• Department of Chemistry

1. Educational Goal

The primary goal of the department is to provide professional development opportunities that equip students with the skills, knowledge and strategies needed to solve relevant chemical problems and aid in development of current research. The Department of Chemistry at Hannam University is home to research groups that are pursuing new insights into structure, reactivity, and functions of molecules and materials that show future promise of benefit for human life. We are a participant of the BK 21 (Brain Korea 21) project, designated by the Ministry of Education's Science and Technology branch. Many graduates advance into diverse areas. These include, but are not limited to; national/public/private research institutes, academic circles, the pharmaceutical industry, hospitals, oil refineries, the petro-chemistry, the fiber industry, pulp and paper making industries, the fertilizer industry, the plastic industry, the rubber industry, the heavy chemical industry, and power industry.

2. Educational Objective

1) General familiarity with the following areas in chemistry: organic, inorganic, analytical, biochemistry, physical and polymer.
2) The ability to perform accurate quantitative measurements with an understanding of the theory and the utilization of current chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.
3) The ability to work effectively and safely in a laboratory environment.
4) The ability to think critically and to analyze chemical problems.
5) Opportunities for students and faculty to interact with alumni and with professional chemists.

3. List of Full-time Faculty

Name	Position	Degree(University)	Field of Instruction	Area of Research
Lee GyuHwan	Professor	Ph.D (Stony Brook University: SUNY)	Inorganic chemistry	Organosilicon Chemistry
Kim SeungJoon	Professor	Ph.D (University of Georgia)	Physical chemistry	Theoretical Quantum Chemistry
Lee SeungHo	Professor	Ph.D (The University of Utah)	Analytical chemistry	Physical-Analytical Chemistry
Choi SeongHo	Professor	Ph. D (Nagoya University)	Organic chemistry	Organic Synthetic Chemistry
Yoon KukRo	Professor	Ph. D (Sogang University)	Organic/polymer chemistry	Organic Nanomaterials Chemistry
Kim Chul	Associate Professor	Ph. D (Seoul National University)	Physical chemistry	Nuclear Magnetic Resonance
Lee SungKwang	Associate Professor	Ph. D (Yonsei University)	Analytical chemistry	Analytical Chemistry, Cheminformatics
Lim ChoonWoo	Associate Professor	Ph. D (Seoul National University)	Organic chemistry	Supramolecular chemistry and Elctronic material
Kim SunHwan	Associate Professor	Ph. D (Yonsei University)	Organic Chemistry	Energetic Material Chemistry
Jung JongJin	Assistant Professor	Ph. D (Rutgers University)	Biochemistry	Bio-Nanochemistry
Kim WoonJung	Assistant Professor	Ph. D (University of Hannam)	Analytical Chemistry	Physical-Analytical Chemistry. Composite material

4. Course Description

◆ **Physical Chemistry & Analytical Chemistry**

• **CH601 Advanced Physical Chemistry 3credits**

Advanced Physical chemistry I is a study on the understanding of macroscopic change of matters and its energy change with thermodynamic state functions. The theme of this course is to provide the principles of thermodynamics and to help students to apply those principles to chemical phenomena. The lectures include the properties of gases, the equations of state, the concepts and the relationships among the internal energy, the enthalpy, the entropy, and the Gibbs energy. The applications of thermodynamic methods to the investigation of chemical systems, such as liquids, surface problems, and phase equilibria, will be introduced during this course.

• **CH602 Advanced Analytical Chemistry 3credits**

The course is the practice of modern quantitative chemical techniques in analytical chemistry I. The objective for students is to gain a fundamental understanding of quantitative analysis through analytical chemistry I, to understand the various types of quantitative measurements and how these are applicable to real life problems.

• **CH603 Quantum Chemistry 3credits**

The principles of quantum theory and applications to chemical systems are included. Quantum mechanics provides the Schrodinger equation and its solution methods for the wavefunction and energy of the micro-particle in an atom or a molecule. At first, we will describe the translational, vibrational, and rotational motions of a particle in a potential energy box, a harmonic function, and on a sphere surface. The basic skills will be applied to solve the Schrodinger equations for the hydrogen atom and many-electron atoms. Variational and perturbation theory are included. In addition, atomic and molecular spectrum will be analyzed by using the understanding of quantum mechanics.

