEM 1020
Exclusion:	Nil
Grade:	P/F

Description:

This course is the laboratory class designed for students who enrolled in CHEM 1010 or CHEM 1020. With laboratory experience acquired in this course, students will be able to relate the physical and chemical principles and theories in practice.

Intended Learning Outcomes

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:

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
Tests and Lab Quizzes	1, 2, 3
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**.
- Other learning resources can be accessed through Canvas.

Teaching and Learning Activities

Laboratory Demonstration: focus on experiments related to co-requisite course

Course Schedule

Keyword Syllabus:

- Laboratory safety
- Common laboratory apparatus
- Basic techniques for measurements in chemistry laboratory
- Gas law
- Boiling point and intermolecular forces
- Solution stoichiometry and volumetric titration
- Chemical energy and calorimetry

Updated 7 December 2021

CHEM 1055 Laboratory for General Chemistry II

2020–21 Spring

Course Outline

Instructor

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

Instructional Assistants (IAs)

Ms. CHEUNG Ruby S. W. (Rm4522; Tel: 2358 8450; Email: rubycheung@ust.hk)

Ms. WONG Cherry C. T. (Rm4523; Tel: 3469 2080; Email: cctwong@ust.hk)

Technical Officers

Mr. SEETO K. (Rm4531; Tel: 2358 7371; Email: chkseeto@ust.hk)

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

Class Schedule

Section	Date	Time	Venue
LA1	Monday	10:30AM – 01:20PM	Online: Canvas & Zoom Face-to-face: UG001, CYT Building
LA2		01:30PM – 04:20PM	
LA3	Tuesday	10:30AM – 01:20PM	
LA4		01:30PM – 04:20PM	
LA5	Wednesday	10:30AM – 01:20PM	
LA6		01:30PM – 04:20PM	

Course Information

Credit Units: 1

Pre-requisite: CHEM 1010 OR CHEM 1020

Co-requisite: CHEM 1030

Exclusion: Nil

Grade: P/F

Description:

This course is the laboratory class designed for students who enrolled in CHEM 1030. Students will perform experiments based on the theory they learned in courses. By conducting experiments independently, students are able to experience the whole process, from pre-lab and studying Material Safety Data Sheet (MSDS), to using suitable labwares, experimental techniques and data treatment.

Intended Learning Outcomes

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:

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
Lab Reports	1, 2, 3, 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: Jo Allan Beran, *Laboratory Manual for Principles of General Chemistry, 9th edition*, McGraw-Hill, **2011**.
- Other learning resources can be accessed through Canvas.

Teaching and Learning Activities

Laboratory Demonstration: focus on experiments related to co-requisite course

Course Schedule

Keyword Syllabus:

- Liquids and solids
- Properties of solutions
- Acids and bases
- Acid-base equilibria
- Solubility and ionic equilibria
- Spontaneity, entropy and free energy
- Electrochemistry
- Transition metals

Revised on 10 March 2021
by Prof. Wei-Min Dai

Updated 7 December 2021

CHEM 2111 Fundamentals of Organic Chemistry

(Spring Term, 1 February – 28 May 2021)

1. Instructor

Prof. Wei-Min DAI; Room CYT-6012, lifts 35/36
Tel. 2358-7365; E-mail: chdai@ust.hk

2. Teaching Assistants

Mr. Peilin TIAN ptianaa@connet.ust.hk
Miss Eryu WANG ewangab@connect.ust.hk

3. Lecture Time and Venue

Date & Time: Tue & Thu 9:00–10:20 am
(3 lecture hours per week)
Venue: Live online mode using Zoom

4. Course Description & Objectives

Credit Points: 3
Pre-requisite: CHEM 1010 or CHEM 1020
Exclusion: CHEM 2110, CHEM 2112, and CHEM 2118
Brief Information/synopsis:
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.

5. Intended Learning Outcomes

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

No.	ILOs
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.

6. Requirement & Assessment Scheme

i. Attendance at all lectures

ii.

Assessment	Assessing Course ILOs
Two Assignments (30% of 100 points)	1, 2, 3, 4
Two Essays (70% of 100 points)	1, 2, 3, 4

iii. The course grade is assigned based on students' performance in assessment tasks/activities.

7. 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; 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; International Edition 2007.

8. Teaching & Learning Activities

Scheduled activities: 3 lecture hours per week

9. Course Schedule

Week 1	*2 & 4 Feb* Chemical bonding
Week 2	*9 & 11 Feb* Alkanes and cycloalkanes
Week 3	*16 & 18 Feb* Acids, bases and alkyl halides
Week 4	*23 & 25 Feb* Alkenes and alkynes I: Structure and preparation
Week 5	*2 & 4 Mar* Alkenes and alkynes II: Reactions
Week 6	*9 & 11 Mar* Stereochemistry
Week 7	*16 & 18 Mar* Nucleophilic substitution
Week 8	*23 & 25 Mar* Free radicals
Week 9	*30 Mar* Spectroscopy
	[31/3–6/4 Mid Term Break]
	8 Apr Spectroscopy (continue)
Week 10	*13 & 15 Apr* Alcohols, ethers, and phenols Aromatic compounds

Week 11 *20 & 22 Apr*
Aromatic compounds (continue)
Aldehydes and ketones

Week 12 *27 & 29 Apr*
Carboxylic acids
Carboxylic acid derivatives

Week 13 *4 & 6 May*
Amino acids, peptides, and proteins

10–14 May, Study Break
No Final Examination

10. Reserve Items in Library

http://ustlib.ust.hk/search/r?SEARCH=chem+2111

Call Number	QD253.2 .A74 2002 c.1-3
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 c.1-2
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

Revised on 10 March 2021 by Prof. Wei-Min Dai

Updated 7 December 2021

CHEM 2155 Fundamental Organic Chemistry Laboratory

2021 Spring

Course Outline

1. Instructor

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

2. Technical support staff / Teaching Assistant:

Technicial support staff:

TSE, Wai Pui Veronica (email: chvaipui@ust.hk)
LAU, Chun Tak Disney (email: disney@ust.hk)
CHAN, Ka Lok Kelvin (email: chkelvin@ust.hk)
WONG, Ka Man Joanne (email: joannewong@ust.hk)
Contact Details: CYT-1003 and CYT-1004; Tel: 3469-2611 & 3469-2612

Teaching Assistant:

Name: [to be provided in a separate file on Canvas]

3. Meeting Time:

Date/Time: Every Fri 10:30 – 13:20

4. Course Description

Credit Points: 1
Pre-requisites: (CHEM 1010 or CHEM 1020) & CHEM 1050
Co-requisites: CHEM 2110 or CHEM 2111
Exclusions: CHEM 2150
Brief Information/synopsis:
This is the laboratory course designed for non-CHEM students who enrolled in CHEM 2110 or CHEM 2111. Students will perform a series of organic experiments related to the theories learnt in the related lecture courses. Students will be trained to practice a wide range of fundamental organic laboratory techniques, operate chemical instruments, relate the physical and chemical principles and theory in practice, and develop their data interpretation and analytical skills. For non-CHEM students in programs that designate this course as required course/specified elective.

5. Intended Learning Outcomes (ILOs)

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

1	Conduct analysis and interpretation of experimental data related to organic experiments.
2	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
3	Know know to conduct standard laboratory procedures involved in synthetic and instrumental work related to organic experiments.
4	Know how to operate chemical instruments.
5	Able to show self awareness, to interact with other people in team working, and to work independently.

6. Assessment Scheme

Grading type: letter grades.

Assessment items	ILOs to be assessed
10% Safety Assignment	2
30% Lab Quizes	1, 2
35% Lab Reports	1, 2, 3, 4, 5
25% Oral Test	1, 2, 4

* *Passing mark: 50%*

7. Student Learning Resources

Reference books:

Kenneth L. Williamson, "*Macroscale and Microscale Organic Experiments 3rd edition*", Boston: Houghton Mifflin ©1999; or
Kenneth L. Williamson, Kathrine M. Maters, "*Macroscale and Microscale Organic Experiments 6th edition*", Australia: Brooks/Cole ©2011; or
Kenneth L. Williamson, Kathrine M. Maters, "*Macroscale and Microscale Organic Experiments 7th edition*", Australia: Cengage ©2017.

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

8. Teaching and Learning Activities

Scheduled activities: 2 hr 50 min (tutorial + laboratory demonstrations, etc.)

