**Department of Chemistry**

We live in the age of chemistry. Chemistry is the study of [materials](http://en.wikipedia.org/wiki/Living_organisms) and their changes for better life. The chemistry department has developed unique graduate programs for our students to acquire strong backgrounds in the principles of modern chemistry and ability for creative thinking in the wide range of scientific fields. Our graduate students are involved in various research programs that department is providing and do their best to become leaders in either academic or industrial fields.

The chemistry department provides a number of core and advanced curricula and research programs. Graduate students can participate in one of nine faculty research laboratories: Analytical Chemistry and Separation Science, Analytical Chemistry and Electrochemistry, Biophysical Chemistry, Organic Synthesis, Computational Catalyst-Design Chemistry, Inorganic Nanomaterials and Catalytic Surface Chemistry, Inorganic Solid State Chemistry, Applied Physical Chemistry, and Organic Photochemistry. The department of chemistry is well equipped with the state-of-the-art research facilities including 600-MHz FT-NMR, SEM and TEM, mass spectrometer (MS), elemental analyzer (EA), UV-Vis spectrophotometer, Photoluminescence, Fluorescence Spectrophotometer, FT-IR spectrophotometer, High performance liquid chromatography (HPLC) and many other research-grade instruments.

For more information, send your inquiries to one of the following faculty members via e-mail.

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| --- | --- | --- | --- | --- |
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| Assistant Professor | Yoon, Seog Joon | Ph.D.  University of Notre Dame | Physical Chemistry | 2358  yoon@yu.ac.kr |

**Course Descriptions**

■ 공통과목 (Core Courses)

고급무기화학                                  3 credit

(ADVANCED INORGANIC CHEMISTRY)

Electronic structure and bonding with emphasis on transition metal and organometallic compounds. Chemical applications of group theory, ligand field, and molecular orbital theory.

Coordination chemistry and organometallic chemistry: structure, reactions, kinetics, and mechanism. Topics in advanced inorganic chemistry including spectroscopic methods, group theory, and bio-inorganic chemistry.

고급물리화학                                 3 credit

(ADVANCED PHYSICAL CHEMISTRY)

Physical and mathematical methods is useful tool to express chemical phenomena. In this course, advance theories in thermodynamics, quantum mechanics and statistical mechanics that deal with equilibrium, dynamics and structures of atoms and molecules will be covered. Thermodynamics part includes ideal solution, real solution, mixtures and chemical equilibrium while quantum mechanics covers atomic and molecular structure and spectroscopy. Transport and chemical kinetics will also be discussed.

고급분석화학                                 3 credit

(ADVANCED ANALYTICAL CHEMISTRY)

The goal of this course is to provide a sound physical understanding of the principles of analytical chemistry with emphasis on chemical equilibrium and to show how these principles are applied to research in chemistry and related disciplines including life and environmental sciences. Principles and applications of acid-base, complexation, precipitation and oxidation-reduction equilibria, potentiometry, electrogravimetry, coulometry, voltammetry and advanced spectroscopic analytical methods are covered.

고급유기화학                                 3 credit

(ADVANCED ORGANIC CHEMISTRY)

The aim of this course is to provide the basis for a deeper understanding of the structures of organic compounds and the mechanisms of organic reactions. Topics covered are: aspects of the structures, bonds and reactivity of organic molecules; thermodynamic and kinetic aspects of organic reactions; discussions of organic intermediates such as carbonium ions, carbenes, carbanions, radicals, and excited states.

■ 전공선택과목 (Elective Courses )

개별연구(1)                                  3 credit

(INDEPENDENT STUDY (1))

This course is offered to make it possible for a doctoral degree student to thoroughly investigate a topic related to his or her research interest.

개별연구(2)                                  3 credit

(INDEPENDENT STUDY (2))

This course is offered to make it possible for a doctoral degree student to thoroughly investigate a topic related to his or her research interest.

화학과세미나(1)                                 1 credit

(CHEMISTRY SEMINAR I)

Discussions and presentations of current issues and researches by students, faculty, and outside speakers. Topics covered will vary from year to year and will be selected in the various fields of chemistry, emphasizing contemporary trends.

