Chemistry

To obtain specific admissions requirements on how to apply to Graduate School, prospective students should visit this page:https://www.uab.edu/cas/chemistry/graduate-program

Degree Offered:	Ph.D., M.S.
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Program Information

The UAB Department of Chemistry offers graduate programs leading to the Doctor of Philosophy (Ph.D.) and Master of Science (M.S.) degrees that are designed to ensure disciplinary quality and research competency. The Department of Chemistry has an outstanding research active faculty and highly collaborative culture that is conducive to stimulating graduate studies in a collegial atmosphere. The graduate program in the Department of Chemistry provides opportunities for research mentors to provide personalized attention to the academic and research progress of each of our graduate students.

Key features of the Department of Chemistry Graduate Program:

- Students are quickly integrated into research laboratories (ideally in first semester)
- Research is highly collaborative, both within the Department of Chemistry and the UAB biomedical research complex
- Interdisciplinary programs to broaden research interests including drug discovery, advanced materials, biophysical chemistry, structural biology, and nanomaterials
- Strong record of career success for graduates in academia, industry, and government

All graduate students are required to pursue a graduate curriculum that provides the general knowledge-based foundation through a series of six core curriculum courses (18 semester hours). The graduate student and the graduate research mentor (in consultation with the student's graduate research committee) select additional graded graduate courses to complete a minimum of 24 semester hours. There is no semester hour requirement for additional course work but the student must complete a minimum of 24 semester hours of graduate coursework with an overall GPA of 3.0 or higher. Chemistry graduate students may also participate in and enroll in interdisciplinary graduate programs, requiring enrollment in courses in other departments throughout the UAB campus that will broaden the students background in selective areas and greatly strengthen their ability to carry out interdisciplinary research.

All graduate students are to demonstrate communication skill competency. Adequate performance is required on the departmental literature seminar, written responses to essay questions, dissertation defense, teaching, written publications, and professional presentations at scientific meetings. All chemistry graduate students are required to complete GRD 715 (Graduate Teaching Assistantship Training) during their first term in the program. Students with English as a second language enroll for 3 semester hours. All others enroll in this course for 2 semester hours. This course is required but is not counted toward the 24 semester hour minimum.

During the Fall semester, first year graduate students are required to enroll in CH 790 (Introduction to Graduate Research). The student will be introduced to the graduate research faculty and their research interests. The student is required to meet with prospective research mentors to discuss interest in the prospective mentor's laboratory and if needed, schedule a 3-4 week rotations in research laboratories of interest. The process of selecting the graduate research mentor must be completed by the end of the student's first year.

Core Courses:

Requirements		Hours
CH 629/729	Special Topics in Physical Chemistry	3
CH 630/730	Physical Organic Chemistry	3
CH 631/731	Organic Reactions and Their Mechanisms	3
CH 632/732	Organic Reactions and Synthesis	3
CH 633/733	Reactive Intermediates and Conservation of Bonding	3
CH 639/739	Special Topics in Organic Chemistry	1-3
CH 642/742	Organometallic Chemistry and Catalysis	3
CH 649/749	Special Topics in Inorganic Chemistry	1-3
CH 651/751	Chemometrics	3
CH 652/752	Analytical Spectroscopy	3
CH 654/754	Multivariate Analysis in Analytical Chemistry	3
CH 659/759	Special Topics in Analytical Chemistry	3
CH 660/760	Fundamentals of Biochemistry	3
CH 661/761	Biochemistry II	3
CH 663/763	Biochemistry Laboratory	3
CH 664/764	Biophysical Chemistry	3
CH 669/769	Special Topics in Biochemistry	3
CH 671/771	Medicinal Chemistry and Drug Discovery	3
CH 672/772	Chemistry of Natural Products	3
CH 680/780	Polymer Chemistry I	3
CHL 680L/780L	Polymer Chemistry I Laboratory	1
CH 681/781	Polymer Chemistry II	3
CHL 681L/781L	Polymer Chemistry II Laboratory	1
CH 689/789	Special Topics in Polymer Chemistry	3

Substitutions are permitted with the approval of the student's research advisory committee and director of the graduate program. Master's students choose from the 600 courses, Ph.D. students from the 700 courses.

M.S. Program

Plan I

Plan I is a research program that requires a minimum of 24 semester hours (including 18 semester hours of core courses) of formal academic coursework approved by the student's graduate study committee. The progress of the student's research program is monitored by the graduate study committee. The student, having been admitted to candidacy and having completed an approved plan of research, will complete and defend a thesis.

Plan II

Plan II is a non-thesis program that requires a minimum of 30 semester hours (including 18 semester hours of core courses) of appropriate

graduate work that has been approved by the student's graduate study committee and Department of Chemistry Graduate Program Director.

