Chemistry and Biochemistry (CHEM)

Courses

CHEM 1051L. Chemistry in the Modern World Laboratory (ACTS Equivalency = CHEM 1004 Lab) (Sp, Fa). 1 Hour.  
Basic laboratory exercises involving measurements of mass and volume, acids and bases, hardness of water, energy content in fuel, sugar content in drinks, and radioactivity. Meets 2 hours per week. Corequisite: CHEM 1053.

The impact of chemical developments upon contemporary society. Chemical problems of ecological, environmental, nutritional, economic, and sociological concern. Designed for non-science majors. Lecture 3 hours per week. Corequisite: CHEM 1051L.

CHEM 1071L. Fundamentals of Chemistry Laboratory (ACTS Equivalency = CHEM 1214 Lab) (Fa). 1 Hour. 
Laboratory exercises in principles and practices of Fundamental Chemistry. Corequisite: CHEM 1073.

CHEM 1073. Fundamentals of Chemistry (ACTS Equivalency = CHEM 1214 Lecture) (Su, Fa). 3 Hours. 
Fundamental principles of chemistry for students majoring in Home Economics or Nursing. Lecture 3 hours, recitation 1 hour per week. Corequisite: CHEM 1071L and related course component drill section for CHEM 1073.

CHEM 1101L. University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab) (Sp, Su, Fa). 1 Hour. 
Laboratory exercises involving density, types of chemical reactions separations and chromatography, solubility, waters of hydration, freezing point depression, gas laws, and data interpretation. Meets 3 hours per week for 1 hour credit.

CHEM 1103. University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture) (Su, Fa). 3 Hours. 
Survey of basic chemical principles designed as an introductory course for science, engineering or agriculture majors. Corequisite: Drill component. Pre- or Corequisite: MATH 1203 or higher, ACT MATH 23 or higher, SAT MATH 540 or higher, UA MPT PALG 80% or higher, or AP Calculus AB 3C or higher, or AP Calculus BC 4C or higher, or MATH 1203 CLEP 54 or higher.

CHEM 1121L. University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab) (Sp, Su, Fa). 1 Hour. 
Quantitative laboratory with data interpretation and exercises covering the topics of stoichiometry, thermodynamics, kinetics, chemical equilibrium, pH, and descriptive inorganic chemistry. Laboratory 3 hours per week. Upon completion of CHEM 1121L on the UAF campus with a grade of "C" or better, credit for CHEM 1101L can be requested. Corequisite: CHEM 1123 and related course component drill section for CHEM 1123.

CHEM 1121M. Honors University Chemistry II Laboratory (Sp, Fa). 1 Hour. 
Qualitative and quantitative laboratory with data interpretation and exercises covering the topics of stoichiometry, thermodynamics, kinetics, chemical equilibrium, pH, and descriptive inorganic chemistry. Laboratory notebooks are required as part of every experiment. Designed for students in the honors programs. Laboratory 3 hours per week. Corequisite: CHEM 1123H and related course component drill for CHEM 1123H. This course is equivalent to CHEM 1121L.

CHEM 1123. University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture) (Sp, Su, Fa). 3 Hours. 
Presents the topics of periodicity, bonding, stoichiometry, thermodynamics, kinetics, and chemical equilibrium in detail. Lecture 3 hours per week. Students who pass the CHEM 1103 Freshman Chemistry Proficiency Exam and enroll in CHEM 1123 and CHEM 1121L and receive a grade of C or better in these courses will also receive credit for CHEM 1103 and CHEM 1101L. Corequisite: CHEM 1121L and related course component drill section for CHEM 1123. Prerequisite: CHEM 1103 (or CHEM 1213 or satisfactory performance on the chemistry proficiency examination) and MATH 1203 or higher or satisfactory performance on the mathematics proficiency examination.

CHEM 1123H. Honors University Chemistry II (Sp, Fa). 3 Hours. 
Presents the topics of periodicity, bonding, stoichiometry, thermodynamics, kinetics, and chemical equilibrium in detail. Lecture 3 hours per week. Upon successful completion of CHEM 1123 with a grade of "C" of better, credit for CHEM 1103 can be requested by students who passed the CHEM 1103 proficiency exam. Corequisite: CHEM 1121M and related course component drill section for CHEM 1123H. Prerequisite: CHEM 1103 (or CHEM 1213 or satisfactory performance on the chemistry proficiency examination) and MATH 1203 or higher or satisfactory performance on the mathematics proficiency examination. This course is equivalent to CHEM 1123.

CHEM 1201L. Chemistry for Majors I Laboratory (Fa). 1 Hour. 
Laboratory exercises involving density, types of chemical reactions separations and chromatography, solubility, waters of hydration, freezing point depression, gas laws, and data interpretation. Laboratory notebooks are required as part of every experiment. Laboratory 3 hours per week. Students may not receive credit for both CHEM 1201L and CHEM 1101L. Corequisite: CHEM 1203 and related course component drill for CHEM 1203.