화학과세미나(2)                                  1 credit

(CHEMISTRY SEMINAR II)

Discussions and presentations of current issues and researches by students, faculty, and outside speakers. Topics covered will vary from year to year and will be selected in the various fields of chemistry, emphasizing contemporary trends.

화학과세미나(3)                                  1 credit

(CHEMISTRY SEMINAR III)

Discussions and presentations of current issues and researches by students, faculty, and outside speakers. Topics covered will vary from year to year and will be selected in the various fields of chemistry, emphasizing contemporary trends.

화학과세미나(4)                                  1 credit

(CHEMISTRY SEMINAR IV)

Discussions and presentations of current issues and researches by students, faculty, and outside speakers. Topics covered will vary from year to year and will be selected in the various fields of chemistry, emphasizing contemporary trends.

화학과세미나(5)                                  1 credit

(CHEMISTRY SEMINAR V)

Discussions and presentations of current issues and researches by students, faculty, and outside speakers. Topics covered will vary from year to year and will be selected in the various fields of chemistry, emphasizing contemporary trends.

화학과세미나(6)                                  1 credit

(CHEMISTRY SEMINAR VI)

Discussions and presentations of current issues and researches by students, faculty, and outside speakers. Topics covered will vary from year to year and will be selected in the various fields of chemistry, emphasizing contemporary trends.

계산화학                                 1 credit

(COMPUTATIONAL CHEMISTRY)

Recent computational chemistry provides, in silico, the chemical theory and method. Theory of Quantum chemical method, Molecular Mechanics, Molecular Dynamics will be introduced and their practice will be performed

고급분리분석                                 3 credit

(ADVANCED SEPARATION SCIENCE)

Recent research articles on theory, instrumentation and applications of various separation and analysis methods such as distillation, liquid-liquid extraction, solid-phase extraction, solid-phase microextraction, dialysis, gas chromatography, high performance liquid chromatography, supercritical fluid chromatography, capillary electrophoresis, high performance thin layer chromatography and field flow fractionation are reviewed and  discussed.

고급전기재료화학                                 3 credit

(ADVANCED ELECTRICAL MATERIALS CHEMISTRY)

- This course requires in English.

- This course focuses on the fundamental electrochemical theory, techniques and reactions required to understand electro-chemical processes with relevance to energy conversion. Particular emphasis is put on the electrochemistry of batteries, fuel cells and solar cells as well as electrochemical techniques that can be used to study such devices and to synthesise new energy-relevant materials.

고급촉매화학(1)                                  3 credit

(ADVANCED CATALYTIC CHEMISTRY Ⅰ)

Synthesis, multifunctional characterization, structural modes, reactions, application on the various nonmetallic and metallic oxides as heterogeneous material compounds.

고체재료화학                                 3 credit

(SOLID STATE MATERIALS CHEMISTRY)

This course will study the technologically important solid state materials, providing comprehensive descriptions of the application area, development history, synthesis routes, main physico-chemical merit parameters, etc. Each semester, 1~2 material classes will be selected from the pool including semiconductors, dielectrics, optical materials, ionic conductors, electrode materials, for detailed discussion.

고체전자재료                                 3 credit

(SOLID -STATE ELECTRONIC MATERIALS)

This course is aimed to deliver universal views of the composition-structure-property relationships in the solid state materials that are potentially applicable in modern electronic devices.  Particularly the materials of unique transport, magnetic, and optical behaviors will be covered.

광에너지화학                                 3 credit

(PHOTOENERGY CHEMISTRY)

Compounds containing a variety of chromophore absorb photoenergy to promote compounds to excited state. Contrary to conventional ground state of compounds, these high energy excited state of compounds undergo various kinds of photochemical and photophysical pathways via interaction with light (i.e., electron transfer, energy transfer, fluorescence, phosphorescence, chemical reaction, etc). This class will provide basic knowledge about photochemical/photophysical properties and will explore mechanistric aspect in chemical point of view. And Photo-related electronic materials and biomaterials will be discussed.

