

Department of Chemistry

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The Department of Chemistry offers a Master of Science degree with a major in Chemistry and the Doctor of Arts in Chemistry (*admission closed*). Also offered is a minor in Chemistry at the graduate level.

The required test score for admission to the M.S. program is a satisfactory Graduate Record Examination score.

Requirements for the Master of Science (5000 and 6000 level)

Chemistry

Candidate must

1. have an undergraduate minor in chemistry or its equivalent at time of admission.
2. complete a minimum of 30 semester hours with no more than 30 percent of the total degree hours dually listed as undergraduate/graduate hours.
3. complete the following core curriculum:
 - CHEM 6100 Intermediate Organic Chemistry, 3 hours
 - CHEM 6230 Intermediate Analytical Chemistry, 4 hours
(Quantitative Analysis is a prerequisite for this course; can be taken for undergraduate credit after admission.)
 - CHEM 6300 Intermediate Physical Chemistry, 3 hours
 - CHEM 6400 Intermediate Inorganic Chemistry, 3 hours
(Exceptionally well-prepared students may substitute another approved graduate chemistry course in the same area for the core course by successful performance on a proficiency examination in that core curriculum area.)
4. complete and present an original thesis approved by the student's advisory committee:
 - CHEM 6640 Thesis Research (3-8 credit hours count toward 30 degree hours)
 - CHEM 6800 Chemistry Seminar, 1 hour
 - CHEM 6870 Chemistry Research, 3 hours
5. complete a minimum of 5 credit hours of additional approved chemistry graduate courses, or approved cognate courses in biology, mathematics, computer science, or physics.
6. file a degree plan with the Graduate Office prior to the completion of 21 credit hours, and annually work out a plan of study for the following twelve months with the academic advisor.
7. successfully complete a comprehensive examination. The exam may be taken no more than twice.

Courses in Chemistry [CHEM]

Graduate standing and permission of department are prerequisites for graduate courses in chemistry. The 5000-level courses also have the same prerequisites as listed for the corresponding 4000-level courses in the undergraduate catalog.

- 5100 Organic Spectroscopy.** Three credits. Prerequisite: CHEM 3020/3021 or equivalent. Theory of and practice in the interpretation of mass, infrared, Raman, ultraviolet-visible, and nuclear magnetic resonance spectra. Offered every other spring.
- 5330/ 5340 Physical Chemistry Fundamentals.** Four credits each. Modern physical chemistry including current theories of atomic and molecular structures, chemical thermodynamics, electrochemistry, chemical kinetics, and related theoretical topics. Three lectures and one three-hour laboratory period. Offered every year.
- 5331/ 5341 Physical Chemistry Fundamentals Lab.** Zero credits. Offered every year.
- 5350/ 5360 Physical Chemistry.** Four credits each. Quantitative principles of chemistry involving extensive use of calculus. Major topics include thermodynamics, phase changes, chemical equilibria, electrochemistry, reaction kinetics, quantum chemistry, molecular structure, and statistical mechanics. Three lectures and one three-hour laboratory period. Offered every year.
- 5351/ 5361 Physical Chemistry Lab.** Zero credits. Offered every year.
- 5400 Inorganic Chemistry.** Three credits. Basic concepts and theories of inorganic chemistry and how these are used to predict and understand the physical and chemical properties of compounds of the elements other than carbon. Inorganic compounds in the air, water, earth, and in the laboratory, and in biochemistry, geochemistry, and industrial materials and processes. Offered on sufficient demand.
- 5600 Introduction to Environmental Chemistry.** Three credits. Quality of the environment and of chemical changes in the environment through contamination or modification of the air, water, and soils as affected by human, agricultural, industrial, and social activities. Offered every fall.