CHEM 1203. Chemistry for Majors I (Fa). 3 Hours. 
The first half of a two-semester course designed especially for students planning to major in chemistry or biochemistry. Students may not receive credit for both CHEM 1203 and CHEM 1103. Corequisite: CHEM 1201L and related course component drill section for CHEM 1203. Prerequisite: MATH 1203 or higher, or AP Calculus AB 3C or higher, or AP Calculus BC 4C or higher, or College Algebra CLEP 54 or higher.

CHEM 1211L. Chemistry for Majors II Laboratory (Sp). 1 Hour. 
Qualitative and quantitative laboratory with data interpretation and exercises covering the topics of stoichiometry, thermodynamics, kinetics, chemical equilibrium, pH, and descriptive inorganic chemistry. Laboratory notebooks are required as part of every experiment. Laboratory 3 hours per week. Students may not receive credit for both CHEM 1221L and CHEM 1121L. Corequisite: CHEM 1223 and related course component drill for CHEM 1223. This course is equivalent to CHEM 1121L.

CHEM 1223. Chemistry for Majors II (Sp). 3 Hours. 
The second half of a two-semester course designed specifically for students planning to major in chemistry or biochemistry. Students may not receive credit for both CHEM 1223 and CHEM 1123. Pre- or Corequisite: MATH 2554. Corequisite: CHEM 1221L and related course component drill section for CHEM 1223. Prerequisite: CHEM 1213 and CHEM 1211L (or CHEM 1103 and CHEM 1101L). This course is equivalent to CHEM 1123.
CHEM 2261L. Analytical Chemistry Laboratory (Sp, Fa). 1 Hour.
Covers techniques of classical and instrumental methods of chemical separation and analysis. Laboratory 4 hours per week. Chemistry Majors/Minors must take analytical lecture and lab prior to any physical chemistry course. Chemistry Majors/Minors should take analytical lecture and lab together. Pre- or Corequisite: CHEM 2263. Prerequisite: (CHEM 1123 and CHEM 1121L) or (CHEM 1123H and CHEM 1121M) or (CHEM 1223 and CHEM 1221L) or (CHEM 1073 and CHEM 1071L) and MATH 1203 or higher, or AP Calculus AB 3C or higher, or AP Calculus BC 4C or higher, or CLEP College Algebra 54 or higher.

CHEM 2263. Analytical Chemistry Lecture (Sp, Fa). 3 Hours.
Principles of chemical separations, analysis by classical and instrumental methods, and chemical equilibrium in physical and biological systems. Lecture 3 hours per week. Chemistry Majors/Minors must take analytical lecture and lab prior to any physical chemistry course. Chemistry Majors/Minors should take analytical lecture and lab together. Prerequisite: (CHEM 1123 and CHEM 1121L) or (CHEM 1123H and CHEM 1121M) or (CHEM 1223 and CHEM 1221L) or (CHEM 1073 and CHEM 1071L) and MATH 1203 or higher, or AP Calculus AB 3C or higher, or AP Calculus BC 4C or higher, or CLEP College Algebra 54 or higher.

CHEM 2611L. Organic Physiological Chemistry Laboratory (ACTS Equivalency = CHEM 1224 Lab) (Sp, Su, Fa). 1 Hour.
A focus on properties of organic compounds as well as reactions of organic compounds with an emphasis on functional groups along with some classifications of certain types of compounds. Laboratory 3 hours per week. Corequisite: CHEM 2613 and related course component drill for CHEM 2613.

CHEM 2613. Organic Physiological Chemistry (ACTS Equivalency = CHEM 1224 Lecture) (Sp, Su, Fa). 3 Hours.
One semester survey of organic chemistry necessary for understanding of biological systems, with some related physiological chemistry. Lecture 3 hours per week. Corequisite: CHEM 2611L and related course component drill section for CHEM 2613. Prerequisite: (CHEM 1073 and CHEM 1071L) or (CHEM 1123 and CHEM 1121L) or (CHEM 1123H and CHEM 1121M) or (CHEM 1223 and CHEM 1221L).

CHEM 3203. Forensic Chemistry (Irregular). 3 Hours.
Survey of chemistry used in criminal investigations. Topics may include detection and identification of drugs, alcohol, toxins, explosives and gun powder residue. Chemical analysis of paint, ink, paper, soil, glass and fibers. Chemical detection of blood and fingerprints. Extraction of DNA from evidence, DNA fingerprinting. Prerequisite: CHEM 2613, or CHEM 3613 (recommended), or CHEM 3613H, or CHEM 3713.

CHEM 3203H. Honors Forensic Chemistry (Irregular). 3 Hours.
Survey of chemistry used in criminal investigations. Topics may include detection and identification of drugs, alcohol, toxins, explosives and gun powder residue. Chemical analysis of paint, ink, paper, soil, glass and fibers. Chemical detection of blood and fingerprints. Extraction of DNA from evidence, DNA fingerprinting. As a requirement of honors designation additional honors-level work is required of students enrolled in this section. Prerequisite: CHEM 2613, or CHEM 3613 (recommended), or CHEM 3613H, or CHEM 3713.
This course is equivalent to CHEM 3203.