Entry Term	Deadline
Deadline for Entry Term(s)	Each semester
Deadline for All Application Materials to be in the Graduate School Office	Six weeks before term begins
Number of Evaluation Forms Required	Three
Entrance Tests	GRE (TOEFL and TWE also required for international applicants whose native language is not English.)
Comments	None

M.S. in Chemistry

Requirements		Hours
Core Coursework		**18**
CH 602/702	Principles of Chemical Instruction	
CH 609	Chemical Safety	
CH 610	Laboratory Experiences in Chemistry	
CH 611	Atomic Structure and Periodicity for the 7-12 Classroom	
CH 612	Valence Electrons and Bonding Models for the 7-12 Classroom	
CH 613	Introductory Organic Chemistry for Teachers	
CH 614	Introductory Biochemistry for Teachers	
CH 615/715	Chemical Reactions and the Conservation of Mass for the 7-12 Classroom	
CH 616	Gases and the Kinetic Molecular Theory for the 7-12 Classroom	
CH 617	Dynamic Equilibria for the 7-12 Classroom	
CH 619	Special Topics in Chemical Education	
CH 625/725	Molecular Structure and Spectroscopy	
CH 629/729	Special Topics in Physical Chemistry	
CH 630/730	Physical Organic Chemistry	
CH 631/731	Organic Reactions and Their Mechanisms	
CH 632/732	Organic Reactions and Synthesis	
CH 633/733	Reactive Intermediates and Conservation of Bonding	
CH 639/739	Special Topics in Organic Chemistry	
CH 640/740	Bonding and Structure in Inorganic Compounds	
CH 642/742	Organometallic Chemistry and Catalysis	
CH 649/749	Special Topics in Inorganic Chemistry	
CH 651/751	Chemometrics	
CH 652/752	Analytical Spectroscopy	
CH 654/754	Multivariate Analysis in Analytical Chemistry	
CH 656	Analytical Separations	
CH 659/759	Special Topics in Analytical Chemistry	
CH 660/760	Fundamentals of Biochemistry	
CH 661/761	Biochemistry II	
CH 663/763	Biochemistry Laboratory	
CH 664/764	Biophysical Chemistry	
CH 665/765	Structural Biochemistry	
CH 669/769	Special Topics in Biochemistry	
CH 670/770	Chemical Literature	
CH 671/771	Medicinal Chemistry and Drug Discovery	
CH 672/772	Chemistry of Natural Products	
CH 673/773	Electron Pushing and Total Synthesis	
CH 674/774	X-Ray Crystallography	
CH 677/777	Radiochemistry for the life sciences	
CH 680/780	Polymer Chemistry I	
CHL 680L/780L	Polymer Chemistry I Laboratory	
CH 681/781	Polymer Chemistry II	
CHL 681L/781L	Polymer Chemistry II Laboratory	
CH 683/783	Chemistry of Polymers and Polymeric Materials I	
CH 684/784	Polymer Chemistry II	
CH 689/789	Special Topics in Polymer Chemistry	
CH 767	Advanced Biomolecular NMR spectroscopy: From Quantum Mechanics to Protein Dynamics	3
Electives [1]		**6**
Seminar [2]		**5**
CH 691/791	Seminar	
CH 692/792	Seminar Presentation	
Dissertation		**1-5**
CH 698/798	Graduate Research	

[1]Any 600 level or above course

[2]Consists of 2 hours of CH 692 or CH 792 and up to 3 hours of CH 691 or CH 791or a 600/700 level Journal Club (For example, CH 768)

5 th Year Master's Degree in Biochemistry

This is a research intensive degree program and to be eligible for admission in the senior year, students must start their undergraduate research experience as early as possible, preferably in their sophomore year.

Admission Requirements:

- Achieved status of Senior chemistry major
- GPA of 3.0 or higher
- Enrolled in CHEM 297 (Introduction to Undergraduate Research) by the Fall semester of the Junior year
- Selection of faculty research mentor (in the Department of Chemistry or Department of Biochemistry & Molecular Genetics) by Spring semester of the Junior year and enroll in CHEM 497 (Undergraduate Research) by Spring semester of the Junior year

Admission to the 5th-year MS program will additionally require:

- Satisfactory performance on Graduate Record Exam (GRE) taken in the Senior year (first term)
- Strong letter of nomination for admission to the program from their undergraduate research mentor

The 5th-year M.S. Chemistry/Biochemistry Oversight Committee, composed of two faculty members from the Department of Chemistry (including the Department of Chemistry Graduate Program Director) and two faculty members from the Department of Biochemistry (GBS-BSSB theme including the GBS-BSSB Graduate Program Director) will review applicants and approve admission to the program.

For detailed information, contact Ms. Laura J. Knighten, Graduate Recruitment Coordinator, 1720 2nd Avenue South, Birmingham, AL 35294-1240.

Telephone 205-934-8139 | E-mail knighten@uab.edu | Web www.uab.edu/cas/chemistry

Ph.D. Program

For Ph.D. students, there are no specific course requirements beyond the core courses. The academic program is determined through the action of the student's graduate research mentor and graduate research committee. The student is required to successfully complete their departmental seminar by the end of their second year. A written qualifying examination must be passed in the student's area of specialization. If failure occurs, only one repeat exam is allowed. An original research proposal must be successfully defended within 12 months of completion of the written qualifying examination. If failure occurs, one repeat defense is allowed. Once admitted to candidacy for the Ph.D. degree, the student must write and successfully defend a research dissertation.

