Dept. of Chemistry

The department offers a full range of courses in physical & analytical, organic, inorganic, nano and biochemistry. In response to the changing nature of chemistry, our department provides outstanding opportunities for advanced study in chemistry. In addition to our interests in education, chemistry faculty members pursue vigorous and productive research in many chemistry-related applied fields, such as sensors, displays, nano electronic materials, industrial application of biomolecules, and etc. The link between teaching and research is a vital factor in a continuously evolving scientific subject; it ensures that students will be provided with optimum information and concepts, and provides opportunities for students to participate in practical research.

❑ Physical and Analytical Chemistry Major

Physical and Analytical Chemistry is a subject dealing with the physical properties and analyses of all matter. Physical Chemistry is concerned with microscopic/ macroscopic, atomic/subatomic and particulate phenomena in chemical systems with respect to physical science. It generally uses the principles, practices and concepts of thermodynamics, quantum chemistry, statistical mechanics and kinetics. Analytical chemistry is the science to analyze morphologies, compositions, and quantities of analytical targets. It also deals with a variety of practical applications, such as biomedical applications, environmental monitoring and quality control of industrial manufacturing.

❑ Organic Chemistry Major

The graduate program 'Organic Chemistry' has several purposes. First, it provides the basic understanding of organic molecules properties which lead to synthesis, isolation, and characterization. Second, it offers the research experience and course work required for careers in teaching, chemistry-related industry, government laboratories, or other postgraduate professions. Third, it gives students the opportunity that relate with biological sciences.

❑ Inorganic Chemistry Major

Inorganic chemistry is a subject dealing with the chemistry concerned with the synthesis, properties and behavior of inorganic compounds. This field covers all chemical compounds except the organic compounds (compounds containing hydrocarbons). Major areas of inorganic chemistry include Solid-State and Materials Chemistry, Organometallic Chemistry, Bioinorganic Chemistry, Coordination Chemistry and Nanoscience.

❑ **Biochemistry Major**

The program in Biochemistry major in the Department of Chemistry is committed to achieving excellence in graduate studies and research. The lectures and seminar courses in the biochemistry major covers in-depth understanding as well as industrial application of biomolecules. In addition, emerging techniques and knowledge in life science are discussed with special focus on drug development, biotechnology, and nano-bio chemistry.

❑ **Nano Chemistry Major**

Nanochemistry is a subject dealing with the chemistry of making, analyzing, and applying substances that are active in the nanoscopic world in which substances are measured in one billionths of a meter. Nanochemistry, while serving as the basis for various sciences and technologies, is a very broad field involving life sciences, energy, electronics, environment, and materials. So, the new discipline of nanochemistry has already made it possible for us to step into the world of superfine substances, first-hand observations of and work with molecules and atoms on a nano-meter scale, including biomolecules and other functionally advanced materials.

☐ **Courses**

❑ **Core Courses**

· **Advanced Organic Chemistry (3)**

Elementary general molecular orbital theory. Reaction Mechanism. Carbocation and carbanion reactions. Carbonyl addition. Oxidation, reduction, rearrangements. Organic photochemistry.

· **Advanced Analytical Chemistry (3)**

This is a lecture designed to explain the most important issues in modern analytical chemistry. Topics include the principles, instrumentations, and applications of spectroscopy, electro-chemistry, separations, mass spectroscopy and chemical sensing.

· **Advanced Inorganic Chemistry (3)**

Topics include atomic and molecular structure, chemical bonds, solvent systems, reactions of the elements and their compounds.

· **Advanced Physical Chemistry (3)**

This is a course meant for graduate student majoring physical chemistry related fileds. The course will develop a fundamental understanding of the principles of thermodynamics, kinetic theory, statistical mechanics, quantum chemistry and molecular spectroscopy.

· **Advanced Biochemistry (3)**

This subject gives an opportunity to understand the life science by dealing with Enzyme structure and mechanism, protein modification, signal transduction in sensory systems, DNA and RNA biochemistry, and biochemistry of disease.

· **Research Ethics & Thesis Study (3)**

In this Subject, students study all the possible ethical issues in scientific researches and how the researchers deal with social responsibilities.

❑ **Physical and Analytical Chemistry Major Courses**

· **Intorduction of Photoelectrochemistry (3)**

This course introduces the fundamental concepts of photoelectrochemistry and demonstrates various applications.

· **Advanced Photoelectrochemistry (3)**

The goal of this course is understanding the advanced theoretical concepts in photoelectrochemistry on the basis of prerequisite subject.

· **Special Topics in Photoelectrochemistry (3)**

This course introduces state-of-the-art research trends in the field of photoelectrochemistry.

· **Energy Chemistry (3)**

This course introduces the concept and theory about the change and accumulation of energy especially placed in the electrochemical reaction. Students can learn the manufacture and analysis of related in an element.

· **Chemical Instrumentation (3)**

This course is designed to developing the knowledge and skills of instrumental analysis. Students are qualified to learn electronics / machining / optics / data analysis.