CHEM 3273. UAteach Research Methods (Sp). 3 Hours.
A project-based course for prospective science and mathematics teachers utilizing scientific research methods and inquiry to solve research problems. Prerequisite: ARSC 1201 and ARSC 1221 and junior standing.
This course is cross-listed with PHYS 3273, BIOL 3273.

CHEM 3273H. Honors UAteach Research Methods (Sp). 3 Hours.
A project-based course for prospective science and mathematics teachers utilizing scientific research methods and inquiry to solve research problems. Prerequisite: ARSC 1201 and ARSC 1221 and junior standing.
This course is cross-listed with PHYS 3273, CHEM 3273, BIOL 3273.

CHEM 3451L. Elements of Physical Chemistry Laboratory (Fa). 1 Hour.
Experimental measurements of the physical properties, chemical systems, error analysis and report writing. Experiments cover topics in thermochemistry, heat capacity, chemical kinetics, spectroscopy, and phase/chemical equilibrium using a variety of physical chemistry techniques. Laboratory 4 hours per week. Corequisite: Chemistry majors and chemistry minors must enroll in CHEM 3453 concurrently. Prerequisite: CHEM 2261L and PHYS 2031L (or PHYS 2074).

CHEM 3453. Elements of Physical Chemistry (Fa). 3 Hours.
One semester accelerated course in physical chemistry primarily for students majoring/minoring in chemistry with biochemistry option, or pre-professional and agriculture students. Topics include thermodynamics, phase & chemical equilibrium, chemical kinetics, quantum chemistry and spectroscopy. Presented at the same level as the 2-semester course with some recourse to calculus, although covering fewer topics in quantum chemistry. Lecture 3 hours per week. Students cannot earn credit for both CHEM 3453 and CHEM 3514. Corequisite: Chemistry majors and chemistry minors must enroll in CHEM 3451L concurrently. Prerequisite: CHEM 2263 and PHYS 2033 (or PHYS 2074), and MATH 2554 (or MATH 2043).

CHEM 3504. Physical Chemistry I (Fa). 4 Hours.
First semester of a 2-semester course in physical chemistry designed for chemistry majors and chemistry minors with topics covering wave-particle duality, quantum chemistry, atomic and molecular structure, bonding, spectroscopy and elementary statistical mechanics. Lecture and recitation 4 hours per week. Pre- or Corequisite: MATH 2564. Prerequisite: CHEM 2263 and PHYS 2074.

CHEM 3512L. Physical Chemistry Laboratory (Sp). 2 Hours.
Experimental studies of molecular structure, thermochemistry, and chemical kinetics, and the determination of other physicochemical properties of matter. Laboratory 8 hours per week. Students cannot earn credit for both CHEM 3451L and CHEM 3512L. Corequisite: Chemistry majors and chemistry minors must take CHEM 3514 concurrently. Prerequisite: CHEM 2261L and PHYS 2031L (or PHYS 2074).

CHEM 3514. Physical Chemistry II (Sp). 4 Hours.
Second semester of a 2-semester course in physical chemistry aimed for B.S. chemistry majors/minors with topics covering the laws of thermodynamics, phase & chemical equilibria; structure and properties of solutions, chemical potential, and chemical kinetics. Lecture and recitation 4 hours per week. Students cannot earn credit for both CHEM 3453 and CHEM 3514. Corequisite: Chemistry majors and chemistry minors must enroll in CHEM 3512L concurrently. Prerequisite: CHEM 3504.

CHEM 3601L. Organic Chemistry Laboratory (Su, Fa). 1 Hour.
Introduction to basic techniques for separation, purification, and identification of organic compounds. Laboratory exercises in organic chemistry. Meets 3 hours per week. Corequisite: CHEM 3603 and related course component drill for CHEM 3603.

CHEM 3602M. Honors Organic Chemistry I Laboratory (Su, Fa). 2 Hours.
Introduction to basic techniques for separation, purification, and identification of organic compounds. Drill lecture-discussion (1hr/wk) and laboratory (4hr/wk). Writing component. Required drill. Corequisite: CHEM 3603H and related course component drill sections for CHEM 3603H and CHEM 3602M. Prerequisite: Honors candidacy. This course is equivalent to CHEM 3601L.

CHEM 3603. Organic Chemistry I (Su, Fa). 3 Hours.
Introduction to organic compounds including alkanes, haloalkanes, aikenes and alkenes; properties including basic stereochemistry and reactions including nucleophilic substitution, elimination, and electrophilic addition reactions. Lecture 3 hours per week. Corequisite: CHEM 3601L and related course component drill section for CHEM 3603. Prerequisite: (CHEM 1123 and CHEM 1121L) or (CHEM 1123H and CHEM 1121M) or (CHEM 1223 and CHEM 1221L).
CHEM 3603H. Honors Organic Chemistry I (Su, Fa). 3 Hours. In-depth introduction to organic compounds; properties and reactions. Including alkanes, haloalkanes, alkenes and alkynes; nucleophilic substitution, elimination, and electrophilic addition reactions. Lecture 3 hours per week. Corequisite: CHEM 3602M and related course component drill sections for CHEM 3603H and CHEM 3602M. Prerequisite: Honors candidacy and ((CHEM 1123 and CHEM 1121L) or (CHEM 1123H and CHEM 1121M) or (CHEM 1223 and CHEM 1221L)). This course is equivalent to CHEM 3603.

