CHEMISTRY (CHEM)

CHEM Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/CHEM)

Courses

CHEM 101 Introductory Chemistry credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/101)
Introduction to the basic concepts and language of chemistry; lectures, discussions, and lab. Preparatory chemistry course for students who require additional background before enrolling in CHEM 102. This course has been approved for graduation credit for all students in the College of LAS. Students in other colleges should check with their college office. Additional fees may apply. See Class Schedule. Prerequisite: 2.5 years of high school mathematics, or credit or concurrent registration in MATH 112.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

CHEM 102 General Chemistry I credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/102)
For students who have some prior knowledge of chemistry. Principles governing atomic structure, bonding, states of matter, stoichiometry, and chemical equilibrium. Credit is not given for both CHEM 102 and CHEM 202. CHEM 102 and CHEM 103 are approved for General Education credit only as a sequence. Both courses must be completed to receive Natural Science and Technology credit. Prerequisite: Credit in or exemption from MATH 112; one year of high school chemistry or equivalent. All students enrolled in CHEM 102 should also enroll in CHEM 103.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

CHEM 103 General Chemistry Lab I credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/CHEM/103)
Laboratory studies to accompany CHEM 102. Additional fees may apply. See Class Schedule. Credit is not given for both CHEM 103 and CHEM 203. CHEM 102 and CHEM 103 are approved for General Education credit only as a sequence. Both courses must be completed to receive Natural Science and Technology credit. Prerequisite: Credit or concurrent registration in CHEM 102 is required.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

CHEM 104 General Chemistry II credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/104)
Lecture and discussions. Chemistry of materials, including organic and biological substances, chemical energetics and equilibrium, chemical kinetics, and electrochemistry. Credit is not given for both CHEM 104 and CHEM 204. Prerequisite: CHEM 102 or CHEM 202 or advanced placement credit for one semester of college-level chemistry.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

CHEM 105 General Chemistry Lab II credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/CHEM/105)
Laboratory studies to accompany CHEM 104. Additional fees may apply. See Class Schedule. Credit is not given for both CHEM 105 and CHEM 205. Prerequisite: CHEM 102 and CHEM 103; credit or concurrent registration in CHEM 104 is required.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

CHEM 108 Chemistry, Everyday Phenomena credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/108)
Laboratory-based work in which students will evaluate products (such as antacids), synthesize materials (such as soap), and gain a better understanding of forensic chemistry. Additional fees may apply. See Class Schedule. Credit in CHEM 108 does not count toward Chemistry requirements for students in the Specialized Curriculum in Chemistry, the Science and Letters Chemistry major, the Chemistry Teaching Option, or the Chemistry minor; however the course may be taken by students in any of these groups for general education hours. Prerequisite: Credit or concurrent registration in MATH 112.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

CHEM 123 Teaching Elementary & Middle School Chemistry credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/123)
Inquiry-based, hands-on study of chemistry for prospective elementary and middle school teachers. Next Generation Science Standards are emphasized. Credit is not given toward the hours of chemistry required for chemistry and related majors. Prerequisite: Preference given to students in Elementary Education.

CHEM 197 Individual Study Freshman credit: 1 to 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/197)
Individual study of problems related to chemistry or research not necessarily leading to a senior thesis. May be repeated in separate terms to a maximum of 4 hours. A maximum of 2 hours may be used toward the major. A maximum of 18 hours of CHEM 197, CHEM 297, CHEM 397, CHEM 497 and/or CHEM 499 may be used toward the degree. Prerequisite: Chemistry faculty approval required to register.

CHEM 199 Undergraduate Open Seminar credit: 0 to 5 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/199)
Approved for letter and S/U grading. May be repeated.

CHEM 202 Accelerated Chemistry I credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/202)
Lectures and discussions. Beginning chemistry course for students in the chemical sciences and others with strong high school chemistry and mathematics preparation. Chemical calculations, structure, bonding and equilibrium. Credit is not given for both CHEM 202 and CHEM 102. Prerequisite: Credit or concurrent registration in MATH 220 or MATH 221; concurrent registration in CHEM 203.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

CHEM 203 Accelerated Chemistry Lab I credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/203)
Companion laboratory course to CHEM 202. Comprehensive skills-oriented approach to learning laboratory technique and safety. Additional fees may apply. See Class Schedule. Students may receive no more than two credit hours for both this course and CHEM 103. Prerequisite: Concurrent registration or credit in CHEM 202 or consent of instructor.

