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%

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,

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CHEM 4130 Medicinal Chemistry

Spring semester, 2021

Instructor: Dr. Zhihong Guo
Rm. 4519; Tel: 2358 7352
Email: chguo@ust.hk

Dr. Yong Huang
Rm. 4530;Tel: 3469 2625
Email: yonghuang@ust.hk

Teaching assistant: Miss XING, Yajie
Email: yxingah@connect.ust.hk

Course Description:
This course will introduce the chemistry principles underlying the drug-target interaction and the development of drugs. One of its major topics is the molecular basis of the interaction of medicinal compounds with various biomolecules and the effect of their structure on their therapeutic activities. In addition, this course will discuss the pharmacokinetics and pharmacodynamics properties of therapeutic agents and how these properties are related to their chemical structure. Moreover, another focus of this course is the chemical strategies to discover and optimize lead compounds that can eventually developed into agents of therapeutic values. *Prerequisite*: CHEM3120, Organic Chemistry II.

Lecture Time: Wednesday and Friday, 4:30—5:50pm

Venue: LSK1027

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

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

1. Graham L. Patrick, An introduction to medicinal chemistry, 5th edition ; ISBN: 0199697396, Oxford University Press, 2013; 6th edition, ISBN: 9780198749691, Oxford University Press, 2017.
2. Graham L. Patrick, An introduction to medicinal chemistry / Graham L. Patrick ; with a chapter on combinatorial and parallel synthesis, 4th edition ; co-authored by John Spence, ISBN 9780199234479, Oxford University Press, 2009
3. Richard B. Silverman, The organic chemistry of enzyme-catalyzed reactions, San Diego, California; London: Academic Press, 2000.
4. William O. Foye (Editor), Principles of Medicinal Chemistry, 3rd Edition, Lea & Febiger, London, 1989.Alex Gringauz, Introduction to Medicinal Chemistry, ISBN 0-471-18545-0, 1997, Wiley-VCH, Inc.
6. Alan Fersht, Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, 1999, W. H. Freeman and Company, New York.
7. Benjamin Lewin, Genes- 5th, 6th, 7th and 8th editions, ISBN 0131238264 (8th Ed. International ed.), Oxford University Press.

8. Lubert Stryer, Biochemistry-5th, 6th, and 7th editions, W. H. Freeman and Company, New York.
9. Review and primary research articles of various sources.

Exams and Grading Scheme:

1. Mid-term exam: 50%.
2. Final examination: 50%

COURSE OBJECTIVES AND INTENDED LEARNING OUTCOMES:

This course focuses on interaction of small organic therapeutics with human or other hosts and the development of therapeutics from ordinary organic compounds of various sources. It is designed to better prepare chemistry majors and other students for careers in medicine-related industries, government agencies, or academic institutions. At the end of the course, students should be able to:

1 To understand and recognize the fundamental chemical principles underlying the interaction of small molecule therapeutic agents with human and other hosts.

2 To explain the essential facts, principles, and theories of the therapeutic agents in disease processes.

3 To understand the favourable and unfavourable interactions of living organisms with the small molecule therapeutic agents to better appreciate the significance of regulation of drug safety and prevention of drug abuse.

4 To formulate chemical strategies to discover hit and lead compounds in search of therapeutic agents against a disease target.

5 To formulate synthetic strategy for optimization of the lead compounds in order to develop them into agents of therapeutic values.