CHEM 3611L. Organic Chemistry II Laboratory (Sp, Su). 1 Hour. Continuation of CHEM 3601L and introduction to basic techniques of synthesis, isolation, and determination of structure and reactivity of organic compounds. Laboratory exercises in organic chemistry. Meets 3 hours per week. Corequisite: CHEM 3613 and related course component drill for CHEM 3613. Prerequisite: CHEM 3601L.

CHEM 3612M. Honors Organic Chemistry II Laboratory (Sp, Su). 2 Hours. Continuation of CHEM 3602M and introduction to basic techniques of synthesis, isolation, and determination of structure and reactivity of organic compounds. Drill lecture-discussion (1 hour/wk) and laboratory (4 hours/wk). Writing component. Drill required. Corequisite: CHEM 3613H and related course component drill sections for CHEM 3612M and CHEM 3613H. Prerequisite: Honors candidacy and CHEM 3602M. This course is equivalent to CHEM 3611L.

CHEM 3613. Organic Chemistry II (Sp, Su). 3 Hours. Basic chemistry of aromatic and carbonyl compounds; properties and reactions. Lecture 3 hours per week. Corequisite: CHEM 3611L and related course component drill section for CHEM 3613. Prerequisite: (CHEM 3603 and CHEM 3601L) or (CHEM 3603H and CHEM 3602M) or (CHEM 3703 and CHEM 3702L).

CHEM 3613H. Honors Organic Chemistry II (Sp, Su). 3 Hours. In-depth coverage of the basic chemistry of aromatic and carbonyl compounds; properties and reactions. Lecture 3 hours per week. Corequisite: CHEM 3612M and related course component drill sections for CHEM 3613H and CHEM 3612M. Prerequisite: Honors candidacy and CHEM 3603H and CHEM 3602M. This course is equivalent to CHEM 3613.

CHEM 3702L. Organic Chemistry I Lab for Chemistry Majors (Fa). 2 Hours. Introduction to basic techniques for separation, purification, and identification of organic compounds. Drill lecture-discussion (1 hour/wk) and laboratory (4 hours/wk). Writing component. Required drill. Corequisite: CHEM 3703 and related course component drill sections for CHEM 3703 and CHEM 3702L. Prerequisite: Chemistry major or minor.

CHEM 3703. Organic Chemistry I Lecture for Chemistry Majors (Fa). 3 Hours. In-depth introduction to organic compounds including alkanes, haloalkanes, alkenes and alkynes; properties including basic stereochemistry and reactions including nucleophilic substitution, elimination, and electrophilic addition. Lecture 3 hours per week. Corequisite: CHEM 3702L and related course component drill sections for CHEM 3703 and CHEM 3702L. Prerequisite: Chemistry major or minor and (CHEM 1123 and CHEM 1121L) or (CHEM 1123H and CHEM 1121M) or (CHEM 1223 and CHEM 1221L).

CHEM 3712L. Organic Chemistry II Lab for Chemistry Majors (Sp). 2 Hours. Continuation of CHEM 3702L and introduction to basic techniques of synthesis, isolation, and determination of structure and reactivity of organic compounds. Drill lecture-discussion (1 hour/wk) and laboratory (4 hours/wk). Writing component. Drill required. Corequisite: CHEM 3713 and related course component drill sections for CHEM 3713 and CHEM 3712L. Prerequisite: Chemistry major or minor and CHEM 3702L.

CHEM 3713. Organic Chemistry II Lecture for Chemistry Majors (Sp). 3 Hours. Continuation of in-depth coverage of the basic chemistry of the compounds of carbon. Properties and reactions of aromatic and carbonyl functional groups. Lecture 3 hours per week. Corequisite: CHEM 3712L and related course component drill sections for CHEM 3713 and CHEM 3712L. Prerequisite: Chemistry major or minor and CHEM 3703 and CHEM 3702L. This course is equivalent to CHEM 3613.

CHEM 3813. Elements of Biochemistry (Sp, Su, Fa). 3 Hours. One semester survey course of the fundamentals of biochemistry. Structures, properties, and reactions of major classes of biomolecules. Basics of enzyme catalysis. Overview of metabolism. Credit for both CHEM 3813 and 4813H may not be counted toward a chemistry degree. Lecture 3 hours per week. Prerequisite: (CHEM 3613 and CHEM 3611L) or (CHEM 3613H and CHEM 3612M) or (CHEM 3713 and CHEM 3712L) or (CHEM 2613 and CHEM 2611L).

CHEM 3923H. Honors Colloquium (Irregular). 3 Hours. Covers a special topic or issue. Offered as a part of the honors program. Prerequisite: Honors candidacy.