CHEM 204 Accelerated Chemistry II credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/204)
Continuation of CHEM 202. Lectures and discussions. Emphasizes chemical thermodynamics, equilibrium, chemical kinetics, and coordination chemistry. Prerequisite: CHEM 202 and/or CHEM 203 and concurrent registration in CHEM 205, or consent of instructor.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

Information listed in this catalog is current as of 05/2019
CHEM 205 Accelerated Chemistry Lab II credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/205)
Laboratory and discussion. Includes experiments in qualitative analysis, inorganic synthesis, and kinetics as well as an individual project. Additional fees may apply. See Class Schedule. Credit is not given for both CHEM 205 and CHEM 223. Prerequisite: Concurrent registration in CHEM 204 or consent of department.

CHEM 222 Quantitative Analysis Lecture credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/222)
Fundamentals of quantitative analysis, chemical equilibrium and kinetics. This lecture course is intended to accompany CHEM 223. Students with credit in CHEM 222 can receive credit for CHEM 203. Prerequisite: CHEM 104 and CHEM 105 or equivalent.

CHEM 223 Quantitative Analysis Lab credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/223)
Laboratory course covers the fundamentals of quantitative analysis, equilibrium and kinetics. Additional fees may apply. See Class Schedule. Credit is not given for both CHEM 223 and CHEM 205. Prerequisite: Credit or concurrent registration in CHEM 222.

CHEM 232 Elementary Organic Chemistry I credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/232)
Presents structural and mechanistic chemistry with emphasis on applications of this material to closely related areas. For students in agricultural, nutritional and biological sciences, as well as premedical, preclinical, and preveterinary programs. One-term survey course; may be followed by CHEM 332. Credit is not given for both CHEM 232 and CHEM 236. 3 hours of credit is an option for those not registered in a discussion-recitation section. 4 hours of credit requires registration in a discussion-recitation section and a live lecture or an online section. Prerequisite: CHEM 104 and CHEM 105 or equivalent.

CHEM 233 Elementary Organic Chemistry Lab credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/233)
Basic laboratory techniques in organic chemistry are presented with emphasis on the separation, isolation, and purification of organic compounds. For students in agricultural science, dairy technology, food technology, nutrition, dietetics, premedical, preclinical, and preveterinary programs. Additional fees may apply. See Class Schedule. Credit is not given for both CHEM 233 and CHEM 237. Prerequisite: Credit or concurrent registration in CHEM 232.

CHEM 236 Fundamental Organic Chem I credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/236)
Fundamental structural, synthetic, and mechanistic organic chemistry is presented. For students whose major is chemistry or for those in the specialized curricula in chemistry or chemical engineering. The first term of a two-term integrated sequence (to be followed by CHEM 436). This lecture course is intended to accompany CHEM 237. Credit is not given for both CHEM 236 and CHEM 232. Prerequisite: Completion of CHEM 104 with a B- or higher, or completion of CHEM 204, or completion of CHEM 222 and 223.

CHEM 237 Structure and Synthesis credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/237)
Laboratory course introduces synthesis and the basic techniques for the separation, isolation and purification of organic and inorganic compounds. Additional fees may apply. See Class Schedule. Credit is not given for both CHEM 237 and CHEM 233. Prerequisite: Credit or concurrent registration in CHEM 236.

CHEM 293 Cooperative Education Practice credit: 0 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/293)
Off-campus cooperative practice of chemistry or chemical engineering in industrial or governmental facilities. Each chemistry or chemical engineering student participating in cooperative education must register for CHEM 293 for each off-campus term. Same as CHBE 202. Approved for S/U grading only. Prerequisite: Acceptance into the School of Chemical Sciences Cooperative Education Program.

CHEM 295 Chemistry Internship credit: 0 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/295)
Full-time practice of chemical science in an off-campus industrial setting or research laboratory environment. Summary report required. Approved for S/U grading only. May be repeated. Prerequisite: Completion of freshman year or equivalent, or consent of Director of Cooperative Education in Chemistry.

CHEM 297 Individual Study Sophomore credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/297)
Individual study of problems related to chemistry or research not necessarily leading to a senior thesis. May be repeated in separate terms. A maximum of 6 hours may be used toward the major. A maximum of 18 hours of CHEM 197, CHEM 297, CHEM 397, CHEM 497 and/or CHEM 499 may be used toward the degree. Prerequisite: Chemistry faculty approval required to register.

CHEM 312 Inorganic Chemistry credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/312)
Basic chemical bonding in molecules, introduction to symmetry, chemistry of the main group elements, coordination chemistry of the transition elements, organometallic chemistry, solid state chemistry, bioorganic chemistry, chemistry of the lanthanide and actinide elements. Prerequisite: CHEM 232 or CHEM 236.

CHEM 315 Instrumental Chem Systems Lab credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/315)
Laboratory course emphasizes the application of modern instrumental techniques for characterizing the kinetic behavior and equilibrium properties of chemical systems. Prerequisite: Either CHEM 237 or both CHEM 223 and CHEM 233.

