Chemistry

Chemistry is a physical science with far-reaching applications that touch virtually every aspect of our day-to-day existence. Careers in chemistry offer numerous possibilities in a wide range of industries and in education.

The Chemistry program offers courses leading to the degrees of Bachelor of Science and Master of Science. The undergraduate curriculum in Chemistry and Biochemistry programs prepares students for careers in industry and environmental chemistry positions as well as for graduate study. Undergraduate courses also provide appropriate backgrounds for students planning careers in medicine, dentistry, pharmacy, nursing and related professional health fields.

In 1985, Northeastern Illinois University was added to the American Chemical Society's (ACS) Approved List of baccalaureate chemistry programs in colleges and universities. Being included on the Approved List means that the chemistry curriculum meets standards established by the ACS Committee on Professional Training. Students completing the ACS track will earn a certificate stating that they have met ACS standards for professional training.

Transfer students majoring in chemistry need to contact a program advisor immediately so that transfer credits may be evaluated and an appropriate program of study planned.

Chemistry courses are designed to be taken in sequence. Students will not be permitted to register for courses if they do not have credit for the required prerequisites.

Undergraduate students are encouraged to participate in research programs with faculty members and may take CHEM-305, and CHEM-399 for that purpose. Internships with local chemical industries and laboratories are also encouraged through CHEM-365, and CHEM-366. Please consult with the undergraduate advisor concerning these courses.

Students should also be aware of the University requirements for the Bachelor's degree.

- Major in Chemistry (http://catalog.neiu.edu/arts-sciences/chemistry/chemistry/)
- Minor in Chemistry (http://catalog.neiu.edu/arts-sciences/chemistry/minor-chemistry/)
- Master of Science in Chemistry (http://catalog.neiu.edu/arts-sciences/chemistry/master-science-chemistry/)

Gregory Anderson, Ph.D., Professor of Physics, Chair

Kenneth Nicholson, Ph.D., Associate Professor
Samantha Brown-Xu, Ph.D., Associate Professor
Jing Su, Ph.D., Associate Professor
Stefan Tsonchev, Ph.D., Professor

CHEM-103. Chemistry And Society. 3 Hours.
Introduction to chemistry based on the study of some of the processes and materials which chemistry contributes to our civilization. Elementary chemical principles are used to explain the behavior of synthetic polymers, toxic substances, food additives, cleaning products, and other chemically manufactured materials. Knowledge of basic algebra skills assumed. Lecture 3 hours.
Prerequisite: (MATH-091 - 499 or MATH-091A - 499Z or NEIU Math Placement Result 02 - 45 or ACT Math 19 - 36 or Accuplacer Elementary Algebra 060 - 084 or Accuplacer College Level Math 020 - 120 or Accuplacer Adv. Algebra & Func 200 - 300 or SAT Math 500 - 800).

CHEM-108. Chemistry Concepts For Educators. 4 Hours.
This lab-oriented course covers the basic principles of chemistry while supporting future educators in the implementation of interdisciplinary mathematics and science curricula. Topics include atomic theory, solution chemistry, inorganic and organic chemistry, states of matter, physical and chemical properties, appropriate use of nomenclature, chemical bonding, and use of quantitative calculations using appropriate number techniques in science. The historical context of how chemistry contributes to our civilization will also be considered. Elementary chemical principles will be used to explain the behavior of everyday chemicals (including food and cleaning supplies) in addition to more scientific and industrial applications. Issues of contemporary critical technologies, such as biomaterials, natural products, alternative fuels, bioremediation, fuel cells, green technology, biodefense, and smart materials may be examined. This course is aligned to the Next Generation of Science Standards and the National Science Teachers Association Standards. Course outcomes include developing students' ability to apply knowledge of chemistry to a variety of real-world problems and settings with particular emphasis on scientific inquiry, the nature of science, civic engagement, and applications to teaching.
Prerequisite: MATH-150 with a minimum grade of C.