CHEM 400V. Chemistry Research (Sp, Su, Fa). 1-4 Hour. Research problems. Students need to enroll in their supervising faculty mentor's section. CHBC students conducting research under a faculty mentor outside of CHBC must enroll in the CHBC chair's section. Additionally, honors students need the approval of the CHBC department honors advisor. Honors students must complete thesis in senior year. May be repeated for degree credit.

CHEM 400VH. Honors Chemistry Research (Sp, Su, Fa). 1-4 Hour. Research problems. Students need to enroll in their supervising faculty mentor's section. CHBC students conducting research under a faculty mentor outside of CHBC must enroll in the CHBC chair's section. Additionally, honors students need the approval of the CHBC department honors advisor. Honors students must complete thesis in senior year. May be repeated for degree credit. This course is equivalent to CHEM 400V.

CHEM 4011H. Honors Seminar (Sp). 1 Hour. Research seminar for chemistry majors enrolled in the honors program. Enrollment is required the spring semester of the junior and senior years for honors students. Senior honors students must make one research presentation to graduate with honors. Prerequisite: Honors candidacy, chemistry major and junior or senior standing. May be repeated for up to 2 hours of degree credit.

CHEM 405V. Special Topics in Chemistry (Irregular). 1-4 Hour. Potential topics include: advanced spectroscopic methods, bioanalytical chemistry, bioorganic chemistry, biophysical chemistry, chemical sensors, drug discovery and design, nanomaterials, pharmaceutical chemistry, process analytical chemistry, and protein folding and design. Prerequisite: Instructor consent.

CHEM 4123. Advanced Inorganic Chemistry I (Fa). 3 Hours. Reactions and properties of inorganic compounds from the standpoint of electronic structure and the periodic table. Emphasis on recent developments. Prerequisite: CHEM 3514.

CHEM 4153L. Nanotechnology Laboratory (Fa). 3 Hours. Provides students with hands-on experience in several major areas of nanotechnology, including nanoscale imaging, synthesis of nanomaterials, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Students can earn credit for only one of the following courses: MEEG 4323L, BENG 4753L, BMEG 4103L, CHEM 4153L, PHYS 4793L. Corequisite: Drill component, junior standing and instructor consent. Prerequisite: MATH 2564, PHYS 2074, CHEM 1123 or CHEM 1133. This course is cross-listed with MEEG 4323L, PHYS 4793L.
CHEM 4153M. Honors Nanotechnology Laboratory (Fa). 3 Hours.
Provides students with hands-on experience in several major areas of nanotechnology, including nanoscale imaging, synthesis of nanomaterials, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Students can earn credit for only one of the following courses: MEEG 4323L, BENG 4753L, BMEE 4103L, CHEM 4153L, PHYS 4793L. Corequisite: Drill component, junior standing and instructor consent. Prerequisite: MATH 2564, PHYS 2074, CHEM 1123 or CHEM 1133. This course is cross-listed with MEEG 4323L, CHEM 4153L, PHYS 4793L.

CHEM 4211L. Instrumental Analysis Laboratory (Sp). 1 Hour.
Provides laboratory experience in parallel with the lecture material in CHEM 4213. Laboratory 3 hours per week. Pre- or Corequisite: CHEM 4213.

CHEM 4213. Instrumental Analysis (Sp). 3 Hours.
Provides students, especially those in the agricultural, biological, and physical sciences, with an understanding of modern instrumental techniques of analysis. Lecture 3 hours per week. Prerequisite: (CHEM 2263 and CHEM 2261L) and ((CHEM 3613 and CHEM 3611L) or (CHEM 3713 and CHEM 3712L)).

CHEM 4283. Energy Conversion and Storage (Even years, Fa). 3 Hours.
Fundamental and applied concepts of energy storage and conversion, with sustainability implications. Chemical reactions (kinetics, thermodynamics, mass transfer), emphasizing oxidation-reduction, electrochemical, and interfacial processes, and impact on performance of fuel and biofuel cells, batteries, supercapacitors, and photocatalytic conversion. Prerequisite: CHEM 1123 and PHYS 2074.

CHEM 4443. Physical Chemistry of Materials (Odd years, Sp). 3 Hours.
Physical and chemical characteristics of materials and discussion of the science behind materials engineering and performance. Topics include theory, principles of characterization methods, modeling, and applications in the context of materials. Pre- or Corequisite: CHEM 3514. Prerequisite: CHEM 3453 or CHEG 3713 or MEEG 2403.

CHEM 4723. Experimental Methods in Organic Chemistry (Fa). 3 Hours.
Introduction to the application of synthetic and spectroscopic methods in organic chemistry, including mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance spectroscopy. Other laboratory techniques applicable to chemical research will be included. Lecture 2 hours, laboratory 3 hours per week, and 1 hour drill. Chemistry students may not receive graduate credit for this course and CHEM 5753. Corequisite: Drill and lab components. Prerequisite: CHEM 3613 and CHEM 3611L (or CHEM 3713 and CHEM 3712L).