• **CH604 Molecular Spectroscopy 3credits**

This course continues the physical chemistry I and II. The theme of this course is to provide the theories about the molecular spectroscopies informing the physical properties of a molecule and to develop application areas by understanding the microscopic symmetries of matters. This is a compulsory course for students wishing to go on to a graduate school. The lectures include group theory, electronic, rotational and vibration spectroscopies, and nuclear and electron magnetic resonance spectroscopies.

• CH605 Molecular Orbital Theory 3credits

This course provides the approximate method to make a molecular wavefunction by linearly combining the atomic wavefunctions and the ways to use basis functions. SCF, MP series, configuration interaction, coupled cluster methods will be treated for the approximate solutions of complex molecular systems. The basic skills will be applied to the real systems and physical and chemical information will be obtained by using the computer programs.

• CH606 Special Topics In Physical Chemistry 1 3credits

Special Topics In Physical chemistry is a branch of chemistry that studies the basic principles and laws describing the physical and chemical changes of matters. The theme of this course is to provide the physicochemical understanding of chemical phenomena and to develop its application areas. The lectures will treat the thermodyanic understandings of spontaneity and chemical equilibrium in a chemical reaction using thermodyanic functions, such as the enthalpy, the Gibbs energy, and the chemical potential. The reaction rate and reaction mechanism will be also treated with catalysts. As a substantial application, you will learn the principles and theories on chemical batteries made of ionic solutions.

• CH607 Photochemistry 3credits

This course will treat chromophores giving the absorption spectrum obtained by an electron transition and the basic theory about the light absorption and emission will be studied with their selection rules. Application area in different light sources and the spectroscopic principles and application of laser will be included. Einstein's photoelectric effect and the basic principles and applications of photoelectron spectroscopy will be learned to investigate the relationship between the molecular ionization energy and photoelectron spectrum.

• CH608 Magnetic Resonance Spectroscopy 3credits

The first half of the course covers the principles and techniques of macro-molecular structure determination using X-ray crystallography. The second half of the course covers extracting biological information from X-ray crystal structures with special emphasis on using structures reported in the recent literature and presented by the students.

• CH609 Catalyst Chemlstry 3credits

Catalysts are the materials which do not change the equilibrium state but change the reaction rate. As catalysts are added to the reaction system the efficiency of the chemical process is enhanced and the cost is improved to a considerable

extent. The topic of this course will include the types and the physical and chemical properties of the homogeneous and heterogeneous catalysts, catalyst synthesis, adsorption and desorption of the catalysts, the acid- or base-catalyzed reactions, photocatalysis, the catalytic mechanisms and their applications.

• CH610 Electroanalytlcal Chemistry 3credits

This course will introduce the student to electroanalytical chemistry with consideration of mass transfer and electrode kinetics for polarizable electrodes. Topic covered will include: electrochemical cells and electrodes, criteria for the design of electroanalytical experiments, sensors and biosensors, interpretation of current-potential curves for a variety of conditions and application in chemical analysis.

• CH611 Analytical Separations 3credits

The course is designed for student whose job involves making chemical measurements and is relevant to many types of people of various of industries. The purpose of the course is to provide a learning framework within which students can effectively and efficiently develop a level of competence with modern instrumental methods of analysis that will allow direct application of the principles learned in future work, and to develop independent thought and problem-solving abilities. The principles associated with separation methods and chromatographic techniques will also be presented.

• CH612 Special Topics In Analytical Chemistry 1 3credits

This course is designed to provide the opportunity to explore new theory and its application for recent research in analytical chemistry to graduate students. The course is dedicated to building knowledge of special field, and improving one's ability as a researcher.

• CH613 Analytical Chemistry Seminar 1 3credits

Graduate students present a 20-30 minute seminar on new research field related to analytical chemistry. The seminar should be treated as a formal exercise to enhance presentation skills and public speaking abilities, through the preparation of a PowerPoint presentation and the organization of the seminar.