9. Keyword syllabus:

- Recrystallization of Organic Solids
- Distillation of Organic Liquids
- Liquid-liquid Extraction of Organic Components from a Mixture
- Organic Synthesis
- Nucleophilic Substitution
- Melting Point Measurement
- Infra-Red Spectroscopy of Organic Compounds

Updated 7 December 2021

CHEM 2311 Analytical Chemistry

Course Outline - Spring 2021

1. Instructor

Dr. Simon W. Chan

Email chanwan@ust.hk, Rm 4520

Office Hours: by appointment

2. Teaching Assistant(s)

Claire Sun (*course content*)	zsunar@connect.ust.hk	GUO, Wanlin (*Quiz*)	wguoag@connect.ust.hk
PAN, Guanrui (*course content*)	gpanaa@connect.ust.hk	CHIN, Man Lung	mlchin@connect.ust.hk
KWOK, Hong Ching	hckwokaa@connect.ust.hk	CHEN, Junyi (h.w.)	jcheneb@connect.ust.hk

3. Lecture Time and Venue

Date/Time: Wed & Fri (4:30 – 5:50); **Venue:** at *your desktop computer*

4. Course Description

Credit Points: 3; Pre-requisite: CHEM 1010 or 1020; Exclusion: CHEM 2310

Brief Information/synopsis:

Fundamental & practical aspects of chemical analysis, including titrimetric, electrical, optical & mass spectroscopic methods, analytical separations by chromatography.

5. Assessment Scheme

- Assignment (30% in total): 2 x 15%;
- [a] Quiz (70% in total): 7 x 10%; (*subject to changes in accordance to University regulation* and for Fairness to the **whole class**)

  [a] Quiz: online, in class; ***Camera must be turned on showing both your face and hands*** *during the quizzes, or Zero mark will be award for that quiz*

**** **2 bonus** (2* x *1) **points** for answering questions during the lecture****

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, Titrations	Redox Titrations
Acids and Bases, Buffers and Indicators	Instrumental Electrochemistry
Acid-Base Titrations & N-Analysis	Optical Spectroscopy and Applications
Mass Spectrometry	Chromatography

Updated 7 December 2021

CHEM 2355 Fundamental Analytical Chemistry Laboratory

Course Outline – Spring 2021

1. Instructor

Instructor: Dr Joanne W T Tung
Office: Rm 4541 (Lift 25/26)
Tel: 2358 7395
E-mail: jwttung@ust.hk

2. Teaching Assistant

Name (Surname first)	**Email (@connect.ust.hk)**
TEWARI, Neha	ntewari
JIN, Long	ljinac
ZHANG, Jiayin	jzhangem
XU, Xin	xxube
PAN, Guanrui	gpanaa
ZHU, Hongni	hzhuap

3. Meeting Time and Venue

Venue: Online mode of delivery

Time of Tutorials/Laboratory:
LA1: Friday 10.30 - 13.20

4. Course Description

Credit Points: 1
Pre-requisites: CHEM1010 General Chemistry IA or CHEM1020 General Chemistry IB, or CHEM1050 Laboratory for General Chemistry I
Co-requisites: CHEM2311 Analytical Chemistry or CHEM2310 Fundamentals of Analytical Chemistry

Course Description: Practical aspects of fundamental chemical analysis.

Course Objective: With the use of analytical instruments and lab equipment, the course applies what the students learned in lectures in practical term.

Design of the Laboratory Course:
This course is delivered online through canvas and Zoom communication software.

5. Intended Learning Outcomes (ILOs)

On completion, students should be able to:
(a) Apply chemical principle for analytical determinations.
(b) Apply the instrumental techniques to quantitative and qualitative chemical analyses.
(c) Calculate and interpret the result based on the experimental data.

6. Assessment Scheme

The ILO points (a) to (c) are assessed by lab reports, lab quizzes and oral quiz.

Expt No.	Title of Experiment	ILOs
1	Calibration of Volumetric Glassware	(a)-(c)
2	Quantitative Analysis of Xylene Isomer (para-Xylene) Using Fourier Transform- Infrared Spectrometer (FT-IR)	(a)-(c)
3	Determiantion of n-Heptane, n-Octane and n-Decane in unknown sample using Gas Chromatograph - Flame Ionization Detector (GC-FID)	(a)-(c)

Course Grading

Weight	Assessment	Course ILOs
60%	Reports	(a)-(c)
20%	Lab Quizzes	(a)-(c)
20%	Oral Quiz	(a)-(b)

7. Student Learning Resources

- Harris D. C., ***Quantitative Chemical Analysis***, 9th Ed., W. H. Freeman and Company, New York, 2016.
- Skoog D A, West D M, Holler F J, ***Fundamentals of Analytical Chemistry***, 7th Ed, Chapter 22B, Saunders College Publishing, 1996.

(A few copies of each of the above textbooks have been reserved at the Course Reserve in HKUST library.)

8. Teaching and Learning Activities

Prelab Practice

Before each lab session, students are strongly advised to read the lab manual, relevant academic websites, textbooks and/or journal papers.

Videos on Canvas

The videos of experiments and videos of background theory will be placed on the canvas website for students to watch.

Lab Briefing

There will be tutorials for the experiments held by the Instructor during the lab session interactively on Zoom.

Students' Enquiry Session

There will be time allowed for students to raise any questions regarding the experiment before the report submission deadline.

(End)

Updated 7 December 2021

CHEM3120 Organic Chemistry II

Instructor: Dr. Jianwei Sun
Office: CYT6010
Telephone: 2358 7351
E-mail: sunjw@ust.hk

Course Website:

http://canvas.ust.hk

use your student account to log in

Lecture Time: Tue, Thu 9:00-10:20

COURSE OBJECTIVES AND INTENDED LEARNING OUTCOMES:

This is the Part II of a two-semester, introductory level organic chemistry course designed for chemistry/biochemistry major undergraduates. The complete two-semester course will prepare students for further studies in organic chemistry and/or biochemistry. Upon the end of the course, students should be able to:

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 relevant to social and daily life.

4 Formulate and analyze mechanisms and products of organic transformations by applying organic chemistry principles.

Textbook: "Organic Chemistry" Eighth Edition by J. McMurry
Study Guide and Solutions Manual for McMurry's *Organic Chemistry*, 8th edition (7th also fine)

Exams and Grading Scheme:

1. Midterm examination, 40%
2. Final examination, 60%

Homework: Will not be collected and graded
Problems will be assigned at the end of the lecture notes.

Schedule

Week 1

Feb. 2 Chapter 12. Mass Spectrometry & Infrared Spectroscopy (1)
Feb. 4 Chapter 12. Mass Spectrometry & Infrared Spectroscopy (2)

Week 2

Feb. 9 Chapter 13. Nuclear Magnetic Resonance Spectroscopy (1)
Feb. 11 Chapter 13. Nuclear Magnetic Resonance Spectroscopy (2)

Week 3

Feb. 16 Chapter 14. Conjugated Dienes and UV Spectroscopy (1)
Feb. 18 Chapter 14. Conjugated Dienes and UV Spectroscopy (2)

Week 4

Feb. 23 Chapter 15. Benzene and Aromaticity
Feb. 25 Chapter 16. Electrophilic Aromatic Substitution (1)

Week 5

Mar. 2	Chapter 16. Electrophilic Aromatic Substitution (2)
Mar. 4	A Preview of Carbonyl Compounds
	Chapter 19. Aldehydes/Ketones: Nucleophilic Addition Reaction (1)

Week 6

Mar. 9	Chapter 19. Aldehydes/Ketones: Nucleophilic Addition Reaction (2)
Mar. 11	Tutorial (1)

Week 7

Mar. 16	Chapter 20. Carboxylic Acids and Nitriles
Mar. 18	No class (swap with midterm exam)

Mar. 20 (Saturday)	**Mid-Term Exam, 16:00 pm – 18:00 pm** **Covering Chapters 12-16 and 19, inclusive** **Venue/mode: to be announced**

Week 8

Mar. 23 Chapter 21. Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions (1)

Mar. 25 Chapter 21. Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions (2)

Week 9

Mar. 30 Chapter 22. Carbonyl Alpha-Substitution Reactions (1)

Apr. 8 Chapter 22. Carbonyl Alpha-Substitution Reactions (2)

Week 10

Apr. 13 Chapter 23. Carbonyl Condensation Reactions (1)
Apr. 15 Chapter 23. Carbonyl Condensation Reactions (2)

Week 11

Apr. 20 Chapter 24. Amines and Heterocycles (1)
Apr. 22 Chapter 24. Amines and Heterocycles (2)

Week 12

Apr. 27 Chapter 30. Orbitals and Organic Chemistry: Pericyclic reactions (1)

Apr. 29 Chapter 30. Orbitals and Organic Chemistry: Pericyclic reactions (2)

Week 13

May 6 Tutorial (1)

Final Exam: Date TBD

Covering all the chapters we taught this semester

Updated 7 December 2021

CHEM 3220 Inorganic Chemistry II

Course Outline- Spring 2021

1. **Instructor**

   Name: Wa-Hung Leung

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

2. **Teaching Assistants**

Name: Lam Cheung KONG	Contact Details: e-mail: lckong@connect.ust.hk
Name: Hoang Long PHAM	Contact Details: e-mail: hlpham@connect.ust.hk
Name: Junyi WANG	Contact Details: e-mail: jwangfj@connect.ust.hk
Name: Zhouyi HE	Contact Details: e-mail: zheam@connect.ust.hk

3. **Meeting Time and Venue**

   Lectures:

   Date/Time: Monday 15:00-14:50; Friday 10:30-11:50

   Venue: Zoom meeting

   Tutorials:

   Date/Time: To be arranged

   Venue: Zoom meeting

4. **Course Description**

   Credit Points: 3

   Pre-requisite: CHEM 2210

   Exclusion: NIL

   Brief Information/synopsis:

   Inorganic Chemistry II is a 3-credit elective course for all Year 2 chemistry undergraduate students. The curriculum is designed to cover a range of topics on bonding, structure and reactivity of inorganic complexes, with intended learning outcomes focusing on developing students' intellectual and generic skills.

