Chemistry

M.S. in Chemistry (https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/chemistry/chem-ms/)

Ph.D. in Chemistry (https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/chemistry/chem-phd/)

CHEM 508. Departmental Lecture. 1 Credit.
S/U grading.

CHEM 509. Graduate Seminar. 1 Credit.
Student presentation of a seminar based on current peer-reviewed literature.

CHEM 510. Intermediate Inorganic Chemistry. 3 Credits.
Review of atomic concepts, molecular topologies, and symmetry. Theories of bonding including directed and undirected atomic orbital view. An introduction to the chemistry of transition metals. Prerequisite: CHEM 454 or an equivalent approved by the department.

CHEM 511. Advanced Inorganic Chemistry. 3 Credits.
Structure of coordination compounds, mechanisms of inorganic reactions, biochemical applications of inorganic chemistry. Three hours lecture per week. Prerequisite: CHEM 510.

CHEM 512. Organometallic Chemistry. 3 Credits.
Preparation, bonding and reactivity of organometallic compounds, both main group and transition metal. Prerequisite: CHEM 454.

CHEM 519. Special Topics in Chemistry. 1-3 Credits.
Topic of current interest to be considered each semester; may be repeated for credit if topic is different. Prerequisite: CHEM 509. Repeatable. On demand.

CHEM 520. Advanced Organic Chemistry I. 3 Credits.
Reaction mechanisms. Carbanions and radicals. Substitution, elimination and addition reactions. Carbonyl chemistry. Three hours lecture per week. Prerequisite: CHEM 342 or an equivalent approved by the department. On demand.

CHEM 521. Advanced Organic Chemistry II. 3 Credits.
Carbocations and carbenes. Oxidations and reductions. Alkylations. Carbonyl additions. Substitution and addition reactions. Three hours lecture per week. Prerequisite: CHEM 352 or an equivalent approved by the department.

CHEM 522. Advanced Organic Chemistry III. 3 Credits.
Photochemistry. Concerted reactions and cycloadditions. Aromatic and heterocyclic chemistry. Transition metals in organic chemistry. Three hours lecture per week. Prerequisite: CHEM 520 or CHEM 521.

CHEM 529. Special Topics in Synthetic Chemistry. 1-3 Credits.
Topic of current interest. May be repeated for credit if topic is different. Prerequisite: CHEM 520 or CHEM 521 or CHEM 510. Repeatable. On demand.

CHEM 530. Chemical Thermodynamics. 3 Credits.
Application of classical and statistical thermodynamics to chemical equilibrium, phase equilibrium and the physical properties of solutions. Prerequisite: CHEM 466 or CHEM 470 or an equivalent approved by the department. On demand.

CHEM 531. Chemical Dynamics. 3 Credits.
Study of the kinetics of complex, coupled chemical reactions in gas and solution phases; dynamics of gas phase reactions. Prerequisite: CHEM 466 or CHEM 470 or equivalent or consent of instructor. On demand.

CHEM 532. Quantum Mechanics in Chemistry. 3 Credits.
Application of the time-dependent Schroedinger equation to rotational, vibrational and magnetic spectroscopy; selection rules. Relation of molecular structural parameters and spectroscopic measurements; principles of group theory. Prerequisite: CHEM 471 or an equivalent approved by the department. On demand.

CHEM 534. Quantum and Computational Chemistry. 3 Credits.
Study of the electronic structure of atoms and molecules using modern approximation methods; formal aspects of various perturbation and variational techniques as applied to chemical problems. 3 hours lecture. Prerequisite: CHEM 532.

CHEM 537. Graduate Cooperative Education. 1-9 Credits.
Practical experience of applying advanced concepts in chemistry. Experience will vary from student to student and must be coordinated with co-op host. Prerequisite: Permission of Department Chair is required, MS students must have minimum of 26 credits and PhD students must have a minimum of 52 credits. On demand.

CHEM 539. Special Topics in Physical Chemistry. 1-3 Credits.
Topic of current interest. May be repeated for credit if topic is different. Prerequisite: Consent of department. Repeatable.

CHEM 541. Analytical Spectroscopy. 3 Credits.
Fundamentals of analytical spectroscopy including principles of emission spectroscopy, flame photometry, atomic absorption, infrared and Raman spectroscopy, ultraviolet/visible spectroscopy, and fluorescence. Prerequisite: CHEM 333 or an equivalent approved by the department. On demand.

CHEM 542. Electrochemical Methods. 3 Credits.
Topics ranging from the fundamentals of electrochemistry (including thermodynamics, kinetics, and mass transfer) to applications of contemporary electroanalytical techniques such as cyclic voltammetry, digital simulation, and spectroelectrochemistry are discussed. Prerequisite: CHEM 333 or an equivalent approved by the department. On demand.

