Appendix A

CHEMISTRY DOCTORAL COURSES

An asterisk after a course number indicates that the course has not been offered during the last three years. Students are encouraged to express their interest in taking a course so designated to the Executive Officer. Five students must be registered for credit to give a course.

Chem. 60000 Glassblowing
90 hours laboratory, 2 credits
Practice in glassblowing as applied in chemical research.
Chem. 60100 Project Teach
15 hours, 1 credit
An introduction to teaching college recitation and laboratory sections.
Chem. 71000 Advanced Inorganic Chemistry
45 hours, 3 credits
Structure and bonding of inorganic compounds. Ligand field theory. An introduction to group theory. Prerequisite: An advanced undergraduate inorganic chemistry course or an undergraduate course in quantum chemistry.
Chem. 73000 Polymer Chemistry
45 hours, 3 credits
Introduction to the principles of polymer chemistry.
Chem. 74000* Advanced Methods of Chemical Analysis
45 hours, 3 credits
General methods in analytical procedures, including sampling, sample handling, data treatment, and calibration methods fundamental to all analyses.
Chem. 75000 Advanced Organic Chemistry, I
45 hours, 3 credits
A fundamental course in physical organic chemistry covering molecular structures and reaction mechanisms. Emphasis is on methodology of physical organic chemistry.
Chem. 75100 Advanced Organic Chemistry, II
45 hours, 3 credits
A survey and evaluation of methods for achieving the more common synthetic transformations in organic chemistry. Prerequisite: Chem. 75000 or permission of the Executive Officer
Chem. 75200 Quantum Organic Chemistry
45 hours, 3 credits
The application of quantum mechanics to organic chemistry and a critical evaluation of the results of various treatments. Prerequisite: Chem. 76000
Chem. 76000 Introductory Quantum Chemistry
45 hours, 3 credits
Introduction to the Schrodinger formulation of quantum mechanics and its application to atomic and molecular systems.
Chem. 76100 Spectroscopy
45 hours, 3 credits
Introduction to the spectroscopic analysis of atomic and molecular systems.
Chem. 77000 Chemical and Statistical Thermodynamics and Chemical Kinetics
60 hours, 4 credits

Introduction to classical chemical thermodynamics, quantum statistical thermodynamics, and chemical kinetics.

Chem. 78000 Chemical Information Sources
15 hours, 1 credit
Introduction to the retrieval of chemical information.

Chem. 78500 Introduction to Nanotechnology
60 hours, 4 credits
This course introduces students to current topics in nanotechnology and surveys basic background in solid-state physics, surface science, synthetic molecular assembly of nanoscale materials and photochemistry.

Chem. 7900l Basic Laboratory Techniques for Research in Analytical, Physical and Inorganic Chemistry
l5 hours lecture, l05 hours laboratory, 4 credits
Lecture and laboratory work dealing with the theories and applications of modern approaches to the solution of problems in analytical, physical, and inorganic chemistry.

Chem. 79002 Basic Laboratory Techniques for Research in Organic Chemistry
l5 hours lecture, l05 hours laboratory, 4 credits
Lecture and laboratory work designed to teach preparative techniques, separation methods, and analytical procedures employed in the contemporary organic chemistry research laboratory.

Chem. 79003 Basic Laboratory Techniques for Research in Polymer Chemistry
l5 hours lecture, l05 hours laboratory, 4 credits
Lecture and laboratory work dealing with the theories and applications of modern approaches to the solution of problems in polymer chemistry.

Chem. 79041 and 79042 Basic Laboratory Techniques for Research in Molecular Biophysics, I and II
15 hours lecture, 105 hours laboratory, 4 credits
These courses consist of a two semester laboratory rotation for students in molecular biophysics that they take during their first year. Students study laboratory techniques in a number of laboratories based on their research interests and the recommendations of graduate advisors. Students gain laboratory experience in analytical and physical laboratory techniques that are needed to conduct research in molecular biophysics.

Chem. 79051 and 79052 Basic Laboratory Techniques for Research in Nanotechnology and Materials Chemistry, I and II
15 hours lecture, 105 hours laboratory, 4 credits
These courses consist of a two-lab rotation during the first year. Students should select their lab rotations based on their research interests and in consultation with the subdiscipline's graduate advisors. Students will gain basic laboratory experience in lab techniques related to research in nanotechnology and materials chemistry.

