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, $p\pi$-$p\pi$ and $d\pi$-$p\pi$ interactions
- Inorganic rings and cages: allotropes of carbons, borazine, polysiloxanes, polyphoshazenes
- Borane clusters, Wades rules

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)

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

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.