CHEM 543. Chromatography. 3 Credits.
Fundamentals of modern chromatographic techniques including principles of band broadening, gas chromatography, liquid chromatography, and representative sampling problems. Prerequisite: CHEM 333 or an equivalent approved by the department. On demand.

CHEM 549. Special Topics in Analytical Chemistry. 1-3 Credits.
Topic of current interest to be considered each semester; may be repeated for credit if topic is different. Prerequisite: CHEM 540. Repeatable.

CHEM 561A. Teaching Fundamental Chemistry I. 3 Credits.
An exploration of modern teaching methods for introductory and general chemistry classes. Materials covered include maintaining a safe and organized laboratory, developing of course materials and learning management sites, and modern teaching methods. On demand.

CHEM 561B. Foundations of Chemistry for Teacher Development. 3 Credits.
Continuation of CHEM 561A. Prerequisite: CHEM 561A. On demand.

CHEM 561L. Introduction to Guided Learning in Chemistry. 2 Credits.
First of a chemistry course sequence intended for: a) teachers planning to qualify to teach high school chemistry; or b) teachers looking to enrich their content knowledge in chemistry for professional development. Topics include: chemical nomenclature and structure; periodicity; aqueous reactions; chemical stoichiometry; ionic and covalent bonding; solutions; thermochemistry; gases, liquids and solids; and pedagogical issues. May not be used in Ph.D. or Master's programs.

CHEM 562A. Intermediate Chemistry for Teacher Development. 3 Credits.
Fourth of a chemistry course sequence intended for: a) teachers planning to qualify to teach high school chemistry; or b) teachers looking to enrich their content knowledge in chemistry for professional development. Topics include: Equilibrium and kinetic principles of chemistry; behavior of solutions; rates of reactions; thermodynamics; aqueous equilibria (acid/base, solubility); electrochemical cells; chemical behavior of main-group elements; nuclear chemistry. May not be used in Ph.D. or Master's programs. Prerequisite: CHEM 562L.

CHEM 562B. Intermediate Chemistry for Teacher Development. 3 Credits.
Continuation of CHEM 562A. Prerequisite: CHEM 562A.

CHEM 562L. Intermediate Guided Inquiry Learning in Chemistry. 2 Credits.
Third of a chemistry course sequence intended for: a) teachers planning to qualify to teach high school chemistry; or b) teachers looking to enrich their content knowledge in chemistry for professional development. Topics include: colligative properties; chemical kinetics and equilibrium; acid/base chemistry; thermodynamics; electrochemistry; and pedagogical issues. May not be used in Ph.D. or Master's programs. Prerequisite: CHEM 561L and CHEM 561B.

CHEM 563A. Approaches to Teaching Organic Chemistry I. 3 Credits.
An exploration of modern teaching methods for organic chemistry classes. Materials covered include maintaining a safe and organized laboratory, developing of course materials and learning management sites, and modern teaching methods. On demand.

CHEM 563B. Organic and Biochemistry for Teacher Development. 3 Credits.
Continuation of CHEM 563A. Prerequisite: CHEM 563A.

CHEM 563L. Guided Inquiry Learning in Organic and Biochemistry. 2 Credits.
Fifth of a chemistry course sequence intended for: a) teachers planning to qualify to teach high school chemistry; or b) teachers looking to enrich their content knowledge in chemistry for professional development. Topics include: hydrocarbons; alcohols; amines; aldehydes and ketones; carboxylic acids and their derivatives; proteins; carbohydrates, lipids; nucleic acids, enzymes; and pedagogical issues. May not be used in Ph.D. or Master's programs. Prerequisite: CHEM 562L and CHEM 562B.

CHEM 599. Research. 1-15 Credits.
Maximum of 15 credits each semester. May be repeated for credit. Repeatable.

CHEM 996. Continuing Enrollment. 1-12 Credits.
Repeatable. S/U grading.

CHEM 997. Independent Study. 1-3 Credits.
Independent study supervised by graduate faculty. Repeatable to 3.00 credits. F,S,SS.

CHEM 998. Thesis. 1-9 Credits.
Repeatable to 9.00 credits.

CHEM 999. Dissertation. 1-18 Credits.
Repeatable to 18.00 credits.

Undergraduate Courses for Graduate Credit

CHEM 361. Problem Solving in Organic Chemistry I. 1 Credit.
Reaction mechanisms and multi-step syntheses based on the reactions of alkenes, alkynes, alkyl halides and alcohols. Prerequisite: CHEM 122, with a grade of C or better and CHEM 122L; or CHEM 254 and CHEM 254L. Corequisite: CHEM 341 and CHEM 341L. F.