CHEM-110. Chemical Concepts. 3 Hours.
Lab-oriented survey course in chemistry designed for the non-science major including such topics as the historical development of chemistry, atomic theory, solution chemistry, organic and biochemistry. Knowledge of basic algebra skills assumed. Lecture 2 hours, lab, 2 hours.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

CHEM-211. General Chemistry I. 5 Hours.
Introduction to general inorganic chemistry, including stoichiometry, concentration units, gas laws, atomic structure, bonding, periodic laws, states of matter, solutions, acid-base theories, rate, equilibrium and oxidation-reduction theory. Lecture and Laboratory. Lecture 4 hours, lab 3 hours.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

CHEM-211C. Enrichment Seminar In General Chemistry I. 1 Hour.
Enrichment seminar accompanying CHEM-211. Students do problem solving in collaborative learning groups on material derived from and supplementing General Chemistry I to gain a deeper understanding of concepts and applications. Lecture 2 hours.
Corequisite: CHEM-211.

CHEM-212. General Chemistry II. 4 Hours.
This is the second course in the General Chemistry sequence. Topics include reaction kinetics, gaseous and aqueous phase equilibria, acids and bases, entropy, free energy and electrochemistry.
Prerequisite: CHEM-211 with a minimum grade of C and MATH-173 with a minimum grade of C.

CHEM-212C. Enrichment Seminar In General Chemistry II. 1 Hour.
Enrichment seminar accompanying CHEM-212. Students do problem solving in collaborative groups on material derived from and supplementing General Chemistry II to gain a deeper understanding of concepts and applications. Lecture 2 hours.
Corequisite: CHEM-212.

CHEM-213. Writing Intensive Program: Quantitative Analysis. 5 Hours.
Statistical analysis of data, chemical equilibrium, simultaneous equilibria, classical and non-classical gravimetric and volumetric techniques, acid-base and oxidation-reduction reactions, spectrophotometric and potentiometric measurements. Lecture 3 hours, lab 6 hours.
Prerequisite: CHEM-212 with a minimum grade of C and ENGL-101 with a minimum grade of C.

CHEM-231. Organic Chemistry I. 4 Hours.
Study of the structure, properties, reaction mechanisms and nomenclature of aliphatic and aromatic hydrocarbons and their derivatives. Lecture and laboratory. Lecture 3 hours, lab 3 hours.
Prerequisite: CHEM-212 with a minimum grade of C and CHEM-211 with a minimum grade of C.

CHEM-231C. Enrichment Seminar In Organic Chemistry I. 1 Hour.
Enrichment seminar accompanying CHEM-231. Students do problem solving in collaborative learning groups on material derived from and supplementing Organic Chemistry I to gain a deeper understanding of concepts and applications. Lecture 2 hours.
Corequisite: CHEM-231.

CHEM-232. Organic Chemistry II. 4 Hours.
Continuation of CHEM-231. A study of structure, properties, reaction mechanisms, synthesis and infrared and nuclear magnetic resonance spectroscopy of the alcohols, acids, amines and other monofunctional compounds. Lecture and laboratory. Lecture 3 hours, lab 3 hours.
Prerequisite: CHEM-231 with a minimum grade of C.

CHEM-232C. Enrichment Seminar In Organic Chemistry II. 1 Hour.
Enrichment seminar accompanying CHEM-232. Students do problem solving in collaborative learning groups on material derived from and supplementing Organic Chemistry II to gain a deeper understanding of concepts and applications. Lecture 2 hours.
Corequisite: CHEM-232.

CHEM-300. Interdisciplinary Seminar In STEM. 2 Hours.
This course uses a hands-on approach to modern inquiry-based research problems and techniques in the physical and computational sciences. The course is structured around a series of modular problem-based exercises, covering topics from the fields of Chemistry, Computer Science, Earth Science, Mathematics, and Physics, and is designed to provide the content and pedagogical background for students to be successful peer leaders. The cross-disciplinary modules will draw connections between scientific disciplines, and showcase common research tools and techniques used in the sciences. The workshop will also incorporate discussions on a range of topics, from scientific ethics, scientific methodology, and error analysis.
Prerequisite: MATH-185 with a minimum grade of C.

CHEM-305. Independent Study In Chemistry. 3 Hours.
An introduction to original chemical research under faculty supervision. Independent Studies require the approval of the instructor, department chair and the College Dean.
Prerequisite: CHEM-213 with a minimum grade of C and CHEM-232 with a minimum grade of C.