· **Applied Analytical Chemistry (3)**

This course is designed to apply the analytical methods to real issues including environmental science, forensic science, and food analysis.

· **Spectrochemical Analysis (3)**

Students will fulfill the determination of chemical structures on the basis upon the interpretation of infrared absorption, Raman scattering, UV/Vis absorption, nuclear magnetic resonance, and mass spectra, comparing with the chemical literature.

· **Statistical Thermodynamics (3)**

This course deals with the concepts of microstates, ensembles, partition functions, and fluctuations in quantum statistics. The issues are related to thermodynamic properties of ideal gases and crystals, chemical equilibrium, and phase transitions.

· **Special Topics in Advanced Quantum Chemistry (3)**

This lecture is designed to explain the concept of quantum chemistry extensively. Students are required to solve the Schrodinger's equation, and to understand the electronics structure of atoms and molecules.

· **Molecular Spectroscopy (3)**

The course will explore the interaction of light with matter. We will start with the quantum mechanical foundations of spectroscopy and follow with a detailed treatment of a variety of different spectroscopies, including the study of rotation, rotation and vibration, and electronic spectra for simple molecules as well as polyatomics.

· **Chemical Kinetics (3)**

Topics include relation between rates and mechanisms of chemical reactions, collision theory of reaction rates, activated complex theory, theory of unimo-lecular processes, classical dynamics of reactive scattering, elastic scattering, quantum theory of inelastic scattering or equivalent curve crossing processes, and experimental methods.

· **Electrochemistry (3)**

Students will learn the theories and applications of electrochemical methods including chronoamperometry, chrono-potentiometry, cyclic voltammetry, coulometry, polarography, and potentiometry.

· **Special Topics in Physical Chemistry (3)**

Students will learn the classical topics such as kinetics and photochemistry, macromolecular and surface chemistry, molecular spectroscopy, electric and magnetic properties of matter.

· **Research in Physical Chemistry (3)**

An upper-level student in good standing is urged to pursue an experimental research in physical chemistry with the guidance of any member of the chemistry faculty chosen.

· **Research in Analytical Chemistry (3)**

An upper-level student in good standing is urged to pursue an experimental

research in analytical chemistry with the guidance of any member of the chemistry faculty chosen.

- **Seminar in Physical·Analytical Chemistry (3)**

  To aid students in learning to speak well publicly. The focus is on discussing in physical and analytical chemistry topics from journal articles appeared in recent year.

- **Electroluminescence Chemistry (3)**

  This course widely introduces the chemical and physical concept and recent studies about the electroluminescent devices, fabrication process, EL materials and material synthesis.

❑ **Organic Chemistry Major Courses**

- **Organic Synthesis (3)**

  Systematic consideration of reaction which allows carbon-carbon bond formation or cleavage, as well as the introduction, removal, interconversion, or transposition of functional groups.

- **Organic Reaction Mechanism (3)**

  Understanding of bond and structure changing in organic chemistry.

- **Stereochemistry (3)**

  Configurational and conformational analysis of molecules: the steric course of organic chemical reactions.

- **Heterocyclic Chemistry (3)**

  Fundamental understanding of heterocyclic reactivity and synthesis, particularly aiming at recent works.

- **Natural Products Chemistry (3)**

  The logic which may be applied to designing synthesis of complex molecules in the context of a comparison of in vivo and laboratory synthesis of natural products synthesis including alkaloids, amino acids, fatty acids, macrolides, porphyrins, prostaglandins, steroids, and terpenoids.

- **Advanced Polymer Chemistry (3)**

  Mechanism of polymer reactions, preparations of addition and condensation polymers, properties of polymer, and the chemical reactions of polymers.

- **Free Radical Chemistry (3)**

  Focusing on new development of radical chemistry. Bond formation, rearrangement, electron transfer, addition, elimination, and substitution reaction will be discussed.

· **Organic Analysis (3)**

Lectures on determination of structure of organic compounds involving separation techniques and the application of FT-IR, UV, and visible spectroscopy, nuclear magnetic resonance spectroscopy, mass spectrometry, and other modern instrumental techniques.

· **Special Topics in Organic Chemistry (3)**

Lectures on advanced topics in organic chemistry presented by staff or visiting lecturers.

· **Research in Organic Chemistry (3)**

Independent research for graduate students for degree in chemistry.

· **Seminar in Organic Chemistry (3)**

Detailed study of a special topic in organic chemistry under the guidance of a faculty member.

❑ **Inorganic Chemistry Major Courses**

· **Science and Technology for reduction of Green house gases (3)**

The character of green house gases and method of detecting it.
The chemical method about isolation and purification from emission source.
The production method of fuel and high added-value chemical production from exchanging Green house gases.

· **Current Research topics: Energy (3)**

This lecture involved in many seminar about the problem of energy which human encounter today. The invited lecturer and professor will discuss how to resolve the problems via conference.

