Description of Courses

CH211 Physical Chemistry I

This course presents thermodynamic principles and their chemical applications to gases, liquids, and solids with an emphasis on equilibrium properties of chemical reactions, phase, and solution.

CH213 Physical Chemistry II

This course is designed to introduce quantum chemistry including electronic structures and molecular spectroscopy. Topics include: historical background of quantum mechanics, the Schrödinger wave equation and simple applications, postulates of quantum mechanics, the harmonic oscillator, the rigid rotor and angular momentum, the hydrogen atom, the variational method and perturbation theory, many-electron atoms, the simple MO and VB description of hydrogen molecules, hybrid and molecular orbitals for polyatomic molecules, the Hückel and extended Hückel molecular orbital method, rudimentary molecular spectroscopy.

CH221 Organic Chemistry I

This course is aimed at sophomores in chemistry-related fields and covers the basic concepts and general principles of organic chemistry to give students an ability to explore structure analysis, organic reactions, and applications for their own advanced study.

Topics:

1. Structure and Properties (3 classes)
2. Alkanes : Transition State, Free Radical Reaction (1 class)
3. Stereochemistry (6 classes)
4. Alkyl Halides : Nucleophilic Substitution (6 classes)
5. Alkenes : Elimination and Electrophilic Additions (6 classes)
6. Conjugation and Resonance (6 classes)
7. Alkynes (3 classes)
8. Tests (3 classes)

CH222 Organic Chemistry Experiment I

This course instructs sophomores in chemistry-related fields how to handle organic apparatus, practice separation techniques, and perform basic organic reactions.

Prerequisites by topic:

1. General Chemistry
2. General Chemistry Experiment
3. Organic Chemistry I

Experiments: (each topic 1 class for 6 hr)

1. Introduction
2. Calibration of Thermometer, Simple Distillation
3. Boiling Point Apparatus
4. Fractional Distillation
5. Recrystallization and Melting Point
6. Column Chromatography
7. Thin-Layer Chromatography
8. *t*-Butyl Chloride S_N1 Reaction
9. *n*-Butyl Bromide S_N2 Reaction
10. Free Radical Halogenation of Cyclohexane
11. Dehydration of Cyclohexanol
12. Oxidation of an Aromatic Side Chain to a Carboxylic Acid
13. Esterification: Preparation of Methyl Benzoate

CH223 Organic Chemistry II

This course presents sophomores in chemistry-related field the basic concepts and the general principles of organic chemistry and gives them the ability to explore structural analysis, organic reactions, and applications useful for advanced study. Topics covered include: alicyclic hydrocarbons, aromaticity and electrophilic aromatic substitution, arenes and their derivatives, spectroscopy and structure, alcohols, ethers and epoxides, neighboring group effects and catalysis by transition metal complexes, aldehydes and ketones, enantiotopic and diastereotopic ligands and faces, carboxylic acids, carboxylic acid derivatives, aldol and Claisen condensations, tests.

Prerequisite Course : CH221

CH224 Organic Chemistry Experiment II

This course is designed for sophomores in chemistry-related fields and involves performing basic organic reactions and interpreting spectroscopic data from these reactions. Topics covered include: General Chemistry, General Chemistry Laboratory, Organic Chemistry 1, Organic Chemistry Experiment I, Organic Chemistry II.

CH261 Analytical Chemistry

This course provides juniors in chemistry with a rigorous background in chemical principles that is particularly important to analytical chemistry and gives an appreciation for the challenging task of judging the accuracy and precision of experimental data.

Prerequisites by topic : Strong and weak electrolytes, Acid and base concepts including strength, Unit of weight and concentration (moles, formula weight, percent (w/w), volume percent (v/v) etc.). Stoichiometric relationship, Equilibrium concept and equilibrium constant calculation.

CH262 Analytical Chemistry Experiment

This course gives junior chemistry majors a broad scope of physical chemistry covering fundamental concepts of transport, spectroscopy, kinetics, statistical thermodynamics, and solid state.

Emphasis is on properties of ideal and non-ideal solutions, surface phenomena, structure of matter, transport properties, chemical kinetics, and electrochemistry. Prerequisite Courses : General Chemistry, Calculus, Analytical Chemistry, Physical Chemistry I.