Syllabus

	Dates	Subjects
Week 1	Feb. 3	Introduction to Medicinal Chemistry and drug targets
	Feb. 5	Nucleic acids: Structure and function
Week 2	Feb. 10	Nucleic acids as targets: interference at the DNA and RNA levels (I)
	Feb. 12	***No Class, Spring Festival***
Week 3	Feb. 17	Nucleic acids as targets: interference at the DNA and RNA levels (II)
	Feb. 19	Protein targets: Protein structure and enzyme catalysis, kinetics, and catalytic mechanism
Week 4	Feb. 24	Protein targets: Enzyme inhibition and inactivation
	Feb. 26	Protein targets: Receptors and signal transduction (I)
Week 5	Mar. 3	Protein targets: Receptors and signal transduction (II)
	Mar. 5	Protein targets: Receptors and signal transduction (III)
Week 6	Mar. 10	Protein targets: Agonists and Antagonists of receptors
	Mar. 12	Other targets: Transport and structural proteins and non-protein targets
Week 7	Mar. 17	Other targets: protein-protein interaction
	Mar. 19	**Mid-term Exam**, in-class
Week 8	Mar. 24	Pharmacokinetics: absorption, distribution, metabolism and excretion
	Mar. 26	Pharmacokinetics: absorption, distribution, metabolism and excretion
Week 9	Mar. 31	***No class, Spring Break***
	Apr. 1	***No class, Spring Break***
Week 10	Apr. 7	Finding a lead from natural world
	Apr. 9	Finding a lead from synthetic chemistry and *de novo* design
Week 11	Apr. 14	Pharmacophore and structure-activity relationships
	Apr. 16	Pharmacophore and structure-activity relationships
Week 12	Apr. 21	Optimization of target binding interaction
	Apr. 23	Optimization of target binding interaction (contd.)
Week 13	Apr. 28	Optimization of target binding interaction (contd.)
	Apr. 30	Optimization of pharmacokinetic properties
Week 14	May 5	Optimization of pharmacokinetic properties (Prodrug)
	May 7	Case study: Antiviral drugs
Week 15	May 10-14	Study Break
Final weeks	May 15-28	**Final Exam, to be announced.**

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CHEM 4150

Biomolecular Synthesis Laboratory

2021 Spring semester

Course Outline

1. Instructor

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

2. Technician/ Instructional Assistant/ Teaching Assistant:

Technicians:
Name: TSE, Wai Pui Veronica (chvaipui@ust.hk)
WONG, Ka Man Joanne (joannewong@ust.hk)
Contact: Laboratory CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details will be provided in a separate file.]

3. Meeting Time and Venue:

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

4. Course Description

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

5. Intended Learning Outcomes

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

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

6. Assessment Scheme

Grading type: letter grade.

Assessment Criteria	ILOs
10% Attendance and risk assessment♣	3
20% Lab Quiz†	1, 2
25% Performance in laboratory	4, 5, 6
10% Product	4
35% Reports	1, 2

♣ *5% - punctuality, 5% - safety sheet*

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

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments 3rd edition,*" Kenneth L. Williamson, Boston: Houghton Mifflin ©1999.

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

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

8. Teaching and Learning Activities

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

9. Keyword Syllabus

- Chemistry of Platelet Aggregation Inhibitor
- Acylation reactions and Chemoselectivity
- Preparation of Poly-Arcylamide Gel
- Radical Chain-Growth Polymerization
- Extraction of Nucleic Acid from Plant Material
- Extraction of Nucleic Acid from Bacteria Sample
- Protecting Groups for Carbohydrate
- Regioselective Substitution Reaction
- Diastereoselectivity Control in Substitution
- Glycosylation Reaction

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CHEM 4155

Biomolecular Characterization Laboratory

2021 Spring semester

Course Outline

1. Instructor

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

2. Technical support / Teaching Assistant:

Name: TSE, Wai Pui Veronica (chvaipui@ust.hk)
WONG, Ka Man Joanne (jaonnewong@ust.hk
Contact: Laboratory CYT-1003; Tel: 3469-2611
Teaching Assistants: [names & contact details will be provided in a separate file.]

3. Meeting Time and Venue:

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

4. Course Description

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

5. Intended Learning Outcomes

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

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

6. Assessment Scheme

Grading type: letter grades.

Assessment Criteria	ILOs
10% Attendance and risk assessment♣	3
20% Lab Quiz†	1, 2
25% Performance in laboratory	4, 5, 6
10% Product	4
35% Reports	1, 2

♣ 5% - punctuality, 5% - safety sheet

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

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments*" *3rd edition*, by Kenneth L. Williamson, Boston: Houghton Mifflin ©1999.

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

(c) "*Quantitative chemical analysis*" by Daniel C. Harris, New York : W. H. Freeman and Co., ©2007.