CHEM 317 Inorganic Chemistry Lab credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/317)
Emphasizes modern techniques for the synthesis, purification, and characterization of inorganic and organometallic compounds. There are three components to the course: lectures on laboratory methodology and reporting, laboratory experiments, and report writing. The final third of the course is dedicated to special individualized projects. Additional fees may apply. See Class Schedule. Prerequisite: CHEM 312; completion of campus Composition I general education requirement. This course satisfies the General Education Criteria for: Advanced Composition

CHEM 332 Elementary Organic Chem II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHEM/332)
Continuation of CHEM 232 focuses on organic chemistry and its applications to biochemistry, enzyme mechanisms and the life sciences. Credit is not given for both CHEM 332 and CHEM 436. This course should not be taken by students who have completed CHEM 236. Prerequisite: CHEM 232 and CHEM 233.

Information listed in this catalog is current as of 05/2019
CHEM 360  Chemistry of the Environment  credit: 3 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/360)
Study of the chemistry of the atmosphere, the chemistry of soil and minerals in the Earth's crust, chemistry of natural waters, agricultural chemicals and organic pollutants, and topics related to energy use. Prerequisite: One year of general chemistry (CHEM 102-105 or CHEM 202-205) and one semester of organic chemistry (CHEM 232 or CHEM 236). The organic chemistry class may be taken concurrently with CHEM 360.

CHEM 397  Individual Study Junior  credit: 1 to 3 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/397)
Individual study of problems related to chemistry or research not necessarily leading to a senior thesis. May be repeated in separate terms. A maximum of 6 hours may be used toward the major. A maximum of 18 hours of CHEM 197, CHEM 297, CHEM 397, CHEM 497 and/or CHEM 499 may be used toward the degree. Prerequisite: Chemistry faculty approval required to register.

CHEM 420  Instrumental Characterization  credit: 2 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/420)
Lecture course covers the fundamentals of instrumental characterization including: nuclear magnetic resonance spectroscopy, potentiometry, voltammetry, atomic and molecular spectroscopy, mass spectrometry, and gas and liquid chromatography. 2 undergraduate hours. 2 graduate hours. Prerequisite: CHEM 440; or credit or concurrent registration in CHEM 442; or consent of the instructor.

CHEM 436  Fundamental Organic Chem II  credit: 3 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/436)
Course is the second term of a two-term integrated sequence and should be taken the term following enrollment in CHEM 236. 3 undergraduate hours. 3 graduate hours. Credit is not given for both CHEM 436 and CHEM 332. Prerequisite: CHEM 236 and CHEM 237; or CHEM 232 and CHEM 233 with consent of instructor.

CHEM 437  Organic Chemistry Lab  credit: 3 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/437)
Laboratory experiments in organic chemistry with emphasis on synthesis, purification and spectroscopic identification of organic compounds. Additional fees may apply. See Class Schedule. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHEM 233 or CHEM 237 and credit or concurrent registration in CHEM 332 or CHEM 436. This course satisfies the General Education Criteria for: Advanced Composition

CHEM 438  Advanced Organic Chemistry  credit: 3 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/438)
Advanced topics in structure, synthesis and reactions of organic chemistry. Lecture only course. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHEM 332 or CHEM 436.

CHEM 440  Physical Chemistry Principles  credit: 4 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/440)
One-term course in physical chemistry emphasizing topics most important to students in the biological and agricultural sciences. Not open to students in the specialized curricula in chemistry and chemical engineering. Laboratory experience in this area provided by CHEM 315 to be taken preferably after CHEM 440. Same as BIOL 440. 4 undergraduate hours. 4 graduate hours. Prerequisite: Completion of either CHEM 104 or CHEM 204, completion of either PHYS 102 or 212, and completion of MATH 241 or equivalent calculus including partial derivatives.

CHEM 442  Physical Chemistry I  credit: 4 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/442)
Lectures and problems focusing on microscopic properties. CHEM 442 and CHEM 444 constitute a year-long study of chemical principles. CHEM 442 focuses on quantum chemistry, atomic and molecular structure, spectroscopy and dynamics. 4 undergraduate hours. 4 graduate hours. Credit is not given for both CHEM 442 and PHYS 485. Prerequisite: CHEM 204 or CHEM 222; MATH 225 or MATH 415, and a minimal knowledge of differential equations, or equivalent; and PHYS 211, PHYS 212, and PHYS 214 or equivalent.