5. Intended Learning Outcomes

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

No.	ILOs
1	Recognize fundamentals of chemistry, including structures, reactivity and properties of inorganic compounds and states of matters.
2	Explain essential facts, principles and theories of inorganic chemistry such as crystal field theory and the 18-electron rule
3	Demonstrate awareness of chemical topics relevant to social and daily life

6. Assessment Scheme

a. Final assessment duration: 2 hours

b. Percentage of coursework, examination, etc.:

Assessment	Assessing Course ILOs
8% by assignments and other assessments	1, 2, 3
54% by quizzes	1, 2,3
32% by final assessment	1, 2, 3
6% (others, e.g. in-class quizzes)	1, 2, 3

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

7. Student Learning Resources

Recommended Reading:

Text(s):

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

8. Teaching and Learning Activities

Scheduled activities: 3 hrs (lecture)

9. Course Schedule

Keyword Syllabus:

- Crystal field splitting of inorganic complexes
- Factors affecting size of crystal field splitting, spectrochemical series
- High-spin and low-spin complexes, ligand field stabilization energy
- Correlation of crystal field splitting with spectral, magnetic and thermochemical properties of metal complexes
- Coordination equilibria, chelate effect, Jahn-Teller distortion of Cu(II) complexes
- The 18-electron rule, rationale and exceptions
- Metal carbonyl complexes: bonding, structure and reactivity, backbonding
- Ligands that are isoelectronic with CO
- Metal alkene and alkyne complexes: Dewar-Chatt model
- Metal cycloolefin complexes: ferrocene, electron count of cycloolefin ligands
- Organometallic reactions: oxidative addition, reductive elimination and migratory insertion

- Examples of homogeneous catalysis
- Main group hydride compounds: classification, bonding and structure and reactions
- Main group organometallic compounds: stability, bonding and structure and reactions, inert pair effect.
- Multiple bonds between main group elements: trends of element-element single and multiple bond strengths, pπ-pπ and dπ-pπ interactions
- Inorganic rings and cages: allotropes of carbons, borazine, polysiloxanes, polyphoshazenes
- Borane clusters, Wades rules

Updated 7 December 2021

CHEM 3320 Instrumental Analysis
(Spring 2021)

Instructor: Prof. Hongkai WU, Rm 4517; Ext: 7246; email: chhkwu@ust.hk

Textbook: Principles of Instrumental Analysis
by Skoog, Holler, Crouch, 6th/7th Edition

Class schedule: Mon. & Wed. 9:00am-10:20am

Location: on-line Zoom meeting

TA office hours: Thur., 7:00-8:00 pm, Zoom meeting

Professor office hours: by appointment or email

Course notes: canvas.ust.hk

TAs: To be announced

Course Outline

- Introduction to Instrumental Method: Chapter 1&Appendix 1
- Electroanalytical Chemistry-An Introduction: Chapter 22
- Potentiometry: Chapter 23
- Coulometry: Chapter 24
- Voltammetry: Chapter 25
- Atomic and Molecular Mass Spectrometry: Chapters 11&20 ⇧ **Midterm**

- Introduction to Optical Spectrometric Methods: Chapters 6&7 ⇩ **Final**
- Introduction to Optical Atomic Spectrometry: Chapter 8
- Atomic Absorption and Emission Spectrometry: Chapters 9&10
- Atomic X-Ray Spectrometry: Chapter 12
- Ultraviolet/Visible Molecular Absorption Spectrometry: Chapters 13&14
- Molecular Luminescence Spectrometry: Chapter 15
- Infrared Spectrometry: Chapters 16&17
- Raman Spectrometry: Chapter 18
- Nuclear Magnetic Resonance Spectroscopy: Chapter 19
- Surface Characterization by Spectroscopy and Microscopy: Chapter 21

Grading

- 3-5 homework assignments
- Mid-term exam (50%): Apr. 7 (Wed) lecture time
- Final exam (50%) (date: arranged by University)

Updated 7 December 2021

Course Syllabus

Jump to Today ✎ Edit

Instructors:

Prof. Ding Pan

Room: 4479, Lift 25/26

Tel: 2358-8896

E-mail: dingpan@ust.hk (mailto:dingpan@ust.hk)

Prof. Xuhui Huang

Room: 4543, Lift 25/26

Tel: 2358-7363

E-mail: xuhuihuang@ust.hk (mailto:xuhuihuang@ust.hk)

Teaching Assistants:

XIA, Hui, hxiaaa@connect.ust.hk (mailto:hxiaaa@connect.ust.hk)

YUAN, Congmin, cyuanac@connect.ust.hk (mailto:cyuanac@connect.ust.hk)

CHOY, Ka Hei (Jimmy), khchoyab@connect.ust.hk (mailto:khchoyab@connect.ust.hk)

Lectures:

Wednesday & Friday	3:00pm-4:20pm Zoom

Office Hours:

Wednesday	4:30 pm-6:00 pm	Zoom
Friday	4:30 pm-6:00 pm	Zoom

Course Website:

https://canvas.ust.hk/36031

COURSE DESCRIPTION

Chem3420: Physical Chemistry II aims to provide the students with a basic knowledge of the concepts, mathematics, and results of quantum mechanics and its application to chemical systems. Specifically, we will cover topics including the principles and mathematics tools in quantum mechanics, one-dimensional problems, particle-in-

box, harmonic oscillator, angular momentum theory, spin, and introduction to methods of modern electronic structure theory, with applications in atomic and molecular structures, spectroscopy, and chemical bonding.

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, to develop an appreciation of the relationship between chemistry and Physics, 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.

TEXTBOOK

Physical Chemistry, 10th Edition, by P. W. Atkins and J. de Paula, Oxford University Press, 2014.

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/) 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 make 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/ (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	50%
Assignments	10%

Notes:

- Midterm Exam and Final Exam are in-class closed-book or on-line examinations.

- Assignments: There will be four sets of homework assignments in total. **Two** out of **FOUR** with highest scores will each contribute 5% to the final grade.

COURSE SCHEDULE

Prof. Ding Pan

Week 1	Feb 3	Introduction & Topic 1: Introduction to Quantum Theory *Textbook: Chapter 7.*
	Feb 5	Topic 1: Introduction to Quantum Theory (continued)
Week 2	Feb 10	Topic 1: Introduction to Quantum Theory (continued)
Week 3	Feb 17	Topic 1: Introduction to Quantum Theory (continued)
	Feb 19	Topic 2: The Quantum Theory of Motion – Translation *Textbook: Chapter 8A.*
Week 4	Feb 24	Topic 2: The Quantum Theory of Motion – Translation (continued)
	Feb 26	Topic 2: The Quantum Theory of Motion – Vibration *Textbook: Chapter 8B.*

Week 5	Mar 3	Topic 2: The Quantum Theory of Motion – Vibration (continued)
	Mar 5	Topic 2: The Quantum Theory of Motion – Rotation *Textbook: Chapter 8C*
Week 6	Mar 10	Topic 2: The Quantum Theory of Motion – Rotation (continued)
	Mar 12	Topic 2: The Quantum Theory of Motion – Rotation (continued)

Prof. Xuhui Huang

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Week 7	Mar 17	Topic 3: Atoms – Atomic Structure of Hydrogen-like atoms *Textbook: Chapter 9A*
	Mar 19	Topic 3: Atoms – Atomic Structure of Hydrogen-like atoms (continued)
Week 8	Mar 24	**Midterm Exam** (covers Topic 1 & 2) Time: 3:00 pm to 4:20 pm Zoom
Week 8	Mar 26	Topic 3: Atoms – Atomic Structure of Hydrogen-like atoms (continued)