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

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

8. Teaching and Learning Activities

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

9. Keyword Syllabus

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

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CHEM 4210
Solid State Chemistry
Spring 2021

Instructors:
Dr. Haibin Su (Associate Professor)
Room: 4521, Lift 25/26
Tel: 2358-7388
E-mail: haibinsu@ust.hk

Teaching Assistants:
Hang LYU (hlyuai@connect.ust.hk) Rm 4207

Lectures:

Tuesday	16:30 - 17:50	Meeting ID: 915 4940 3424 Passcode: 067639
Thursday	16:30 - 17:50	Meeting ID: 915 4940 3424 Passcode: 067639

Chem4210 forum:
tWiki (the URL will be announced)

Course Website:
Canvas: https://canvas.ust.hk/courses/36022

COURSE DESCRIPTION

Basic crystallography;
Structures of solid state materials;
Pauling rules;
Chemical bonding in solid state materials;
Electronic structure in solid state materials;
Defects in solid state materials;
Surface / grain boundary / interface in solid state materials
Phase diagram of solid state materials
Growth of solid state materials.

Objectives:

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

No.	Objectives
1	Obtain key fundamental knowledge about what parameters determine the properties of solids.
2	Able to apply fundamental chemistry principles (periodic table, electronegativity, etc) to understand the structural-property relationship of solids.
3	Able to understand important applications of solid-state materials and relate the applications with the main principles of solid-state chemistry.
4	Able to present the most important knowledge and principles learned in this course in a clear and simple presentation.

Intended LEARNING OUTCOMES

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

1) Using bonding theory, Pauling rules and the geometric information to analyze the local bonding in a solid structure;
2) Assessing surfaces and interfaces with chemical bonding knowledge;
3) Able to apply fundamental chemistry principles (periodic table, electronegativity, etc) to understand the structural-property relationship of solids;
4) Use basic crystallography to analyze the crystal unit cell of a solid state compound (e.g. the close packing pattern, the hole occupancy situation, etc);
5) Able to present the most important knowledge and principles learned in this course in a clear and simple presentation.
6) Able to understand important applications of solid-state materials and relate the applications with the main principles of solid-state chemistry.

TEXTBOOK

Solid State Chemistry and its Applications, 2nd Edition, Student Edition
Anthony R. West
ISBN: 978-1-119-94294-8 January 2014

BOOK
Solid state chemistry and its applications
Anthony R. West.
Chichester, West Sussex : Wiley, 2014
Online access

The instructor will also provide additional notes.

REQUIREMENTS

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

GRADING

Assessment
30% by assignments
30% quiz
40% report & presentation

Notes:

Number of assignments: 2
Quiz: Week 24
Final Presentation: topics will be provided

COURSE SCHEDULE

Week 1	Lecture 1	Introduction & Basic Crystallography: Basic Concept of Crystal; Lattice and Unit Cell; Symmetry in Crystal.
	Lecture 2	Basic Crystallography: Close Packing Pattern and Hole Occupancy in Crystal
Week 2	Lecture 3	Basic Crystallography: Some Important Crystal Structures & 2D Phosphorus allotropes
	Lecture 4	Basic Crystallography: Silicate
Week 3	Lecture 5	Pauling rules
	Lecture 6	Pauling rules analysis on common crystal structures
Week 4	Lecture 7	Basic X-ray crystallography

	Lecture 8	Basic X-ray crystallography (continued)
Week 5	Lecture 9	Chemical bonding and electronic structure in solid
	Lecture 10	Chemical bonding and electronic structure in solid (continued)
Week 6	Lecture 11	Defects in solids
	Lecture 12	Defects in solids (continued)
Week 7	Lecture 13	Surface of solid state
	Lecture 14	Surface of solid state (continued)
Week 8	Lecture 15	Grain boundaries / interfaces of solid state
	Lecture 16	Grain boundaries / interfaces of solid state (continued)
Week 9		Midterm break
Week 10	Lecture 17	Grain boundaries / interfaces of solid state (continued)
	Lecture 18	Phase diagram
Week 11	Lecture 19	Phase diagram (continued)
	Lecture 20	Phase diagram (continued)
Week 12	Lecture 21	Growth of solid state materials
	Lecture 22	Growth of solid state materials (continued)
Week 13	Lecture 23	Growth of solid state materials (continued)
	Lecture 24	Quiz
Week 14		Presentation

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CHEM 4250 Material Preparation Laboratory
2021 Spring semester
Course Outline

1. Instructor

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

2. Technician/ Instructional Assistant/ Teaching Assistant:

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

3. Meeting Time and Venue:

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

4. Course Description

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

5. Intended Learning Outcomes

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

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

6. Assessment Scheme

Grading tyep: letter grade.