CHEM-311. Physical Chemistry I. 4 Hours.
Theoretical and experimental study of the structure and properties of matter, including the gaseous state, chemical thermodynamics, chemical equilibrium, liquids and phase equilibria, solutions of nonelectrolytes and ionic solutions. Lecture and laboratory. Lecture 3 hours, lab 3 hours. It is strongly suggested that the student has completed a year of physics with laboratory.
Prerequisite: CHEM-231 with a minimum grade of C and MATH-187 with a minimum grade of C and MATH-202 with a minimum grade of C and (PHYS-206 with a minimum grade of C or PHYS-201 with a minimum grade of C or PHYS-207 with a minimum grade of C or PHYS-202 with a minimum grade of C).

CHEM-311C. Physical Chemistry I Seminar. 1 Hour.
This course accompanies Physical Chemistry I, CHEM-311. Students will do problem solving in collaborative learning groups on material derived from and supplementing Physical Chemistry I lecture, in order to gain a deeper understanding of concepts and applications.
Corequisite: CHEM-311.

CHEM-312. Physical Chemistry II. 4 Hours.
Continuation of CHEM- 311, including the kinetic-molecular theory, transport properties, chemical kinetics, statistical mechanics, quantum theory, atoms and diatomic molecules and spectroscopy. Lecture and laboratory. Lecture 3 hours, lab 3 hours.
Prerequisite: CHEM-231 with a minimum grade of C and MATH-202 with a minimum grade of C and MATH-187 with a minimum grade of C and (PHYS-206 with a minimum grade of C or PHYS-201 with a minimum grade of C or PHYS-207 with a minimum grade of C or PHYS-202 with a minimum grade of C).

CHEM-312C. Physical Chemistry II Seminar. 1 Hour.
This course accompanies Physical Chemistry II, CHEM-312. Students will do problem solving in collaborative learning groups on material derived from and supplementing Physical Chemistry II lecture, in order to gain a deeper understanding of concepts and applications.
Corequisite: CHEM-312.

CHEM-316. Inorganic Chemistry. 4 Hours.
A thorough study of bonding in non-transition and transition elements, periodic trends and tendencies, structural relationships and mechanisms of inorganic reactions. Lecture and laboratory. Lecture 3 hours, lab 3 hours.
Prerequisite: CHEM-212 with a minimum grade of C.

CHEM-319. Chemical Aspects Of Environmental Chemistry. 3 Hours.
A survey of the chemical principles involved in environmental problems. Topics include atmospheric, aquatic and geographic chemistry, sources of pollutants and the consequences of pollution. Lecture 3 hours.
Prerequisite: CHEM-212 with a minimum grade of C.

CHEM-320. Industrial Aspects Of Environmental Chemistry. 3 Hours.
Industrial aspects of environmental chemistry covering specific topics such as energy, water and wastewater treatment, treatment and disposal of domestic and industrial wastes, techniques for detecting and analyzing chemical pollutants, environmental modeling and analyzing chemical pollutants, environmental modeling and recycling strategies. Lecture 3 hours.
Prerequisite: CHEM-213 with a minimum grade of C and CHEM-232 with a minimum grade of C.

CHEM-321. Environmental Chemistry In The City. 2 Hours.
This is a laboratory and field course that will concentrate on topics of environmental interest in the city of Chicago. Field work will include visits to the Chicago River, Lake Michigan, the Chicago Forest Preserve, and other locations in the metropolitan area. Students will learn proper methods of sample collection, storage, and transport. Chemical analysis of collected samples by titrimetric, gravimetric, spectroscopic, chromatographic, and electrochemical methods will take place in the field and in the laboratory. Lecture 1 hr, Lab/Field 2.5 hrs. Prerequisite: CHEM-213 with a Grade of C or better.
Prerequisite: CHEM-213 with a minimum grade of C.

CHEM-330. Instrumental Analysis: Spectroscopy. 4 Hours.
The course includes an intensive laboratory introduction to infrared spectroscopy, mass spectrometry, nuclear magnetic resonance spectroscopy and Raman spectroscopy. Research projects are part of the course to develop instrumental methods for qualitative and quantitative analysis of various chemical materials used in everyday life. Lecture and laboratory. Lecture 3 hours, lab 6 hours.
Prerequisite: CHEM-231 with a minimum grade of C.