Week 9	Apr 7	Topic 3: Atoms – Atomic Structure of Hydrogen-like atoms (continued)
	Apr 9	Topic 3: Atoms – Atomic Structure of many electron atoms *Textbook: Chapter 9B*
Week 10	Apr 14	Topic 3: Atoms – Atomic Spectra *Textbook: Chapter 9C*
	Apr 16	Topic 4: Molecules – Valence Bond theory *Textbook: Chapter 10A*
Week 11	Apr 21	Topic 4: Molecules – Valence Bond theory (continued)
	Apr 23	Topic 4: Molecules – Valence Bond theory (continued)
Week 12	Apr 28	Topic 4: Molecules – Molecular Orbital theory *Textbook: Chapter 10B-D*
	Apr 30	Topic 4: Molecules – Molecular Orbital theory (continued)

Week 13	May 5	Topic 4: Molecules – Hückel theory *Textbook: Chapter 10B-D*
	May 7	Review
May 15-28		**Final Exam** (covers Topic 3 & 4) Arranged by the university

Updated at Jan 28, 2021

Course Summary:

Date	Details	Due
Fri Mar 5, 2021	**Assignment 1** (https://canvas.ust.hk/courses/36031/assignments/147094)	due by 11:59pm
Tue Mar 16, 2021	**Assignment 2** (https://canvas.ust.hk/courses/36031/assignments/148292)	due by 11:59pm
Fri Apr 23, 2021	**CHEM3420 Physical Chemistry II, Spring 2021 Assignment 3** (https://canvas.ust.hk/courses/36031/assignments/152751)	due by 5pm
	midterm (https://canvas.ust.hk/courses/36031/assignments/149949)	

Updated 7 December 2021

CHEM 3550 Synthetic Chemistry Laboratory

2021 Spring

Course Outline

1. Instructor

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

2. Technical support staff / Teaching Assistant:

Name: TSE, Wai Pui Veronica (email: chvaipui@ust.hk)
LAU, Chun Tak Disney (email: disney@ust.hk)
CHAN, Ka Lok Kelvin (email: chkelvin@ust.hk)
WONG, Ka Man Joanne (email: joannewong@ust.hk)
Contact Details: CYT-1003 & CYT-1004; Tel: 34692611 & 34692612

Teaching Assistant:
Name: [to be provided in a separate file]

3. Meeting Time:

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

4. Course Description

Credit Points: 2
Pre-requisite: CHEM 2150 and CHEM 2250
Corequisite: CHEM 3120 and CHEM 3220
Exclusion: NIL
Brief Information/synopsis:

This course was designed and introduced to suit chemistry major students who are enrolling in CHEM 3120 Organic Chemistry II and CHEM 3220 Inorganic Chemistry II, in which it provides students some hands-on experience in organic synthesis and metal complexes formation. Different spectroscopic methods will also be used for characterization of products. The topics of experiments covered in the laboratory course will be related to those taught in the lecture courses.

5. Intended Learning Outcomes (ILOs)

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 and instrumental work.
5	Conduct analysis and interpretation of experimental data.
6	Able to show self-awareness and work independently.

6. Assessment Scheme

(Grading type: Letter Grades)

Assessment Criteria	ILOs
30% Lab Quiz†	1, 2
35% Lab Reports	1, 2, 3, 4, 5, 6
35% Oral Test (Zoom)	1, 2, 3, 5, 6

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

7. Student Learning Resources

Reference books:

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

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

(c) Lutz F. Tietze, Theophil Eicher, Ulf Diederichsen, *Reactions and Syntheses: In the Organic Chemistry Laboratory*, Weinheim: Wiley ©2015. [*available online / UST library*]

(d) J. Derek Woollins, *Inorganic Experiments 3rd edition*, Weinheim: Wiley ©2010.

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

8. Teaching and Learning Activities

Scheduled activities: 3 hr 50 min (Zoom, tutorial, f2f laboratory work, etc)

9. Course Schedule

Keyword syllabus:

- Separation of an Organic Mixture by Column Chromatography
- Purification of Organic Compounds
- Chemical Resolution of a Racemic Mixture
- Carbon-Carbon Bond Formation by Aldol Condensation
- Reductive Amination
- Synthesis of Schiff Bases
- Synthesis of Transition Metal Complexes
- Isomerism of Transition Metal Complexes
- Measurement of Magnetic susceptibility
- Polarimetry of Organic Compounds
- Infrared Spectroscopy of Organic Compounds
- ^{1}H-NMR Spectroscopy of Organic Compounds
- UV-Vis Spectroscopy of Organic Compounds

Updated 7 December 2021

CHEM 3555 Molecular Characterization Chemistry Laboratory
Course Outline – Spring 2021

1. Instructor

Instructor: Dr Joanne W T Tung
Office: Rm 4541 (Lift 25/26)
Tel: 2358 7395
E-mail: jwttung@ust.hk

2. Teaching Assistants

Name of TA (Surname first)	**Email <@connect.ust.hk>**
SABRINA, Jacqueline Cheryl	jcsabrina
CHEN, Dezhang	dchenba
FU, Wenhao	wfuag
MESIAS, Vince St. Dollente	vsdmesias
LEI, Siqi	siqi.lei
Wilwin	wilwin
CHIN, Man Lung	mlchin
GUO, Wanlin	wguoag
HE, Zhouyi	zheam
LIU, Xiaonan	xliudb

3. Meeting Time and Venue

Venue: Rm 6122, 7122, 7122A

Time of Tutorials/Laboratory:
LA1 & LA3: 10.30 - 14.20 (Tuesday)
LA2: 10.30 - 14.20 (Wednesday)

4. Course Description
Credit Points: 2

Pre-requisites: CHEM 2350 Analytical Chemistry Laboratory, and
CHEM2450 Physical Chemistry Laboratory

Co-requisites: CHEM3320 Analytical Chemistry II,
CHEM3420 Physical Chemistry II.

Course Objective: With the use of analytical instruments, equipment and computational software, the course applies what the students learned in lectures in practical term.

Course Description: Computational chemistry and instrumental methods in characterisation of molecular properties.

Design of the Laboratory Course:
This course is delivered in mixed mode: Three experiments are run in both face-to-face and online modes, the rest of the three are run in online mode through canvas and Zoom communication software.

5. Intended Learning Outcomes (ILOs)
On successful completion of this course, students are expected to be able to:

a. Apply the instrumental methods to analytical determinations, and apply computational software to theoretical study of physical chemistry;
b. Learn standard laboratory procedures involved in instrumental and experimental works safely;
c. Explain and interpret experimental results independently.

6. Assessment Scheme
The ILO points (a) to (c) are assessed by lab reports, lab quizzes and oral quiz.

Expt No	Title of Experiment	ILOs
1	Spectroscopic Evidence of Energy Quantisation from the UV-Visible Spectra of SO_2, I_2 and NH_3 Gases	(a)-(c)
2	Molecular Emission Method: Spectrofluorimetric Determination of Riboflavin in Vitamin Tablet	(a)-(c)
3	Illustration of 1-D Particle in a Box: Study of β-Carotene by UV-Visible Spectroscopy	(a)-(c)
4	Atomic Absorption Method: Lead Content in Hair Dye Sample by Atomic Absorption Spectrophotometry (AAS)	(a)-(c)
5	Electroanalytical Method: Determination of Chloride Content in Biscuit Samples with Ion-Selective Electrode (ISE)	(a)-(c)
6	Visualisation of Molecular Orbitals of a Heteronucleus Diatomic Molecule Simulated by a Computational Software - Gaussian	(a)-(c)

Course Grading

Weight	Assessment	Course ILOs
60%	Reports	(a)-(c)
20%	Lab Quizzes	(a)-(c)
20%	Oral Quiz	(a)-(b)

7. Student Learning Resources

Recommended Reading
Analytical Chemistry

- Harris D. C., ***Quantitative Chemical Analysis***, 9th Ed., W. H. Freeman and Company, New York, 2016.
- Skoog D. A., Leary J. J., ***Principles of Instrumental Analysis***, 6th Ed., Saunders College Publishing, 2007.

Physical Chemistry

- Atkins P. W., Julio de Paula, ***Atkins' Physical Chemistry,*** 10th Ed., Oxford University Press, 2014.

(A few copies of each of the above textbooks have been reserved at the Course Reserve in HKUST library.)

8. Teaching and Learning Activities

Prelab Practice

Before each lab session, students are strongly advised to read the lab manual, relevant academic websites, textbooks and/or journal papers.

Videos on Canvas

The videos of experiments and background theory are placed individually on the canvas website for students to watch.

Lab Briefing

There are tutorials for the experiments held by the Instructor during the lab session interactively on Zoom.

Report and Data Handling

There are time for students to treat their data and do e-report online.

Updated 7 December 2021

CHEM 4110 Structural Elucidation in Organic Chemistry — Spring Term 2021

Course Instructors: Prof. Rongbiao Tong, Office: Rm CYT6011. Email: rtong@ust.hk

Teaching Assistant: N.A.