Requirements		Hours
CH 790	Introduction to Graduate Research	1
GRD 715	Preparing TAs to Be Effective Teachers	2
GRD 717	Principles of Scientific Integrity	3
Core Coursework		**18**
CH 702	Principles of Chemical Instruction	
CH 715	Introductory Biochemistry for Teachers II	
CH 725	Molecular Structure and Spectrosocpy	
CH 729	Special Topics in Physical Chemistry	
CH 730	Physical Organic Chemistry	
CH 731	Organic Reaction and Their Mechanisms	
CH 732	Organic Reaction and Synthesis	
CH 733	Reactive Intermediates and Conservation of Bonding	
CH 739	Special Topics in Organic Chemistry	
CH 740	Bonding and Structure in Inorganic Compounds	
CH 742	Organometallic Chemistry and Catalysis	
CH 744	Inorganic Structure and Spectroscopy	
CH 749	Special Topics in Inorganic Chemistry	
CH 751	Chemometrics	
CH 752	Analytical Spectroscopy	
CH 754	Multivariate Analysis in Analytical Chemistry	
CH 759	Special Topics in Analytical Chemistry	
CH 760	Fundamentals of Biochemistry	
CH 761	Biochemistry II	
CH 763	Biochemistry Laboratory	
CH 764	Biophysical Chemistry	
CH 765	Structural Biochemistry	
CH 767	Advanced Biomolecular NMR spectroscopy: From Quantum Mechanics to Protein Dynamics	
CH 769	Special Topics in Biochemistry	
CH 770	Chemical Literature	
CH 771	Medicinal Chemistry and Drug Discovery	
CH 772	Chemistry of Natural Products	
CH 773	Electron Pushing and Total Synthesis	
CH 774	X-Ray Crystallography	
CH 777	Radiochemistry for the life sciences	
CH 780	Polymer Chemistry I	
CH 780L	Polymer Chemistry I Laboratory	
CH 781	Polymer Chemistry II	
CH 781L	Polymer Chemistry II Laboratory	
CH 783	Chemistry of Polymers and Polymeric Materials I	
CH 784	Chemistry of Polymers and Polymeric Materials II	
CH 789	Special Topics in Polymer Chemistry	
Electives [1]		**6**
Seminar [2]		**10**
CH 791	Seminar	
CH 792	Seminar Presentation	
Dissertation [3]		**40**
CH 798	Non-Dissertation Research	
CH 799	Dissertation Research	

[1]Any 700 level or above course

[2]Consists of 2 hours of CH 792 and up to 8 hours of CH 791 or a 700 level Journal Club (For example, CH 768)

[3]CH 798 for a total of 22 hours and CH 799 for a total of 18 hours

Courses

CH 525. Physical Chemistry I for Graduate Study. 3 Hours.
Thermodynamics and chemical equilibria; and chemical kinetics. Prerequisites: Calculus II, College Physics II and General Chemistry II.

CH 526. Physical Chemistry II for Graduate Study. 3 Hours.
Quantum mechanics, chemical bonding, and molecular spectroscopy. Prerequisites: Calculus II, College Physics II and General Chemistry II.

CH 535. Organic Chemistry I for Graduate Study. 3 Hours.
Structure, nomenclature, properties, and reactivity of compounds with various organic functional groups: alkanes, alkenes, alkynes, alkyl halides and alcohols. Emphasis on the mechanisms of organic reactions and problem solving. Prerequisite: General Chemistry II.

CH 537. Organic Chemistry II for Graduate Study. 3 Hours.
Reactions of aromatic compounds and carbonyl containing functional groups: aldehydes, ketones, acids, esters and amides. Molecules of biological interest, such as proteins and carbohydrates. Prerequisite: Organic Chemistry I.

CH 540. Inorganic Chemistry I for Graduate Study. 3 Hours.
Chemical reactivity and descriptive chemistry in terms of structural and electronic parameters. Prerequisites: Organic Chemistry II and Organic Chemistry II laboratory with a grade of C or better.

CH 541. Transition Metal Chemistry. 3 Hours.
Atomic structure, chemical bonding characterization and reactivity of transition metal complexes. Prerequisites: Inorganic Chemistry and Physical Chemistry II.

CH 550. Instrumental Analysis for Graduate Study. 3 Hours.
Focus on modern analytical chemistry instrumentation including chemical separations, spectroscopies (atomic absorption, infrared, UV-visible, fluorescence), nuclear magnetic resonance spectroscopy, mass spectroscopy, and thermal analysis. Concurrent enrollment in CH 550L Instumental Analysis Laboratory is recommended. Prerequisites: Quantitative Analysis Techniques.

CH 550L. Instrumental Analysis Laboratory for Graduate Study. 0 Hours.
Instrumental Analysis Laboratory . Concurrent enrollment in CH 550 Instrumental Analysis for Graduate Study required.

CH 555. Quantitative Analysis for Graduate Study. 4 Hours.
Principles of analytical measurements, gravimetric analysis, spectrophotometric analysis, and chromatography, with emphasis on equilibrium and applications. Lecture and laboratory. Concurrent enrollment in CH 555L Quantitative Quanitative Analysis Lab required. Prerequisite: General Chemistry II.
Prerequisites: CH 550 [Min Grade: C]

CH 555L. Quantitative Analysis I for Graduate Study Lab. 0 Hours.
Emphasizing quantitative analysis laboratory. Concurrent enrollment in CH 555 Quantitative Analysis required.

CH 560. Fundamentals of Biochemistry. 3 Hours.
Overview of biochemical principles; chemistry of aqueous solutions, biochemical building blocks including amino acids, carbohydrates, lipids, and nucleotides; structure and function of proteins, membranes and nucleic acids; enzyme kinetics. Catabolic and anabolic metabolism in biomolecules, regulation of metabolic processes.
Prerequisites: CH 237 [Min Grade: C] or CH 247 [Min Grade: C]

CH 561. Advanced Biochemistry I. 3 Hours.
Advanced study of protein structure and function, enzymology, DNA structure, prokaryotic replication, transcription, and protein synthesis. Membrane structure and function, carbohydrate structure and function. Methods for isolating and characterizing macromolecule structure and function including chromatography, gel electrophoresis, CD, UV, and fluorescence spectroscopy, mass spectroscopy, X-ray crystallography and nuclear magnetic resonance spectroscopy.
Prerequisites: CH 560 [Min Grade: C]

CH 562. Advanced Biochemistry II. 3 Hours.
Continuation of Advanced Biochemistry I focusing on eukaryotic replication, transcription, translation, regulation of gene expression, genomics, proteomics, biological signaling. Prerequisites: Successful completion of CHEM 561.
Prerequisites: CH 561 [Min Grade: C]

CH 563. Biochemistry Laboratory. 3 Hours.
Introduction to modern bioanalytical techniques used for the expression, isolation and characterization of proteins and other biological macromolecules. Prerequisites: Quantitative Analysis and Biochemistry and permission of instructor.