CHEM 444  Physical Chemistry II  credit: 4 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/444)
Continuation of CHEM 442, focusing on thermodynamics, statistical mechanics and kinetics from single molecules to the bulk, in gases and in the condensed phase. 4 undergraduate hours. 4 graduate hours. Credit is not given for CHEM 444 and MSE 401 or PHYS 427. Prerequisite: CHEM 442.

CHEM 445  Physical Principles Lab I  credit: 2 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/445)
Laboratory course featuring experiments of interest to chemists and biochemists: nuclear magnetic resonance (NMR); magnetic resonance imaging (MRI); X-ray diffraction; Fourier-transform infrared (FTIR) spectroscopy and electron paramagnetic resonance spectroscopy (EPR). This course covers hands-on experience with instrumental techniques that are frequently used in both industrial and academic research and will be of interest to students proposing to carry out work in organic, inorganic, physical and materials chemistry as well as in chemical biology, biochemistry and medicine. There are 4 experiments, each approximately 3 weeks in duration. 2 undergraduate hours. 2 graduate hours. Prerequisite: Credit for or concurrent registration in CHEM 440, CHEM 442 or CHEM 472 (same as BIOL 446 or MCB 446) or consent of instructor.

CHEM 447  Physical Principles Lab II  credit: 2 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/447)
Laboratory course featuring experiments of primary interest to students who plan to carry out research in the physical, materials, analytical, theoretical and astro areas of Chemistry. Experiments include laser-induced fluorescence spectroscopy, Raman spectroscopy, ion cyclotron resonance (ICR) mass spectrometry, and low energy electron diffraction (LEED) and Auger spectroscopy. There are 4 experiments, each approximately 3 weeks in duration. 2 undergraduate hours. 2 graduate hours. Prerequisite: Credit for or concurrent registration in CHEM 440 or CHEM 442 or consent of instructor.

CHEM 450  Astrochemistry  credit: 4 Hours.  (https://courses.illinois.edu/schedule/terms/CHEM/450)
Covers the foundations of astrochemistry, a young field at the intersection between chemistry and astronomy. Topics to be discussed include the interstellar medium, atomic and molecular physics, interstellar chemistry, molecular astronomy, and unresolved enigmas in the field. Same as ASTR 450. 4 undergraduate hours. 4 graduate hours. Prerequisite: CHEM 442 and CHEM 444, or PHYS 427 and PHYS 486, or equivalent experience in quantum mechanics, thermodynamics, and statistical mechanics.

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CHEM 451  Astrochemistry Laboratory  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/451](https://courses.illinois.edu/schedule/terms/CHEM/451))
An active, hands-on introduction to observational astrochemistry, laboratory astrochemistry and theoretical astrochemistry. Activities will include astronomical observations of interstellar molecules at the Observatory, spectroscopy of molecules in the laboratory, quantum chemical calculations and simulations of molecular spectra, and modeling of interstellar chemistry. Same as ASTR 451. 3 or 4 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CHEM 450.

CHEM 460  Green Chemistry  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/460](https://courses.illinois.edu/schedule/terms/CHEM/460))
This course seeks to reduce the environmental consequences of the chemical industry. It includes modifying engineering practices, the development of new catalytic processes, modification of existing chemical processes, and bioremediation. 3 undergraduate hours. 4 graduate hours. Prerequisite: CHEM 312, CHEM 332, CHEM 360, or consent of instructor.

CHEM 472  Physical Biochemistry  credit: 3 Hours. ([courses.illinois.edu/schedule/terms/CHEM/472](https://courses.illinois.edu/schedule/terms/CHEM/472))
Same as MCB 446 and BIOC 446. See BIOC 446.

CHEM 474  Drug Discovery & Development  credit: 3 Hours. ([courses.illinois.edu/schedule/terms/CHEM/474](https://courses.illinois.edu/schedule/terms/CHEM/474))
Lecture course on fundamentals of drug discovery and development. Topics include case studies of top-selling, mechanistically diverse drugs, chemistry of drug contraindications, structural biology of drug targets, mechanisms of drug resistance, and drug metabolism and toxicity. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHEM 332 or CHEM 436; and MCB 354 or MCB 450, or consent of instructor.

CHEM 480  Polymer Chemistry  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/480](https://courses.illinois.edu/schedule/terms/CHEM/480))
Same as M57. See M57.

CHEM 482  Polymer Physics  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/482](https://courses.illinois.edu/schedule/terms/CHEM/482))
Same as M58. See M58.

CHEM 483  Solid State Structural Anlys  credit: 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/483](https://courses.illinois.edu/schedule/terms/CHEM/483))
Lectures and laboratory on various aspects of X-ray diffraction studies of solids; topics include the properties of crystals, symmetry, diffraction techniques, data collection methods, and the determination and refinement of crystal structures. 4 undergraduate hours. 4 graduate hours. Prerequisite: CHEM 442 or consent of instructor.