• CH614 Surfacechemistry 3credits

The details of the structure and composition of solid surfaces will be treated in this course. The extent of surface coverage will be varied by the temperature and pressure change. The effects of the surface on the rate and course of chemical reactions will be also discussed as the site of catalysis. We will focus on the

dynamics of electrode processes and power production in fuel cells and for corrosion as its applications.

• CH615 Separation Science 3credits

This course focuses on the chromatographic and electrophoretic separations. Topics include general plate theory, the principles and optimization of gas chromatography, liquid chromatography, supercritical fluid chromatography and capillary electrophoresis, and the principles of the detection systems utilized in these separation techniques.

• CH616 Nano-Bio Separation 3credits

Property characterization of the materials is necessary for applying and developing nano and biomaterials. Separation at the particular and molecular level is prior to their characterization. This course will provide a thorough grounding in basic and advanced aspects of separation of nano- and biomaterials such as chromatography, field-flow fractionation and sedimentation method. The course will develop the ability to critically select the appropriate method for separation nano, and biomaterials.

• CH617 Molecular Informatics 3credits

The course objectives are to introduce participants to different molecular informatics methods, to provide examples on the use of molecular informatics in modern drug research, pharmacology, organic synthesis, material design, risk assessment, toxicology, polymer science and instrument analysis, and to gain practical experience through exercises with representative methods used in molecular informatics. The course focuses primarily on molecular information related to or derived from structural information. Thus, the topics cover areas such as design, organization, management, retrieval, analysis and visualization of molecular information.

• CH643 Seminar on Physical Chemistry 3credits

Course will be offered to the students who will major in physical chemistry to bring up the ability and creativity for theory and experimental methods in their research fields by survey of recently published literatures. Special topics will be selected each semester by considering the research field of the students, and will be discussed for theory, synthesis, and application.

• CH640 Chemometrics 3credits

This course will provide a graduate level discussion of chemometric method and applications of chemical data. Included are multivariate statistical treatment of

quantitative and qualitative data matrices, exploratory data analysis, regression & classification methods, scaling and standardization of raw data, cluster analysis, principal component analysis, partial least square method, and validation of data, especially cross-validation.

• CH641 trace drug analysis 3credits

This course will provide a graduate level discussion of trace drug analysis using separation methods employed in medicinal laboratory investigation. Included are instrumentation theory, troubleshooting and method development, quantitation & application, gas chromatography, liquid chromatography, ion chromatography, capillary electrophoresis and practical application of trace drug analysis.

• CH1701 Advanced Quantum Chemistry 3credits

This course is to provide the quantum mechanical methods for solving the structure of many-electron atoms or molecules. The ways to get an appropriate atomic or molecular Hamiltonian and the electronic term symbol will be discussed. The basic theory and its applications for the molecular structure, the vibrational frequency, the dipole moment will be provided with the introduction to the group theory. Potential energy surface will be calculated to get the activation energy and to identify the reaction intermediate. This course will discuss the relation between the quantum chemical calculation and statistical thermodynamics.

• CH702 Chemical Kinetics 3credits

Chemical kinetics is a part of the physical chemistry investigating the reaction rate and its mechanism reaching to the equilibrium state. The students will learn the basic theory and the experimental results related to the reaction rate and they can apply the results to the real systems. The lecture includes the reaction rate laws, the orders of reaction rate, the integrated rate laws, the experimental methods to measure the rates, the classification of the reaction rates by the rate law, the reaction mechanism, the catalysis, the photochemistry, etc.

• CH703 Statistical Thermodynamics 3credits

This course will provide the student with the statistical thermodynamic concepts which correlate the microscopic molecular properties to the macroscopic thermodynamic properties. With Boltzmann distribution function and the molecular partition function we will understand the concept of the ensemble. The partition functions of ensembles make the macroscopic thermodynamic functions, such as enthalpy, entropy, Gibbs free energy, and equilibrium constant, calculated by correlating the quantum mechanical results to the molecular spectroscopy and chemical thermodynamics. The methods finding the thermodynamic parameters will

be also discussed.

• CH704 Special Topics in Physical Chemistry 2 3credits

The theme of this course is not pre-determined and restricted to the special topics but will be changed according to the student's needs. The students will study their research topics by searching and reviewing the related articles and the published reviews. They will discuss new experimental methods and a new theory related to the physical chemistry, and the current hot issues of the physical chemistry.