Text Book: "*Introduction to spectroscopy*", Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan, 4th Ed. 2009; (Library only has the 3rd Edition: QD 272.S6 P38 2001 and is also available at Bookstore)
"*Spectrometric Identification of Organic Compounds*" 7th edition, Robert M. Silverstein, Francis X. Webster, David J. Kiemle., 2005.

Course Notes: You are responsible to get the notes of CHEM4110 from the Canvas web (http://canvas.ust.hk), using your email account and password to get access) before class.

Course Objectives: The emphasis of this course is on development of problem-solving techniques. After completion of CHEM4110, students will be able to: (i) recognize and comprehend the basic principles of 1D- & 2D-NMR, IR, and mass spectrometric techniques; (ii) analyze spectroscopic data of organic compounds; (iii) apply these spectrometric methods for structural determination of organic molecules.

Course Prerequisite: CHEM 3120.

Venue: Lectures are given via ZOOM meeting and Mixed mode (Rm 2504) from 12:00-1:20 am on every Monday and Wednesday.

Course Requirements:

Midterm presentation	40%
Final assignment	60%

CHEM 4110 Structural Elucidation in Organic Chemistry — Spring Term 2021

Course Content

Lecture 1&2: Infrared Spectroscopy 1:
- Mode of Stretching and Bending
- How to Approach the Analysis of IR Spectrum
- Hydrocarbons: Alkanes, Alkenes and Alkynes

Lecture 3: Infrared Spectroscopy 2:
- Alcohols and Amines
- Carbonyl compounds; Effect of ring size
- Nitriles and Nitro Compounds

Lecture 4 &5: Mass Spectroscopy:
- Basic principles of MS
- Ionization methods
- Ionization and fragmentation theory
- Determination of Molecular formula
- Isotopic effects

Lecture 6: Mass Spectroscopy:
- Cleavage mechanisms
- Functional group fragments
- MS spectra analysis

Lecture 7: UltraViolet-Visible:
- Basic theory about UV absorption
- Selection Rules
- Sample preparation and UV spectra
- Beer Lambert Law and Woodward-Fieser Rules
- Chromophores and their UV spectra

Lecture 8: 1D-NMR 1:
- Nuclear Magnetic Moments
- Mechanism of Resonance
- Population Densities of Nuclear Spin States
- Free Induction Decay (FID)

Lecture 9: 1D-NMR 2:
- NMR Spectrometer: CW vs FT
- How to Approach the Analysis of NMR Spectrum
- Chemical Shift and Shielding
- Anisotropy

Lecture 10: 1D-NMR 3:
- Chemical Equivalence
- Integrals and Integration
- Multiplet Patterns for Common Fragments (CH_3CH_2-, -$CH(CH_3)_2$...)
- Examples of ^{1}H-NMR Spectrum of Different Types of Compounds

Lecture 11: 1D-NMR 4:
- Types of Coupling
- Coupling Constant
- Pascal's Triangle and Splitting Diagram
- Mechanism of Coupling

Lecture 12: 1D-NMR 5:
- One Bond Couplings (^1J)
- Two Bond Couplings (^2J)
- Three Bond Couplings (^3J): Effect of Torsional and Dihedral angle
- Long Range Couplings (^4J-^nJ)

Lecture 13: 1D-NMR 6: - Magnetic and Chemical Equivalence
- First Order Spectra
- Second Order Spectra
- Spin System Notation AB, AX, AB_2, AX_2...

Lecture 14: 1D-NMR 7: - Homotopic, Enantiotopic and Diastereotopic System
- Dynamic NMR: Rapid Bond Rotation (C-N), Variable-Temperature NMR
- Protons on Oxygen: Alcohols
- Protons on Nitrogen: Amines

Lecture 15: 1D-NMR 9: - Carbon-13 NMR Spectroscopy
- Carbon-13 Chemical Shifts
- Proton-Decoupled Carbon-13 Spectra
- Nuclear Overhauser Effect

Lecture 16: 1D-NMR 10: - Advanced Carbon-13 NMR Techniques
- Attached Proton Test experiment (APT)
- Distortionless Enhancement by Polarization Transfer (DEPT)

Lecture 17: 2D-NMR 1: - Two dimension NMR theory
- ^1H-^1H COSY
- Analysis of COSY spectra
- Double Quantum Filtered COSY (DQF-COSY)

Lecture 18 &19: 2D-NMR 2: - Correlation Spectroscopy optimized for Long Rang (COSY-LR)
- Total Correlation Spectroscopy (TOCSY)
- Homonuclear Hartmann-Hann (HOHAHA)
- Nuclear Overhauser Effect
- 2D Nuclear Overhauser Effect Spectroscopy (2-D NOESY)
- 2D Incredible Natural Abundance Double Quantum Transfer Experiment (2D INADEQUATE)

Lecture 20&21: 2D-NMR 3: - Heteronuclear 2-Dimensional NMR Spectroscopy
- Heteronuclear Chemical Shift Correlation Spectroscopy (HETCOR)
- Heteronuclear Single Quantum Coherence (HSQC)
- Heteronuclear Multiple Quantum Coherence (HMQC)
- Correlation Spectroscopy via Long-range Coupling (COLOC)
- Heteronuclear Multiple Bond Correlation (HMBC)

Lecture 22: NMR 4:
- Comprehensive NMR Techniques
- Strategies to analyze spectra of unknown compounds
- For examples: ethyl crotonate (H-NMR, C-NMR, DEPT,HMQC, COSY, TOCSY, HMBC, NOESY) & 2-phenyl ethanol (H-NMR, C-NMR, DEPT, HMQC, COSY, TOCSY, HMBC)

Lecture 23: Comprehensive strategies: - Comprehensive Spectral Analysis (NMR, IR & MS)
- Spectral Interpretation of IR, MS and NMR
- Strategies of determination of unknown structure
- For Example: Pinanediol (MS, IR, H-NMR, C-NMR, DEPT, HETCOR, COSY, COLOC, INADEQUATE,

Instructor: *Prof. Jonathan Halpert* Spring, 2020

Chem4230: Materials Characterization Methods
(home: https://canvas.ust.hk/courses/29721)

Description:
This 3-credit course is an elective in analytical methods mainly for students majoring in chemistry. It covers:
(a) The basic principles and applications of analytical methods of characterization for materials; and
(b) A description of types of nanomaterials and how to apply these methods to measures their properties

Prerequisites:
(a) CHEM2310: Fundamentals of Analytical Chemistry *(CHEM2311 will be considered)*
(b) CHEM2410: Physical Chemistry I

Schedule/Venue:
(a) Lectures: Tuesday (1:30 – 3:00 PM), Rm# 1511 (Lift 27/28)
Thursday (1:30 – 3:00 PM), Rm# 1511 (Lift 27/28)
ALL LECTURES ONLINE (ZOOM via CANVAS)
UNTIL END OF TERM…DO NOT COME TO THE UNIVERSITY
(b) Instructors' Office Hours: Friday: 10:00 – 11:00 AM, Rm #4545 (*by appointment only*)
(c) TAs' Tutorial: **Office Hours:** *by apt. only* ; **Revision Session for midterm: April 14 class**

(d) Examinations (tentative):
Midterm (online, MC): April 23 (Week 10)
Final Presentations: Due Tue May 19 (online presentation)

Chem4230 TA(s) Contact Information:
Pai GENG (pgeng@connect.ust.hk): Tel: 2358-7355 ; Rm: 6124-B

Credit/Grading :

Midterm:	50% (covers Weeks 1-9)
Final Project:	30% (Group + Individual Score)
Participation:	20% (*class participation, in-class work and/or HW*)

Worksheets and assignments must be handed on time and this will contribute directly to your final grade!

(i) Worksheets, HW and in-class assignments will be completed and handed in after class to TA.
(ii) Questions marked based on completeness and accuracy. Model answers are on CANVAS.
(iii) ALSO: Midterm exam questions: 20-30% from worksheets/HW/in-class, the rest from lectures
(iv) We will most of the exercises in-class and present model answers.
(v) ***Don't wait until exam time!*** By then it is too late to learn everything.

REFERENCE TEXTS:

- Sam Zhang, Lin Li and Ashok Kumar, *"Materials Characterization Techniques"*, CRC Press, Taylor & Francis Group 2009 (TA410.Z45 2009).
- Guozhong Cao and Ying Wang, "*Nanostructures and Nanomaterials*", World Scientific Publishing Co. Pte. Ltd., 2011.
- Douglas A. Skoog, F. James Holler and Stanley R. Crouch, "*Principles of Instrumental Analysis*", 6th Edition, Brooks/Cole, Cengage Learning, 2007.
- "Handbook of instrumentation and techniques for semiconductor nanostructure characterization", TA418.9.N35 H36 2012 v.1-2.