CH 564. Physical Biochemistry Laboratory. 3 Hours.
Physical/analytical approaches (including mass spectroscopy and NMR) toward determination of macromolecular structures, ligand binding, and enzymology. Prerequisites: Background in physical chemistry I and II, quantitative analysis, and biochemistry. Permission of instructor required.
Prerequisites: CH 325 [Min Grade: C] and CH 355 [Min Grade: C] and CH 461 [Min Grade: C]

CH 565. Structural Biochemistry. 3 Hours.
Principles of macromolecular structure, emphasizing proteins, nucleic acids, and macromolecular assemblies. Computational methods used to teach principles and modeling software used for construction of computer models of proteins and nucleic acids. Lecture and computer Laboratory.

CH 571. Medicinal Chemistry & Drug Discovery. 3 Hours.
An advanced organic course with emphasis on design strategies for discovering small organic molecule drugs using common macromolecular drug targets. Examples of successful design for clinically used drug classes will be presented.

CH 573. Electron Pushing and Total Synthesis. 3 Hours.
The advanced organic course is aimed to enhance students' comprehension of advanced organic chemistry theory and principles, and apply them to understand reaction mechanisms and tactic of total synthesis. It will cover different types of common organic reactions each week, for example, reactions involving anion intermediates, cation intermediates, rearrangement, photochemical process, carbonyl compounds, and other reactive intermediates. Using electron pushing for mechanistic reasoning will be emphasized.

CH 574. X-Ray Crystallography. 3 Hours.
Fundamental principles of X-ray crystallography. Students gain enough information to be able to collect meaningful data and analyze and refine structures. Students learn how to collect, process and and analyze x-ray data, focus on heavy atom phasing techniques and use state of the art software for refinement. Permission of instructor.

CH 580. Polymer Chemistry I. 3 Hours.
Basic chemical principles of polymers with the focus on synthesis, characterization, and applications of synthetic and biological macromolecules. Includes laboratory. Prerequisites: undergraduate organic chemistry and permission of instructor. Concurrent enrollment in CH 580 is recommended.

CH 580L. Polymer Chemistry I for Graduate Study Laboratory. 1 Hour.
Polymer Chemistry I Laboratory.

CH 581. Polymer Chemistry II. 3 Hours.
Fundamentals of chemical, physical, and molecular aspects of polymers in bulk and solutions. Prerequisites: undergraduate organic chemistry and permission of instructor. Concurrent enrollment in CH 581L is recommended.
Prerequisites: CH 580 [Min Grade: C]

CH 581L. Polymer Chemistry II Laboratory. 1 Hour.
Laboratory to accompany CH 581 (Polymer Polymer Chemistry II). Concurrent enrollment in CH 581 is recommended.

CH 583. Chemistry of Polymers and Polymeric Materials I. 3 Hours.
Basic chemical principles of polymers with the focus on synthesis, characterization, and applications of synthetic and biological macromolecules. No laboratory is required. This course sequence is for BME or Material Science Graduate Students. The laboratory accompanying Polymer Chemistry I is NOT required for these students.

CH 584. Chemistry of Polymers and Polymeric Materials II. 3 Hours.
Fundamentals of chemical, physical and molecular aspects of polymers in bulk and solutions. No laboratory is required. The laboratory accompanying Polymer Chemistry II is NOT required.

CH 602. Principles of Chemical Instruction. 3 Hours.
Responsibilities of laboratory instructors, safety regulations, grading, teaching styles and formats, and instructional objectives.

CH 609. Chemical Safety. 3 Hours.
Principles involved in the potential hazards of storing, using, and disposal of chemicals for chemical educators.

CH 610. Laboratory Experiences in Chemistry. 3 Hours.
Application of chemical experiments to high school science programs. Experiments and emphasis may change depending on instructor. Course may be repeated for credit.

CH 611. Atomic Structure and Periodicity for the 7-12 Classroom. 3 Hours.
Exploration of the historical development of atomic structure. Developing instructional strategies to analyze and predict patterns from atomic structure.

CH 612. Valence Electrons and Bonding Models for the 7-12 Classroom. 3 Hours.
Describes how to use the periodic table as a systematic representation to predict and explain physical properties. Explores ionic and covalent bonding models. Predicts molecular shapes and investigates how these predictions are related to macroscopic properties.

CH 613. Introductory Organic Chemistry for Teachers. 3 Hours.
A laboratory, lecture, demonstration course on the nature of carbon compounds including hydrocarbons, functional groups and their reactions. Emphasis given to laboratory experiments and demonstrations suitable for high school students.

CH 614. Introductory Biochemistry for Teachers. 3 Hours.
Lecture series covering carbohydrates, lipids, and proteins. Emphasis given to practical applications and relationship between chemistry and biology.

CH 615. Chemical Reactions and the Conservation of Mass for the 7-12 Classroom. 3 Hours.
Exploration of the types of intensive and extensive properties that allow scientists to identify a compound. Common chemical reaction types will be investigated, and activities showing how chemists use chemical equations to analyze and interpret reaction outcomes will be included. Exploration of the mathematical description of grams, moles, molecules, and atoms are presented. Solution concentration and the use of solutions in chemical reactions will also be investigated. Simple acid-base phenomena will be studied.