- 5630 Detection of Chemical Pollutants.** Four credits. Theory and practice of analytical chemistry methods used in pollution measurement. Three lectures and one three-hour laboratory period. Offered every other spring.
- 5631 Detection of Chemical Pollutants Lab.** Zero credits. Offered every other spring.
- 5700 Polymers, an Introduction.** Three credits. Structure, properties, and applications of polymers. Offered every other spring.
- 5730 Advanced Physical Chemistry.** Four credits. Modern chemical concepts and computations applied to quantum chemistry, molecular spectroscopy, and statistical thermodynamics. Three lectures and one three-hour calculation laboratory period. Offered on sufficient demand.
- 5731 Advanced Physical Chemistry Lab.** Zero credits. Offered on sufficient demand.
- 6100 Intermediate Organic Chemistry.** Three credits. Prerequisite: CHEM 3020/3021 or 2030/2031 or equivalent. Concepts and modern theories of organic chemistry: stereochemistry of reactions, mechanistic interpretation of organic reactions, and multi-step synthesis. Offered every fall.
- 6110 Topics in Organic Chemistry.** Three to six credits. Prerequisite: CHEM 6100. A selection of modern topics. Offered every other spring.
- 6200 Topics in Analytical Chemistry.** Three to six credits. Prerequisite: CHEM 4230/4231 or 6230/6231. Selected topics of major interest in chemical analysis. Offered every other fall.
- 6230 Intermediate Analytical Chemistry.** Four credits. Prerequisite: CHEM 2230/2231 or equivalent. Selected instrumental methods of analysis including but not limited to gas and liquid chromatography methods; ultraviolet, visible, and infrared spectroscopic methods; and flame emission and atomic absorption spectrometry. Three lectures and one three-hour laboratory period. Offered every spring.
- 6231 Intermediate Analytical Chemistry Lab.** Zero credits. Offered every spring.
- 6300 Intermediate Physical Chemistry.** Three credits. Key concepts from classical thermodynamics, quantum theory, and chemically relevant spectroscopies. Statistical thermodynamics introduced. Offered every spring.
- 6400 Intermediate Inorganic Chemistry.** Three credits. Concepts of inorganic chemistry needed for effective teaching of general chemistry and for safe and effective use of inorganic chemicals and materials in industrial and academic laboratories; atomic theory, principles of inorganic reactivity in acid-base; precipitation, complexation, and oxidation-reduction reactions; crystal and ligand field theory; symmetry; molecular orbital theory; organometallic chemistry. Offered every fall.
- 6410 Transition Metal and Theoretical Inorganic Chemistry.** Three credits. Prerequisite: CHEM 5400 or consent of instructor. The chemistry of transition metal complexes, organometallic compounds, and of related compounds, their practical applications, and modern theoretical treatments of this chemistry. Offered on sufficient demand.
- 6420 Topics in Inorganic Chemistry.** Three to six credits. Prerequisite: CHEM 6400. Selected topics of current interest in inorganic chemistry such as organo-metallic chemistry, inorganic materials science, and kinetics and mechanisms of inorganic reactions. Offered every other spring.
- 6480/ 6490 Laboratory in Inorganic Chemistry.** One credit each. Prerequisite or corequisite: CHEM 6400 (for 6480), CHEM 6420 or CHEM 5700 (for 6490), or consent of instructor.
6480 Inorganic Synthetic Methods. Offered every other fall.
6490 Physical Methods in Inorganic Chemistry Offered every other fall.
- 6500 Biochemistry I.** Three credits. Chemical properties of biological molecules such as proteins, lipids, nucleotides, and carbohydrates. Chemical basis of enzyme catalysis. Structure of biological membranes. Three hours lecture per week.
- 6510 Biochemistry II.** Three credits. Prerequisite: CHEM 6500. The structure of lipids, amino acids, nucleotides, and nucleic acids and their metabolism at a molecular level. Emphasis on understanding the chemical basis of biological phenomena. Offered every spring.
- 6520 Topics in Biochemistry.** Three to six credits. Prerequisite: CHEM 6500 or 6510 or consent of instructor. Selected topics of particular interest in biochemistry. Offered every other fall.