광화학반응메커니즘                                 3 credit

(PHOTOCHEMICAL REACTION MECHANISM)

Excited state of compounds arisen by photoirradiation can undergo various photochemical-and photophysical pathways to form photoproducts or recover substrates. These photochemical pathways are largely dependent on functional groups of substrate. This class, especially, mainly will discuss photochemical reaction mechanism of substrate that lead to formation of photoproducts

나노소재화학                                 3 credit

(NANO MATERIALS CHEMISTRY)

Nowadays we can design and synthesize many nanomolecules and control the composition of matter on the nanometer scale, and pattern matter using lithographic and scanning probe manipulation techniques to the nanometer scale. The aim of this course to provide an understanding of fundamental principles and applications of nanomaterials in chemical perspective of view. Topics covered are varied year to year: the basic and the recent research topics of synthesis, composition, and patterning of nanomaterials; fundamentals of physical properties and characterization of nano particles; measurement of physical and chemical properties of nano materials and  instrumentation.

물리생화학 (1)                                3 credit

(BIOPHYSICAL CHEMISTRY I)

In order to study the structure and function of biomolecules, the principles and applications of various spectroscopic and hydrodynamic methods, equilibrium and kinetic between the structures of the biomolecules including nucleic acids and proteins will be dealt with in this course.

물리생화학 (2)                                3 credit

(BIOPHYSICAL CHEMISTRY II)

Equilibrium, dynamics and statistics on the interaction between biopolymers and ligand will be dealt with in this course. Various cases in the equilibrium between protein/DNA ligand as well as the binding kinetics and the factors that regulates the binding will also be discussed. This course includes the effect of the structure of DNA and protein on the ligand binding kinetics and their equilibrium.

물리화학 특성측정론                                3 credit

(METHODOLOGY OF PHYSICOCHEMICAL PROPERTIES)

In this course, the theoretical background of various physicochemical properties of materials will be explored. Furthermore, various spectroscopic techniques, used for elucidating the properties will be discussed. To successfully finish this course, it is necessary for students to complete physical chemistry course as a prerequisite.

바이오센서화학                                3 credit

(BIOSENSOR CHEMISTRY)

Traditional analytical methods for compounds are applied in the identification of biological compounds. Also the characteristic properties of biological materials can be utilized in sensing. In this course, general methods for sensing and continuous sensing and immobilization methods of biocompounds will be presented.

분말결정학                                  3 credit

(POWDER CRYSTALLOGRAPHY)

This course will cover the theoretical and practical parts of the crystal structure determination of crystalline inorganic solids by powder diffraction method.  Detailed aspects of the diffraction processes are described in terms of the type of radiation, constituent atoms, lattice disorder, and crystal imperfection.  Several application softwares for crystallographic studies will be also introduced.

분석화학특론                                 3 credit

(ADVANCED ANALYTICAL CHEMISTRY)

Analytical chemistry provides a measurement of materials for every field in up-to-date science including life science, communications, environment, astroscience and semiconductor. This course introduces an improvement in established analytical methods, and discuss new development in analytical methods.

분자분광학                                 3 credit

(MOLECULAR SPECTROSCOPY)

This course includes the principle and application of spectroscopy, which is the basic tool for modern chemistry. Applying quantum mechanical principles, the energy levels, transitions between the energy levels, and selection rules that governing the transitions will be understood. Various spectroscopy corresponding the vibration, rotation and electronic energy levels will be dealt with. This course also includes the action of the lasers which is related to the stimulated radiative decay.

신소재화학                                  3 credit

(NEW MATERIALS CHEMISTRY)

This lecture introduces the bioactive materials, electronic materials, and luminescence material. The synthesis and screening for the development of bioactive materials and the procedure for the marketing drugs and crop-protecting compounds is introduced with examples. Several materials recently are applied for the development of electronics and emitting materials. Their trends will be also treated.

신재생에너지화학                                  3 credit

(CHEMISTRY FOR RENEWABLE ENERGY)

- This course requires in English.

- Chemistry has a key role in the development of alternative energy sources. Within the section of chemistry many fundamental and applied research projects within this area are successfully being pursued; for example dry and wet solar cells, smart windows, hydrogen production, hydrogen storage, batteries and fuel cells. This study track focuses on chemical principles, materials and methods required for the development of renewable energy resources and energy carriers. This includes solar-based methods such as solar cells and solar fuels as well as hydrogen production, fuel cells and efficient batteries.