CHEM 488  Surfaces and Colloids  credit: 3 or 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/488](https://courses.illinois.edu/schedule/terms/CHEM/488))
Same as M58. See M58.

CHEM 492  Special Topics in Chemistry  credit: 1 to 3 Hours. ([courses.illinois.edu/schedule/terms/CHEM/492](https://courses.illinois.edu/schedule/terms/CHEM/492))
Open to advanced undergraduates and graduate students. Deals with subjects not ordinarily covered by regularly scheduled courses. 1 to 3 undergraduate hours. 1 to 3 graduate hours. Approved for letter and S/U grading. Prerequisite: Credit or concurrent registration in any 400-level course in chemistry.

CHEM 494  Lab Safety Fundamentals  credit: 1 Hour. ([courses.illinois.edu/schedule/terms/CHEM/494](https://courses.illinois.edu/schedule/terms/CHEM/494))
Same as MSE 492. See MSE 492.

CHEM 495  Teaching Secondary Chemistry  credit: 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/495](https://courses.illinois.edu/schedule/terms/CHEM/495))
Intended for undergraduates working toward certification to teach high school chemistry and graduate students working towards a Master’s degree in the Teaching of Chemistry. Course aims to provide future teachers with hands-on experience in conducting laboratory experiments, demonstrations, and teaching strategies. 4 undergraduate hours. 4 graduate hours. Course does not count toward the eleven advanced hours in chemistry required in the specialized curriculum, nor does it apply to coursework required for the Ph.D. in Chemistry. Prerequisite: Undergraduate background in general chemistry and credit or concurrent enrollment in CH 403.

CHEM 496  Undergraduate Research Abroad  credit: 1 to 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/496](https://courses.illinois.edu/schedule/terms/CHEM/496))
Students assist in research under faculty supervision at a location outside of the United States. Topics and type of assistance vary. 1 to 4 undergraduate hours. No graduate credit. May be repeated in separate terms up to 6 hours. Prerequisite: Evidence of adequate preparation for such study; consent of faculty member supervising the work (who will have examined the proposed research plan); and approval of the department. Not available to freshmen.

CHEM 497  Individual Study Senior  credit: 1 to 3 Hours. ([courses.illinois.edu/schedule/terms/CHEM/497](https://courses.illinois.edu/schedule/terms/CHEM/497))
Individual study of problems related to chemistry or research not necessarily leading to a senior thesis. Course Information:1 to 3 undergraduate hours. No graduate credit. May be repeated in separate terms. A maximum of 6 hours may be used toward the major. A maximum of 18 hours of CHEM 197, CHEM 297, CHEM 397, CHEM 497 and/or CHEM 499 may be used toward the degree. Prerequisite: Chemistry faculty approval required to register.

CHEM 499  Senior Thesis  credit: 2 to 6 Hours. ([courses.illinois.edu/schedule/terms/CHEM/499](https://courses.illinois.edu/schedule/terms/CHEM/499))
Research with thesis, under the direction of a senior staff member in chemistry. Normally the student takes two terms of CHEM 499 in the senior year. 2 to 6 undergraduate hours. No graduate credit. May be repeated up to 10 hours in separate terms. CHEM 499 is recommended for all those who plan to do research and graduate study and it is a prerequisite for graduation with distinction in chemistry. In the term preceding their initial enrollment, those interested in taking the course should consult with their advisers and with the graduate adviser for the area of interest in which they plan to work. A maximum of 10 hours may be counted toward graduation and a thesis must be presented for credit to be received.

CHEM 512  Advanced Inorganic Chemistry  credit: 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/512](https://courses.illinois.edu/schedule/terms/CHEM/512))
Descriptive chemistry of the main group and transition elements, reactions and reaction mechanisms of inorganic systems, and electronic structure of inorganic molecules and solids. Prerequisite: CHEM 312 or approval of instructor.

CHEM 515  Inorganic Chemistry Seminar  credit: 1 Hour. ([courses.illinois.edu/schedule/terms/CHEM/515](https://courses.illinois.edu/schedule/terms/CHEM/515))
Required of all Chemistry graduate students whose area is inorganic chemistry. Prerequisite: Enrollment is allowed only by second-year graduate students who are presenting their Ph.D. literature seminar during that semester. Undergraduate students are not eligible to enroll in this course.
### CHEM 516 Physical Inorganic Chemistry  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/516](https://courses.illinois.edu/schedule/terms/CHEM/516))  
Includes group theory and use of physical methods to provide information about the geometry, electronic structures, and reactivity of inorganic compounds in solution; emphasizes NMR and ESR.  
**Prerequisite:** CHEM 444.