CHEM-331. Instrumental Analysis: Quantitative Methods. 5 Hours.
In this course, students will learn about instrumental methods used to determine composition of materials, including gas and liquid chromatography, UV-Vis spectroscopy, fluorescence emission spectroscopy, atomic absorption and emission spectroscopy, X-ray diffraction, and potentiometry. The course emphasizes the theory and practice of designing an analytical method.
Prerequisite: CHEM-231 with a minimum grade of C.

CHEM-333. Introduction To Polymer Chemistry. 3 Hours.
This course provides an introduction to the broad field of polymer chemistry. Topics will focus on the properties, synthesis, processing, and applications of polymers that have industrial and commercial importance. The properties of biological polymers and environmental concerns of polymers will also be discussed.
Prerequisite: CHEM-231 with a minimum grade of C and CHEM-232 with a minimum grade of C.

CHEM-347. Advanced Organic Chemistry: Polyfunctional Compounds. 3 Hours.
Chemistry of polyfunctional compounds, condensed aromatic and heterocyclic systems, electrocyclic reactions and molecular rearrangements. Lecture 3 hours.
Prerequisite: CHEM-232 with a minimum grade of C.

CHEM-348. Advanced Organic Chemistry: Bio-Organic Compounds. 3 Hours.
The chemistry of complex molecules such as proteins, nucleic acids and carbohydrates is studied from the point of view of their physical properties and their reaction, synthesis and structure-function relationships. Lecture 3 hours.
Prerequisite: CHEM-232 with a minimum grade of C.

CHEM-349. Organic Synthesis. 4 Hours.
A systematic approach to the synthesis of complex organic compounds will be developed. The retrosynthetic approach will be taken, with a final target molecule being the goal of the synthesis. It will be taken apart, step-by-step to arrive at reasonable starting materials for the synthesis. Availability and expense of potential starting materials, necessity of protecting groups, and production of isomeric and/or stereoisomeric mixtures will be among the points of consideration for each synthesis. An accompanying laboratory will involve several multistep syntheses, which serve to illustrate principles developed in lecture and build upon experimental techniques encountered in prerequisite organic chemistry courses.
Prerequisite: CHEM-232 with a minimum grade of C.

CHEM-350. Principles Of Toxicology. 3 Hours.
This course offers an introduction to the basic principles of the broad field of toxicology. The mechanisms involved in what constitutes a toxic response will be explored, including examples of toxic chemicals targeting specific biochemical pathways in the human body. Major groups of toxic chemicals such as pesticides, metals, solvents, vapors, radiation and radioactive materials, animal venoms and poisons, will be surveyed. Also addressed are the applied areas of food, forensic/ analytical, and occupational toxicology.
Prerequisite: CHEM-231 with a minimum grade of C.

CHEM-353. Principles of Pharmacology. 3 Hours.
This course will focus on the action of drugs on major organ systems, including the nervous, cardiovascular, gastrointestinal, respiratory, and reproductive systems, as well as drugs for cancer, infectious, and inflammatory diseases. It is also covers pharmacokinetics, drug-receptor interactions, and drug metabolism for these categories of therapeutic agents.
Prerequisite: CHEM-231 with a minimum grade of C.

CHEM-355. Principles Of Medicinal Chemistry. 3 Hours.
This course offers an introduction to the principles of drug design and the molecular mechanism by which drugs act on the human body. It covers basic structure and function of drug targets, lead compound identification, optimization of drug-target interaction and improvement of pharmacokinetic properties of drugs. Tools in the modern drug discovery and development such as high-through-put synthesis and screening, structure–activity relationships, and computer-aided drug design will be also addressed.
Prerequisite: CHEM-231 with a minimum grade of C.

CHEM-356. Bioorganic Chemistry Laboratory. 4 Hours.
This course offers a laboratory introduction to bioorganic chemistry, with experiments involving each of the main classes of biomolecules, including proteins, carbohydrates, lipids, and nucleic acids.
Prerequisite: CHEM-231 with a minimum grade of C and CHEM-232 with a minimum grade of C.