CHEM 362. Problem Solving in Organic Chemistry II. 1 Credit.
Reaction mechanisms and multi-step syntheses involving organometallic compounds, aldehydes, ketones, carboxylic acids and their derivatives, aromatic compounds and amines. Prerequisite: CHEM 341 with a grade of C or better, CHEM 341L, and CHEM 361. Corequisite: CHEM 342 and CHEM 342L. S.

CHEM 401. Nanotechnology & Nanomaterials. 3 Credits.
Introduction to the underlying synthetic principles and applications of the emerging field of nanotechnology. Intended for a multidisciplinary audience with a variety of backgrounds. Introduces characterization tools and principles relevant at the nanoscale dimension. Discusses current and future nanotechnology applications in biology, energy, electronics and engineering. Prerequisite: CHEM 333 and CHEM 341 or CHEM 340. F, odd years.

CHEM 402. Trends in Forensic and Environmental Analytical Chemistry. 3 Credits.
Approaches to the characterization of complex samples using separation methods. The topics will include characteristics compounds relevant to forensic and environmental fields. Methods of sample preparation and analysis. Prerequisite: CHEM 333 and CHEM 341 or CHEM 340. F, even years.

CHEM 441. Instrumental Analysis I - Spectroscopy. 2 Credits.
Topics ranging from the fundamentals of spectroscopic analysis to contemporary techniques (including atomic absorption spectroscopy, atomic emission spectroscopy, atomic fluorescence spectroscopy, UV-vis molecular spectroscopy, fluorescence molecular spectroscopy, and infrared spectroscopy) are explored in the classroom and in laboratory exercises. Prerequisite: CHEM 333 and CHEM 333L. S, even years.

CHEM 442. Instrumental Analysis II - Electrochemistry. 2 Credits.
Topics ranging from the fundamentals of electrochemistry (including thermodynamics, kinetics, and mass transfer) to contemporary techniques of electroanalysis (such as potentiometry, coulometry, amperometry, and voltammetry) are explored in classroom and laboratory exercises. Prerequisite: CHEM 333 and CHEM 333L. S, odd years.

CHEM 443. Instrumental Analysis III - Chromatography/Mass Spectrometry. 2 Credits.
Topics involving the fundamentals of gas and liquid chromatography (GC and LC) and mass spectrometry (MS) as well as their practical considerations in the method development (including sample preparation and MS interpretation) are covered. The modern chromatographic techniques (GC, GC/MS, and high resolution MS) are explored in classroom and laboratory exercises. Prerequisite: CHEM 333 and CHEM 333L. F, odd years.

CHEM 454. Inorganic Chemistry II. 3 Credits.
Chemistry of inorganic compounds in terms of modern theories and concepts. Prerequisite: CHEM 254 and CHEM 342. Corequisite: CHEM 454L. F, even years.

CHEM 455. Spectroscopy and Structure. 3 Credits.
Applications of spectroscopic techniques to the determination of molecular structure. Prerequisite: CHEM 342 or CHEM 466. On demand.

CHEM 466. Fundamentals of Physical and Biophysical Chemistry. 3 Credits.
Required for students pursuing a B.S. with a Major in Chemistry degree, Biochemistry track. Survey of topics in physical and biophysical chemistry with an emphasis on the life sciences. Topics include chemical thermodynamics, kinetics, introductory quantum mechanics, and spectroscopy. Prerequisite: CHEM 340 or CHEM 342, MATH 146 or MATH 165, and PHYS 211 or PHYS 251. S, even years.

CHEM 470. Thermodynamics & Kinetics. 3 Credits.
The use of energy concepts in studying and understanding the nature of matter, equilibria, reactivity, kinetics, criteria for reactions, entropy. Prerequisite: CHEM 340 or CHEM 341, MATH 265, and PHYS 252. F.

CHEM 471. Quantum Mechanics & Spectroscopy. 3 Credits.
Theory and nature of bonding and structure, spectroscopy, and optics. Prerequisite: CHEM 470, MATH 265, and PHYS 252. S, even years.

CHEM 475. Materials Chemistry. 3 Credits.
Materials' synthesis, material chemistry, preparation methods and case studies in materials science. Prerequisite: CHEM 340 or CHEM 342. S, odd years.

CHEM 494. Senior Research. 0-3 Credits.
An opportunity for advanced students to work on research problems under close faculty guidance. A total of 45 hours is typically required over the course of the semester per credit. Prerequisite: Instructor consent and CHEM 342 or CHEM 340. Repeatable to 6.00 credits. F,S,SS.

CHEM 495. Chemistry Capstone. 3 Credits.
Designed for all senior students majoring in Chemistry. Discussion of current research topics in chemistry. Practice critical thinking skills and the knowledge gained in various chemistry courses to interpret and evaluate chemistry research data. Process information from different sources to provide an original interpretation of a given chemical phenomenon. Prepare a professional research paper and poster or oral presentation. Prerequisite or Corequisite: CHEM 466L or CHEM 470L. S.