### CHEM 517 Advanced Inorganic Chem Lab  
**credit:** 1 to 3 Hours. ([courses.illinois.edu/schedule/terms/CHEM/517](https://courses.illinois.edu/schedule/terms/CHEM/517))  
Specialized laboratory techniques; more difficult inorganic syntheses.  
**Prerequisite:** Credit or concurrent registration in one of the lecture courses in inorganic chemistry in the 500 series.

### CHEM 518 Topics in Inorganic Chemistry  
**credit:** 2 to 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/518](https://courses.illinois.edu/schedule/terms/CHEM/518))  
Advanced course dealing with a subject not ordinarily covered by regularly scheduled courses, such as organometallic chemistry, advanced ligand field theory and molecular orbital theory of inorganic compounds, kinetics and mechanisms of inorganic reactions, etc. May be repeated.  
**Prerequisite:** CHEM 516 or consent of instructor.

### CHEM 520 Advanced Analytical Chemistry  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/520](https://courses.illinois.edu/schedule/terms/CHEM/520))  
Treatment of the basic issues of importance in modern analytical chemistry. Topics include basic chemical and measurement concepts, measurement instrumentation and techniques, and principles, tools, and applications in spectroscopy, electrochemistry, separations, sensors, mass spectroscopy and surface characterization.  
**Prerequisite:** CHEM 315, CHEM 420, and CHEM 444.

### CHEM 522 Experimental Spectroscopy  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/522](https://courses.illinois.edu/schedule/terms/CHEM/522))  
Principles and applications of spectroscopic measurements and instrumentation. Atomic and molecular absorption, emission, fluorescence, and scattering, emphasizing physical interpretation of experimental data.  
**Prerequisite:** General physics and chemistry equivalent to a major in physical sciences for a bachelor's degree.

### CHEM 524 Electrochemical Methods  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/524](https://courses.illinois.edu/schedule/terms/CHEM/524))  
**Prerequisite:** General physics and chemistry equivalent to a major for a bachelor's degree.

### CHEM 525 Analytical Chemistry Seminar  
**credit:** 1 Hour. ([courses.illinois.edu/schedule/terms/CHEM/525](https://courses.illinois.edu/schedule/terms/CHEM/525))  
Required of all Chemistry graduate students whose area is analytical chemistry.  
**Prerequisite:** Enrollment is allowed only by second-year graduate students who are presenting their Ph.D. literature seminar during that semester. Undergraduate students are not eligible to enroll in this course.

### CHEM 530 Structure and Spectroscopy  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/530](https://courses.illinois.edu/schedule/terms/CHEM/530))  
Advanced survey of structure determination in organic chemistry with emphasis on NMR, IR, UV and mass spectroscopy.  
**Prerequisite:** CHEM 332 or CHEM 436.

### CHEM 532 Physical Organic Chemistry  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/532](https://courses.illinois.edu/schedule/terms/CHEM/532))  
Advanced survey of physical organic chemistry. The emphasis is on structure and bonding in organic compounds; scope of reaction mechanisms, including reactive intermediates and how these mechanisms and intermediates are studied; and writing reasonable organic reaction mechanisms.  
**Prerequisite:** CHEM 332 or CHEM 436 and one year of physical chemistry.

### CHEM 534 Advanced Organic Synthesis  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/534](https://courses.illinois.edu/schedule/terms/CHEM/534))  
Advanced survey of organic chemistry with emphasis on synthesis of organic compounds. Course content includes survey of important synthetic reactions, construction of fundamental subunits and illustrations of strategy and synthetic analysis.  
**Prerequisite:** CHEM 332 or CHEM 436.

### CHEM 535 Organic Chemistry Seminar  
**credit:** 1 Hour. ([courses.illinois.edu/schedule/terms/CHEM/535](https://courses.illinois.edu/schedule/terms/CHEM/535))  
Required of all Chemistry graduate students whose area is organic chemistry.  
**Prerequisite:** Enrollment is allowed only by second-year graduate students who are presenting their Ph.D. literature seminar during that semester. Undergraduate students are not eligible to enroll in this course.

### CHEM 536 Organic Chemistry Research  
**credit:** 1 Hour. ([courses.illinois.edu/schedule/terms/CHEM/536](https://courses.illinois.edu/schedule/terms/CHEM/536))  
Lecture course on research techniques in organic chemistry. Approved for letter and S/U grading.  
**Prerequisite:** Consent of instructor.

### CHEM 538 Topics in Organic Chemistry  
**credit:** 2 to 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/538](https://courses.illinois.edu/schedule/terms/CHEM/538))  
Advanced course dealing with subject matter not ordinarily covered by regularly scheduled courses, such as natural product synthesis and biosynthesis, organic photochemistry, chemistry of special families of organic compounds, etc. May be repeated.  
**Prerequisite:** CHEM 532 and CHEM 534, both of which may be taken concurrently.