• C705 Special Topics in Physical Chemistry 3 3credits

The theme of this course is not pre-determined and restricted to the special topics but will be changed according to the student's needs. The students will study their research topics by searching and reviewing the related articles and the published reviews. They will discuss new experimental methods and a new theory related to the physical chemistry, and the current hot issues of the physical chemistry.

• CH706 Biophysical Chemistry 3credits

This course will treat the molecular structure in an equilibrium state and the structural change of the functional group in a biomolecule and the change of the physicochemical properties. The students will study the relationship between catalytic efficiency and the activation energy of the enzyme reaction and the molecular dynamics affecting the reaction rate and the reaction mechanism with the application of pre-equilibrium principle. This lecture includes the analysis of the 2D-NMR spectrum of proteins, the pulse sequencing for the various NMR experiments, and the molecular modeling.

• CH707 Special Topics In Analytical Chemistry 2 3credits

This course is designed to provide graduate students in analytical chemistry with the opportunity to explore new analysis theory and its application for recent research in analytical chemistry. The course is dedicated to building knowledge of special field, and to improving one's ability as a researcher.

• CH708 Special Topics in Analytical Chemistry 3 3credits

Same to Special Topics in Analytical Chemistry 2.

• CH709 Analytical Chemistry Seminar 2 3credits

Graduate students in analytical chemistry present a seminar on actual research results in the laboratory and on new research trend related to analytical

chemistry. The seminar exchange ideas on research topics of chemical interest and provide essential educational opportunities to both the speaker and their audiences from discussion and presentation.

• CH710 Spectroscopic analytical Chemistry 3credits

This course introduces various aspects of modern analytical spectroscopy. Individual topics include general theory of spectroscopy, UV/Vis spectroscopy, fluorescence- phosphorescence spectroscopy, atomic absorption spectroscopy, atomic emission spectroscopy, plasma-arc-spark atomic emission spectroscopy, Raman spectroscopy, X-ray spectroscopy, and their applications to real samples.

• CH712 Experimental Practice and Applications of Advanced Equipments 3credits

This course is directed towards graduate students planning to use advanced analytical instrument. The theoretical backgrounds for a number of advanced instrumental analytical methods are given, and their application to new material science is presented. The lectures cover X-ray diffraction, nuclear magnetic resonance, inductively coupled plasma, GC/Mass and electron microscope that belong to the department. At the end of the course, the student will have a better understanding of instrumentation and analytical ability.

• CH714 Material Chemistry 3credits

This course begins with a review of fundamental concepts in material science, provides an introduction to more advanced theory, finally, focuses on the chemistry involved both in production of modern materials and their uses. The latter topics include the chemistry of thin films, ceramic, self-assembled chemical systems, surface chemistry and cluster chemistry.

• CH715 Electrochemistry 3credits

This course will provide a graduate level discussion of electroanalytical and physical electrochemical topics. Included are amperometric, voltammetric, electrolytic, and potentiometric methods. Analysis of literature publications using one or more of these approaches will be emphasized. We will investigate the practical applications of electrochemistry in analysis, materials synthesis and energy technology.

• CH735 molecular modeling 3credits

This course is focused on learning theoretical and computational techniques to predict, model, and simulate biomolecular structure. Starting from the basics the different theoretical approaches to describe and analyze biological macromolecules are explained. Of course illustrative examples from current research projects in molecular modelling are also given. Due to the interdisciplinary nature of these

subjects the lecture addresses students from various fields of the life sciences.

◆ Organic Chemistry

• CH618 Advanced Organic Chemistry 3credits

A study of all aspects of fundamental organic chemistry, including nomenclature, chemical and physical properties, reactions and syntheses of the major classes of organic compounds. The study includes theoretical aspects, reaction mechanisms, multistep syntheses and the chemistry of polycyclic and heterocyclic compounds. Students will learn the mechanisms of organic chemistry and general principles through a combination of lectures and problem solving. The fundamental structures of organic molecules and the spectroscopic methods used to define them are studied. A comprehensive understanding of the reactions and properties of organic molecules is developed and applied to the synthesis of organic compounds and to an appreciation of nature's important molecules. This course is appropriate for students in chemistry, biology, and premedical programs.

