CHEMISTRY (CHE)

Chemistry (CHE) Courses

CHE 5263. Advanced Analytical Chemistry. (3-0) 3 Credit Hours.
Prerequisites: CHE 3214 and CHE 4213, or equivalents. The physical and chemical principles of modern analytical chemistry with emphasis on error analysis, signals and noise, electrochemical techniques, analytical separations, and selected spectroscopic methods based on absorption and emission. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5313. Advanced Biochemistry. (3-0) 3 Credit Hours.
Prerequisite: Undergraduate biochemistry. Advanced topics in modern biochemistry, including cell signaling, apoptosis, trafficking and processing of proteins, DNA array technology, and various aspects of bioinformatics. Ligand interactions and the thermodynamics and mechanisms underlying how these important macromolecules interact with each other. Spectroscopic determination of nucleic acid and protein structures, and reactions using techniques such as nuclear magnetic resonance spectroscopy, mass spectrometry and x-ray diffraction. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5453. Advanced Inorganic Chemistry. (3-0) 3 Credit Hours.
Prerequisite: CHE 4463 or equivalent. This course is intended to provide students with a firm foundation in modern inorganic chemistry and serve as a basis for advanced elective courses within the subdiscipline. Topics to be covered include symmetry and group theory, electronic structure and bonding in transition metal complexes, applications of group theory to vibrational and electronic spectroscopy, rudimentary topics in molecular magnetism, and inorganic reaction mechanisms. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5483. Inorganic Solid State Materials. (3-0) 3 Credit Hours.
Prerequisite: CHE 4463 or equivalent. This course is intended as an introductory course to inorganic materials and solid state chemistry for graduate students and advanced undergraduate students. The objective is to understand solid state materials from structural and chemistry perspectives and to introduce general solid state synthesis methodologies and characterization techniques. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5643. Advanced Organic Chemistry. (3-0) 3 Credit Hours.
Prerequisites: 8 semester credit hours each of undergraduate organic chemistry and physical chemistry or graduate standing in chemistry. An advanced study of topics in organic chemistry such as stereochemistry, conformational analysis, nonbenzenoid, aromaticity, molecular orbital theory, and organic reaction mechanisms. Applications of these concepts to the structure and reactivity of biomolecules such as peptides and proteins, nucleic acids, and carbohydrates. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5653. Structure Determination Using Spectroscopic Methods. (3-0) 3 Credit Hours.
Prerequisite: CHE 3643 or equivalent. An introduction to the techniques of multinuclear (1H, 13C) NMR spectroscopy, infrared spectroscopy, and mass spectrometry as powerful tools for structure elucidation in organic chemistry. A brief introduction to the principles of NMR spectroscopy, infrared spectroscopy, and mass spectrometry will be followed by extensive analysis and discussion of NMR parameters such as chemical shift, coupling constants, splitting patterns, etc. The course will also describe the use of multi-pulse experiments (spin decoupling, NOE, APT, INEPT, DEPT etc.) and 2-dimensional techniques (COSY, NOESY, ROESY, etc.) along with mass spectrometry in the structure elucidation of natural products and organic small molecules. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5833. Computational Chemistry. (3-0) 3 Credit Hours.
Prerequisite: CHE 3824 or equivalent. The application of molecular mechanical, molecular orbital, and density functional methods to problems of molecular structure, property, reactivity, and spectroscopy. (Formerly CHE 7843. Credit cannot be earned for both CHE 5833 and CHE 7843.) Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5843. Advanced Physical Chemistry. (3-0) 3 Credit Hours.
Prerequisite: CHE 3824 or equivalent. An advanced study of valence and spectra as grounded in valence bond theory, molecular orbital theory and the extended Hückel method. Topics include group theory as applied to molecular structure and spectra, electronic, vibrational and rotational spectroscopies, and chemical reactivity including Woodward-Hoffmann theory. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 5922. Research and Teaching Practice and Ethics. (0-0) 2 Credit Hours.
Prerequisites: Graduate standing in Chemistry and concurrent designation as a teaching assistant in the Chemistry program or consent of instructor. The course is designed to improve the instructional effectiveness of graduate students teaching at the college level. The course will cover, but is not limited to, board-work, clear speech, teacher-student interaction, professional responsibilities, course content and pace, grading policy, quiz writing, sensitivity training to student needs, information on technical support, and guest lecturers on special topics. Research ethics will be discussed based on case studies. The grade report for the course is either “CR” (satisfactory performance) or “NC” (unsatisfactory performance). (Formerly CHE 5923. Credit cannot be earned for both CHE 5922 and CHE 5923.) Differential Tuition: $100. Course Fees: GS01 $60.