CHEM 4230 Syllabus (final)

WEEK (Date)	Topic Summary (final)
1	Course Intro + Zoom Basics **L-1:** What are Nanomaterials?
2	**L-2:** Properties of Materials and Nanomaterials *X-ray Diffraction I: crystalline materials (XRD)*
3	**L-3:** Synthesis and Purification of Nanomaterials *X-ray Diffraction II: powder XRD*
4	**L-4:** Benchtop Analysis, Absorbance/Fluorescence Spectroscopy – Light Matter Interactions: UV-vis, PL, PLE, PLQY, TCSPC lifetimes, DLS, turbidity and scattering *X-ray Diffraction III: Single crystal X-ray diffraction, (S-XRD)*
5	**L-5:** Elemental Analysis Techniques: FAAS, ICP-AES, ICP-MS **L-6:** intro to X-ray: absorption (XAS, XAFS, XANES, NEXAFS),
6	**L-7:** X-ray cont'd emission processes (XRF, EDX, Auger, XPS) **L-7+8:** Band Edge States: UV-photon Techniques: UPS, IPES Electrochemistry (CV)
7	**L-8 cont'd:** Band Edge States: UV-photon Techniques: UPS, IPES Electrochemistry (CV) **L-9:** Microscopy, Scanning Electron Microscopy (SEM) w/ EDX
8	**L-9+10:** Transmission Electron Microscopy (TEM), High Resolution Transmission Electron Microscopy, HRTEM, and e- diffraction (SAED) **L-10 cont'd:** scanning transmission electron microscopy (STEM) elemental analysis, liquid cell TEM, cryo-TEM, TEM tomography
9	**L-11:** Surface Probe Microscopies (SPM): STM **L-12:** Surface Probe Microscopies (SPM): AFM, also **REV-1: revision**
10	**REV-2 (April 21):** revision + practice exam + sound/video check MIDTERM EXAM **(April 23)**
11	*Ultrafast Spectroscopy of Nanomaterials I*
12	*Ultrafast Spectroscopy of Nanomaterials II* Final Project Introduction and Teams + Group Work I
13	*Guest Lecture: Characterization of Perovskite Nanomaterials* Group Work II
End of Week 13:	Presentations Live on ZOOM

Guest lecturers for special topics:
Diffraction guest lecturer: Prof. Ian Williams (CHEM)
Ultrafast guest lecturer: Dr. Chris Chan (PHYS)
Guest lecturer: Dr. Parth Vashishtha (NTU)

CHEM 4230: Materials Characterization Methods
"Nanomaterials Characterization"

Course Description

*Credit Points:*3

Pre-requisite: CHEM 2310 and CHEM 2410

Brief Information/synopsis:
This course will introduce a selected series of materials characterization methods with an emphasis on the characterization methods of nanomaterials, especially chemically processed nanomaterials. The characterization methods will include electron spectroscopies, electron microscopies, scanning probe microscopies, and optical, thermal, mechanical, scattering and diffraction methods.

Intended Learning Outcomes (ILOs)

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

1. Understand how to choose a characterization method for a given material property.
2. Understand the working principles of the materials characterization methods.
3. Understand how to get the maximum information from a characterization method for a given material

Updated 7 December 2021

CHEM4310
Environmental Chemistry

Lecture venue : Rm 1410 (lift 25/26)
Lecture time: Mon (3:00-4:20 pm) | Fri (10:30-11:50 am)

Instructors:
Prof. Jianzhen YU
Rm 4532, Tel: 2358-7389, chjianyu@ust.hk

Enrollment requirement: CHEM 2310 OR CHEM 2311

Contact information

Instructor:

Prof. Jianzhen YU

Rm 4532, Tel: 2358-7389, chjianyu@ust.hk

Office hours: Walk-in or by appointment.

TA:

CHENG, Yuhuang: ychengbn@connect.ust.hk

Course ILO

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

(1) Explain the essential facts, principles and theories in environmental science

(2) Evaluate and discuss the relevance of chemistry to environmental issues.

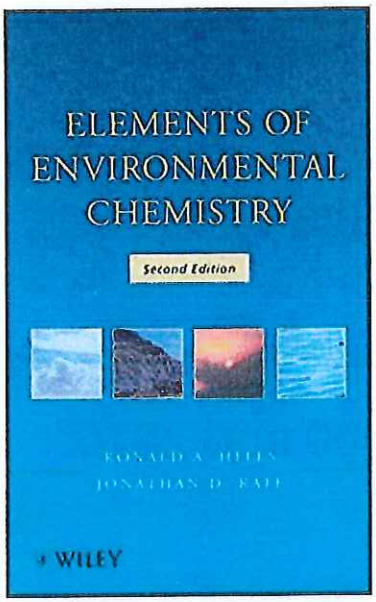
(3) Analyze and interpret experimental data, critically assess data from literature sources and extract and apply useful data from those sources.

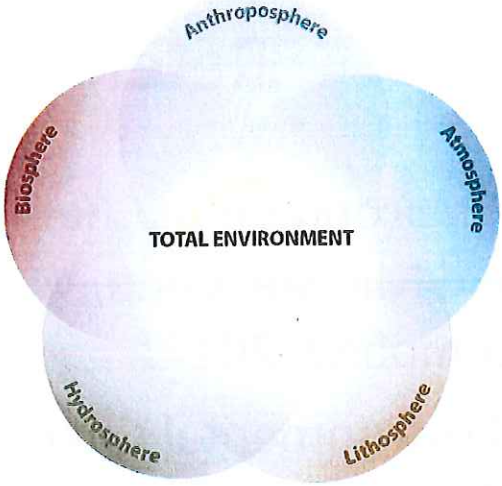
(4) Demonstrate self-awareness and the ability to work independently and collaborate effectively with other people in a team.

Grade Assessment

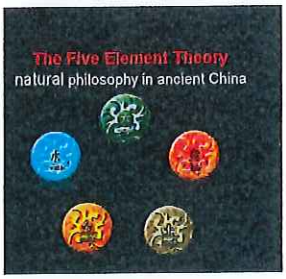
- Group homework assignments (22%)
  - 4 assignments [2-3 students per group, formed on a voluntary basis]
  - Group effort; one submission from each group
- Quizzes (78%)
  - 7 Quizzes
  - 6 best quiz scores will be used for grade assessment
- No final exam

Textbook





金木水火土



Four "elements" in an environmental chemist's periodic table: air, earth, fire, and water.

An e-copy of this book is available through UST library.

Reference Books

- "Environmental Chemistry", 5th ed, Colin Baird and Michael Cann, W. H. Freeman and Company, 2012.
- "Environmental Chemistry", 10th ed,Stanley E. Manahan, Lewis Publisher, 2000 and 2010.

❄ Older editions of these two books are available from the HKUST library.

❄ Select chapters from these two books will be posted on Canvas.

What is the course about?

- This course is about environmental issues and the chemistry behind them.
- It aims to apply knowledge of chemistry to understand environmental issues.

Environmental chemistry is the discipline that describes the origin, transport, reactions, effects, and fates of chemical species hydrosphere, atmosphere, geosphere, biosphere, and anthroposphere."

- Stanley E. Manahan. 2017. Environmental Chemistry, tenth edition.

Course Outline

1. Simple Tool Skills
2. Mass Balance and Kinetics
3. Fundamentals of water chemistry
4. Fates of Organic Compounds
5. Persistent Organic Pollutants
6. Heavy metal pollution
7. Atmospheric Chemistry: Chemical composition
8. Chemical kinetics of atm reactions
9. Oxidizing power of the troposphere & ozone pollution
10. Stratospheric ozone
11. Greenhouse gases and global warming
12. Particulate matter in the atmosphere

Updated 7 December 2021

CHEM 4330 Separation Science

Course Instructor: Dr. Simon W. Chan; email chanwan@ust.hk; tel.: 2358-7370

Lecture Hour: Tue & Thu 10:30 - 11:50 PM

Venue: Online via Zoom @ your computer; **microphone and web-cam are needed!**
Later, when off-line ready, @ Rm 2304 (Lift 17/18)

Office Hour: by appointment via Skype (Simonchan0328)

Venue: @ your computer;

Course Outline: This course aims to provide an in-depth understanding of the working principles in separating substances by chemical and physical techniques. Topics in this course include: sample preparation for chromatographic analysis; instrumentation for gas and liquid chromatography; mass spectrometry, and etc. Applications of various separation techniques for forensic, environmental, biological, pharmaceutical, food and drink analyses are provided as illustrating examples.