CH 616. Gases and the Kinetic Molecular Theory for the 7-12 Classroom. 3 Hours.
An exploration into the molecular level view of gases and how changes in pressure, temperature, and volume of a gas affect the particles of a gas. The mathematical relationships between these properties will be investigated. Applications of the Ideal Gas Law to real-world problems will be explored.

CH 617. Dynamic Equilibria for the 7-12 Classroom. 3 Hours.
The study of dynamic equilibria including the application of LeChatelier's Principle. Practical applications of LeChatelier's Principle and calculations related to the effects of these macroscopic changes on solution concentrations. Classroom investigations into gas phase, acid-base, and solubility equilibria will be included.

CH 619. Special Topics in Chemical Education. 3 Hours.
Topics determined by interest of students and faculty.

CH 625. Molecular Structure and Spectroscopy. 3 Hours.
Classical and quantum mechanical descriptions of molecular structure and bonding. Basic principles and techniques of molecular spectroscopic methods. Exercises and experiments with computational software and spectroscopic instrumentation will be conducted.

CH 629. Special Topics in Physical Chemistry. 3 Hours.
Topics determined by interest of s students and faculty. Typical are computational chemistry, molecular spectroscopy, nuclear magnetic resonance. Topics determined by interest of students and faculty.
Prerequisites: CH 600 [Min Grade: C]

CH 630. Physical Organic Chemistry. 3 Hours.
Localized and delocalized chemical bonds, stereochemistry, acidity and basicity, determining organic mechanisms and structure. Fall.

CH 631. Organic Reactions and Their Mechanisms. 3 Hours.
Nucleophilic and electrophilic substitution, free radical substitutions, additions to carbon-carbon and carbon-hetero multiple bonds, elimination reactions. Prerequisite: Spring.
Prerequisites: CH 630 [Min Grade: C]

CH 632. Organic Reactions and Synthesis. 3 Hours.
Strategy of synthesis, carbon skeletal assembly, selective functional group interconversion, blocking groups, stereochemical control. Spring.
Prerequisites: CH 631 [Min Grade: C]

CH 633. Reactive Intermediates and Conservation of Bonding. 3 Hours.
Behavior of organic molecules in static and reactive situations. Spring.
Prerequisites: CH 631 [Min Grade: C]

CH 639. Special Topics in Organic Chemistry. 1-3 Hour.
Topics determined by interest of students and faculty.
Prerequisites: CH 327 [Min Grade: C]

CH 640. Bonding and Structure in Inorganic Compounds. 3 Hours.
Advanced treatment of bonding in main group and transition metal compounds, and a study of its relationship properties of compounds. Spring.
Prerequisites: CH 540 [Min Grade: C]

CH 642. Organometallic Chemistry and Catalysis. 3 Hours.
Study of transition metal organometallic compounds and their applications as homogeneous catalysts for organic and polymer syntheses. Summer (alternate years).
Prerequisites: CH 640 [Min Grade: C] or CH 740 [Min Grade: C]

CH 649. Special Topics in Inorganic Chemistry. 1-3 Hour.
Topics determined by interest of students and faculty.

CH 651. Chemometrics. 3 Hours.
Introduction to basic data analysis techniques that include testing hypotheses, establishing tendencies and correlations, experimental design, etc. This course is designed to provide a support to a research chemist in effectively solving everyday problems associated with production and interpretation of experimental data.

CH 652. Analytical Spectroscopy. 3 Hours.
Instrumentation and methodology used in modern analytical spectrometry. Emphasis and examples taken primarily from vibrational spectroscopy (infrared and Raman), however, principles are applicable to many types of spectrometric measurements. Physical theory, optical principles, experimental methodology, instrument design, and numerical data processing are covered.

CH 654. Multivariate Analysis in Analytical Chemistry. 3 Hours.
Theoretical and practical concepts of multivariate statistical methods applied to data obtained from analytical measurements, including advanced data analysis in experimental spectroscopy. Systematic evaluation of high-dimensional data sets through multivariate means of calibration and classification. The course is intended for graduate students in chemistry, or related fields such as the physical or biochemical sciences, or engineering, who wish to understand the application of informatics methods and numerical analysis techniques to complex data sets.

CH 656. Analytical Separations. 3 Hours.
Advanced treatment of distillation, extraction, gas chromatography, HPLC, TLC, and GC-MS.
Prerequisites: CH 551 [Min Grade: C]

CH 659. Special Topics in Analytical Chemistry. 3 Hours.
Introduction to thermally initiated physical and chemical processes in the condensed phase systems such as liquids, crystalline solids, and glasses (amorphous solids). The course covers the use of calorimetry, thermogravimetry, and thermomechanical methods for exploring thermodynamics and kinetics of crystallization, glass transition, solid-solid and helix-coil transitions, decomposition, polymerization, etc.

CH 660. Fundamentals of Biochemistry. 3 Hours.
Overview of biochemical principles; chemistry of aqueous solutions, biochemical building blocks including amino acids, carbohydrates, lipids, and nucleotides; structure and function of proteins, membranes and nucleic acids; enzyme kinetics. Catabolic and anabolic metabolism in biomolecules, regulation of metabolic processes.

CH 661. Biochemistry II. 3 Hours.
Biochemistry II: Structure and function of proteins, membranes, membrane proteins, and nucleic acids. Ligand binding and enzyme kinetics. Molecular genetics (replication, transcription, translation) and the control of gene expression and protein synthesis.