CHE 5981. Graduate Seminar in Chemistry. (0-3) 1 Credit Hour.
Prerequisite: Graduate standing in Chemistry or consent of the Graduate Advisor of Record. Current research and literature seminars presented by faculty, visiting lecturers, and doctoral candidates. Students in the Doctoral chemistry program must register every semester while in residence, but only 8 hours will apply toward the Doctoral degree. The grade report for the course is either “CR” (satisfactory performance) or “NC” (unsatisfactory performance). Differential Tuition: $50. Course Fees: GS01 $30.

CHE 6433. Organometallic Chemistry. (3-0) 3 Credit Hours.
Prerequisite: CHE 4463 or equivalent. This course is intended to provide students with an introduction to the field of organometallic chemistry covering concepts in bonding, synthesis, and catalysis. Students will become familiar with common ligands and preparative methods in organometallic chemistry, theories of bonding and electronic structure, basic reaction mechanisms, and applications to catalysis in organic chemistry. (Formerly CHE 7433. Credit cannot be earned for both CHE 6433 and CHE 7433.) Differential Tuition: $150. Course Fees: GS01 $90.
CHE 6443. Green Chemistry and Catalysis. (3-0) 3 Credit Hours.
Prerequisite: CHE 3464 or consent of instructor. Introduction to the 12 principles of green chemistry as well as the tools of green chemistry including the use of alternative feed stocks or starting materials, reagents, solvents, target molecules, and catalysts; demonstrates how to evaluate a reaction or process and determine “greener” alternatives; focuses on the application of innovative technology the development of “greener” routes to improve industrial processes and to produce important products. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6623. Advanced Organic Synthesis. (3-0) 3 Credit Hours.
Prerequisite: CHE 3643 or consent of instructor. A study of modern methods of organic functional group transformation, simple carbon skeleton construction, asymmetric synthesis, introduction to the synthon concept and to retrosynthetic analytical methodology for designing rational synthetic approaches to complex organic molecules of biological interest. (Formerly CHE 7623. Credit cannot be earned for both CHE 6623 and CHE 7623.) Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6643. Chemistry of Heterocyclic Compounds. (3-0) 3 Credit Hours.
The course gives a broad introduction to cyclic organic compounds that include heteroatoms, especially nitrogen, oxygen and sulfur, in their ring structures. Emphasis is given to aromatic heterocyclic systems, such as pyridines, quinolines, isoquinolines, pyrroles, furans, thiophenes, indoles, pyrimidines, purines, and imidazoles. For each group, ring synthesis, chemical properties and characteristic reactions will be discussed, as will be the biological effects of representative structures. Aromaticity applied to heterocyclic compounds, general methods for ring synthesis, and different systems for nomenclature will be presented. This course requires a firm understanding of the principles of organic chemistry. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6673. Advanced Catalysis in Organic Synthesis. (3-0) 3 Credit Hours.
Prerequisite: CHE 5643 or equivalent. This course will cover advanced topics in modern catalytic transformations useful in the synthesis of complex molecular structures. Topics will include an introduction to catalysis, organometallics overview, kinetics of catalysis, non-linear effects, kinetic resolutions, asymmetric hydrogenations, CH activation, olefin metathesis, Pd-catalyzed allylic substitutions, transition metal mediated cross-couplings, biocatalysis and organocatalysis. (Formerly CHE 7673. Credit cannot be earned for both CHE 6673 and 7673.) Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6693. Pharmaceutical Chemistry. (3-0) 3 Credit Hours.
Prerequisite: CHE 3643 or equivalent or consent of instructor. This course aims to provide students with an understanding of the overall process of drug discovery and development with particular emphasis on the role of organic chemistry in these endeavors. It will cover the basic principles of how new drugs are discovered, how drugs interact with their biological targets, application of medicinal chemistry in lead optimization, and the role of process chemistry in large-scale drug synthesis and development. The second half of the course will provide actual case studies of both successful and unsuccessful drug candidates where students will learn about the entire drug discovery and development process from firsthand experience. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6823. Chemical Kinetics and Dynamics. (3-0) 3 Credit Hours.
Prerequisite: CHE 5843. An advanced study of topics in chemical kinetics and dynamics. (Formerly CHE 7823. Credit cannot be earned for both CHE 6823 and CHE 7823.) Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6883. Mass Spectrometry. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. The basic principles of interpreting mass spectra and how they are produced. The effect the method of ion production has on the observed mass spectra, and the theory and operation of various types of mass spectrometers will be covered. The basic theory of ion-molecule reactions and other advanced topics will be presented. Differential Tuition: $150. Course Fees: GS01 $90; IUC1 $15; L001 $30.