### CHEM 540 Quantum Mechanics  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/540](https://courses.illinois.edu/schedule/terms/CHEM/540))  
The sequence, CHEM 540 and CHEM 542, is designed to give seniors and graduate students a unified treatment of quantum mechanics and spectroscopy on an advanced level. CHEM 540 covers the principles of formalism of quantum mechanics, as well as the solution of the Schrodinger equation for models and simple chemical systems.  
**Prerequisite:** CHEM 442 or equivalent.

### CHEM 542 Quantum Mech and Spectroscopy  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/542](https://courses.illinois.edu/schedule/terms/CHEM/542))  
Continuation of CHEM 540. Focusing on molecular spectroscopy, nonlinear spectroscopy, kinetics and application of quantum mechanics to dissipative systems.  
**Prerequisite:** CHEM 540.

### CHEM 544 Statistical Thermodynamics  
**credit:** 4 Hours. ([courses.illinois.edu/schedule/terms/CHEM/544](https://courses.illinois.edu/schedule/terms/CHEM/544))  
Fundamentals of thermodynamics and statistical mechanics, covering equilibria, thermodynamic transforms, phase transitions, ensembles and non-equilibrium statistical mechanics, from single molecules to complex biological systems.  
**Prerequisite:** CHEM 442 and CHEM 444, or equivalent.
CHEM 545  Physical Chemistry Seminar  credit: 1 Hour. ([https://courses.illinois.edu/schedule/terms/CHEM/545](https://courses.illinois.edu/schedule/terms/CHEM/545))
Required of all Chemistry graduate students whose area is physical chemistry. Prerequisite: Enrollment is allowed only by second-year graduate students who are presenting their Ph.D. literature seminar during that semester. Undergraduate students are not eligible to enroll in this course.

CHEM 546  Advanced Statistical Mechanics  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/546](https://courses.illinois.edu/schedule/terms/CHEM/546))
Fundamentals of equilibrium statistical mechanics with selected applications to interacting classical fluids: dense gases, solutions, liquids, plasmas, and ionic solutions; introduction to nonequilibrium statistical mechanics and linear response theory. Prerequisite: CHEM 540 and CHEM 444, or equivalent, or consent of instructor.

CHEM 548  Molecular Electronic Structure  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/548](https://courses.illinois.edu/schedule/terms/CHEM/548))
Theoretical basis of the electronic structure of atoms and molecules; molecular orbital concepts and self-consistent field theory; angular momentum and the full rotation group; electron correlation effects; and applications to electronic spectroscopy of organic molecules, detailed descriptions of chemical reactions, and molecular properties. Prerequisite: CHEM 540.

CHEM 550  Advanced Quantum Dynamics  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/550](https://courses.illinois.edu/schedule/terms/CHEM/550))
The quantum mechanical and semi-classical description of time-dependent processes, including discussions of the time-dependent Schrodinger equation, approximations, interaction of matter with radiation, wave packets, elastic and inelastic scattering, and relaxation phenomena. Prerequisite: Concurrent registration in CHEM 540 or consent of instructor.

CHEM 570  Concepts in Chemical Biology  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/570](https://courses.illinois.edu/schedule/terms/CHEM/570))
An overview of the concepts and methods utilized in research at the interface of chemistry and biology, and their application to contemporary problems in biological chemistry. Specific topics covered include, but are not limited to, chemical genetics, bioconjugation reactions, combinatorial chemistry, high-throughput screening, identifying biological targets of small-molecule compounds, combinatorial biosynthesis, sequence-specific DNA-binding compounds, activity-based protein profiling, anti-cancer agents, targeted therapeutics, phase display, and yeast-hybrid systems. Prerequisite: One year (two semesters) of undergraduate organic chemistry is required. One semester of undergraduate biochemistry or molecular biology is preferred.

CHEM 571  Chemical Biology Laboratory  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/571](https://courses.illinois.edu/schedule/terms/CHEM/571))
Laboratory course in advanced state-of-the-art experimental techniques used to investigate problems at the interface of chemistry and biology. Specific topics include, but are not limited to, solid-phase peptide synthesis, native chemical ligation and expressed protein ligation, protein expression and analysis, enzyme kinetics and inhibition, high-throughput screening, various methods for examining biomolecular interactions, radiolabeling, mammalian cell biology, fluorescence microscopy, and flow cytometry. Prerequisite: One year (two semesters) of undergraduate organic chemistry is required. One semester of undergraduate biochemistry or molecular biology is preferred.