Assessment Criteria	ILOs
10% Attendance and risk assessment♣	3
20% Lab Quiz†	1, 2
25% Performance in laboratory	4, 5, 6
10% Product	4
35% Reports	1, 2

♣ *5% - punctuality, 5% - safety sheet*

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

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments 3rd edition*," Kenneth L. Williamson, Boston: Houghton Mifflin ©1999.

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

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

8. Teaching and Learning Activities

Laboratory work related to preparative chemistry related to material chemistry.

9. Keyword Syllabus

- Preparation of Nano Particle Suspensions
- Size Control of Nano Particles in a Bottom-up Synthesis
- Synthesis of Light Emitting Metal Complex with Bidentate Ligands
- Constructing Organic Light-Emitting Device from Metal Organic Complex
- Synthesis by Suzuki cross coupling
- Organic Synthesis by Transition Metal Catalysis
- Synthesis of Solid-State Material by Partial Oxdiation of Metal Oxides
- Synthesis of Mixed-Valence Metal Oxides by Precipitation

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CHEM 4255 Material Characterization Laboratory

2021 Spring semester

Course Outline

1. Instructor

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

2. Technician/ Instructional Assistant/ Teaching Assistant:

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

3. Meeting Time and Venue:

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

4. Course Description

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

5. Intended Learning Outcomes

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

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

6. Assessment Scheme

Grading type: letter grades.

Assessment Criteria	ILOs
10% Attendance and risk assessment♣	3
20% Lab Quiz†	1, 2
25% Performance in laboratory	4, 5, 6
10% Product	4
35% Reports	1, 2

♣ *5% - punctuality, 5% - safety sheet*

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

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments 3rd edition*," Kenneth L. Williamson, Boston: Houghton Mifflin ©1999.

(b) "*Quantitative chemical analysis*" by Daniel C. Harris, New York: W. H. Freeman and Co., ©2007.

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

8. Teaching and Learning Activities

Tutorial + Laboratory work related to chemical analysis related to material chemistry.

9. Keyword Syllabus

- Materials Characterization by Thermal Analytical Method(s) – DSC
- Materials Characterization by Thermal Analytical Method(s) – TGA
- Materials Characterization by Transmission FT-IR, ATR FT-IR
- Characterization of molecular Materials by Fluorescence Spectrocopy
- Characterization of molecular materials by UV-vis Spectrocopy
- Characterization of solid state materials by Powder X-ray Diffraction (pXRD)
- Characterization of solid state materials by Scanning Electron Microscope (SEM)
- Characterization of molecular materials by High-Resolution ^{1}H-NMR spectrocopy
- Characterization of molecular materials by 2-dimensional NMR COSY

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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.

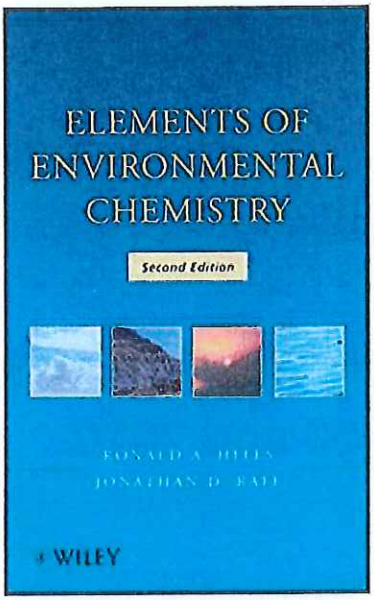
(3) Analyze and interpret experimental data, critically assess data from literature sources and extract and apply useful data from those sources.

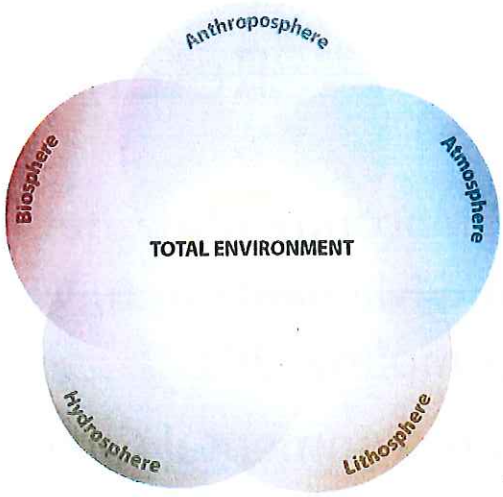
(4) Demonstrate self-awareness and the ability to work independently and collaborate effectively with other people in a team.