CHEM 4813H. Honors Biochemistry I (Fa). 3 Hours.
The first of a two-course series covering biochemistry for undergraduate students in biology, agriculture, and chemistry. Topics covered include protein structure and function, enzyme kinetics, enzyme mechanisms, and nucleic acid and carbohydrate structures. Credit cannot be earned in both CHEM 3813 and CHEM 4813H. Additional honors-level work required in this section. Prerequisite: Honors candidacy and (CHEM 3613 and CHEM 3611L) or (CHEM 3613H and CHEM 3612M) or (CHEM 3713 and CHEM 3712L).
This course is cross-listed with CHEM 5813.

CHEM 4843H. Honors Biochemistry II (Sp). 3 Hours.
A continuation of CHEM 4813H covering topics including biological membranes and bioenergetics, photosynthesis, lipids and lipid metabolism, nucleic acid structure, structure and synthesis, and molecular biology. Credit cannot be earned in both CHEM 3813 and CHEM 4843H. Additional honors-level work required in this section. Prerequisite: Honors candidacy and CHEM 4813H.

CHEM 4853. Biochemical Techniques (Sp). 3 Hours.
Techniques for handling, purifying and analyzing enzymes, structural proteins, and nucleic acids. Lecture 1 hour, laboratory 6 hours per week. Pre- or Corequisite: CHEM 5813 or CHEM 3813.

CHEM 5011. Introduction to Research (Sp, Fa). 1 Hour.
Introduces new graduate students to research opportunities and skills in chemistry and biochemistry. Meets 1 hour per week during which new students receive information from faculty regarding research programs in the department and training in the use of research support facilities available in the department.

CHEM 5143. Advanced Inorganic Chemistry II (Irregular). 3 Hours.
Chemistry of metallic and non-metallic elements emphasizing molecular structure, bonding and the classification of reactions. Knowledge of inorganic chemistry comparable to material in CHEM 4123 and CHEM 5123 is recommended.

CHEM 5153. Structural Chemistry (Irregular). 3 Hours.
Determination of molecular structure by spectroscopic, diffraction, and other techniques. Illustrative examples will be chosen mainly from inorganic chemistry. Pre- or Corequisite: CHEM 3504 and CHEM 4123.

CHEM 5223. Chemical Instrumentation (Odd years, Sp). 3 Hours.
Use and application of operational amplifiers to chemical instrumentation; digital electronic microprocessor interfacing; software development and real-time data acquisition. Prerequisite: CHEM 4213 and PHYS 2074.

CHEM 5233. Chemical Separations (Even years, Fa). 3 Hours.
Modern separation methods including liquid chromatography (adsorption, liquid-liquid partition, ion exchange, exclusion) and gas chromatography. Theory and instrumentation is discussed with emphasis on practical aspects of separation science. Prerequisite: CHEM 4213.

CHEM 5243. Electrochemical Methods of Analysis (Even years, Sp). 3 Hours.
Topics will include diffusion, electron transfer kinetics, and reversible and irreversible electrode processes; followed by a discussion of chronoamperometry, chronocoulometry, polarography, voltammetry and chronopotentiometry. Prerequisite: CHEM 4213 and MATH 2574.

CHEM 5253. Spectrochemical Methods of Analysis (Odd years, Fa). 3 Hours.
Principles and methods of modern spectroscopic analysis. Optics and instrumentation necessary for spectroscopy is also discussed. Topics include atomic and molecular absorption and emission techniques in the ultraviolet, visible, and infrared spectral regions. Prerequisite: CHEM 4213.

CHEM 5263. Nuclear Chemistry (Odd years, Fa). 3 Hours.
Nuclear structure and properties, natural and artificial radioactivity, radioactive decay processes, nuclear reaction and interactions of radiation with matter. Prerequisite: CHEM 3514.

CHEM 5273. Cosmochemistry (Odd years, Sp). 3 Hours.
Laws of distribution of the chemical elements in nature, cosmic and terrestrial abundance of elements; origin and age of the earth, solar system, and the universe. Prerequisite: CHEM 3514.

CHEM 5283. Energy Conversion and Storage (Even years, Fa). 3 Hours.
Fundamental and applied concepts of energy storage and conversion, with sustainability implications. Chemical reactions (kinetics, thermodynamics, mass transfer), emphasizing oxidation-reduction, electrochemical, and interfacial processes, and impact on performance of fuel and biofuel cells, batteries, supercapacitors, and photocatalytic conversion. Prerequisite or Corequisite: MATH 2564. Prerequisite: CHEM 1103, CHEM 1123, PHYS 2054, PHYS 2074, and MATH 2554.

CHEM 5383. Chemometrics (Even years, Sp). 3 Hours.
Chemometrics is the process of extracting relevant information from chemical data by mathematical and statistical tools. These tools allow for designing optimal experimental procedures, extracting important information from complex chemical systems, and better understanding of complex chemical systems.

CHEM 5753. Honors Nanotechnology Laboratory (Sp). 1 Hour.
Introduces new graduate students to research opportunities and skills in chemistry and biochemistry. Meets 1 hour per week during which new students receive information from faculty regarding research programs in the department and training in the use of research support facilities available in the department.