CH314 Physical Chemistry Experiment

This course covers an introduction to principles of experimental methods applied to physical chemistry, practice using experimental techniques, and data analysis. Subjects include electronics, chemical equilibrium, thermodynamics, transport phenomena, chemical kinetics, molecular orbital calculation applications of molecular spectroscopy including NMR, ESR, IR and laser, scanning tunneling microscopy, diffraction, surface phenomena and electrochemistry. This course is designed for sophomores in chemistry-related fields.

CH315 Physical Chemistry III

This course gives junior chemistry majors a broad scope of physical chemistry covering fundamental concepts of transport, spectroscopy, kinetics, statistical thermodynamics, and solid state materials. Emphasis is on properties of ideal and non-ideal solutions, surface phenomena, structure of matter, transport properties, chemical kinetics, and electrochemistry Prerequisite Course : General Chemistry, Calculus, Analytical Chemistry, Physical Chemistry I

CH316 Molecular Spectroscopy

This course includes molecular symmetry and application of group theory, interpretation of rotational, vibrational, and electronic spectra, and the basic principles of various spectroscopic methods to determine

molecular structure.

CH325 Organic Chemistry III

This course is designed to explain the mechanism of organic reactions and to give juniors in chemistry the ability to understand modern organic chemistry. Topics include: Carbanions, Amines, Phenols, Carbonyl, Compounds, Molecular Orbitals, Aromatic Compounds, Heterocyclic Compounds, Macromolecules, Fats, Carbohydrates. Amino Acids, and Molecular Biology. Topical Prerequisites: formation and utilization of carbaions. structure and characterization of amino acids, nucleophilic aromatic substitution of arylhalides, molecular orbital theory and orbital symmetry, structure and chemical properties of heterocyclic compounds, synthesis and properties of polymers, introduction of carbohydrates.

CH336 Physical Organic Chemistry

This course is designed to give juniors in chemistry an insight of bonding and conformational analysis, nucleophilic substitution at carbon, elimination and addition reactions, carbene chemistry and cycloaddition reaction.

Topics include : Structure and mechanism, aliphatic nucleophilic substitution, elimination reactions, addition reactions, aromatic electrophilic substitution, molecular rearrangement, aliphatic radical substitution, pericyclic reaction, kinetic studies, linear Gibbs energy relations, acid & bases, and reaction medium.

CH341 Inorganic Chemistry I

This course is designed to give juniors in chemistry a modern insight into inorganic chemistry with a good balance between theory, descriptive chemistry, and applications. The principal purpose is to instill the fundamental concepts regarding chemical bonds, molecular symmetry, physical methods in inorganic chemistry, coordination, and organometallic chemistry of transition elements. Topics include : theoretical basis, molecular structure, analytical methods, coordination chemistry, and advanced topics in coordination chemistry.

CH342 Inorganic Chemistry II

This course is designed to provide juniors in chemistry with an understanding of periodic trends for the elements, simple compounds and more complex compounds. Course topics include : periodic trends for the elements, complex compounds, solid-state chemistry, solution chemistry.

Topical Prerequisites: Review of atomic theory, theories of chemical bonds, molecular symmetry in inorganic chemistry, theories of coordination chemistry.

Prerequisite course : CH341

CH343 Inorganic Chemistry Experiment

This course is designed to acquaint students with all the techniques commonly used for synthesis and characterization of inorganic and organometallic compounds. Topics discussed include : synthesis and reactions of inorganic and organometallic compounds coordination chemistry, optical isomers. Topical Prerequisites: molecular symmetry in inorganic chemistry, infrared and Raman spectroscopy, resonance spectroscopy, coordination theories and crystal field theory.

Prerequisite Course : CH341

CH381 Biochemistry I

This course is designed to teach structure and function of protein, storage of metabolic energy, and introduce recombinant DNA technology for various biochemical studies. Topics discussed include : amino acids and proteins, molecules of heredity, protein conformation, enzymes, introduction to biological membranes, bioenergetics, carbohydrates, glycolysis, the citric acid cycle, oxidative phosphorylation, pentose phosphate pathway, gluconeogenesis, glycogen metabolism.

CH417 Chemical Reaction Dynamics
This course covers chemical kinetics with a discussion of various theories. Theories of rate constants and chemical dynamics are treated with special emphasis on applications to other fields, including industry.

CH418 Computation Chemistry
This course covers numerical methods for molecular mechanics, the principle of molecular dynamics and the Monte Carlo method.

