Department of Chemistry

Earl Pearson, Chair
Davis Science Building 239

The Department of Chemistry offers a Master of Science degree with a major in Chemistry and the Doctor of Arts in Chemistry; 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. For admission to the D.A. program, a score of 900 on the GRE is expected.

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 Candidacy Form with the Graduate Office prior to the completion of 24 credit hours, and annually work out a plan of study for the following twelve months with the academic advisor.
7. successfully complete five of six comprehensive examinations in the following areas of chemistry: analytical/instrumental, biochemistry, general, inorganic, organic, and physical chemistry. The exam in each area may be taken no more than twice.

Requirements for the Doctor of Arts (6000 and 7000 level)

1. Full admission requires a master's degree and at least 20 undergraduate and/or graduate hours of coursework in chemistry including a course in quantitative chemical analysis, demonstrated English proficiency, and familiarity with basic computer applications. Students not meeting requirements for full admission may seek conditional admission.
2. The D.A. in chemistry specifies 64 semester hours with at least two-thirds of the program on the 7000 level; however, this can be reduced to 52 semester hours for students entering with a master's in chemistry or education. With the approval of the D.A. Program Committee, students may transfer up to 12 credits for work done in a master's or a doctoral program in chemistry or education. The D.A. coordinator should be consulted for details on transfer credits.
3. The core requirement in chemistry constitutes 19 hours: CHEM 6100, 6230, 6300, 6400, 6500, and 7900. With departmental approval, well-prepared students with recent coursework in any of these areas may fulfill this requirement by passing a proficiency exam in that area; if the exam is passed, the student must substitute an advanced chemistry course in the same area.
4. The advanced chemistry requirement constitutes 15 hours, including at least three of the following courses: CHEM 7110, 7200, 7420, 7510, and 7720. The remaining 6 hours may be chosen, with approval of the advisor and the D.A. Program Committee, from the following: CHEM 7210, 7220, 7700, 7710, 7820, 7910; SPSE 7010; PSY 6280, 6290.
5. The education requirement constitutes 18 hours: CHEM 7800, 7810; FOED 7520, 7560; SPSE 7540, 7550. Consult the D.A. coordinator for details regarding the two chemistry teaching internships (CHEM 7800, 7810).
6. The research requirement constitutes 12 hours of CHEM 7640.
7. A plan of study for the following twelve months and a provisional candidacy form (see no. 10 below) must be worked out annually with the D.A. coordinator.
8. Students should interview prospective research advisors early, and select an advisor by the end of the second semester in residence. A doctoral committee will then be appointed; consult the D.A. coordinator for details.
9. A dissertation proposal (prospectus) will be prepared and submitted to the doctoral committee, then (at least one week later) the proposal will be defended orally before the committee. Consult the D.A. coordinator and page 48 of the catalog for details.
10. A Candidacy Form (see page 39) must be filed with the Graduate Office after completion of the core requirement in chemistry and after approval of the dissertation proposal but prior to the completion of 36 credit hours.
11. Qualifying exams as described on page 49 must be completed during the last semester of prescribed coursework other than dissertation research but after advancement to candidacy is approved.

12. Guidelines and relevant deadlines for the preparation of the dissertation are available from the D.A. coordinator and should be carefully followed. The dissertation must include both chemistry and chemical education components.
13. At least two weeks after the dissertation has been written and submitted to the doctoral committee, the student must present an oral defense of the dissertation to the committee in a seminar open to members of the public. After the examination, the committee will discuss the defense and vote on whether or not the student has successfully defended the dissertation; approval of the committee is required. Upon successful completion of the defense, the candidate submits the corrected dissertation to the Graduate Office. Other details are included on page 49 of this catalog.

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 3220 or equivalent. Theory of and practice in the interpretation of mass, infrared, Raman, ultraviolet-visible, and nuclear magnetic resonance spectra.

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.

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.

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.

5500 Biochemistry I. Three credits. Prerequisite: CHEM 3220 or consent of instructor. The chemical properties of biological molecules such as amino acids, proteins, enzymes, and carbohydrates. Chemical basis of enzyme catalysis and reactions of carbohydrate metabolism.

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.

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.

5700 Polymers, an Introduction. Three credits. Structure, properties, and applications of polymers.

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.

6100 Intermediate Organic Chemistry. Three credits. Prerequisite: CHEM 3020 or 2030 or equivalent. Concepts and modern theories of organic chemistry: stereochemistry of reactions, mechanistic interpretation of organic reactions, and multistep synthesis.

6110 Topics in Organic Chemistry. Three to six credits. Prerequisite: CHEM 6100. A selection of modern topics.

6200 Topics in Analytical Chemistry. Three to six credits. Prerequisite: CHEM 4230 or 6230. Selected topics of major interest in chemical analysis.

6230 Intermediate Analytical Chemistry. Four credits. Prerequisite: CHEM 2230 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.

6300 Intermediate Physical Chemistry. Three credits. Key concepts from classical thermodynamics, quantum theory, and chemically relevant spectroscopies. Statistical thermodynamics introduced.

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.

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.

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.

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
6490 Physical Methods in Inorganic Chemistry

6500 Intermediate Biochemistry. Three credits. The chemistry and metabolism of biological compounds such as proteins, carbohydrates, lipids, and nucleic acids.

6510 Biochemistry II. Three credits. Prerequisite: CHEM 5500. 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.

6520 Topics in Biochemistry. Three to six credits. Prerequisite: CHEM 6500 or 6510 or consent of instructor. Selected topics of particular interest in biochemistry.

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.

6610 Environmental Soil Chemistry. Three credits. Prerequisite: Working knowledge of physical and organic chemistry. Fundamental chemical principles applied to the fate and behavior of organic and inorganic contaminants in the soil-water environment. Topics include sorption and redox reactions of contaminants.

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.

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.

6800 Chemistry Seminar. One credit. Required of graduate students specializing in chemistry. Scientific articles reviewed and reports on individual research projects presented.

6870 Chemistry Research. Three credits. Original laboratory problem that will furnish material for a thesis.

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.

7200 Advanced Chemical Separations and Chemical Equilibrium. Three credits. Prerequisite: CHEM 6230 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.

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.

7220 Independent Study of Instrumental Analysis. Three credits. Developing skill in using selected sophisticated instruments.

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.

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.

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.

7700 Topics in Theoretical Chemistry. Three to six credits. Bonding, stereochemistry, empirical and semi-empirical parameters, state functions, spectroscopic interpretation, and reaction mechanisms.

7710 Topics in Applied Chemistry. Three to six credits. Some important and current practical applications.

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.

7800/ 7810 Chemistry Internship. Three credits each. Prerequisite: Permission of department. Admission based on recommendations and performance in teaching.

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.

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.

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.

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.

5080 Problems in Physical Science. Four credits. A problem from chemistry, physics, or other physical science appropriate to the student's background and interest.

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.