CHEM 5143. Advanced Inorganic Chemistry II (Irregular). 3 Hours.
Chemistry of metallic and non-metallic elements emphasizing molecular structure, bonding and the classification of reactions. Knowledge of inorganic chemistry comparable to material in CHEM 4123 and CHEM 5123 is recommended.

CHEM 5153. Structural Chemistry (Irregular). 3 Hours.
Determination of molecular structure by spectroscopic, diffraction, and other techniques. Illustrative examples will be chosen mainly from inorganic chemistry. Pre- or Corequisite: CHEM 3504 and CHEM 4123.

CHEM 5223. Chemical Instrumentation (Odd years, Sp). 3 Hours.
Use and application of operational amplifiers to chemical instrumentation; digital electronic microprocessor interfacing; software development and real-time data acquisition. Prerequisite: CHEM 4213 and PHYS 2074.

CHEM 5233. Chemical Separations (Even years, Fa). 3 Hours.
Modern separation methods including liquid chromatography (adsorption, liquid-liquid partition, ion exchange, exclusion) and gas chromatography. Theory and instrumentation is discussed with emphasis on practical aspects of separation science. Prerequisite: CHEM 4213.

CHEM 5243. Electrochemical Methods of Analysis (Even years, Sp). 3 Hours.
Topics will include diffusion, electron transfer kinetics, and reversible and irreversible electrode processes; followed by a discussion of chronoamperometry, chronocoulometry, polarography, voltammetry and chronopotentiometry. Prerequisite: CHEM 4213 and MATH 2574.

CHEM 5253. Spectrochemical Methods of Analysis (Odd years, Fa). 3 Hours.
Principles and methods of modern spectroscopic analysis. Optics and instrumentation necessary for spectroscopy is also discussed. Topics include atomic and molecular absorption and emission techniques in the ultraviolet, visible, and infrared spectral regions. Prerequisite: CHEM 4213.

CHEM 5263. Nuclear Chemistry (Odd years, Fa). 3 Hours.
Nuclear structure and properties, natural and artificial radioactivity, radioactive decay processes, nuclear reaction and interactions of radiation with matter. Prerequisite: CHEM 3514.

CHEM 5273. Cosmochemistry (Odd years, Sp). 3 Hours.
Laws of distribution of the chemical elements in nature, cosmic and terrestrial abundance of elements; origin and age of the earth, solar system, and the universe. Prerequisite: CHEM 3514.

CHEM 5283. Energy Conversion and Storage (Even years, Fa). 3 Hours.
Fundamental and applied concepts of energy storage and conversion, with sustainability implications. Chemical reactions (kinetics, thermodynamics, mass transfer), emphasizing oxidation-reduction, electrochemical, and interfacial processes, and impact on performance of fuel and biofuel cells, batteries, supercapacitors, and photocatalytic conversion. Prerequisite or Corequisite: MATH 2564. Prerequisite: CHEM 1103, CHEM 1123, PHYS 2054, PHYS 2074, and MATH 2554.

CHEM 5383. Chemometrics (Even years, Sp). 3 Hours.
Chemometrics is the process of extracting relevant information from chemical data by mathematical and statistical tools. These tools allow for designing optimal experimental procedures, extracting important information from complex chemical systems, and better understanding of complex chemical systems.
CHEM 5453. Quantum Chemistry I (Odd years, Sp). 3 Hours.
Fundamental quantum theory: Hamiltonian formalism in classical mechanics, Schrödinger equation, operators, angular momentum, harmonic oscillator, barrier problems, rigid rotor, hydrogen atom and interaction of matter with radiation. Prerequisite: CHEM 3504. (Recommended: MATH 3404).

CHEM 5473. Chemical Kinetics (Sp). 3 Hours.
Theory and applications of the principles of kinetics to reactions between substances, both in the gaseous state and in solution. Prerequisite: CHEM 3514.

CHEM 5513. Biochemical Evolution (Even years, Sp). 3 Hours.
Abiotic synthesis of biomolecules on Earth, the origin of life, genetic information, origin of life on Earth and elsewhere, evolution and diversity, ecological niches, bacteria, archaea, eukaryotes, novel metabolic reshaping of the environment, life being reshaped by the environment, molecular data and evolution. Prerequisite: CHEM 5813.

CHEM 5603. Physical Organic Chemistry (Fa). 3 Hours.
Introduction to the theoretical interpretation of reactivity, reaction mechanisms, and molecular structure of organic compounds. Application of theories of electronic structure; emphasis on recent developments. Prerequisite: (CHEM 3514 and CHEM 3713 and CHEM 3712L).

The more important types of organic reactions and their applications to various classes of compounds. Prerequisite: (CHEM 3514 and CHEM 3713 and CHEM 3712L).

CHEM 5753. Methods of Organic Analysis (Fa). 3 Hours.
Interpretation of physical measurements of organic compounds in terms of molecular structure. Emphasis on spectroscopic methods (infrared, ultraviolet, nuclear magnetic resonance, and mass spectra). Prerequisite: (CHEM 3712L and CHEM 3713 and CHEM 3514).