CH437 Organic Spectroscopy
This course is designed to give students in chemical science an understanding of spectroscopic methods of structure determination and qualitative analysis in organic chemistry.

CH444 Inorganic Chemistry III
The course covers basic principles of group theory for the application of molecular structure determination, chemical bonding and spectroscopy of inorganic substances.

CH463 Instrumental Analysis
This course is designed to give seniors and graduate students in chemistry an insight into a variety of spectroscopic instruments and separation techniques. The principal purpose of this course is to give an appreciation for modern instrumentation and to explain how to analyze transduced instrumental signals. Topics include basic principles and analysis of spectra of spectroscopic methods (NMR, IR, UV, Mass, X-ray, etc.) and separation techniques (GC, HPLC).

CH471 Introduction to Polymer Chemistry
This course is designed to introduce polymer chemistry at the advanced undergraduate level for students with a background in organic chemistry. Topics include: concepts of polymerization reaction mechanisms, kinetics and stereochemistry. Prerequisites by topic: Organic Chemistry I

CH482 Biochemistry II
This course is designed to teach the biosynthesis of macromolecules and their precursors, and the chemical, physiological, and genetical aspects of regulation of biosynthesis. This is a continuation of Biochemistry I (CH381).

CH483 Biochemistry Experiment
This course is designed to introduce basic concepts of biochemical principles through classical and modern biochemical experiments. This includes an introduction to experimental techniques of classical and modern biochemistry.
CH490 B.S. Thesis Research

CH495 Individual Study

CH502 Quantum Chemistry I
The purpose of this course is to give graduate students in Chemistry the ability to understand electronic structure and spectroscopic properties of atoms and molecules by means of theoretical techniques, such as ab initio and semiempirical methods. Topics include : Hartree-Fock Approximation, configuration interaction, ab initio and semiempirical methods.
Prerequisite Course : CH315
Prerequisites by topic : Matrix algebra, Hypergeometric functions, Fundamentals of classical mechanics, and

Group theory.

CH503 Statistical Thermodynamics I
This course covers the principles of statistical mechanics and many practical applications involving gas, solid, liquid, surface and dielectric properties. Also, emphasis is made on the dynamical aspects of topics such as transport phenomena and chemical reactions. Statistical mechanics of gas, solid, liquid, surface, dielectric properties, transport, phenomena is also covered.

CH521 Advanced Organic Chemistry I
The course surveys both classical and modern concepts using electronic interpretation of organic reactions. Topics include electrophilic reactions of Aromatic compounds, Nucleophillic reactions, Stereochemistry, Hammett linear free-energy relationships, Adddition-elimination molecular rearrangements and Woodward-Hoffmann-type relationships.

CH522 Organic Synthesis
The lecture covers carbon-carbon bond formation of organic syntheses including alkylation, aldol condensation, free radical reaction rearrangement and cycloaddition reaction.

CH523 Organic Synthesis II
This course allows graduate students in Chemistry to survey new widely applied synthetic methods in organic synthesis and to understand the basic ideas and advances in the field.
Topic include : Formation of carbon-carbon single bonds, formation of carbon-carbon double bonds, the Diels-Alder and related reactions, Reactions at unactivated C-H bonds, Synthetic applications of organoboranes and organosilanes, Oxidation reactions, and Reduction reactions.

CH541 Advanced Inorganic Chemistry
This course is intended for first-year graduate students. The principal purpose is to introduce the fundamental theoretical concepts of geometrical and electronic structures of transition element compounds.
Descriptive Chemistry will not be developed to any great extent in this lecture. Topical Prerequisites: Inorganic Chemistry, Physical Chemistry, Analytical Chemistry

CH542 Organometallic Chemistry
This course is designed for senior undergraduate and graduate students in teaching reaction mechanisms, and synthetic and catalytic aspects of transition metal organometallic compounds.
Prerequisite Courses : CH341 and CH342
rerequisite by Topics: General properties of organometallic complexes, survey of organometallic complexes and their reactions categorized by ligands, reaction mechanisms, characterization of organometallic complexes, catalytic processes, applications to organic synthesis, and bioorganometallic Chemistry.

CH581 Advanced Biochemisty
This course covers advanced description of biosynthesis of macromolecules including such topics as replication gene expression, protein synthesis as well as a discussion of nature and functional aspects of protein and nucleic and structures.