CH 663. Biochemistry Laboratory. 3 Hours.
Introduction to modern analytical techniques used for the isolation and characterization of biological macromolecules.

CH 664. Biophysical Chemistry. 3 Hours.
Common physical methods for understanding the structure and stability of macromolecules that include several spectroscopic, thermodynamic and computational methods. Underlying physical principle described, instrumentation discussed, and examples cited from the literature. Spring.

Prerequisites: CH 323 [Min Grade: C]

CH 665. Structural Biochemistry. 3 Hours.
Principles of macromolecular structure, emphasizing proteins, nucleic acids, and macromolecular assemblies. Computational methods used to teach principles and modeling software used for construction of computer models of proteins and nucleic acids. Lecture and computer Laboratory.

CH 669. Special Topics in Biochemistry. 3 Hours.
Detailed consideration of areas of special interest.
Prerequisites: CH 462 [Min Grade: C]

CH 670. Chemical Literature. 3 Hours.
Use of on-line literature and development of searching techniques.

CH 671. Medicinal Chemistry and Drug Discovery. 3 Hours.
Description. Emphasis on design strategies for small organic drugs using common macromolecular drug targets. Examples of successful design for clinically used drug classes will be presented. Prerequisites include undergraduate organic chemistry (CH235 and CH237) and undergraduate biochemistry (CH461) or equivalent. 999999.
Prerequisites: CH 325 [Min Grade: C] and CH 237 [Min Grade: C] and CH 461 [Min Grade: C]

CH 672. Chemistry of Natural Products. 3 Hours.
The principal focus of this course will be the introduction of synthesis and medicinal chemistry of natural products. Drugs discovery using natural products, with specific examples in the areas of antibacterials, anticancer, and analgesic drugs will be introduced. An overview of structural classes, biosynthetic pathways and application of asymmetric synthesis in the synthesis of specific examples from each class will be discussed. This course is intended for undergraduate students at the senior level.

CH 673. Electron Pushing and Total Synthesis. 3 Hours.
The advanced organic course is aimed to enhance students' comprehension of advanced organic chemistry theory and principles, and apply them to understand reaction mechanisms and tactic of total synthesis. It will cover different types of common organic reactions each week, for example, reactions involving anion intermediates, cation intermediates, rearrangement, photochemical process, carbonyl compounds, and other reactive intermediates. Using electron pushing for mechanistic reasoning will be emphasized.

CH 674. X-Ray Crystallography. 3 Hours.
Fundamental principles of X-ray crystallography. Students gain enough information to be able to collect meaningful data and analyze and refine structures. Students learn how to collect, process and and analyze x-ray data, focus on heavy atom phasing techniques and use state of the art software for refinement. Permission of instructor.

CH 677. Radiochemistry for the life sciences. 3 Hours.
This course is intended to act as an introduction to radiochemistry. It will cover production, instrumentation, and radiochemistry techniques to make use of radiotracers in the life sciences from basic biological and environmental applications to medical imaging and therapy.

CH 680. Polymer Chemistry I. 3 Hours.
Basic chemical principles of polymers with the focus on synthesis, characterization, and applications of synthetic and biological macromolecules. Includes laboratory. Prerequisites: undergraduate organic chemistry and permission of instructor. Concurrent enrollment in CH 580L is recommended.

CH 680L. Polymer Chemistry I Laboratory. 1 Hour.
Polymer Chemistry I Laboratory. Recommended with CH 680 lecture.

CH 681. Polymer Chemistry II. 3 Hours.
Fundamentals of chemical, physical, and molecular aspects of polymers in bulk and solutions. Prerequisites: undergraduate organic chemistry and permission of instructor. Concurrent enrollment in CH 680L is recommended.
Prerequisites: CH 680 [Min Grade: C]

CH 681L. Polymer Chemistry II Laboratory. 1 Hour.
Laboratory to accompany CH 681 (Polymer Chemistry II). Concurrent enrollment in CH 681 is recommended.

CH 683. Chemistry of Polymers and Polymeric Materials I. 3 Hours.
Basic chemical principles of polymers with the focus on synthesis, characterization, and applications of synthetic and biological macromolecules. No laboratory is required. This course sequence is for BME or Material Science Graduate Students. The laboratory accompanying Polymer Chemistry I is NOT required for these students.

CH 684. Polymer Chemistry II. 3 Hours.
Fundamentals of chemical, physical and molecular aspects of polymers in bulk and solutions. No laboratory is required. This course sequence is for BME or Material Science Graduate Students. The laboratory accompanying Polymer Chemistry II is NOT required for these students.

CH 689. Special Topics in Polymer Chemistry. 3 Hours.
Detailed consideration of areas of special interests in polymer chemistry.
Prerequisites: CH 580 [Min Grade: C] and CH 581 [Min Grade: C]

CH 691. Seminar. 1 Hour.
Seminars on current topics in chemical research.

CH 692. Seminar Presentation. 2 Hours.
Seminar given by graduate students on current topics in chemical research.

CH 698. Graduate Research. 1-12 Hour.
Prerequisite: Permission of graduate faculty member. Research hours.

CH 699. Thesis Research. 1-12 Hour.
Prerequisites: Admission to candidacy and permission of graduate faculty member. Must have approved 3 member committee and approved candidacy by the graduate dean before registering for 699.
Prerequisites: GAC M

CH 702. Principles of Chemical Instruction. 1 Hour.
Responsibilities of laboratory instructors, safety regulations, grading, teaching styles and formats, and instructional objectives. Prerequisite: Permission of instructor. Fall.