CHEM-357. Chemical Kinetics. 3 Hours.
The study and evaluation of various theories of reaction rates and mechanisms of chemical reactions. Lecture 3 hours.
Prerequisite: CHEM-311 with a minimum grade of C.

CHEM-362. Biochemistry. 4 Hours.
Biochemistry examines the chemistry that underlies the biological processes common to all living organisms. The course will explore the chemical nature of the four major biological molecules and the processes that drive their activities. Topics include the structures of proteins, nucleic acids, carbohydrates, and lipids, and processes that include thermodynamics, acid-base reactions, catalysis, and energetics. This course is also offered at the 400-level for graduate credit. Lecture and laboratory.
Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C and CHEM-231 with a minimum grade of C.

CHEM-365. Internship In Chemistry I. 6 Hours.
Experience in chemistry in an off-campus location, e.g. business or government. The student registering selects well-defined academic goals to be achieved. These goals will be selected in cooperation with an on-campus advisor. Independent studies require the approval of the instructor, department chair and the College Dean.

CHEM-366. Internship In Chemistry II. 6 Hours.
Continuation of CHEM-365. Independent studies require the approval of the instructor, department chair and the College Dean.

CHEM-372. Biochemistry Of Metabolism. 3 Hours.
This course focuses on the processing of carbohydrates, lipids, proteins, and nucleotides, offering a mechanistic view of metabolic pathways related to each macromolecule group, including feedback control. Topics will be linked to clinical situations and will incorporate current primary research literature in the field of metabolism. Quantitative analysis of chemical reactions, bioenergetics, thermodynamics and interpretation of research articles will be incorporated as part of the lectures.
Prerequisite: BIO-362 with a minimum grade of C or CHEM-362 with a minimum grade of C.

CHEM-391. Chemistry Capstone Seminar. 3 Hours.
Critical review of research presented by visiting university and industrial chemists and student preparation of original and library research topics. The course will also explore issues related to becoming a morally responsible scientist and will include ethical problem solving. Lecture 4 hours. May be taken concurrently with CHEM-311.
Prerequisite: CHEM-311 with a minimum grade of C or CHEM-312 with a minimum grade of C.

CHEM-399. Undergraduate Research. 3 Hours.
Original laboratory research conducted with a faculty member. The course will usually require some library research, 10-12 hours per week laboratory work and the preparation of a formal, typed report. The course is useful for those students seeking recognition under the guidelines authorized by the American Chemical Society.
Prerequisite: CHEM-311 with a minimum grade of C and CHEM-330 with a minimum grade of C.

CHEM-401. Carbohydrates. 3 Hours.
Structure, stereochemistry and reactions of monosaccharides, disaccharides, oligosaccharides and polysaccharides. Lecture 3 hours. Graduate Standing.
Prerequisite: CHEM-312 with a minimum grade of C.

CHEM-402. Organometallic Chemistry. 3 Hours.
The metal-carbon bond including organometallic synthesis, structure, reaction mechanisms and thermodynamics. Main group metal-carbon compounds, transition metal-carbon compounds and such special topics as Grignard compounds, ferrocenes, carbonyl complexes and inorganic mutiple bonding. Lecture 3 hours. Graduate Standing.
Prerequisite: CHEM-312 with a minimum grade of C and CHEM-316 with a minimum grade of C.

CHEM-403. Physical Methods Of Organic Chemistry. 3 Hours.
Various physical techniques of interest to the organic chemist are discussed including spectroscopic methods as proton and carbon-13 nuclear magnetic resonance, infrared and electronic spectroscopy and mass spectrometry, with emphasis on interpreting the combined data. The three credit hours include 2 hours of lecture and 1 hour of lab. Graduate standing.
Prerequisite: CHEM-312 with a minimum grade of C.

CHEM-404. Chemical Thermodynamics. 3 Hours.
Principles of thermodynamics and their application to chemical problems with particular emphasis on partial molal qualities, the chemical potential and the thermodynamics of chemical equilibria. Lecture 3 hours. Graduate Standing.
Prerequisite: CHEM-312 with a minimum grade of C.