CH604 Quantum Chemistry II
This course presents molecular spectroscopy and modern quantum chemistry with main emphases on the understanding of modern electronic structure calculations.
Topics include : Brief review of rudimentary Quantum Mechanics, Atomic spectra, Rovibronic spectra of diatomic molecules, Rovibronic spectra of polyatomic molecules, Magnetic resonance spectroscopy, Modern

spectroscopy, Ab initio MO calculations and Semi-empirical MO calculations.

CH605 Statistical Thermodynamics II
This course presents a rigorous treatment of classical statistical mechanics with the application to real systems followed by the recent theory of critical phenomena.

CH606 Molecular Reaction Dynamics
This course is designed to give graduate students in Physical Chemistry major an ability to interpret chemical and physical observations of reaction chemical species and to predict their behavior in different environments. Topics include: Basic concepts of elementary reactions, Molecular collisions, Reaction scattering, and Molecular energy transfer.
Prerequisites by Topic: Chemical Kinetics, CH417 and Calculus and differential equations, operational mathematics, and matrix algebra.

CH607 Surface Chemistry
This course is designed to give high-level understanding to the Chemistry of solids, mainly metal and gas-solid interface structures. Thermodynamics and dynamics of the solid surface are discussed with a brief introduction to solid state dynamics. The main area of study is the absorption and deabsorption of gas molecules on metal surfaces and implications of these phenomena to the theory of catalytic behavior.
Topic include: Principle of the surface analysis methods such as Auger, XPS, LEED, SEXAFS, Chemisorption on surfaces, and Catalytic reactions on surfaces.

CH609 Electrochemistry
This course is designed to provide graduate students in Chemistry with insight into electrode processes in various electrochemical excitation situations. The principal purpose is to apply this knowledge to the study of various electrochemical properties and analysis of compounds. Topics covered are: basic principles and applications for the study of electrochemical properties and analysis of compounds.

CH610 NMR Spectroscopy
This course is designed for graduate students and research scientists with an interest in how nuclear magnetic resonance (NMR) techniques can be used to provide valuable information to physical and biological chemists. This course will introduce basic NMR theory, including a Quantum Mechanical description of the NMR experiment. Examples of chemical data obtained using NMR will be summarized along with other related experiments. The course will then focus on density matrix treatment of multipulse NMR sequence and include discussions of product operator formalism.

CH626 Natural Product Chemistry
This course is designed to acquaint the graduate student with isolations, purifications and structural elucidations, and total syntheses of various interesting biologically active natural products. Isolation and structural determination of natural products are introduced. Organic synthesis of natural products in selected topics such as antibiotics, toxins, proteins, steroids, and various alkaloids is introduced.

CH627 Heterocyclic Chemistry
This course is designed to give graduate students a grasp of topics surrounding the synthesis and characterization of heterocycles and utilization of heterocycles for general organic syntheses. The effects of hetero-atoms on reactivity will be discussed. The course also deals with some topics such as the synthesis and characterization of heterocyclic compounds, and how to use these compounds for organic synthesis.

CH628 Organometallic Chemistry

This course involves a systematic survey of organic reactions regarding organometallics particularly organo-transition metal complexes including addition, elimination, insertion, and oxidation / reduction reactions.

CH632 Stereochemistry

This course is designed to introduce graduate students to the study of reaction mechanisms, the determination of relative configurations and the synthesis of optically active compounds. Topics include : Fundamental comprehension of sterochemistry in organic chemistry, resolution, asymmetric synthesis, stereocontrolled organic reactions and new chiral auxilliaries.

CH644 Bio-Inorganic Chemistry

This graduate course is designed to cover the role of metal ions in biological processes observed in biological systems. Metallobiomolecules which will be discussed in detail include enzymes, transport and storage proteins, non-proteins etc. Synthetic model approaches will be emphasized. Prerequisites by topic : Inorganic Chemistry and Analytical Chemistry.

CH645 Catalysis Chemistry

This course is designed to introduce graduate students in Chemistry and Chemical Engineering to fundamental concepts of heterogeneous catalysts and to illustrate various aspects of homogeneous and heterogeneous catalysis research.

Topic include: Catalytic activities of transition metal systems, Heterogeneous Catalysis, Catalytic cycles, Ligand systems.

CH646 Solid State Chemistry

This course introduces the synthesis, structure, properties and applications of solid state materials: topics that are very close to modern technology from a chemist's viewpoint. Solid state reaction mechanism, synthesis and characterization of materials are the important topics. Other topics include physical and chemical properties and applications to materials.

