MPhil-PhD in Chemistry Program

Lecture Courses

- All students are required to complete at least 6 units of required courses and 6 units of elective courses during the pre-candidacy stage, subject to the approval of the supervisor and Division Head.

- All students must take one 2-units or 3-units course coded 2000-level or above from other programs related to their research as recommended by the thesis supervisor. If course taken is coded 5000-level or above, it could be used to fulfil the requirement for elective courses.

Thesis Research Courses

All students must register for the relevant Thesis Research Courses in every term throughout their study period.

Seminar Courses

All students must register for the relevant Seminar Courses in every term throughout their study period.

PhD Candidacy Examination

Ph.D. students are required to pass the candidacy examination within the maximum period of their pre-candidacy stage for the advancement to their post-candidacy stage.

Other Courses

All students should pass the required safety courses examination and complete the test required by our Graduate School.

The following elective lecture courses are offered on selective basis each year.

Course Description

CHEM5080 Introduction to Macromolecules

Introduction of basic concepts, synthesis and special solution and bulk properties of macromolecules, particularly the emphasis of various differences between small and macro-molecules.

CHEM5301 Colloids and Surface Chemistry

Colloids are of increasing importance in both industry and academics. Not only do many commercial products involve colloids, but research in modern chemistry, biology, material science, and physics often require knowledge of the colloidal domain. This course will give the student an introduction to the physico-chemical principles governing surface phenomena and the properties of colloidal materials. We will explore the interactions and self-organization on the nanometer and micron scale with great relevance for material engineering as well as biological processes.

CHEM5302 Statistical Mechanics

In this advanced statistical mechanics class, the following topics will be discussed:
(1) A brief review of the fundamental knowledge on statistical mechanics;
(2) Statistical mechanics of classical particles;
(3) Statistical mechanics of particles exhibiting quantum phenomena;
(4) Diffusion models; and
(5) Mean-field theory.

CHEM5530 Advanced Organometallic Chemistry

To understand, appreciate and utilize the basic organometallic reaction steps in chemical reactions and catalysis.

CHEM5540 Advanced Bioinorganic Chemistry

An overview of bioinorganic chemistry. Principles of coordination chemistry related to bioinorganic research. Biomolecules: proteins, nucleic acids and other metal-binding biomolecules. Transition-metal storage and transport. Metalloproteins. Electron-transfer proteins. Dioxygen transport and oxygen-atom-transfer reactions. The bioinorganic chemistry of Photosynthesis and Respiration. Hydrolytic reactions by metalloenzymes.

CHEM5550 Organolanthanide Chemistry

This course consists of introduction, metallocene and non-metallocene complexes of lanthanides and their applications in homogeneous catalysis. It will focus on the synthesis, structure, and reactivity of organolanthanide compounds. Similarities and differences between d- and f-block organometallic chemistry will be discussed.

CHEM5560 Organometallic Chemistry & Catalysis

Catalysis is a cutting-edge science and plays a central role in modern organic synthesis. Enjoying the modification of the ligand, the activity of the transition metal complex can be manipulated to fit specific catalysis. This course will give students an in-depth understanding of catalyst structures via organometallic and organic chemistry approaches, and how those catalyst (transition metal complex) can be applied in sustainable and complex chemical synthesis. The industrial applications of some tailor-made catalysts will also be discussed. In this course, student presentation of current frontier catalysis is required.

The following elective lecture courses are offered on selective basis each year.

Course Description

CHEM5620 Synthetic Methods in Organic Chemistry

The aim of this course is to provide students with comprehensive knowledge of synthetic methods in organic chemistry and deeper understanding of factors that control reactions and product formations. Details in retrosynthetic analysis, modern synthetic tools, named organic reactions and natural product synthesis will be discussed. Specific topics including oxidation, reduction, olefination, protecting groups, functional groups interconversion, carbonyl chemistry, cycloaddition, rearrangement and organometallic reagents will be covered.

CHEM5630 Synthesis of Natural Products

The basic knowledge of Organic Chemistry I-IV is required. Fundamentals of modern synthetic organic chemistry will be developed. The contents of the lectures cover stereoselective chemical syntheses of a wide range of natural products with emphasis on strategy and methodology. The idea of retrosynthetic (antithetic) analysis is used to show how the research chemist evolves sequences of stereocontrolled reactions which allow the construction of complex molecules. The syntheses of natural products are chosen to demonstrate as wide a range of strategy and methodology as possible. Topics include (stereochemical control and stereoelectronics in cyclic and acyclic systems), (enantioselective and diastereoselective carbon-carbon and carbon-heteroatom bond formation), and (the chiron approach to enantiomerically pure target molecules).