Grade Assessment

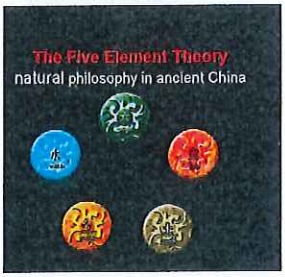
- Group homework assignments (22%)
  - 4 assignments [2-3 students per group, formed on a voluntary basis]
  - Group effort; one submission from each group
- Quizzes (78%)
  - 7 Quizzes
  - 6 best quiz scores will be used for grade assessment
- No final exam

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

8

Updated 7 December 2021

CHEM4350 Environmental 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)
XUE, Mingyi	mxueab
YUAN, Congmin	cyuanac
CHENG, Yuhuang	ychengbn
DUFFIELD, Mark Brian	mbduffield
CHOY, Ka Hei	khchoyab
CHEUNG, Man Hong Andy	acheungab
CHOW, Ting Fung	tfchowaa
XUE, Yilei	yxuean

3. Meeting Time and Venue

Venue: Room 6122 (MC Lab), 7122 and 7122A

Time of Laboratory:
CHEM4350: 10.30 - 13.20 (Thursdays)

4. Course Description
Credit Points: 1

Pre-requisite: CHEM2310 Fundamentals of Analytical Chemistry or
CHEM2311 Analytical Chemistry

Co-requisite: CHEM4355 Instrumental Analytical Chemistry Laboratory

Course Description:
CHEM4350: This is a laboratory course for students to gain hands-on experience in collection and handling environmental samples. Analyses particularly for determining analytes in environmental samples using specific instruments and methods will be covered, such as TOC analyser, air collection using DNPH-sorbent cartridge, etc. Experiments covered in this course will be closely connected with the topics covered in the lecture courses of CHEM4310 and CHEM4320, including preparation of environmental samples for analytical analysis.

(Please turn over)

Design of the Laboratory Course:

Arrangement of the course

The format of the laboratory course is operated in mass, suggesting that all students are doing the same experiment in the same lab session. Some experiments are in two-session, some are one-session.

Student Grouping

Students are separated into groups in each session, in which two students in a group.

5. Intended Learning Outcomes (ILOs)

On completion, students should be able to:

1. Analyze and interpret experimental data.
2. Conduct standard laboratory procedures involved in instrumental and laboratory works.
3. Understand some chemical instruments with adequate hands-on experiences.

6. ILOs Assessments

The ILO points 1 to 3 are assessed by reports, lab performance and lab quizzes.

Expt No	Title of Experiment	ILOs
E1	Degradation of a Dye in Industrial Wastewater Sample by Household Bleach	1-3
E2	Volatile Organic Compounds (VOCs) Collected by a Passive Sampler and Analysed by Gas Chromatography - Flame Ionisation Detector (GC-FID)	1-3
E3	Sampling of Gaseous Carbonyl Compounds Collected by an Active Sampler using On-Sorbent 2,4-Dinitrophenylhydrazine (DNPH) Reaction and Detected by High Performance Liquid Chromatography – Ultraviolet-Visible Detector	1-3
E4	Removal of Organic Matter in Pond Water Sample Using Powdered Activated Carbon Assessed By Total Organic Carbon (TOC) Analyser	1-3

(Please turn over)

7. Student Learning Resources

- Harris D. C., *Quantitative Chemical Analysis*, 8th Ed., W. H. Freeman and Company, New York, 2010.
- Skoog D. A., Holler F. J. and Crouch S. R., *Principles of Instrumental Analysis*, 6th Ed., Chapter 27, Thomson Brooks/Cole, Thomson Corporation, 2007.

8. Teaching and Learning Activities

Prelab Reading

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

Lab Briefing

There will be tutorials for the experiments which are held by the Instructor during the lab session.

Report and Data Handling

Students are required to do report and treat their experimental data.

Conduct Experiments

Students can gain some hands-on experience in bench-top work and operation of instrument in the practicals.