• CH619 Stereochemistry 3credits

This lecture will be discussed that the stereoisomeric phenomenon of the organic molecules is determined via symmetricalic classification of the organic compound structure. Furthermore, this lecture will be also described for the phenomenon of the organic stereoisomerism, enantiomeric reaction, asymmetric synthesis and etc. In addition, this lecture will be performed the seminar for recently published paper because of understanding the advance study for stereochemistry.

• CH620 Chemistry for Natural Compounds 3credits

Introduction to new reactions for organic synthesis, and the applications of such chemistry to target molecules of structural or biological significance, especially potential anti-cancer and anti-parasitic agents, and compounds that might reverse multi-drug resistance. Synthetic efforts focused on developing new cationic or radical polycyclisations lead to the synthesis of complex diketopiperazine natural products, such as the stephacidins, and on the synthesis of members of the polycyclic acylphloroglucinol family using bridgehead metallation chemistry.

• CH621 Organic Synthetic Chemistry 3credits

Discusses the principles of experimental organic molecules design, data acquisition, analysis and interpretation, and the presentation of experimental results. Students are exposed to a broad range of quantitative laboratory methods in preparation for thesis work in organic chemistry. Typical laboratory exercises include synthesis, characterization, spectroscopy, kinetics, thermodynamics, electronics and instrument design. Lectures on experimental organic molecules

design, data analysis, interpretation, and presentation. More reactions that are useful to the practice of synthetic organic chemistry.

• CH622 Heterocyclic Chemistry 3credits

There are many heterocyclic compounds on organic compounds. This lecture will be discussed for the synthesis, chattelization and application cyclic compounds for cyclic compounds because the cyclic compounds have the many specific property than that of linear carbon hydrogen compounds. This lecture will be also discussed for reaction mechanism, the property according to structure, and etc. about heterocyclic compounds.

• CH623 Polymer Chemistry 3credits

Introduction to the basic concepts of chemistry: stoichiometry, types of reactions, thermodynamics, quantum mechanics, and chemical bonding. Introduction to the structure, chemistry, and properties of technologically important materials: metals, semiconductors, ceramics, and polymers. Fulfills medical school requirements in general chemistry and qualitative analysis.

• CH624 Seminar on Organic Chemistry 3credits

This lecture will be discussed for the research and arrangement of the organic paper's reference which is published on now. This lecture will be also done that the graduate students will present the interesting subject as oral presentation to other graduate students.

• CH625 Special Topics in Organic Chemistry 1 3credits

This lecture will be discussed about the published organic specific subject, recently as lecture and discussion. Specially, the graduate students will present to other graduate students for the published research papers and discussed with other graduate students for the published subjects. This lecture will be used the research papers, recently.

• CH626 Biochemlstry 3credits

Introductory course devoted to the concepts of biochemistry, including the structures, properties, and reactivity of simpler organic compounds. Emphasis on the mechanisms of biochemistry; examples from biology when appropriate to illustrate the principles. Biochemistry take an interdisciplinary approach to the study of the chemical basis for biological phenomena, combining physical, synthetic, and biochemical methods. Research directions span from the behavior of single molecules to the interactions between cells in living animals. Systems being studied include signaling proteins, enzymes, DNA and RNA, membranes, and

carbohydrates. Within chemistry, the disciplines of physical, organic, and analytical chemistry all contribute valuable ideas to enhance our understanding of the complexities in biology. Progress is being made throughout this field by combining new ideas in chemistry with advances in molecular biology, biochemistry, and biophysics.

• CH627 Polymer Synthesis 3credits

Introduction to the basic concepts of chemistry: stoichiometry, types of reactions, thermodynamics, quantum mechanics, and chemical bonding. Introduction to the structure, chemistry, and properties of technologically important materials: metals, semiconductors, ceramics, and polymers. Fulfills medical school requirements in general chemistry and qualitative analysis.