실응용물리화학                                  3 credit

(APPLIED PHYSICAL CHEMISTRY IN INDUSTRY)

This course deals with the real application of physical chemistry in various industrial fields such as energy, environment, bio, water treatment, electronics and chemical industry. Basic concepts of physical chemistry are also included.

유기광화학의이해                                  3 credit

(APPLIED PHYSICAL CHEMISTRY IN INDUSTRY)

Organic photochemistry has undergone a greater change and has stimulated more interest than propbbly any other area of organic chemistry. Since photochemistry is no longer the sole domain of the specialist, it is relatively safe to predict a dramatic increase in the future of the synthetic and industrial uses of organic photochemistry.

The goal of this class is to learn photophysical (i.e., energy distribution, fluorescence, phosphorescence and etc) and photochemical (electron transfer, energy transfer, photoreaction and etc) concepts along with the chemical and physical techniques necessary to understand a variety of photoreactions.

유기전자재료                                  3 credit

(ORGANIC ELECTRONIC MATERIALS)

Advance in science and technology enable organic-inorganic compounds to be used as useful electronic materials. In this class, various kinds of organic based electronic materials will be presented and be discussed how these materials are prepared and worked in detail.

유기촉매화학                                  3 credit

(ORGANIC CATALYST CHEMISTRY)

Catalyst can accelerates a reaction rate and derive achirality into a product. Many excellent metallic catalysts have been studed. And, recently, organic catalysts are gaining attentions in many reactions. Here the pro/con of organic catalysts will be introduced.

유기합성방법                                 3 credit

(ORGANIC SYNTHETIC METHODS)

Discussions of practical issues in organic synthesis with emphasis on synthetic techniques and procedures. Topics covered are: the preparative, isolation and purification techniques in organic synthesis; the chemical procedures for the structural characterization of pure compounds; new reagents and procedures.

유기합성세미나                                 3 credit

(ORGANIC SYNTHESIS SEMINAR)

Discussions and presentations of current issues and researches in organic synthesis. Topics covered will vary from year to year in the area of organic synthesis, emphasizing contemporary trends.

유기합성특론                                 3 credit

(ADVANCED ORGANIC SYNTHESIS)

Discussions of the important methods of synthetic organic chemistry and their application to the construction of complex organic molecules. The course deals with the multistage synthesis of representative natural compounds and theoretically interesting molecules with emphasis on the logical design and analysis of complex synthetic problems.

유기화학반응메카니즘                                 3 credit

(MECHANISM IN ORGANIC REACTION)

Organic reaction mechanism is important issue to understand oragnic reaction and utilize these reactions to organic synthesis. This class will mainly discuss organic reaction mechanism with charge- and orbital- concepts.

이론유기화학                                  3 credit

(THEORETICAL ORGANIC CHEMISTRY)

Quantum chemistry will be applied in the interpretation of organic compounds and their properties including reactivities. Modern computer programming will also introduced in only organic level not in serious level. Several practices will be performed by each students.

입체유기화학                                  3 credit

(ORGANIC STEREOCHEMISTRY)

Many organic reactions produce chiral products but as racemate mixtures. Several asymmetric synthetic methods, Resolution and Asymmetric catalysts will be discussed.

전기분석화학특론                                 3 credit

(TOPICS IN ELECTROANALYTICAL CHEMISTRY)

Electric measurement in analytical chemistry is an important area to study the compositions and properties of material. This course covers basic principle of electrodes, electrochemical cell, potentiometry, coulometry, voltammetry and sensors.

전자전달광화학반응                                 3 credit

(ELECTRON TRANSFER PHOTOCHEMISTRY)

Owing to the large energetic driving force provided by the high energies of electronic excited state, photoinduced electron transfer is the key mechanistic event in a wide variety of photochemical processes. The unique feature of electron tranfer-photochemical processes arises from the fact that the chemistry is governed principally by the chemical properties of electron donor/electron acceptor compounds.

Investigation of these chemical properties can lead to the elucidation of electron transfer reaction mechanism and their photochemical behaviors.

The goal of this class is to learn electron transfer promoted-photochemical reactons such as photoaddition, photocyclication in monomer, photodegradation in oligomer (i.e. lignin), and hole / energy transfer process in polymer.