Reference Books:

1: Principles of Instrumental Analysis, Skoog. Holler. Nieman, Brooks/Cole
2: Quantity Chemical Analysis, Daniel C. Harris, Freeman

Assessment:

- Assignment (10% in total): 2 x 5%;
- [a] Quiz (45% in total): 9 x 5%, 9 best out of 10 quizzes; (***subject to changes***. Quiz will be replaced by on campus exam, if later University announced resume on campus teaching and exams)
- [b] Project (45% in total): oral presentation, 20% (10% by audience + 10% by instructor & TA); written report 25%; &

[a] Quiz: online, in class; ***Camera must be turned on showing both your face and hands*** *during the quizzes*

[b] Project: select an ***Interesting, Separating Science-related topic,*** do literature study, give a 10-15 min PowerPoint group presentation to the class and hand-in a not less than 5 pages report. Topic to be approved by Dr. Simon Chan at least 2 weeks ahead of the presentation, but *no later than 5th May, 2020*.

Sample topics for projects:

. Identification of drugs of abuse and metabolites of drugs of abuse in blood, urine, and saliva
. Monitoring gases in patient's breath during surgery
. Testing for the presence of drugs in blood in race horses and in Olympic athletes
. Dating archaeological specimens
. Analyses of aerosol particles
. Determination of pesticide residues in food
. Monitoring volatile organic species in water supplies

Welcomed: Open discussion
Not Welcomed: Chatting; Cheating

Course Outline:

Week 1	Introduction to separation science
Week 2	Chromatographic theory
Week 3	Gas Chromatography: Instrumentation
Week 4	Gas Chromatography: Molecular interactions in GC
Week 5	Liquid Chromatography: Instrumentation
Week 6	Liquid Chromatography: Different modes of chromatography
Week 7	2-dimensional chromatography: 2D-GC, 2D-LC
Week 8	Mass spectrometry: ionization techniques and mass analyzers
Week 9	Tandem mass spectrometers and their applications in drug discovery, forensic, and food safety testing
Week 10	Hyphenated Gas/liquid chromatography mass spectrometry; and case study
Week 11	Sample preparation methods for chromatographic separations & Chemical derivatization for chromatographic separation
Week 12	Quantitative analysis with separation methods & Case study: Application of separation science in toxicology study and/or for anti-doping programs
Week 13	**Project presentations**

* Tentative schedule subject to changes depending on progress

Updated 7 December 2021

CHEM 4430 [3-0-0:3]

Symmetry Principles and Group Theory in Chemistry:
Structure, Bonding and Spectroscopy

Xiao-Yuan Li（李曉原）

Department of Chemistry
The Hong Kong University of Science and Technology

Spring 2020

Course Description

- **Chem-4430 is an *elective* course for *the year-4* UG and the *first year PG* students majoring in *Chemistry* or *Interdisciplinary Areas* involving chemistry .**
- **The *first half* of the course covers the *fundamentals* of symmetry principles and group theory that are most relevant to common chemistry problems. *(Symmetries of molecular structures are classified, represented and correlated in this part).***
- **The *second half* of the course covers the *applications* of symmetry principles and group theory in various chemistry problems such as bonding, spectroscopies and reactions. *(Applications in bonding, reactions, and spectroscopies are discussed in this part).***
- **Students enrolled in this course are expected to have completed the *four core subjects* in chemistry, since all the working examples and applications are selected from different chemistry sub-disciplines, including *inorganic, organic, physical* and *analytical* chemistry, as well as from *supramolecular* chemistry, *biochemistry,* and *materials(e.g. solid-state, catalysis etc.)* chemistry among other subjects.**

Prof. Xiao-Yuan Li, Dept. of Chemistry, HKUST

Course Syllabus

PART – I : Basics of Symmetry Principle and Group Theory.

Chapter 1: Introduction - ***Why Group Theory for Chemistry?***

Chapter 2: Classification of ***Symmetry Transformations***

Chapter 3: Classification of Figures (**i.e., static models of molecular structures**) **-** ***Chirality***

Chapter 4: Point Groups - ***The Basic Concepts***

Chapter 5: Point Groups - ***Group Elements, Class Structure, Figure Recognition, Relationships***

Chapter 6: Representation of Point Groups - ***Character Tables***

PART – II : Applications of Symmetry Principle and Group Theory in Chemical Problems.

Chapter 7: Symmetry and ***Physical(Chemical) Properties***

Chapter 8: Symmetry Aspect of ***MO Theory and Bonding***

Chapter 9: Symmetry Aspect of ***Molecular Vibrations***

Chapter 10: Symmetry Aspect of ***Electronic(& Vibronic) Spectroscopy-I*** ***(Non-transition metal compounds)***

Chapter 11*: Symmetry Aspect of ***Ligand Field Theory and Electronic(& Vibronic) Spectroscopy-II***
(Transition Metal Compounds)

Chapter 12*: Symmetry Aspect of ***Chemical Reactions***

Chapter 13*: Non-rigid Symmetry and ***Dynamic Stereochemistry***

Chapter 14*: Special Topics on Symmetry and Group Theory in Chemistry (***solid state, supramolecular, magnetic…***)

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The Main Textbooks and References

The contents will be adopted mainly from but *not* limited to the following textbooks. Materials from other sources and references will also be used wherever in need.

(i) Pre-requisite reading:

- **Chapt. 11, « *Physical Chemistry* » P. W. Atkins & J. de Paula, 10th ed., *Oxford Univ. Press*, 2014.**

or

- **Chapt. 6, « *Inorganic Chemistry* » M. Weller *et al*, 6th ed., *Oxford Univ. Press*, 2014.**

(ii) Most relevant reading*:

- **« *Chemical Applications of Group Theory* » F. A. Cotton, 3rd ed., *Wiley*, 1990.**

(iii) Supplementary reading:

- **« *Symmetry and Spectroscopy* » D. C. Harris and M. D. Bertolucci, *Oxford Univ. Press*, 1978.**
- **For each and every chapter, supplementary readings will be recommended.**

(iv) Useful resource (handbook type):

- **« *Point-Group Theory Tables* » S. L. Altmann and P. Herzig, *Oxford Univ. Press*, 1994.**

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List of Useful References

Altmann, S.L. Herzig, P.	Point-Group Theory Tables	Oxford Sci., 1994
Bonchev, D., Rouvray, D.H.	Chemical Group Theory(Vol. 1 and II)	Gordan&Breach, 1994
Bunker, P.R. Jensen P	Molecular Symmetry and Spectroscopy	Acad. Press, 1979 / 2005/2008
Budden, F.A.	Fascination of Groups	Cambridg U. Press, 1972
Cotton, F. A.	Chemical Applications of Group Theory(3ed Ed)	Wiley, 1990
Donaldson, J.D., Ross, S.D.	Symmetry and Stereochemistry (2nd Ed.)	Wiley, 2006
Ernet, B.	The Magic Mirror of M.C. Escher	Ballantine Books, 1976
Flurry jr., R.L.	Symmetry Groups : Theory and Chemical Appl.	Prentice-Hall, 1980
Halevi,E.A.	Orbital Symmetry and Reaction Mechanisms:	Springer-Verlag,1991
Hall, L.H.	Group Theory and Symmetry in Chemistry	McGraw-Hill, 1969
Hargittai, I., Hargittai, M.	Symmetry through the Eyes of a Chemist	VCH, 1987
Harris,D.C., Bertolucci,M.D.	Symmetry and Spectroscopy : An Introduction to Vibrational and Electronic Spectroscopy	Oxford, 1978 (Dover, 1989)
Douglas,B.E. / Hollingsworth,C.A.	Symmetry in Bonding and Spectra	Acad. Press, 1985
Jacobs P.W.M.	Group Theory with Applications in Chemical Physics	Cambridge U Press 2005
Kettle, S.F.A.	Symmetry and Structure (2nd Ed)	Wiley, 1995
Ladd, M. F. C.	Symmetry and group theory in chemistry	Chichester:Horwood, 1998
Lax, M.	Symmetry Principles in Solid State and Molecular Physics,	Dover, 2001
Mirman, R.	Point Groups, Space Groups, Crystals, Molecules	World Scientific 1999
Pearson, R.	Symmetry Rules for Chemical Reactions	Wiley, 1976
Salthouse, J.A., Ware, M.J.	Point Group Character Tables and Related Data	Cambridge Press, 1972
Shubnikov, A.V., Koptsik, V.A.,	Symmetry in Science and Art,	Plenum, 1974
Tinkham, M.	Group Theory and Quantum Mechanics	McGraw-Hill, 1964
Tsukerblat, B.S.	Group Theory in Chemistry and Spectroscopy	Acad. Press, 1994
Willock, D.J.	Molecular Symmetry	Wiley, 2009
Woodward, R.B.,Hoffmann, R.,	The Conservation of Orbital Symmetry	Verlag Chemmie, 1970

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Intended-Learning-Outcomes (ILOs):

- **Be able to appreciate the *significance* and *limitations* of symmetry principles and group theory in chemistry;**
- **Be able to grasp the *symmetry operations* and their classifications;**
- **Be able to grasp the concepts of *point group theory* and *the structures of point groups*;**
- **Be familiar with the *classification* and *correlation* of molecular structures according to their *chirality* and other symmetry properties;**
- **Be able to correctly *assign a point group* to a molecular structure or a figure according to its symmetry properties, and especially be able to establish the *hierarchical relationships between groups*;**
- **Be familiar with the structures, properties and usage of the *character tables* of point groups;**

- **Be able to apply the methods of point group theory to the analysis of the *ground state properties* of a molecule, such as the electric dipole moment, electric quadrupole moment, and optical activity;**
- **Be able to apply the methods of point group theory to analyzing the *bonding* from Molecular Orbital Theory (MOT) and Valence Bond Theory (VBT);**
- **Be able to apply the methods of point group theory to the analysis of *molecular vibrations* and their activities in Raman and IR spectroscopies;**
- **Be able to apply the methods of point group theory to the analysis of *electronic and vibronic transitions* in UV-Vis and fluorescence spectroscopies;**
- **Be able to apply the methods of symmetry/group theory to the analysis of *chemical reactions*;**
- **Be able to apply the methods of point group theory to the analysis of other *physical and chemical properties* of molecules from their structures and other experimental observables.**

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Requirements, LectureNotes and Office-Hour

Course Requirements:

(i) Lecture attendance.