• CH642 Study on Current Experimental Approaches for Biochemistry 3credits

(Fluorescence) Microscope, Single molecule fluorescence spectroscopy, Recombinant DNA technology, Basics for protein separation and purification, Electrophoresis techniques, Luminescence-based analysis, Basic bioconjugation techniques, Target-specific bioconjugation and delivery techniques (antibody, aptamer etc), Cell biological analysis using FRET (fluorescence resonance energy transfer) and molecular beason.

• CH713 Nanochemistry 3credits

This course will provide a graduate level discussion of Nanoscience and Technology (NST) refers to science and technology of charaterizing, understanding, and controlling the structure and properties of matter at nanometer (10-9 nm) scale. Nanoscience and Technology is moving beyond simple miniaturization, and is moving toward understanding and manipulating matter based on fundamental principles in order to transcend the natural limits. Nanoscience and Technology, based on fundamental science ranging from Physics, Chemistry, and Biology, is finding applications in all areas of technology ranging from high-tech fields such as computer science, automotive industry, semiconductors to high value-added industries such as medicine, life science, energy, and agriculture.

• CH716 NanoBio Chemistry 3credits

This course provides basic knowledge of recent advances in bio-nanotechnology from a chemical science aspect. Nano and Bio Technology, based on fundamental science ranging from Physics, Chemistry, and Biology, is finding applications in all areas of technology ranging from high-tech fields such as computer science, automotive industry, semiconductors to high value-added industries such as

medicine, life science, energy, and agriculture.

• CH717 Organic Reaction Mechanism 3credits

This lecture will be discussed for the reaction example according to various organic reaction in order to understand the organic reaction. This lecture is contained the kinetic reaction according to electron transfer in organic reaction.

• CH718 Organic Spectroscopy 3credits

Organic spectroscopy principles, instrumentation, and analytical applications of atomic spectroscopies, mass spectrometry, separations, NMR, electrochemistry, and micro-characterization on small organic molecules and bioanalytical applications. a survey of modern surface analytical techniques including electron diffraction, auger electron spectroscopy, photoelectron spectroscopy, vibrational spectroscopy, scanning tunneling microscopy, and mass spectrometry. Research in these areas is based on a variety of experimental techniques and approaches: synchroton radiation; photoelectron spectroscopy; molecular beams; low-energy electron diffraction; X-ray diffraction; ultrafast laser spectroscopy; high-resolution and solid state NMR, ESR and optical spectroscopy; chemical synthesis; the measurement of thermodynamic and transport properties; second harmonic generation (SHG) and sum frequency generation (SFG)-surface vibrational spectroscopy; scanning tunneling microscope; atomic force microscope; and Coherent anti-Stokes Raman microscopy.

• CH719 Special Topics in Organic Chemistry 2 3credits

Discusses the principles of experimental organic molecules design, data acquisition, analysis and interpretation, and the presentation of experimental results. Students are exposed to a broad range of quantitative laboratory methods in preparation for thesis work in organic chemistry. Typical laboratory exercises include synthesis, characterization, spectroscopy, kinetics, thermodynamics, electronics and instrument design. Lectures on experimental organic molecules design, data analysis, interpretation, and presentation. More reactions that are useful to the practice of synthetic organic chemistry.

• CH720 Special Topics in Organic Chemistry 3 3credits

Discusses the principles of experimental organic molecules design, data acquisition, analysis and interpretation, and the presentation of experimental results. Students are exposed to a broad range of quantitative laboratory methods in preparation for thesis work in organic chemistry. Typical laboratory exercises include synthesis, characterization, spectroscopy, kinetics, thermodynamics, electronics and instrument design. Lectures on experimental organic molecules design, data analysis, interpretation, and presentation. More reactions that are

useful to the practice of synthetic organic chemistry.

• CH721 Structural Polymer Chemistry 3credits

An interdisciplinary course on the synthesis, characterization, and properties of polymer materials. Emphasis on the molecular origin of properties of polymeric materials and technological applications. Topics include single molecule properties, polymer mixtures and solutions, melts, glasses, elastomers, and crystals. Characterization of macromolecules. Structure-property relationships. Specialty polymers and their applications: polymers in therapeutics, biomedical polymers and implants, conducting polymers, polymers in microelectronics and photonics, polymers in separation and molecular recognition, supramolecular chemistry, and self-assembly.