· **X-Ray Diffractometry (3)**

The principles and practice of the determination of structures by single crystal x-ray diffraction techniques. Crystal symmetry, diffraction, structure solution and refinement. Opportunities for hands-on experience in structure determination.

· **Organometallic Chemistry (3)**

Principles of electronic structure and bonding in organometallic species will be handled, related to reactivity patterns in common systems. Preparation and characterization methods of organometallic compounds, having applications to catalytic and stochiometric organic syntheses, will be presented.

· **Special Topics in Inorganic Chemistry (3)**

A lecture course in inorganic chemistry in areas of specialization of the faculty, with emphasis on current developments. Specific topics will be changed from semester to semester, so a student may take the course for credit more than once.

· **Research in Inorganic Chemistry (3)**

An upper-division student in good academic standing is urged to pursue an experimental research in inorganic chemistry with the guidance of any member of the chemistry faculty chosen.

· **Seminar in Inorganic Chemistry (3)**

To aid students in learning to present well publicly, the class is focused on discussing in inorganic chemistry topics from journal articles appearing in recent years.

❑ **Biochemistry Major Courses**

· **Biotechnology for Conservation Ecology**

The foundation of Biotechnology
The comprehension to photosynthesis that is a immobilization process of CO2
The comprehension to CA enzyme related to production of carbonic acid and of process of CO2 collection from using it.
The comprehension to methane monooxygenase (methane switch enzyme).
The comprehension to methane switch strain and of the process of methanol production.
The comprehension to enyme and strain of alcohol production from switching alkane.
The comprehension to Conservation Ecology Skill via the reduction technology of green house gases using enzyme and strain.

· **Enzyme Chemistry (3)**

This subject studies general properties of enzyme reactions such as enzyme activity, substrate specificity, and biocatalysis using an enzyme as a biocatalyst in chemical reaction.

· **Bioscience (3)**

The aim of this subject provides information of principle of life phenomenon taking place in animal, plant, and microorganisms.

· **Protein Engineering (3)**

This subject will provide essential knowledge for understanding various protein

engineering techniques to create novel and improved protein functions, recent trends of protein engineering, and applications of engineered proteins for scientific, medical and industrial purposes.

· **Proteomics (3)**

This subject studies combinatorial function network of total proteins in organisms on the basis of interpreting the relationships between proteome and its functions.

· **Chemical Biology (3)**

This subject deals with physiological functions of small chemical compounds.

· **Structural Genomics (3)**

This subject deals with functional analysis of life on the basis of structure interpretation of proteins translated from genome.

· **Research in Biochemistry (3)**

Graduate students in good standing are urged to pursue an experimental research in biochemistry with the guidance of any member of the chemistry faculty chosen.

· **Seminar in Biochemistry (3)**

To aid students to give a speech publicly in classes. The focus is discussions of biochemistry topics from journal articles published in recent years.

❑ **Nano Chemistry Major Courses**

· **Display Material Chemistry (3)**

This course teach how to deal chemical method used in developing display material.

· **Advanced Material Chemistry (3)**

This course teach how to deal advanced chemical method used in developing new advanced materials as advanced cource of material chemistry.

· **Material Chemistry (3)**

Chemistry has a vital role to play in materials processing and in the development of new materials. This course is concerned with the basic underlying principles and the technological relevance of major topics in advanced material chemistry. This course includes organic, inorganic, solid-state, and surface chemistry as well as polymer and materials science.

· **Thin Flims (3)**

This course includes the developments in the physical and chemical sciences that have changed the design, manufacture, and analysis of thin films, and their

applications, especially in communications and information processing, storage, and display.

· **Electronic Materials (3)**

This course is concerned with the basic underlying principles and the technological relevance of major topics in electronic material chemistry. This course deals various electronic materials such as organic, inorganic, and polymers.

· **Solid State Chemistry (3)**

Solid state chemistry has emerged as a very important element of mainstream chemistry and modern materials science. This course is concerned with the synthesis, structure, and properties and applications of solid-state materials. Understanding of solid-state chemistry is also essential in materials design.

· **Surface Nano Chemistry (3)**

Introduction to the behavior of molecules adsorbed on solid surfaces: the structure of surfaces and adsorbate layers. The bonding of molecules to surfaces: adsorbate phase transitions: trapping and sticking of molecules on surfaces. An introduction to surface reactions: kinetics of surface reactions. A review of principles of chemical reactivity: reactivity trends on surfaces: prediction of rates and mechanisms of reactions on metals, semiconductors, and insulators.

· **Research in Nano Chemistry (3)**

Upper division students in good standing are urged to pursue an experimental research in nanochemistry along with the guidance by faculty members.

· **Seminar in Nano Chemistry (3)**

The course focuses on discussing in nanochemistry topics from journal articles appearing in recent years. This course can provide much opportunity to learn how to efficiently communicate scientific knowledges to the public.

☐ Faculty Members

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