Chem. 79500 First-level Laboratory Research
Credits and hours variable
This course will accommodate students who wish to explore the feasibility of different research problems prior to deciding upon a dissertation topic. Permission of the Executive Officer is required. Open only to matriculated doctoral students.

Chem. 8050l Advanced Seminar in Theoretical, Physical and Inorganic Chemistry
l5 hours, l credit

Chem. 805ll Advanced Seminar in Organic Chemistry

l5 hours, l credit
Chem. 80521 Advanced Seminar in Analytical Chemistry
l5 hours, l credit
Chem. 80531 Advanced Seminar in Polymer Chemistry
l5 hours, l credit
Chem. 80541 Advanced Seminar in Molecular Biophysics
15 hours, 1 credit
Chem. 80551 Advanced Seminar in Nanotechnology and Materials Chemistry
15 hours, 1 credit
Chem. 81000 Research for the Doctoral Dissertation
Credits variable, one or more credits per semester
Prerequisite: First Examination

Special Topics Courses Admission to the following special topics courses is restricted to students who have completed all their required 70000-level courses or to other students upon permission of the instructor and the Executive Officer. Each course meets 45 hours, 3 credits, unless otherwise specified.

Chem. 81900* Special Topics in Inorganic Chemistry
Chem. 81901* Inorganic Systems
A comprehensive study of the structure and reactivity of inorganic compounds.
Chem. 81902* Kinetics and Mechanisms of Inorganic Reactions. Mechanism and theory of substitution reactions. Oxidation-reduction mechanisms. Homogeneous catalysis and stereochemical non-rigidity.
Chem. 81903* Bioinorganic Chemistry
Chem. 81904* Inorganic Photochemistry
Chem. 81905* Organometallic Chemistry and Catalysis
Chem. 83900* Special Topics in Polymer Chemistry
Chem. 83901 Advanced Polymer Chemistry I, Structure and Mechanisms in Polymerization
Mechanisms, kinetics and thermodynamics of step, chain, ring-opening and nonclassical polymerizations. Macromolecular synthesis by copolymerization, stereochemical regulation, and reactions of polymers. Structural analysis by NMR and other spectroscopic methods and correlation of structure with reaction parameters. Prerequisite: Chem. 73000
Chem. 83902 Advanced Polymer Chemistry II, Characterization and Properties of Polymers
Theory of polymer solutions and the characterization of molecular size, size distribution, configuration and conformation. Polymers as liquid and solid phases: morphological theory and examination, deformation and flow; mechanical, electrical and other properties. Relationship of polymer structure and behavior. Prerequisite: Chem. 73000
Chem. 84900* Special Topics in Analytical Chemistry
Chem. 84901* Theories of Analytical Chemistry
Chem. 84902* Chemistry in Nonaqueous Solutions
Chem. 84903 Chemical Separations
Principles, recent developments and applications of modern analytical separation techniques, with emphasis on chromatographic and electrophoretic methods.
Chem. 84904 Electroanalytical Chemistry
Methods of analysis and fundamental aspects of electrochemistry. Techniques covered include