• CH722 Alkaloid Chemistry 3credits

There are many alkaloid compounds with nitrogen element in nature compounds. This lecture will be discussed for the property of alkaloid compounds, the structure of alkaloid, the mechanism of alkalods in reaction, and the purification of alkalod compounds for nature. In addition, this lecture also will be discussed about history of alkaloid compounds, about application of alkaloid compounds for drugs, and about vision of alkaloid compounds.

• CH723 Enzyme Chemistry 3credits

The course will focus on the principles of enzyme catalysis. The course will begin with an introduction to the general concepts of enzyme catalysis, which will be followed by detailed examples that will examine the chemistry behind the reactions and the three-dimensional structures that carry out the transformations.

• CH724 Organometallic Chemistry 2 3credits

This course is focused on molecular species that contain metal-carbon bonds, and the role of these compounds in catalytic processes and organic synthesis. Aspects of the synthesis, structure and reactivity of important classes of organometallic compounds such as metallo alkyl, aryl, alkene, alkylidene and alkylidyne complexes are surveyed for the d and f block metals. Emphasis is placed on general patterns of reactivity and recurring themes for reaction mechanisms.

• CH725 Structural Organic Chemistry 3credits

Introduction to advanced organic synthesis. Study of important synthetic reactions including: oxidations, reductions, and methods for the formation of carbon-carbon bonds, with an emphasis in chemoselectivity, stereoselectivity and asymmetric

synthesis. Survey of modern methods for the synthesis of small, medium and large ring systems. Analysis of modern synthetic strategies, with illustrative examples from total synthesis of natural and unnatural products.

• CH726 NanoBio Sensor 3credits

An interdisciplinary course on the synthesis, characterization, and properties of Organic nano-materials chemistry. Emphasis on the molecular origin of properties of organic nano-materials chemistry materials and technological applications. Introduction to the basic concepts of nano/organic hybrid and design nanoarchitecture as a concomitant objective, to further develop next-generation display materials, highly sensitive diagnostics systems for biomolecules and nanomembranes that support green chemistry.

• CH732 NanoBio Material Chemistry 3credits

This lecture will be discussed for NanoBio Material Chemistry, deal with Biology, Chemistry, Medical Science, Pharmacology and materials. We consist of Nanotechnology and Biotechnology. Nanomaterials make the connection between chemistry and a wide range of practical materials used to fabricate electronic, optical and other devices. Also Chemistry is designed for students with career objectives in the science of synthetic or biological macromolecules, including plastics.

◆ Inorganic Chemistry

• CH628 Advanced Inorganic Chemistry 3credits

Structural principles and bonding theories are discussed for the various classes of inorganic and organometallic compounds. Includes an introduction to the electronic structure of transition elements and ligand field theory. Synthetic and mechanistic aspects of inorganic chemistry are presented; modern problems in inorganic chemistry are emphasized.

• CH629 Complex Chemistry 3credits

Lectures will include basic principles of bonding theories such as valence bond theory (VBT), molecular orbital theory (MOT), and crystal field theory (CFT) for coordination compounds, and also include the physical properties such as stereochemistry, preparations, stability, and reactivities such as substitutions, reduction-oxidation.

• CH630 Structural Inorganic Chemistry 3credits

This course will explain in non-mathematical terms how essentially all biological properties are determined by the microscopic chemical properties of proteins. It

will also explain how research results, especially those of structural biology, are presented to its various audiences.

• CH631 Inorganic Reaction Machanism 3credits

A detailed treatment of the theory and application of modern physical methods for the elucidation of structure and mechanism in inorganic and organometallic chemistry. An introduction to symmetry and group theory is followed by the application of these concepts to vibrational and electronic spectroscopy of inorganic complexes. Magnetic resonance is discussed in detail, including topics such as EPR, fourier transform methods, dynamic systems, and 2-dimensional NMR.

• CH632 Special Topics In Inorganic Chemistry 1 3credits

Special topics in inorganic chemistry among the recent literatures will be discussed for the literature survey, experimental, and discussion for results, developing creativity in research for inorganic chemistry and learning new concepts and theories.