CH 715. Introductory Biochemistry for Teachers II. 3 Hours.
Lecture series covering vitamins, minerals, enzymes, biochemical energy and metabolism. Strong connections between chemistry and biology. Practical applications are emphasized.

CH 725. Molecular Structure and Spectrosocpy. 3 Hours.
Classical and quantum mechanical descriptions of molecular structure and bonding. Basic principles and techniques of molecular spectroscopic methods. Exercises and experiments with computational software and spectroscopic instrumentation will be conducted.

CH 729. Special Topics in Physical Chemistry. 3 Hours.
Topics determined by mutual student-faculty interest. Typical are computational chemistry, molecular spectroscopy, nuclear magnetic resonance.
Prerequisites: CH 700 [Min Grade: C]

CH 730. Physical Organic Chemistry. 3 Hours.
Localized and delocalized chemical bonds, stereochemistry, acidity and basicity, determining organic mechanisms and structure. Fall.

CH 731. Organic Reaction and Their Mechanisms. 3 Hours.
Nucleophilic and electrophilic substitution, free radical substitutions, additions to carbon-carbon and carbon-hetero multiple bonds, elimination reactions. Spring.

CH 732. Organic Reaction and Synthesis. 3 Hours.
Strategy of synthesis, carbon skeletal assembly, selective functional group interconversion, blocking groups, stereochemical control. Spring.
Prerequisites: CH 731 [Min Grade: C]

CH 733. Reactive Intermediates and Conservation of Bonding. 3 Hours.
Behavior of organic molecules in static and reactive situations. Spring.
Prerequisites: CH 731 [Min Grade: C]

CH 739. Special Topics in Organic Chemistry. 3 Hours.
Topics determined by interest of students and faculty.

CH 740. Bonding and Structure in Inorganic Compounds. 3 Hours.
Advanced treatment of bonding in main group and transition metal compounds, and a study of its relationship to the properties of compounds. Spring.
Prerequisites: CH 540 [Min Grade: C]

CH 742. Organometallic Chemistry and Catalysis. 3 Hours.
Study of transition metal organometallic compounds and their applications as homogeneous catalysts for organic and polymer syntheses. Summer (alternate years).
Prerequisites: CH 640 [Min Grade: C] or CH 740 [Min Grade: C]

CH 744. Inorganic Structure and Spectroscopy. 3 Hours.
This course will cover fundamental principles of inorganic structure and spectroscopy. Lecture topics will focus on major principles and theories governing inorganic structure of chemical compounds, and discussion of related physical analytical methods. Undergraduate inorganic chemistry is strongly recommended as a prerequisite.

CH 745. Fundamentals in Inorganic Chemistry. 3 Hours.
Fundmental concepts of inorganic chemistry, including electronic configuration, bonding theory, solid-state chemistry, reactivity, and catalysis.

CH 747. Fundamentals and Applications of Actinide Chemistry. 3 Hours.
Fundamentals and Application of Actinide Chemistry is intended to act as an introduction to 5f elements and their applications. Topics will include the chemistry of the actinide elements, radiochemistry of the nuclear fuel cycle, environmental actinide chemistry, nuclear forensics, and related areas. By the end of the semester, you should have a strong foundation in these areas, allowing you to pursue research in a number of related fields.

CH 749. Special Topics in Inorganic Chemistry. 1-3 Hour.
Topics determined by interest of students and faculty.

CH 751. Chemometrics. 3 Hours.
Introduction to basic data analysis techniques that include testing hypotheses, establishing tendencies and correlations, experimental design, etc. This course is designed to provide a support to a research chemist in effectively solving everyday problems associated with production and interpretation of experimental data.

CH 752. Analytical Spectroscopy. 3 Hours.
Instrumentation and methodology used in modern analytical spectrometry. Emphasis and examples taken primarily from vibrational spectroscopy (infrared and Raman), however, principles are applicable to many types of spectrometric measurements. Physical theory, optical principles, experimental methodology, instrument design, and numerical data processing are covered.

CH 754. Multivariate Analysis in Analytical Chemistry. 3 Hours.
Theoretical and practical concepts of multivariate statistical methods applied to data obtained from analytical measurements, including advanced data analysis in experimental spectroscopy. Systematic evaluation of high-dimensional data sets through multivariate means of calibration and classification. The course is intended for graduate students in chemistry, or related fields such as the physical or biochemical sciences, or engineering, who wish to understand the application of informatics methods and numerical analysis techniques to complex data sets.

CH 759. Special Topics in Analytical Chemistry. 3 Hours.
Topics of interest to faculty and students.

CH 760. Fundamentals of Biochemistry. 3 Hours.
Overview of biochemical principles; chemistry of aqueous solutions, biochemical building blocks including amino acids, carbohydrates, lipids, and nucleotides; structure and function of proteins, membranes and nucleic acids; enzyme kinetics. Catabolic and anabolic metabolism in biomolecules, regulation of metabolic processes.

CH 761. Biochemistry II. 3 Hours.
Biochemistry II: Structure and function of proteins, membranes, membrane proteins, and nucleic acids. Ligand binding and enzyme kinetics. Molecular genetics (replication, transcription, translation) and the control of gene expression and protein synthesis.

CH 763. Biochemistry Laboratory. 3 Hours.
Introduction to modern analytical techniques used for the isolation and characterization of biological macromolecules.

CH 764. Biophysical Chemistry. 3 Hours.
Common physical methods for understanding the structure and stability of macromolecules that include several spectroscopic, thermodynamic, and computational methods. Underlying physical principle described, instrumentation discussed, and examples cited from the literature. Spring.