CH671 Organic Chemistry of High Polymers

This course is designed to give graduate students in Chemistry a survey of the synthesis and reactions of organic polymers and their physical characterization including kinetics of radical species and condensation polymerization, stereochemistry of polymers, ionic polymerizations and other organic chemistry of polymers.

CH672 Polymer Physical Chemistry

This course involves thermodynamic analysis of structure and properties of polymer systems. The focus here is on polymer structure, thermodynamics of polymer solutons, elasticity of rubber, phase equilibrium, friction, and transport processes.

CH673 Specialty Polymer Chemistry

This course involves synthesis and properties of photonically and electronically functional polymers. Focus is on conducting polymers, photoconducting polymers, photoresponsive polymers, nonlinear optical polymer, electroluminescent polymers, polymer batteries, and photoresists.

CH711 Special Topics in Physical Chemistry I

This course is designed to give students exposure to "hot topics" and recent advancements in the field of gas and liquid phase studies through lectures and seminars. The formal structure of this course combines lectures by the instructor as well as seminars contributed by students.

CH712 Special Topics in Physical Chemistry II
This course is designed to give students exposure to ″hot topics″ and recent advancements in the field of solid phase and surface studies through lectures and seminars. The formal structure of this course combines lectures by the instructor as well as seminars contributed by students.

CH713 Special Topics in Physical Chemistry III
This course is designed to give students exposure to ″hot topics″ and recent advancements in the field of theoretical and computational studies through lectures and seminars. The formal structure of this course combines lectures by the instructor as well as seminars contributed by students.

CH733 Special Topics in Organic Chemistry I
This course covers special topics in physical organic chemistry such as mechanisms of new organic reactions, molecular dynamics, chemical structures and reactivity, and new molecular orbital calculations.

CH734 Special Topics in Organic Chemistry II
This course involves the study of recent research papers in the aim to acquire various synthetic strategies applicable in synthesizing organic compounds such as terpenoid, macrolide, alkaloid, carbohydrate, and heterocyclic compounds. Based on this new knowledge, students are expected to apply new tools in their own studies and to develop their creativity in their research. The formal structure of this course involves lectures by the instructor as well as seminars contributed by students.

CH735 Special Topics in Organic Chemistry III
This course involves the study of electron rearrangements in various chemical functional groups and the progression of chemical properties due to structural changes. Mechanisms of many biologically active compounds are considered in great depth and the synthesis of new compounds and their synthetic strategies are studied.

CH746 Special Topics in Inorganic Chemistry I
This course is designed to texpand on recent ″hot topics″ in inorganic chemistry through lectures and seminars in the aim to increase students' exposure to broader fields other than their immediate research interests.

CH747 Special Topics in Inorganic Chemistry II
This course is designed to involve in-depth study of a special topic, such as crystallography and inorganic structure. The formal structure of this course may involve seminars contributed by students and case studies in addition to the normal lectures.

CH773 Special Topics in Polymer Chemistry I
This course is composed of lectures on special topics selected from recent ″hot topics″ in polymer chemistry. The topics include synthetic metals, liquid crystals, photonic polymers, degradable polymers, thermoresistant polymers and new materials.

CH774 Special Topics in Polymer Chemistry II
This course involves an in-depth study of molecular weight distribution, degrees of freedom, structural regularity, determination of micro-structures, and the relationship between chemical structure and polymer properties.

CH782 Special Topics in Biochemistry I

This course involves lectures on special topics selected from recent hot topics in nucleic acid biochemistry and discussions through seminars. Topics including the properties and structures of nucleic acids, gene structure and function, gene expression, gene recombination, and their applications will be covered.

CH783 Special Topics in Biochemistry II

This course develops selected recent ″hot topics″ in protein biochemistry and discussions through seminars. Topics include the physical and chemical properties of proteins, protein structure, protein purification, the formation of the protein-ligand complexes, enzyme reaction theory and enzyme reaction mechanisms.

CH791 Special Topics in Contemporary Chemistry I

This course involves recent research trends in all chemical research areas; in particular, joint research among chemistry, life science and material science, are systematically covered.

CH792 Special Topics in Contemporary Chemistry II

Following from CH791, this course involves further recent research trends in all chemical research areas, again focusing systematically on joint research efforts among chemistry, life science and material science.