(ii) Reading assignments + Non-graded questions/problems.

(iii) Mid-Term Exam(50%) + Final Exam(50%).

Lecture-notes/Lecture-PPTs:

(i) All Lecture PPTs will be posted on Canvas.

(ii) Useful tables and references will also be posted on Canvas.

Office Hour and Off-hour Help:

(i) Office Hour: 4:30 – 5:30 pm, Wed, Rm 4516.

(ii) Off-hour Support: Appointment by email to "*chxyli@ust.hk*"

Assessment and Grade

Course Grade: Mid-term Exam + Final Exam

(i) **Close-Book Exam (50%; Chapters 1 ~ 6).**

(ii) **Final Term Paper (50%; Chapters 7 ~ 12).**

Final Exam: Guideline for Written-Report

(i) **For *PG students* and *UG students* taking Capstone Project/Research, it is advised that the topic of your *Written-Report* is related to your research project;**

(ii) **For *UG students* not taking any research courses, the topic of your *Written-Report* can be related to any chem-subject of your interest. However, you have to seek my *prior approval* of your topic before you start writing.**

(iii) **The requirements for *Written-Report* (such as the format and the length *etc*) will be announced on 10th week of the semester.**

Prof. Xiao-Yuan Li, Dept. of Chemistry, HKUST

END

Updated 7 December 2021

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 2150 and CHEM 2250
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

Updated 7 December 2021

CHEM 4689 Capstone Project
Course Outline (Spring 2020-2021)

1. **Course Coordinators:**

Prof. Jason Chan	(kkjchan@ust.hk)	Rm 4543; Tel: 34692098
Prof. Yong Huang	(yonghuang@ust.hk)	Rm 4530; Tel: 34692625
Prof. Emily Tsang	(chetsang@ust.hk)	Rm 4536; Tel: 34692100

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

Prof. Jason Chan	(kkjchan@ust.hk)
Prof. Simon Chan	(chanwan@ust.hk)
Dr. Peter Cheung	(ppcheung@ust.hk)
Prof. Wei Min Dai	(chdai@ust.hk)
Prof. Guochen Jia	(chjiag@ust.hk)
Dr. Ryan Kwok	(chryan@ust.hk)
Prof. Yong Huang	(yonghuang@ust.hk)
Dr. Jacky Lam	(chjacky@ust.hk)
Prof. Haipeng Lu	(haipenglu@ust.hk)
Prof. Stefan Nagl	(chnagl@ust.hk)
Dr. Fu Kit Sheong	(chemfksheong@ust.hk)
Prof. Haibin Su	(haibinsu@ust.hk)
Prof. Jianwei Sun	(sunjw@ust.hk)
Prof. Benzhong Tang	(tangbenz@ust.hk)
Prof. Ian Williams	(chwill@ust.hk)

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

Mr. Jacky Leung, Sci-Tech Librarian	(lbjacky@ust.hk)
Mr. Lewis Li, Sci-Tech Librarian	(lblewis@ust.hk)
Mr. Samson Choi, Sci-Tech Librarian	(lbsamson@ust.hk)

2. **Class Time and Venue:**

Date/Time: Fridays 9:30 – 10:20 (*refer to timetable)
Venue: Zoom Meetings – Refer to meeting links on Canvas (pw: **chem4689**)

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).*

CAPSTONE NINJA: English Lanugage Support App for CHEM capstone projects
Contents are co-developed by Center for Language Education and Department of Chemistry

Capstone Ninja can be downloaded from

For iphone, ipad: (Apple Appstore) https://apps.apple.com/hk/app/capstone-ninja/id1352231678
For Andriod (Google Play Store) https://play.google.com/store/apps/details?id=hk.edu.polyu.edc.capstoneninja&hl=zh_HK

7. Teaching and Learning Activities

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

Consultations: With your supervisor (at least 3 times)
Individual Coaching: With your 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	5 Feb (Fri) 9:30-10:20 *before 18 Feb*	**Course Introduction &** **Introduction to 'Capstone Ninja'** [† ***meet your supervisor for topic assignment***] [† ***upload topic to Canvas after assignment***]	**Zoom Meeting** Profs. Chan/Huang/Tsang
2	12 Feb (Fri)	Public Holiday (Lunar New Year's Day)	
3	19 Feb (Fri) 9:30-10:20	**Literature Search Training**	**Zoom Meeting** Mr J. Leung/Mr S. Choi
4	26 Feb (Fri) 9:30-10:20 ***between 22 Feb – 5 Mar***	**SciFinder Workshop** **Literature Search Individual Coaching Session** [***Compulsory***] (with your Referencing Advisor during Weeks 4-5)	**Zoom Meeting** SciFinder vendor (by appointment with your referencing advisor)
5	5 Mar (Fri) 9:30-10:20 ***between 22 Feb – 5 Mar*** ***before 5 Mar***	**Chemical Structure Drawing Training** **Literature Search Individual Coaching Session** [***Compulsory***] (with your Referencing Advisor during Weeks 4-5) [† ***submit Weekly Timetable to Canvas for scheduling Oral Presentation Time***]	**Zoom Meeting** Profs. Huang/Tsang (by appointment with your referencing advisor)
6	During this week ***before 14 Mar***	**Consultation with supervisor #1** [† ***submit Research Plan***]	(by appointment with your supervisor)
7	19 Mar (Fri) 9:30-10:20	**Referencing Training**	**Zoom Meeting** Mr L. Li/ Mr S. Choi
8	26 Mar (Fri) 9:30-10:20 During this week	**Poster Design Workshop** **Consultation with supervisor #2**	**Zoom Meeting** Prof. Chan (by appointment with your supervisor)
9	2 Apr (Fri) 9 Apr (Fri)	*Mid-term break* *Work on your project*	
10	16 Apr (Fri)	*Work on your project*	
11	During this week	**Consultation with supervisor #3**	(by appointment with your supervisor)
12	30 Apr (Fri) ***before 2 May***	*Work on your project* [† ***submit Poster file to Canvas***]	
13	7 May (Fri)	**Oral Presentations**	TBA
Study break	10 May (Mon) 14:00-17:00	**Poster Mini-Conference**	Library LG4 Conference Room
	16 May (Sun)	† ***Deadline for Literature Research Report***	

- Week 4 – 5: Library - Individual Literature Search Coaching Session [***Compulsory***]
- Week 8 – 11: Library - Individual Referencing Coaching Session [*Optional*]

Updated 7 December 2021

CHEM 4691 Capstone Research I

Course Outline (Spring 2020/21)

1. Course Description

Pre-requisite: CHEM 3550 and CHEM 3555

Exclusion: CHEM 4689

Instructor(s): Research Faculties of Chemistry Department

Reference Librarians:

Mr. CHOI, Samson (lbsamson@ust.hk) (Tel: 2358 6763)

Mr. LI, Lewis (lblewis@ust.hk) (Tel: 2358-6769)

Mr. LEUNG Jacky (lbjacky@ust.hk) (Tel: 2358-6767)

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 sessions are ***mandatory***. Attendances will be taken and counted towards your course participation scores.

Date	Activity	Venue
Feb 19 (Fri, 9:30 – 10:20)	**Literature Search Training**	Zoom Meeting (Mr. J. Leung/Mr. S. Choi)
Feb 26 (Fri, 9:30 – 10:20)	**SciFinder Workshop**	Zoom Meeting (SciFinder vendor)
Mar 05 (Fri, 9:30 – 10:20)	**Chemical Structure Drawing Training**	Zoom Meeting (Profs. Y. Huang/E. Tsang)
Mar 19 (Fri, 9:30 – 10:20)	**Referencing Training**	Zoom Meeting (Mr. L. Li/Mr. S. Choi)

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