9. Course Grading

60% Lab reports
20% Lab Quizzes
20% Lab Performance

(End)

CHEM4355 Instrumental 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)
CHOY, Ka Hei	khchoyab
CHEUNG, Man Hong Andy	acheungab
CHOW, Ting Fung	tfchowaa
XUE, Yilei	yxuean
XUE, Mingyi	mxueab
YUAN, Congmin	cyuanac
CHENG, Yuhuang	ychengbn
DUFFIELD, Mark Brian	mbduffield

3. Meeting Time and Venue

Venue: Room 6122 (MC Lab), 7122 and 7122A

Time of Laboratory:
CHEM4355: 13.30 - 16.20 (Thursdays)

4. Course Description

Credit Points: 1

Pre-requisite: CHEM2310 Fundamentals of Analytical Chemistry or CHEM2311 Analytical Chemistry; and
CHEM2350 Analytical Chemistry Laboratory or CHEM2355 Fundamentals Analytical Chemistry Laboratory

Co-requisite: CHEM4350 Environmental Chemistry Laboratory

Course Description:

CHEM4355: This is a laboratory course for students to gain hands-on experiences in operation of the modern instruments. The instruments include liquid chromatography, gas chromatography, LC-MS/MS, ICP-OES, etc. The experiments covered in this course will be closely connected with the topics covered in CHEM4320 and CHEM4330.

(Please turn over)

Design of the Laboratory Course:

Arrangement of the course

The format of the laboratory course is operated in mass, suggesting that all students are doing the same experiment in the same lab session. Some experiments are in two-session, some are one-session.

Student Grouping

Students are separated into groups in each session, in which two students in a group.

5. Intended Learning Outcomes (ILOs)

On completion, students should be able to:

1. Analyze and interpret experimental data.
2. Conduct standard laboratory procedures involved in instrumental and laboratory works.
3. Understand some chemical instruments with adequate hands-on experiences.

6. ILOs Assessments

The ILO points 1 to 3 are assessed by reports, lab performance and lab quizzes

Expt No	Title of Experiment	ILOs
A1	Analysis of Metals Contents in Pre-packaged Dried Food Products using Inductively Coupled Plasma – Optical Emission Spectrometer (ICP-OES)	1-3
A2	Application of Ion Chromatography (IC) to Determination of Water Soluble Anions on $PM_{2.5}$ Air Filters	1-3
A3	Determination of Sugars Content in Food Products by High Performance Liquid Chromatography - Evaporative Light Scattering Detector (HPLC-ELSD)	1-3
A4	Identification and Quantification of Pesticides in an Unknown Sample using Liquid Chromatography – Tandem Mass Spectrometers (LC-MS/MS)	1-3

(Please turn over)

7. Student Learning Resources

- Harris D. C., *Quantitative Chemical Analysis*, 8th Ed., W. H. Freeman and Company, New York, 2010.
- Skoog D. A., Holler F. J. and Crouch S. R., *Principles of Instrumental Analysis*, 6th Ed., Chapter 27, Thomson Brooks/Cole, Thomson Corporation, 2007.

8. Teaching and Learning Activities

Prelab Reading

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

Lab Briefing

There will be tutorials for the experiments which are held by the Instructor during the lab session.

Report and Data Handling

Students are required to do report and treat their experimental data.

Conduct Experiments

Students can gain the hands-on experience in bench-top work and operation of instrument in the practicals.

9. Course Grading

60% Lab report
20% Lab Quiz
20% Lab Performance

(End)

Updated 7 December 2021

CHEM 4550 Advanced Synthetic Laboratory

2021 Spring semester

Course Outline

1. Instructor

Name: Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099
Name: Dr. CHEUNG, Man Sing (sing@ust.hk)
Contact: Office Room 4535; Tel: 2358-7401

2. Technical support / Teaching Assistant:

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

3. Meeting Time and Venue:

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

4. Course Description

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

5. Intended Learning Outcomes

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

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

6. Assessment Scheme

Grading type: letter grades.

Assessment Criteria	ILOs
10% Attendance and risk assessment*	3
20% Lab Quiz†	1, 2
25% Performance in laboratory	4, 5, 6
10% Product	4
35% Reports	1, 2

** 5% - punctuality, 5% - safety sheet*

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

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments 6th edition*," by Kenneth L. Williamson and Katherine M. Masters, Australia: Brooks/Cole ©2011.