CHEM 5813. Biochemistry I (Fa). 3 Hours.
The first of a two-course series covering biochemistry for graduate students in biology, agriculture, and chemistry. Topics covered include protein structure and function, enzyme kinetics, enzyme mechanisms, and carbohydrate metabolism. Prerequisite: CHEM 3712L and CHEM 3713 (or CHEM 3613 and CHEM 3611L). This course is cross-listed with CHEM 4813H.

CHEM 5843. Biochemistry II (Sp). 3 Hours.
A continuation of CHEM 5813 covering topics including biological membranes and bioenergetics, photosynthesis, lipids and lipid metabolism, nucleic acid and amino acid metabolism, and molecular biology. Knowledge of organic chemistry comparable to material in CHEM 3613 is recommended. Prerequisite: CHEM 5813.

CHEM 600V. Master’s Thesis (Sp, Su, Fa). 1-6 Hour.
Master’s Thesis. Chemistry graduate students enroll in this course as needed until all CUMES are passed and the student is officially a doctoral candidate. Prerequisite: Chemistry graduate student. May be repeated for degree credit.

CHEM 6011. Chemistry Seminar (Sp, Fa). 1 Hour.
Members of the faculty, graduate and advanced students meet weekly for discussion of current chemical research. Weekly seminar sections are offered for the Departmental seminar and for divisional seminars in biochemistry and in analytical, inorganic, nuclear, organic, and physical chemistry. Chemistry graduate students register for the Departmental seminar section and one of the divisional seminar sections each semester they are in residence. Seminar credit does not count toward the minimum hourly requirements for any chemistry graduate degree. Prerequisite: (CHEM 3514 and CHEM 3713 and CHEM 3712L) and senior or graduate standing. May be repeated for up to 1 hours of degree credit.

CHEM 619V. Special Topics in Inorganic Chemistry (Irregular). 1-3 Hour.
Topics which have been covered in the past include: technique and theory of x-ray diffraction, electronic structure of transition metal complexes, inorganic reaction mechanisms, and physical methods in inorganic chemistry. May be repeated for degree credit.

CHEM 6283. Mass Spectrometry (Odd years, Sp). 3 Hours.
This course is devoted to the fundamental principles and applications of analytical mass spectrometry. Interactions of ions with magnetic and electric fields and the implications with respect to mass spectrometer design are considered, as are the various types of mass spectrometer sources. Representative applications of mass spectrometry in chemical analysis are also discussed. Prerequisite: Graduate standing.

CHEM 629V. Special Topics in Analytical Chemistry (Irregular). 1-3 Hour.
Topics that have been presented in the past include: electroanalytical techniques, kinetics of crystal growth, studies of electrode processes, lasers in chemical analysis, nucleosynthesis and isotopic properties of meteorites, theraluminescence of geological materials, early solar system chemistry and analytical cosmochemistry. May be repeated for degree credit.

CHEM 6643. Organometallic Chemistry (Irregular). 3 Hours.
Theories and principles of organometallic chemistry. Concepts include bonding, stereochemistry, structure and reactivity, stereochemical principles, conformational, steric and stereoelectronic effects. Transition metal catalysis of organic reactions will also be described. Prerequisite: CHEM 3504, and CHEM 3514, and CHEM 3703, and CHEM 3713 or permission of instructor.

A detailed description of the fundamental reactions and mechanisms of organic chemistry. Prerequisite: CHEM 5633.

CHEM 669V. Special Topics in Organic Chemistry (Irregular). 1-3 Hour.
Topics which have been presented in the past include heterogeneous catalysis, isotope effect studies of organic reaction mechanisms, organometallic chemistry, stereochemistry, photochemistry, and carbonium chemistry. May be repeated for degree credit.

CHEM 6823. Physical Biochemistry (Even years, Fa). 3 Hours.
Physical chemistry of proteins, nucleic acids, and biological membranes. Ultracentrifugation, absorption and fluorescent spectrophotometry, nuclear magnetic resonance spectroscopy, x-ray diffraction, and other techniques. Prerequisite: (CHEM 3514 and CHEM 5813) or graduate standing.

CHEM 6863. Enzymes (Odd years, Fa). 3 Hours.
Isolation, characterization, and general chemical and biochemical properties of enzymes. Kinetics, mechanisms, and control of enzyme reactions. Prerequisite: CHEM 5813 and CHEM 5843.

CHEM 6873. Molecular Biochemistry (Odd years, Sp). 3 Hours.
Nucleic acid chemistry in vitro and in vivo, synthesis of DNA and RNA, genetic diseases, cancer biochemistry and genetic engineering. Prerequisite: CHEM 5813 and CHEM 5843.

CHEM 6883. Bioenergetics and Biomembranes (Even years, Sp). 3 Hours.
Cellular energy metabolism, photosynthesis, membrane transport, properties of membrane proteins, and the application of thermodynamics to biological systems. Prerequisite: CHEM 5813 and CHEM 5843.
CHEM 700V. Doctoral Dissertation (Sp, Su, Fa). 1-18 Hour.
Doctoral Dissertation. Prerequisite: Graduate standing. May be repeated for degree credit.