CHEM-405. Quantum Chemistry. 3 Hours.
Application of quantum mechanism to chemistry. Topics include the Schrodinger equation and simple applications, the postulates and general principles of quantum mechanics, the harmonic oscillator, three-dimensional systems, atoms and molecules, and molecular spectroscopy. Lecture 3 hours. Graduate standing.
Prerequisite: CHEM-312 with a minimum grade of C.

CHEM-406. Coordination Chemistry. 3 Hours.
Scope of transition metal coordination complexes, coordination number and structure, ligand types, isomerization, complex stability, bonding, reaction mechanisms, magnetic moments. Lecture 3 hours. Graduate Standing.
Prerequisite: CHEM-312 with a minimum grade of C and CHEM-316 with a minimum grade of C.

CHEM-407. Symmetry In Chemistry. 3 Hours.
Introduction to those aspects of group theory and symmetry which are particularly relevant to chemistry including point groups, molecular vibrations, hybrid orbitals and crystal field theory. Lecture 3 hours.
Prerequisite: CHEM-312 with a minimum grade of C or PHYS-335 with a minimum grade of C.

CHEM-408. Independent Study In Chemistry. 3 Hours.
Research in a particular area of chemistry under faculty supervision.

CHEM-408A. Independent Study In Chemistry. 3 Hours.

CHEM-411. Organic Reaction Mechanisms. 3 Hours.
Reaction pathways in organic chemistry including isotope effects, linear free energy relationships, stereochemistry, configurational analysis and pericyclic reactions. Lecture 3 hours. Graduate Standing.
Prerequisite: CHEM-312 with a minimum grade of C.

CHEM-412. Reaction Kinetics. 3 Hours.
Methods of studying reaction rates and mechanisms, derivation of mechanisms from rate laws. Theories of unimolecular and bimolecular reactions, and chain mechanisms and appropriate mathematical analysis. Lecture only. Lecture 3 hours. Graduate Standing.
Prerequisite: CHEM-312 with a minimum grade of C.

CHEM-413. Modern Inorganic Chemistry. 3 Hours.
In-depth survey of modern developments in inorganic chemistry, including noble gas chemistry, multiple bonding in coordination complexes, unusual oxidation states of elements, template reactions , inorganic polymers, and inorganic catalysis. Lecture 3 hours. Graduate Standing.
Prerequisite: CHEM-316 with a minimum grade of C.

CHEM-414. Advanced Analytical Chemistry. 3 Hours.
Electronic and computer-instrument interface, practical aspects of modern instrumental techniques based on various methods of optical spectroscopy and chromatography. Lecture 3 hours.
Prerequisite: CHEM-331 with a minimum grade of C.

CHEM-416. Nanoscience. 3 Hours.
This course introduces the students to the modern field of nanoscience and develops concepts and methodology for creation of new functional nanomaterials. Emphasis is put on the molecular self-assembly approach. The methods of film deposition, lithography, chemical synthesis and atom optics are covered as well. Scanning probe microscopy is introduced as a method of choice for studying and building nanoscale materials. Applications in the fields of electronic devices and nanomedicine are discussed.
Prerequisite: CHEM-312 with a minimum grade of C.

CHEM-417. Inorganic Chemistry. 4 Hours.
This course will consist of a thorough study of bonding in main-block and transition metal compounds, periodic trends and tendencies, structural relationships, and mechanisms of inorganic reactions. Lecture and laboratory. Lecture 3 hours, lab 3 hours.
Prerequisite: CHEM-232 with a minimum grade of C.

CHEM-418. Instrumental Analysis: Spectroscopy. 5 Hours.
The course includes an intensive laboratory introduction to infrared spectroscopy, mass spectrometry, nuclear magnetic resonance spectroscopy and Raman spectroscopy. Research projects are part of the course to develop instrumental methods for qualitative and quantitative analysis of various chemical materials used in everyday life. Lecture and laboratory. Lecture 3 hours, lab 6 hours.
Prerequisite: CHEM-232 with a minimum grade of C.

CHEM-419. Instrumental Analysis: Quantitative Methods. 5 Hours.
In this course, students will learn about instrumental methods used to determine composition of materials, including gas and liquid chromatography, UV-Vis spectroscopy, fluorescence emission spectroscopy, atomic absorption and emission spectroscopy, X-ray diffraction, and potentiometry. The course emphasizes the theory and practice of designing an analytical method.
Prerequisite: CHEM-232 with a minimum grade of C.