CHE 6961. Comprehensive Examination. (0-0) 1 Credit Hour.
Prerequisite: Approval of the appropriate Graduate Program Committee. Independent study course for the purpose of taking the Comprehensive Examination. May be repeated as many times as approved by the Graduate Program Committee. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either “CR” (satisfactory performance on the Comprehensive Examination) or “NC” (unsatisfactory performance on the Comprehensive Examination). Differential Tuition: $50. Course Fees: GS01 $30.

CHE 6973. Special Problems. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Problems courses may be repeated for credit when the topics vary, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6983. Master’s Thesis. (0-0) 3 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and thesis director. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master’s degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 6991. Directed Research. (0-0) 1 Credit Hour.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student’s Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. Normally a written report is required. May be repeated for credit, but not more than 9 hours or 19 hours, regardless of discipline, will apply to the Master’s degree or Doctoral degree, respectively. Differential Tuition: $50. Course Fees: GS01 $30.

CHE 6992. Directed Research. (0-0) 2 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student’s Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. Normally a written report is required. May be repeated for credit, but not more than 9 hours or 19 hours, regardless of discipline, will apply to the Master’s degree or Doctoral degree, respectively. Differential Tuition: $100. Course Fees: GS01 $60.

CHE 6993. Directed Research. (0-0) 3 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student’s Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. Normally a written report is required. May be repeated for credit, but not more than 9 hours or 19 hours, regardless of discipline, will apply to the Master’s degree or Doctoral degree, respectively. Differential Tuition: $150. Course Fees: GS01 $90.
CHE 6994. Directed Research. (0-0) 4 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. Normally a written report is required. May be repeated for credit, but not more than 9 hours or 19 hours, regardless of discipline, will apply to the Master's degree or Doctoral degree, respectively. Differential Tuition: $200. Course Fees: GS01 $120.

CHE 6995. Directed Research. (0-0) 5 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. Normally a written report is required. May be repeated for credit, but not more than 9 hours or 19 hours, regardless of discipline, will apply to the Master's degree or Doctoral degree, respectively. Differential Tuition: $250. Course Fees: GS01 $150.

CHE 6996. Directed Research. (0-0) 6 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. Normally a written report is required. May be repeated for credit, but not more than 9 hours or 19 hours, regardless of discipline, will apply to the Master's degree or Doctoral degree, respectively. Differential Tuition: $300. Course Fees: GS01 $180.

CHE 6997. Directed Research. (0-0) 7 Credit Hours.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. Normally a written report is required. May be repeated for credit, but not more than 9 hours or 19 hours, regardless of discipline, will apply to the Master's degree or Doctoral degree, respectively. Differential Tuition: $350. Course Fees: GS01 $210.

CHE 7911. Chemistry Research Colloquium. (0-0) 1 Credit Hour.
Prerequisite: Graduate standing in Chemistry. Discussions of current journal articles, reviews, and recent advances in specialized areas of chemistry (including current research progress of students). May be repeated for credit as topics vary. The grade report for this course is either "CR" (satisfactory participation in the colloquium) or "NC" (unsatisfactory participation in the colloquium). Differential Tuition: $50. Course Fees: GS01 $30.