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

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

8. Teaching and Learning Activities

Tutorial + Laboratory work related to preparative chemistry.

9. Key word Syllabus

- Synthesis of Organometallic Compounds and its Light-senstive Derivatives
- Synthesis of Tranistion Metal Chelate Complex
- Wittig-Horner Synthesis
- Use of Organophosphorus Reagent
- Suzuki Cross Coupling
- Transition Metal Catalyzed Organic Synthesis
- Protecting Groups for Carbohydrate
- Regioselective Substitution Reaction
- Control of Distereoseletivity in Substitution Reactions
- Glycosylation Reaction

Updated 7 December 2021

CHEM 4555 Advanced Molecular Characterization Lab

2021 Spring semester

Course Outline

1. Instructor

Name: Dr. CHAN, Ho-Wai Dennis (chanhw@ust.hk)
Contact: Office Room 4528; Tel: 3469-2099
Name: Dr. CHUENG, Man Sing (sing@ust.hk)
Contact: Office Room 4535; Tel: 2358-7401

2. Technical support / Teaching Assistant:

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

3. Meeting Time and Venue:

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

4. Course Description

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

5. Intended Learning Outcomes

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

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

6. Assessment Scheme

Grading type: letter grades.

Assessment Criteria	ILOs
10% Attendance and risk assessment♣	3
20% Lab Quiz†	1, 2
25% Performance in laboratory	4, 5, 6
10% Product	4
35% Reports	1, 2

♣ *5% - punctuality, 5% - safety sheet*

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

7. Student Learning Resources

Reference books:

(a) "*Macroscale and Microscale Organic Experiments 6th edition*," by Kenneth L. Williamson and Katherine M. Masters, Australia: Brooks/Cole ©2011.

(b) "*Quantitative chemical analysis*" by Daniel C. Harris, New York : W. H. Freeman and Co., ©2007.

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

8. Teaching and Learning Activities

Tutorial + Laboratory work related to chemical analysis.

9. Key word Syllabus

- Characterization by 1D NMR spectroscopies: ^{1}H-NMR, ^{13}C-NMR, DEPT135
- Characterization by 2D NMR correlation spectroscopy - COSY
- Characterization by 2D NMR multiple bond coherence spectroscopy - HMBC
- Chemical Kinetics Study: Rate Constant and Activation Energy
- Computational Study using MMFF and td-DFT
- Simulation of Electronic Absorption Spectra
- Characterization Analysis by MALDI-Tof Mass Spectroscopy
- Optical Characterization by UV-vis Spectroscopy
- Optical Characterization by FT-IR Spectroscopy
- Chromatographic Analysis by GC-FID
- Chromatographic Analysis by HPLC-PDA
- Determination of Diastereoselectivity by High Resolution ^{1}H-NMR

Updated 7 December 2021

Organometallic Chemistry
CHEM4620, Spring 2021

Course Vector: [3-0-0:3]

Lectures: Monday, 15:00-14:20
Friday, 10:30-11:50

Course Instructor: **Name:** **Guochen JIA**

Office: **CYT6009**

Email: **chjiag@ust.hk**

Extension: 7361

Office hour: Monday, 4:30 pm - 5:30 pm

Course objectives

- To describe the synthesis and general properties of organometallic compounds.
- To describe fundamental organometallic reactions.
-
- To describe catalytic reactions involving organometallic compounds with an emphasis on mechanistic understanding.

Learning outcomes

On completion of this course, you are expected to be able to

- Recognize organometallic ligands and compounds.
- Devise synthetic route to common organometallic compounds.
- Describe fundamental organometallic reactions.
- Select catalysts common organometallic based catalytic reactions
- Describe mechanisms of common organometallic based catalytic reactions; and propose catalytic cycles for metal-catalyzed catalytic reactions.

Course Outline

1. General properties of organometallic complexes
2. Complexes with metal-carbon σ bond:

   Metal alkyls, aryl, hydride and related σ-bonded ligands
3. Carbonyls, phosphine complexes
4. Complexes of π-ligands
5. Substitution reactions
6. Oxidative addition and reductive elimination
7. Insertion and elimination
8. Nucleophilic and electrophilic addition and abstraction
9. Carbene and carbyne complexes
10. Homogeneous catalysis
11. Presentations

Course Evaluation

Midterm Exam	40%
Final Exam	40%
Presentation	20%

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