CHEM-430. Fourier Transform Spectroscopy. 3 Hours.
Prerequisite: CHEM-311 with a minimum grade of C and CHEM-312 with a minimum grade of C.

CHEM-431. Separation Methods. 3 Hours.
Review of thermodynamic and kinetic parameters as their impact on selectivity and efficiency of separation process, classification and application of modern chromatographic techniques. Lecture 3 hours.
Prerequisite: CHEM-331 with a minimum grade of C.

CHEM-433. Introduction To Polymer Chemistry. 3 Hours.
This course provides an introduction to the broad field of polymer chemistry. Topics will focus on the properties, synthesis, processing, and applications of polymers that have industrial and commercial importance. The properties of biological polymers and environmental concerns of polymers will also be discussed.
Prerequisite: CHEM-231 with a minimum grade of C and CHEM-232 with a minimum grade of C.

CHEM-450. Gas Chromatography. 3 Hours.
Principles and instrumentation, including classification and methods for selection of stationary phases, optimization of operational parameters, and various detection systems. Separation techniques prior to analysis, applications and hyphenated methods will be discussed. Lecture 3 hours. Graduate Standing and Consent of Instructor.
Prerequisite: CHEM-331 with a minimum grade of C.

CHEM-451. Liquid Chromatography. 3 Hours.
Review of thermodynamic and kinetic parameters as they impact on selectivity and efficiency of liquid chromatographic separations. Classification of mobile phases, including selection and ways to improve resolution. Principles of conventional liquid chromatographic techniques and their applications, including hyphenated methods. Lecture 3 hours. Consent of instructor. Graduate Standing.
Prerequisite: CHEM-331 with a minimum grade of C and CHEM-450 with a minimum grade of C.

CHEM-455. Method Development And Validation In Liquid Chromatography. 3 Hours.
Systematic approaches to the successful development of HPLC-based analytical methods and their optimization. Practical tools based on the use of computer simulation in method development. HPLC-methods validation presented on the basis of the currently accepted United States Pharmacopeia terminology.
Prerequisite: CHEM-451 with a minimum grade of C.

CHEM-456. Advanced Chromatographic Methods. 3 Hours.
Principles, methods and applications of various advanced chromatographic techniques of interest to the analytical chemist, including such chromatographic methods as chiral separations, ligand exchange chromatography, capillary electrophoresis, micellar chromatography, micellar electrokinetic capillary chromatography, and supercritical fluid chromatography. Lecture 3 hours.
Prerequisite: CHEM-451 with a minimum grade of C.

CHEM-462G. Biochemistry. 4 Hours.
Biochemistry examines the chemistry that underlies the biological processes common to all living organisms. The course will explore the chemical nature of the four major biological molecules and the processes that drive their activities. Topics include the structures of proteins, nucleic acids, carbohydrates, and lipids, and processes that include thermodynamics, acid-base reactions, catalysis, and energetics. Lecture and laboratory.
Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C and CHEM-231 with a minimum grade of C.

CHEM-472G. Biochemistry Of Metabolism. 3 Hours.
This course focuses on the processing of carbohydrates, lipids, proteins, and nucleotides, offering a mechanistic view of metabolic pathways related to each macromolecule group, including feedback control. Topics will be linked to clinical situations and will incorporate current primary research literature in the field of metabolism. Quantitative analysis of chemical reactions, bioenergetics, thermodynamics and interpretation of research articles will be incorporated as part of the lectures.
Prerequisite: BIO-362 with a minimum grade of C or CHEM-362 with a minimum grade of C or BIO-462G with a minimum grade of C or CHEM-462G with a minimum grade of C.

CHEM-5901. Thesis Hours: Chemistry. 1 Hour.
Guidance of students conducting research and writing a thesis to fulfill the requirements for the Master of Science degree in Chemistry.

CHEM-5902. Thesis Hours: Chemistry. 2 Hours.
See course description for CHEM-5901.

CHEM-5903. Thesis Hours: Chemistry. 3 Hours.
See course description for CHEM-5901.