CHE 7913. Research Proposal Development. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing in Chemistry or consent of instructor. The course is intended to provide students with a hands-on experience in the development of a research grant proposal. Topics will include development of specific aims, literature review, biosketch, and other grant components. Technical aspects, such as scientific database and literature searches, the use of chemical drawing and reference management software, as well as general principles of effective grant writing and proposal review will also be covered. The course will culminate in the development and oral presentation of a NIH/NSF-style research proposal. Differential Tuition: $150. Course Fee: GS01 $90.

CHE 7921. Doctoral Research. (0-0) 1 Credit Hour.
Prerequisite: Graduate standing in Chemistry. Doctoral research and preparation. May be repeated for credit, but not more than 26 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $50. Course Fees: GS01 $30.

CHE 7922. Doctoral Research. (0-0) 2 Credit Hours.
Prerequisite: Graduate standing in Chemistry. Doctoral research and preparation. May be repeated for credit, but not more than 26 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $100. Course Fees: GS01 $60.

CHE 7923. Doctoral Research. (0-0) 3 Credit Hours.
Prerequisite: Graduate standing in Chemistry. Doctoral research and preparation. May be repeated for credit, but not more than 26 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $150. Course Fees: GS01 $90.

CHE 7926. Doctoral Research. (0-0) 6 Credit Hours.
Prerequisite: Graduate standing in Chemistry. Doctoral research and preparation. May be repeated for credit, but not more than 26 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $300. Course Fees: GS01 $180.

CHE 7927. Doctoral Research. (0-0) 7 Credit Hours.
Prerequisite: Graduate standing in Chemistry. Doctoral research and preparation. May be repeated for credit, but not more than 26 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $350. Course Fees: GS01 $210.

CHE 7928. Doctoral Research. (0-0) 8 Credit Hours.
Prerequisite: Graduate standing in Chemistry. Doctoral research and preparation. May be repeated for credit, but not more than 26 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $400. Course Fees: GS01 $240.

CHE 7931. Doctoral Dissertation. (0-0) 1 Credit Hour.
Prerequisites: Permission of the Graduate Advisor of Record and dissertation director. Preparation and writing of the Doctoral dissertation. May be repeated for credit, but not more than 12 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $50. Course Fees: GS01 $30.

CHE 7932. Doctoral Dissertation. (0-0) 2 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and dissertation director. Preparation and writing of the Doctoral dissertation. May be repeated for credit, but not more than 12 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $100. Course Fees: GS01 $60.

CHE 7933. Doctoral Dissertation. (0-0) 3 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and dissertation director. Preparation and writing of the Doctoral dissertation. May be repeated for credit, but not more than 12 hours will apply to the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8, depending on progress, is required each term in which the dissertation is in progress. Differential Tuition: $150. Course Fees: GS01 $90.
CHE 7934. Doctoral Dissertation. (0-0) 4 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and
May be repeated for credit, but not more than 12 hours will apply to
the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8,
depending on progress, is required each term in which the dissertation is

CHE 7936. Doctoral Dissertation. (0-0) 6 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and
May be repeated for credit, but not more than 12 hours will apply to
the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8,
depending on progress, is required each term in which the dissertation is

CHE 7937. Doctoral Dissertation. (0-0) 7 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and
May be repeated for credit, but not more than 12 hours will apply to
the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8,
depending on progress, is required each term in which the dissertation is

CHE 7938. Doctoral Dissertation. (0-0) 8 Credit Hours.
Prerequisites: Permission of the Graduate Advisor of Record and
May be repeated for credit, but not more than 12 hours will apply to
the Doctoral degree. Enrollment in either CHE 7921-8 or CHE 7931-8,
depending on progress, is required each term in which the dissertation is

CHE 7973. Special Problems. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the
opportunity for specialized study not normally or not often available
as part of the regular course offerings. Special Problems courses may
be repeated for credit when the topics vary, but not more than 6 hours,
regardless of discipline, will apply to the Doctoral degree. Differential
Tuition: $150. Course Fees: GS01 $90.