CHEM5642 Supramolecular Chemistry

This course provides an overview of fundamental concepts and essential applications of supramolecular chemistry. This course covers two parts. The first part focuses on the fundamental concepts, including a brief history of supramolecular chemistry, characterization of supramolecular systems, noncovalent interactions and ion binding, templated synthesis and self-assembly as well as inclusion complexes. The second part focuses on the application of supramolecular chemistry, discussing selected supramolecular systems and introducing important examples of applying supramolecular chemistry in materials sciences and biology.

CHEM5660 Selected Topics in Physical Organic Chemistry

This course is designed for students with fundamental knowledge of organic chemistry, and aimed to provide the students a deep understanding on structure, reactivity and non-covalent interactions of organic molecules and the relationships between them. This course covers three parts. The first part focuses on structures and stability, including conformational analysis and strains, reactive intermediates, delocalized electrons and aromaticity. The second part focuses on reactivity and reaction mechanisms, including kinetic analysis and reaction selectivity, conformational and stereoelectronic effects, neighboring group participation, rearrangements. The third part focuses on non-covalent interactions and molecular recognition.

CHEM5680 Introduction to Chemical Biology

This course will cover basic knowledge of biochemistry and bioorganic synthesis and selected topics in modern chemical biology. Part I: the first 7 weeks will be knowledge-based, lecture type classes introducing the basic knowledge of biochemistry and bioorganic chemistry of peptides (and proteins), enzymes, and other biomolecules such as carbohydrates and lipids. A Problem Set and a midterm will be used to evaluate students' learning performance. Part II: the next 6 weeks will be a training-based, literature intensive course composed of a variety of learning methods including lectures, seminar and group discussion sections. Students will be evaluated based on (1) literature reading, (2) presentations, (3) classroom performance and (4) research summary. Two of the four major biomacromolecules, peptides (and proteins) and carbohydrates will be introduced to the students through lectures. Enzymes and chemical genetics will also be introduced. Students will learn how to view protein structure through a tutorial class. The teacher expects the students to learn basic knowledge of bioorganic chemistry and biochemistry, and also grasp the recent progress in chemical biology.

The following elective lecture courses are offered on selective basis each year.

Course Description

CHEM5780 Mass Spectrometry for Biomolecules

Being one of the indispensable analytical methods in analytical, clinical and biomedical research laboratories, mass spectrometry has becoming an important analytical tool for the analysis of biomolecules. The objective of this a specialized course is to provide a comprehensive coverage of the current status of mass spectrometry for students with strong interest in mass spectrometry analysis of biomolecules. The first part covers the fundamental concept of mass spectrometry analysis and a brief discussion of the information that can be derived from mass spectrometry and tandem mass spectrometry analysis. Various desorption / ionization methods and mass analysers will also be described. The second part concentrates on the biological applications of mass spectrometry, including genomic and proteomic applications.

CHEM5781 Advanced NMR Spectroscopy

Advanced course in Nuclear Magnetic Resonance (NMR) spectroscopy. There are two focuses in the design of this course. The first is to develop the student's understanding and appreciation of the theory of NMR parameters and the second is to equip the student with the theoretical background needed to understand the workings of a pulse experiment using Product Operator Method.

CHEM5782 Principles of Biomolecular NMR Spectroscopy

This course aims to provide students with the fundamental principles of applying solution state NMR spectroscopy to study structures and dynamics of biomolecules. General approaches for assigning resonance signals and studying structures and dynamics of proteins and nucleic acids will be covered.

CHEM5784 Instrumental Analysis of Biomolecules

This course reviews analytical methods to solve biological problems. It serves as a primer to the expanding field of bioanalysis. The topics covered by this course include: purification and separation, spectroscopic methods; eletrophoresis; mass spectroscopy; chromatography; NMR; analysis of nucleic acids; nucleic acid and protein sequencing; immunoanalysis, single molecule techniques; single cell analysis; biochips; etc.

CHEM5910 Current Topics in Chemistry

This course describtes the new developments of chemical research.

CHEM5930 Molecular Quantum Mechanics

The topics to be discussed in this course include (1) background of quantum theory; (2) formulism of quantum mechanics and approximation methods; (3) molecular Hamiltonian and its symmetry properties; (4) Born-Oppenheimer approximation and its consequences; (5) quantum treatments of molecular vibration and rotation; (6) coupling of angular momenta in molecules; (7) intra and inter-molecular interactions; (8) Rydberg states of atoms and molecules; and (9) van der Waals molecules.