Prerequisites: CH 325 [Min Grade: C]

CH 765. Structural Biochemistry. 3 Hours.
Principles of macromolecular structure, emphasizing proteins, nucleic acids, and macromolecular assemblies. Computational methods used to teach principles and modeling software used for construction of computer models of proteins and nucleic acids. Lecture and computer Laboratory.

CH 767. Advanced Biomolecular NMR spectroscopy: From Quantum Mechanics to Protein Dynamics. 3 Hours.
This course is designed for graduate students who use NMR as a major tool to study structure and dynamics of biomolecules. It covers quantum mechanics explanation of NMR, pulse programming, non-uniform sample, data processing, NMR dynamics at different time scales.

CH 768. Biochemistry and Biophysics Journal Club. 1 Hour.
Weekly journal literature seminar and discussion group for chemistry graduate students. Intended for students working in the fields of biochemistry and biophysics.

CH 769. Special Topics in Biochemistry. 1-3 Hour.
Detailed consideration of areas of special interest.
Prerequisites: CH 462 [Min Grade: C]

CH 770. Chemical Literature. 3 Hours.
Use of on-line literature and development of searching techniques.

CH 771. Medicinal Chemistry and Drug Discovery. 3 Hours.
Emphasis on the structure-based design strategies for small organic molecule drugs using common macromolecular drug targets. Students in CH 771 should have had undergraduate preparation including organic chemistry and biochemistry or the equivalent.

CH 772. Chemistry of Natural Products. 3 Hours.
The principal focus of this course will be the introduction of synthesis and medicinal chemistry of natural products. Drugs discovery using natural products, with specific examples in the areas of antibacterials, anticancer, and analgesic drugs will be introduced. An overview of structural classes, biosynthetic pathways and application of asymmetric synthesis in the synthesis of specific examples from each class will be discussed. This course is intended for undergraduate students at the senior level.

CH 773. Electron Pushing and Total Synthesis. 3 Hours.
The advanced organic course is aimed to enhance students' comprehension of advanced organic chemistry theory and principles, and apply them to understand reaction mechanisms and tactic of total synthesis. It will cover different types of common organic reactions each week, for example, reactions involving anion intermediates, cation intermediates, rearrangement, photochemical process, carbonyl compounds, and other reactive intermediates. Using electron pushing for mechanistic reasoning will be emphasized.

CH 774. X-Ray Crystallography. 3 Hours.
Fundamental principles of X-ray crystallography. Students gain enough information to be able to collect meaningful data and analyze and refine structures. Students learn how to collect, process and and analyze x-ray data, focus on heavy atom phasing techniques and use state of the art software for refinement. Permission of instructor.

CH 777. Radiochemistry for the life sciences. 3 Hours.
This course is intended to act as an introduction to radiochemistry. It will cover production, instrumentation, and radiochemistry techniques to make use of radiotracers in the life sciences from basic biological and environmental applications to medical imaging and therapy.

CH 780. Polymer Chemistry I. 3 Hours.
Basic chemical principles of polymers with the focus on synthesis, characterization, and applications of synthetic and biological macromolecules. Includes laboratory. Prerequisites: undergraduate organic chemistry and permission of instructor.

CH 780L. Polymer Chemistry I Laboratory. 1 Hour.
Polymer Chemistry I Laboratory.

CH 781. Polymer Chemistry II. 3 Hours.
Fundamentals of chemical, physical, and molecular aspects of polymers in bulk and solutions. Prerequisites: undergraduate organic chemistry and permission of instructor.
Prerequisites: CH 780 [Min Grade: C]

CH 781L. Polymer Chemistry II Laboratory. 1 Hour.
Laboratory to accompany CH 781 (Polymer Chemistry II).

CH 783. Chemistry of Polymers and Polymeric Materials I. 3 Hours.
Basic chemical principles of polymers with the focus on synthesis, characterization, and applications of synthetic and biological macromolecules. No laboratory is required. This course sequence is for BME or Material Science Graduate Students. The laboratory accompanying Polymer Chemistry I is NOT required for these students. Permission of instructor is required before registration.

CH 784. Chemistry of Polymers and Polymeric Materials II. 3 Hours.
Fundamentals of chemical, physical and molecular aspects of polymers in bulk and solutions. No laboratory is required. This course sequence is for BME or Material Science Graduate Students. The laboratory accompanying Polymer Chemistry II is NOT required for these students. Permission of instructor is required for registration.

CH 789. Special Topics in Polymer Chemistry. 3 Hours.
Detailed consideration of areas of special interests in polymer chemistry.
Prerequisites: CH 580 [Min Grade: C] and CH 581 [Min Grade: C]

CH 790. Introduction to Graduate Research. 1 Hour.
The purpose of this course is to acquaint incoming graduate student with departmental, school and university policies and procedures for conducting research and teaching undergraduate students. Pass/Fail.

CH 791. Seminar. 1 Hour.
Seminars on current topics in chemical research.

CH 792. Seminar Presentation. 2 Hours.
Seminar given by graduate students on current topics in chemical research.

CH 798. Non-Dissertation Research. 1-12 Hour.
Prerequisite: Permission of graduate faculty member.

CH 799. Dissertation Research. 1-12 Hour.
Prerequisite: Admission to candidacy and permission of graduate faculty member.Must have graduate dean's approval of 5 member committee. Must have IRB and graduate dean's approval of candidacy. Need at least 2 semesters of candidacy to graduate.
Prerequisites: GAC Z