층간삽입화학                                 3 credit

(INTERCALATION CHEMISTRY)

The intercalation (inclusion) phenomena of low-dimensional inorganic materials will be described.  Topics include the thermodynamic and kinetic controls of intercalation reaction, nature of host-guest stabilization, and the application areas in electrodes and catalysts.

카이랄 분석                                 3 credit

(CHIRAL ANALYSIS)

The concepts of chirality and chiral analysis are introduced. Principles, instrumentation and applications of chromatographic, electrophoretic and spectroscopic methods of chiral analysis are then discussed.

표면물리화학                                  3 credit

(Surface physical chemistry)

There are many observable phenomena on solid and liquid surfaces including liquid wetting on a surface and adsorption of gases. These phenomena directly determine the change in chemical reactions and physical energy changes, and therefore it is very important to deeply understand. This course deals with the chemical and physical phenomena on surfaces and interfaces including mathematical expressions, and experimental techniques to measure the phenomena.

합성유기화학                                  3 credit

(SYNTHETIC ORGANIC CHEMISTRY)

An introduction of the art and craft of organic synthesis, focusing on concepts, methods, starting materials, and target molecules that play important roles in modern synthesis.  Emphasis will be placed on rational design of synthetic routes. Important topics covered are: the basic concept of retrosynthetic analysis, synthon approach and functional group conversions; systematic evaluation of the arrangement of functionality; protection; design and use of selective reagents; control of regio- and stereochemistry.

핵산구조동역학                                 3 credit

(DYNAMICS OF NUCLEIC ACID STRUCTURE)

Understanding the structure of biomolecules is important in extending our knowledge on the biological phenomena. Modeling via components of macromolecules is important in predicting their functions and significance. This course will cover principles and application of various spectroscopy techniques, and will focus on the understanding of structures of biomolecules such as DNA, RNA and Protein.

핵산물리화학특강                                  3 credit

(PECIAL TOPICS IN NUCLEIC ACID PHYSICAL CHEMISTRY)

This course introduces students to our current understanding of life processes at the molecular level. we will discuss recent progress in understanding the Interaction of between DNA and various compounds, especially in the aspect of their binding mode. This course can also be introduce advanced concepts related to the chemical diversity of nucleic acids as the storage molecules of genetic information.

During the course, students will be expected to develop skills for the critical analysis of data in the field.

핵산및단백질구조분석                                  3 credit

(ANALYSIS OF NUCLEIC ACID AND PROTEIN STRUCTURE)

Since the sequencing of the entire human genome, studies on Nucleic acids and Protein structure have received more attention. This course covers methodology of DNA and Protein structure determination and prediction. In particular, the teaching for the physico-chemical properties of the protein and interaction of DNA-protein complex. In addition, students participate in discussion on their properties.

헤테로고리화학                                  3 credit

(HETEROCYCLIC CHEMISTRY)

Heterocyclic compounds containing heteroatoms including N, S, O have unique chemical and biological properties. The aim of this class is to present essential features of synthesis of heterocycles and reactions occurring in heterocycles will be discussed.

화학기기                                 3 credit

(CHEMICAL INSTRUMENTATION)

Electronic measurement and control pervade all corners of science and engineering. This course is designed to provide science and engineering students with a basic understanding of electronic devices and circuits so that they appreciate the operation and characteristics of the many electronic instruments they will use in academic and professional careers. Thus the analysis, rather than design, of analog and digital circuits is emphasized.

화학통계                                  3 credit

(CHEMOMETRICS)

 Principles and applications of various mathematical and statistical methods for treatment and evaluation of experimental data are discussed.  Accuracy and precision, average, linear relationships between two variables, ANOVA, preparation and evaluation of calibration curves using matrices, multi-variate analysis and optimization of analytical methods are covered.

화학평형론                                 3 credit

(EQUILIBRIUM IN ANALYTICAL CHEMISTRY)

Equilibria govern diverse natural phenomena. Chemical equilibrium provides a foundation not only for chemical analysis but also for other areas of science, such as environmental science, biochemistry, geology, and oceanography. This course covers of solubility of ionic compound, complex formation, acid-base reactions, redox reactions, and the  determination of chemical equilibrium constants.