• CH633 Seminar on Inorganic Chemistry 3credits

Course will be offered to the students who will major in inorganic chemistry to bring up the ability and creativity for theory and experimental methods in their research fields by survey of recently published literatures. Special topics will be selected each semester by considering the research field of the students, and will be discussed for theory, synthesis, and application.

• CH634 Silicon chemistry 3credits

Introduction to coordination chemistry with transition metals. Topics are structure and bonding, synthesis and reactions of the d-transition metals and their compounds. Also include the nomenclature, isomerism, stability of coordination compounds, and Synthesis, structure analysis, and reactivity patterns in terms of symmetry orbitals.

• CH635 Inorganic material chemistry 3credits

Development of a new inorganic material is a big issue recently, and those are mostly solid materials such as a thin film, ceramics, and single crystals. Course will include the chemical bonds that formed by atoms and ions in solid, and arragnement/structure of neutral atoms and anions/cations inside solid crystals. Course also will include the several theories such as molecular orbital theory, band theory, spectroscopy, and symmetry in order to understand the properties of these solid materials, and applications such as inorganic super-conductors,

inorganic magnetic materials, non-linear optical materials, bio-inorganic materials, liquid-crystal containing metals, materials for electronical parts.

• CH636 Inorganic Polymer Chemistry 3credits

Synthesis, study of properties, and applications of inorganic polymers such as polyphospazenes, polysiloxanes and polysilanes are very active recently in the fields of chemistry, polymer chemistry, chemical engineering, and material science, and many inorganic polymeric materials were developed as high-tech materials with special purposes and applications such as conductive polymers or photoresists. Course will include the synthesis, structure determination, properties, reactivity and applications of those inorganic polymers.

• CH727 Organometallic Chemistry1 3credits

Organometallic chemistry is a conjunction field of organic and inorganic chemistry. Organometallic compounds which contain transition metals and main group metals have characteristic properties that can be useful as a reactant in synthetic organic chemistry, and a catalyst in polymer synthesis. Course will include the synthesis, structure determination, properties and reactivity of organometallic compounds. and study the applications such as a homogeneous catalyst and a new material.

• CH728 Ligand Field Theory 3credits

Ligand field theory is a theory for bonding of transition metals and other compounds and for electronic and magnetic and spectroscopic properties of transition metal complexes. Course will include the electrostatic consideration of orbitals of metal ions with surrounding atoms/groups, study the structural characteristics, spectroscopic and magnetic properties.

• CH729 Special Topics In Inorganic Chemistry 2 3credits

For advanced students: Special topics in inorganic chemistry among the recent literatures will be discussed for the literature survey, experimental, and discussion for results, developing creativity in research for inorganic chemistry and learning new concepts and theories.

• CH730 Special Topics In Inorganic Chemistry 3 3credits

For advanced students: Special topics in inorganic chemistry among the recent literatures will be discussed for the literature survey, experimental, and discussion for results, developing creativity in research for inorganic chemistry and learning new concepts and theories.

• CH731 Bio-inorganic chemistry 3credits

The course covers selected topics in bioinorganic chemistry; special emphasis is placed on dioxygen chemistry and electron transfer processes. Course topics include: (i) oxygen uptake and utilization; (ii) diatomic oxygen trans port; (iii) diatomic and monoatomic oxygen incorporation into substrates; (iv) metalloenzyme-catalyzed C-C bond formation; (v) the metallobiochemistry of DNA; (vi) metal-sulfide proteins; (vii) manganese-containing metalloproteins; (viii) Photosystem II: light-driven electron transfer and the biological water-splitting reaction; (ix) biological electron transfer; (x) electron transfer theory; (xi) mechanisms of energy storage and release; and (xii) long-distance electron transfer reactions.

• CH637 Master Seminar1
• CH638 Master Seminar2
• CH733 Doctor Seminar1
• CH734 Doctor Seminar2
• Research for the Master's Degree 1
• Research for the Master's Degree 2
• Research for the Doctoral Degree 1
• Research for the Doctoral Degree 2
• Research for the Doctoral Degree 3