- 6530 Biochemical Techniques.** Two credits. Prerequisite/corequisite: CHEM 6500 or 6510 or consent of instructor. Laboratory in biochemical techniques with emphasis on protein purification, enzyme kinetics, carbohydrate and lipid analysis, and manipulation of DNA. Offered every spring.
- 6610 Environmental Chemistry.** Three credits. Fundamental chemical principles applied to the fate and behavior of organic and inorganic contaminants in the soil-water environment. Overview of soil-water chemistry presented, followed by contaminant reactions including adsorption.
- 6640 Thesis Research.** One to six credits per semester. Selection of a research problem, review of pertinent literature, collection and analysis of data, and composition of thesis. Once enrolled, student should register for at least one credit hour of master's research each semester until completion. S/U grading. Offered every term.
- 6720 Topics in Physical Chemistry.** Three to six credits. Prerequisite: CHEM 6300. Advanced theories of, latest literature in, and unsolved problems of a particular research area in physical chemistry selected by the professor. Offered every other fall.
- 6800 Chemistry Seminar.** One credit. Required of graduate students specializing in chemistry. Scientific articles reviewed and reports on individual research projects presented. Offered every term.
- 6870 Chemistry Research.** Three credits. Original laboratory problem that will furnish material for a thesis. Offered every fall.
- 7110 Advanced Topics in Organic Chemistry.** Three credits. Prerequisite: CHEM 6100. Applications and advanced concepts in physical organic chemistry, including those used in teaching organic chemistry. Topics include classical and modern approaches in physical organic chemistry including MO theory, conformational analysis, stereochemistry, reaction mechanisms, structure and solvent effects, pericyclic reactions, and theories of acidity/basicity. Offered every other spring.
- 7200 Advanced Chemical Separations and Chemical Equilibrium.** Three credits. Prerequisite: CHEM 6230/6231 or equivalent including a course in quantitative chemical analysis. Advances in theories and applications of analytical chemistry for students familiar with laboratory techniques and chemical instrumentation. Special attention given to chemical equilibrium as it applies to the practice and teaching of chemical separations. Offered every other fall.
- 7210 Problems in Modern Chemical Laboratory Procedures.** Three credits. Newly developed laboratory techniques and procedures which the student had not previously had the opportunity to learn. Offered on sufficient demand.
- 7220 Independent Study of Instrumental Analysis.** Three credits. Developing skill in using selected sophisticated instruments. Offered on sufficient demand.
- 7400 Computational Chemistry I.** Four credits. Prerequisite: foundation courses of the Computational Science Ph.D. program (COMS 6100, MATH 6500, CSCI 6300) or consent of instructor. Fundamental concepts and practical aspects of various electronic-structure models used in modern computational chemistry. Molecular orbital theory, *ab initio* and density functional methods, wave-function analyses, and geometry optimization techniques. Offered every fall. Three lectures and one three-hour computer lab.
- 7410 Computational Chemistry II.** Four credits. Prerequisites: CHEM 7400 and consent of instructor. Practical applications of quantum chemistry models. Calculation of molecular properties with high accuracy, computational techniques for large systems, structure prediction and structure-activity relationships. Offered every spring. Three lectures and one three-hour lab.
- 7420 Advanced Topics in Inorganic Chemistry.** Three credits. Prerequisite: CHEM 6400. Applications and advanced concepts of inorganic chemistry; methods of teaching these concepts. Inorganic materials such as metals, superconductors, zeolites, and fullerenes; organometallic compounds, halides, hydrides, and oxides of elements; inorganic reaction mechanisms; bioinorganic chemistry; electronic states and term symbols. Modern methods of teaching inorganic content in general chemistry courses. Offered every other spring.
- 7510 Advanced Biochemistry.** Three credits. Prerequisite: CHEM 6500 or consent of instructor. Advanced subjects in biochemistry including current techniques in structure/activity relationships of biomolecules, regulation and control of metabolic pathways, bioenergetics, enzymology, control of transcription and translation, regulation of gene expression, and biochemistry of inherited disease. Offered every other fall.
- 7640 Dissertation Research.** One to six credits. Selection of a research problem, review of pertinent literature, collection and analysis of data, and composition of dissertation. Once enrolled, student should register for at least one credit hour of doctoral research each semester until completion. S/U grading. Offered every term.
- 7700 Topics in Theoretical Chemistry.** Three to six credits. Bonding, stereochemistry, empirical and semi-empirical parameters, state functions, spectroscopic interpretation, and reaction mechanisms. Offered on sufficient demand.
- 7710 Topics in Applied Chemistry.** Three to six credits. Some important and current practical applications. Offered every other spring.
- 7720 Advanced Topics in Physical Chemistry.** Three credits. Prerequisite: CHEM 6300. Theoretical basis and application of the principal methods used for experimental molecular structure determination. Computational methods of structure prediction and interpretation of data. Searching and retrieving structural information from structural databases. Offered every other fall.
- 7800/ 7810 Chemistry Internship.** Three credits each. Prerequisite: Permission of department. Admission based on recommendations and performance in teaching. Offered every term.
- 7820 Seminar in Chemical Education.** One credit. Areas and ideas associated with chemical education. Readings from current literature or seminal texts on given topics which may include the role of laboratory in chemical education, current research in science education, trends in chemical education, research techniques in chemical education, and the historical development of chemistry. Offered online. May be taken up to three times for credit. Offered every fall.
- 7900 Teaching and Learning in Chemistry.** Three credits. Areas and ideas associated with chemical education. Readings from the current literature or seminal texts on misconceptions in chemistry, theories of learning, and theories of teaching. Offered summer only.
- 7910 Instructional Technology in the Science Classroom.** Three credits. Explores concepts and applications associated with the use of computer- and other technology-based instructional materials in the science classroom. Readings from current literature or seminal texts on theoretical issues; practical applications associated with the use of technology in teaching scientific concepts. Offered summer only.

Courses in Physical Science [PSCI]

Graduate standing and consent of instructor are prerequisites for graduate courses in physical science.

5030 Experimental Physical Science. Four credits. Basic concepts, laws, and principles of astronomy, chemistry, geology, and physics with particular emphasis on the utilization of equipment available or easily improvised in actual school situations to illustrate these concepts, laws, and principles. Offered every term.

5080 Problems in Physical Science. Four credits. A problem from chemistry, physics, or other physical science appropriate to the student's background and interest. Offered on sufficient demand. May be repeated for a total of eight credits with departmental approval.

6020 Investigations in Physical Science. One, two, or three credits. Prerequisite: Graduate standing or consent of instructor. Topics from astronomy to chemistry and physics, with special emphasis on the development of hands-on activities, determination of content cognitive demand, development of appropriate assessment instruments/implementation plans, and implementation of these across the pre-college curriculum. For practicing pre-college science teachers and school administrators. Consult the listed instructor for costs and specific credits. Does not apply toward chemistry graduate degrees. Offered on sufficient demand. May be repeated for a total of six credits with departmental approval. Repeatable for up to six credit hours.