DC and AC voltammetry, electrolysis, potentiometry and amperometry. Fundamental aspects of electron transfer, double layers and mass transport, and electronics.
Chem. 84905 Analytical Spectroscopy.
Principles of and practical consequences in analytical spectroscopic methods. Application of modern spectrochemical techniques to chemical analysis.
Chem. 84908 Light Microscope and Microchemical Analysis for Analytical Chemists
20 hours lecture, 60 hours laboratory, 3 credits
Chem. 84909 Microscopy and Microchemical Analysis for Chemists.
Chem. 85900 Special Topics in Organic Chemistry
Chem. 8590l* Determination of the Structure of Organic Molecules
A study of modern methods for determining the structure of organic compounds.
Chem. 85902 Organic Chemistry of Heterocycles
The preparation and properties of simple heterocyclic compounds of nitrogen, oxygen and sulfur with emphasis on medicinals and biologically active heterocycles.
Chem. 85903* Chemistry of Natural Products
Selected topics in the chemistry of naturally occurring compounds.
Chem. 85906* Photochemistry
The mechanisms of reactions occurring via electronically excited states.
Chem. 85907* Stereochemistry
Dynamic and structural aspects of stereochemistry including the special stereochemical aspects of second row elements.
Chem. 85908* Nuclear Magnetic Resonance Spectroscopy
The principles of nuclear magnetic resonance spectroscopy with illustrations of its applications in organic chemistry.
Chem. 859l0* Physical Organic Chemistry
A theoretical and practical treatment of the application of kinetics and thermodynamics to the study of organic mechanisms.
Chem. 86900 Special Topics in Physical Chemistry
Chem. 8690l* Colloid Chemistry
Introduction to the preparation and experimental characterization of colloids and the theoretical principles underlying the application of colloid chemistry in various fields.
Chem. 86902* Group Theory
Introduction to the group theoretical analysis of atomic and molecular systems
Chem. 86903* Statistical Mechanics
Advanced treatment of the application of quantum statistical mechanics to atomic and molecular systems.
Chem. 86904* Quantum Mechanics
Advanced treatment of the application of quantum mechanics to atomic and molecular systems.
Chem. 86905* Magnetic Resonance Spectroscopy
Theoretical treatment of magnetic resonance and its application to various aspects of nuclear magnetic resonance and electron spin resonance spectroscopy.
Chem. 86906* Radiochemistry
30 hours lecture, 60 hours laboratory, 4 credits
Treatment of the characteristics of radioactive decay, nuclear radiations, and the structure of the nucleus with emphasis on chemical applications of nuclear and radiochemical techniques.
Chem. 86907* Thermodynamic and Statistical Theories of Liquids and Solutions

Treatment of thermodynamic and statistical theories of liquids and solutions and their applications.

Chem. 86908* High Resolution Infrared Spectra

Theoretical treatment of the quantum states of a vibrating-rotating molecule and its application to the interpretation of high resolution infrared spectra.

Chem. 86909* Relaxation Processes Near Equilibrium

Treatment of the thermodynamics of irreversible processes, fluctuations in physical and chemical systems, linear transform methods, and relaxation methods.

Chem. 86910* Chemical Kinetics

Treatment of phenomenological chemical kinetics and theories of chemical reaction rates.

Chem. 86911* Catalysis

A detailed study of the nature of the catalytic process with emphasis upon the theoretical and mechanistic aspects.

Chem. 86912 Surface Chemistry

A detailed study of surface chemistry including the thermodynamic treatment of surfaces, electrical phenomena, interfacial transport, emulsions, and biological interfaces.

Chem. 86913* Solid State Physical Chemistry

A detailed study of solid state chemistry including bonding theory, statistical thermodynamic treatment of imperfections, diffusion in crystals, electrochemistry, and chemical reactions in solids.

Chem. 86915* Photochemistry

A detailed study of the experimental characterization and theoretical treatment of chemical reactions caused by the absorption of light.

Chem. 86916* Mechanistic Kinetics

A detailed study of the measurement of rates, determination of reaction orders, and characterization of mechanisms for specific chemical reactions including thermal decompositions, photochemical reactions, polymerization processes and chain reactions.

Chem. 86917* Computers in Chemistry

30 hours lecture, 45 hours laboratory, 3 credits

An introduction to the use of computers as an integral part of chemical experimentation.

Chem. 86918* Isotope Chemistry

An introduction to the experimental and theoretical treatment of the chemistry of stable and radioactive isotopes.

Chem. 86919 X-ray Crystal Structure Analysis

An introduction to the theory of structural analysis by X-ray methods.

Chem. 86920* Microprocessors for Experimentalists

45 hours lecture, 30 hours laboratory, 4 credits

Chem. 86921 Computational Chemistry

3 credits

Chem. 87901 Molecular Biophysics

45 hours, 3 credits

This is the second part of the core molecular biophysics sequence. The first part is Biochem. 77000: Physical Biochemistry. Whereas Biochem. 77000 teaches the fundamental principles of molecular biophysics Chem. 87901 is application and problem oriented. Topics include protein-DNA binding, molecular motors, G-protein coupled receptors, rational drug design, and protein association and aggregation.

Chem. 89000* Special Lectures in Chemistry
Hours and credits variable, 15 hours per credit
Chem. 90000 Dissertation Supervision
1 credit, Prerequisite: Advancement to Candidacy