CHEM 572  Enzyme Reaction Mechanisms  credit: 3 or 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/572](https://courses.illinois.edu/schedule/terms/CHEM/572))
Introduction to the catalytic strategies used by enzymes for accelerating chemical reactions using a combination of kinetics, enzymology, and structural information. Application of gene databases to infer evolutionary relationships among catalytic mechanisms. Same as MCB 553. Prerequisite: Two semesters of undergraduate organic chemistry (CHEM 232 or CHEM 236 and CHEM 332 or CHEM 436) or consent of instructor.

CHEM 575  Chemical Biology Seminar  credit: 1 Hour. ([https://courses.illinois.edu/schedule/terms/CHEM/575](https://courses.illinois.edu/schedule/terms/CHEM/575))
Required of all Chemistry graduate students whose area is chemical biology. Prerequisite: Enrollment is allowed only by second-year graduate students who are presenting their Ph.D. literature seminar during that semester. Undergraduate students are not eligible to enroll in this course.

CHEM 576  Computational Chemical Biology  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/576](https://courses.illinois.edu/schedule/terms/CHEM/576))
Hands-on introduction to the simulation of biological molecules and bioinformatics. Topics included the principles of molecular modeling, molecular dynamics and monte carlo simulations, structure prediction in the context of structural and functional genomics, and the assembly of integrated biological systems. Course counts towards the CSE option. Same as BIOP 576 and CSE 576. 4 graduate hours. No professional credit. Prerequisite: One semester of undergraduate biochemistry and statistical thermodynamics or consent of instructor. Recommended: proficiency in Matlab and CS 101 or equivalent.

CHEM 582  Chemical Kinetics & Catalysis  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/582](https://courses.illinois.edu/schedule/terms/CHEM/582))
Same as CHBE 551. See CHBE 551.

CHEM 584  Introduction to Materials Chem  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/584](https://courses.illinois.edu/schedule/terms/CHEM/584))
Processing of ceramics, metals, polymers, and semiconductors, both traditional and advanced, and their mechanical, electrical, magnetic, optical and thermal properties.

CHEM 585  Materials Chemistry Seminar  credit: 1 Hour. ([https://courses.illinois.edu/schedule/terms/CHEM/585](https://courses.illinois.edu/schedule/terms/CHEM/585))
Required of all Chemistry graduate students whose area is materials chemistry. Prerequisite: Enrollment is allowed only by second-year graduate students who are presenting their Ph.D. literature seminar during that semester. Undergraduate students are not eligible to enroll in this course.

CHEM 586  Surface Chemistry  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/586](https://courses.illinois.edu/schedule/terms/CHEM/586))
Same as CHBE 553. See CHBE 553.

CHEM 588  Physical Methods Mat Chem  credit: 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/588](https://courses.illinois.edu/schedule/terms/CHEM/588))
Includes physical techniques for characterization in materials chemistry, including thermal analysis, electron microscopy, microprobe analysis and electron spectroscopies, adsorption and surface area measurements, and X-ray powder diffraction.

CHEM 590  Special Topics in Chemistry  credit: 1 to 4 Hours. ([https://courses.illinois.edu/schedule/terms/CHEM/590](https://courses.illinois.edu/schedule/terms/CHEM/590))
Designed for students majoring or minoring in chemistry who wish to undertake individual studies of a non-research nature under the direction of a faculty member of the department. Approved for both letter and S/U grading. Prerequisite: Consent of instructor and written approval of department head. Staff for the course is the same as for CHEM 599.
CHEM 592  Preparing Graduate Fellowships  credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/CHEM/592)
This course assists first- and second-year graduate students as well as
a selected few senior undergraduate students in their efforts to obtain
external grants and fellowships. Using the National Science Foundation
(NSF) Graduate Research Fellowship Program (GRFP) as an example,
the course provides the students with general information and guidance
about preparing grant applications. Each student will prepare a complete
application package, which can be submitted to the NSF GRFP at the
end of the course, although such submission is optional. Approved
for S/U grading only. Prerequisite: For first- and second-year graduate
students in Chemistry. Some senior undergraduate students who have
high GPA and research experience in faculty laboratories may enroll with
the instructor's approval.

CHEM 599  Thesis Research  credit: 0 to 16 Hours. (https://
courses.illinois.edu/schedule/terms/CHEM/599)
Candidates for the master’s degree who elect research are required to
present a thesis. A thesis is always required of students working toward
the degree of Doctor of Philosophy. Not all candidates for thesis work
necessarily are accepted. Any student whose major is in a department
other than chemistry or chemical engineering must receive permission
from the head of the Department of Chemistry to register in this course.
Approved for S/U grading only. May be repeated in separate terms. During
Summer terms, this course can only be taken for 0 to 8 hours.