Academic Regulations
A grade of "C" in chemistry, cognate, and all other major courses is the minimal grade acceptable for progression into subsequent chemistry courses and for graduation. Students who fail to achieve at least a "C" may repeat the course. If a course is satisfactorily completed, the prior unsatisfactory grade will no longer bar a student from continuing in the Chemistry program. Credit, no-credit courses are not acceptable for the major or minor.

Lower Division

CHEM 1000 Foundations of Chemistry (3)
This course is designed to provide students with fundamental skills foundational to all areas of chemistry. Atomic and molecular structure, reactions and stoichiometry will be emphasized, along with the development of conceptual understanding and problem-solving skills. Completion of this course will enable students to progress to foundational courses in the subdisciplines of chemistry. This course is equivalent to most first semester general chemistry lecture courses. Prerequisite: Student must satisfy at least one of the following four requirements (1) ELM score of 50 or higher, or (2) SAT (Math) score of 550 or higher, or (3) ACT (Math) score of 23 or higher, or (4) C- or better in MATH 930. 150 minutes of lecture/discussion per week.

CHEM 1001 Foundations of Chemistry Laboratory (2)
This course is a general chemistry laboratory course designed to teach mastery of key concepts, skills and habits essential to success in a chemistry laboratory. This course is equivalent to most year-long general chemistry laboratory courses. Prerequisite: CHEM 1000. 300 minutes of laboratory per week.

CHEM 1002 Foundations of Chemistry Recitation (1)
A workshop in which students work on problems related to CHEM 1000 coursework with help from a facilitator. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 1000.

CHEM 1009 CSI: Crime Scene Investigation Chemistry (3)
A general education course introducing basic concepts of chemistry to the non-science major using examples from forensic science. The course focuses on the use of crime-scene case studies, Sherlock Holmes stories, and true accounts of drug deals, murders, and thefts to introduce chemical principles. 100 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major. Satisfies general education requirement B1.

CHEM 1019 Chemistry of Wine and Beer (3)
A general education course introducing basic concepts of chemistry to the non-science major using examples from the beer and wine industries. The course focuses on the use of the processes of beer brewing and winemaking to introduce chemical principles. 100 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major. Satisfies general education requirement B1.

CHEM 1029 Molecular Gastronomy: The Chemistry of Cooking (3)
A general education course introducing basic concepts of chemistry to the non-science major using examples from cooking and baking. The course focuses on the use of the processes of cooking to introduce chemical principles. 100 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major. Satisfies general education requirement B1.

CHEM 1039 Introduction to Nutrition and Food Toxicology (3)
This general education course provides an overview of nutrition and food toxicology with particular emphasis on how course topics relate to quality of life. Course topics include digestion and metabolism of nutrients and toxicants, impact of nutrients and toxicants on human health, basic chemical analysis of food components, and quantitative expression of laboratory results. Basic analytical skills will be applied in quantifying a food-born nutrient or toxicant of particular interest to the student. 100 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major. Prerequisite or Corequisite A4. Satisfies general education Quality of Life and B1.

CHEM 1100 Foundations of Analytical Chemistry (2)
This course is designed to provide students with fundamental knowledge foundational to analytical chemistry and how this knowledge applies to all of chemistry. This includes the chemical analysis process, precipitation and oxidation-reduction reactions, acid-base chemistry, and the dynamic chemical equilibrium and its basic application to chemical problems. Prerequisite: CHEM 1000 or equivalent. 100 minutes of lecture/discussion per week.

CHEM 1102 Foundations of Analytical Chemistry Recitation (1)
A workshop in which students work on problems related to CHEM 1100 coursework with help from a facilitator. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 1100.

CHEM 1600 Foundations of Physical Chemistry (2)
This course is designed to provide students with fundamental knowledge foundational to physical chemistry and how this knowledge applies to all of chemistry. This includes the laws of thermodynamics, equilibrium, and chemical kinetics. The course incorporates spreadsheets to generate plots, analyze thermochemical data, and complete problems sets. Prerequisite: CHEM 1000 or equivalent and a grade of C or better in MATH 1040 or MATH 1050. 100 minutes of lecture/discussion per week.

CHEM 1602 Foundations of Physical Chemistry Recitation (1)
A workshop in which students work on problems related to CHEM 1600 coursework with help from a facilitator. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 1600.

CHEM 2010 Problem Solving in Chemistry (1)
A workshop in which students work on problems related to their chemistry coursework with help from a facilitator. This workshop is designed to accompany specific chemistry courses which must be taken concurrently. Consult the electronic course description for the acceptable companion course(s).

CHEM 2080 Careers in Chemistry and Biochemistry (1)
An introduction to career opportunities available in the fields of chemistry and biochemistry. Students will learn about career options, graduate school, and professional development through activities, discussion, and guest speakers. Offered on a credit, no-credit basis only. May be repeated twice for credit. Prerequisite: CHEM 1100, 1600, and 2300 or equivalent.

CHEM 2200 Foundations of Inorganic Chemistry (2)
This course is designed to provide students with fundamental knowledge foundational to inorganic chemistry and how this knowledge applies to all of chemistry. This includes periodic trends, bonding, and structure in inorganic chemistry, periodic element survey of main groups, transition metals, f-block metals, transition metal complexes, and nuclear chemistry. Prerequisite: CHEM 1000 or equivalent. 100 minutes of lecture/discussion per week.

CHEM 2300 Foundations of Organic Chemistry (3)
This course is designed to provide students with fundamental knowledge foundational to organic chemistry and how this knowledge applies to all of chemistry. This includes structure and bonding, acids and bases, nomenclature, stereochemistry, alkanes and cycloalkanes, and introduction to reactivity. Prerequisite: CHEM 1000 or equivalent. 150 minutes of lecture/discussion per week.

CHEM 2302 Foundations of Organic Chemistry Recitation (1)
A workshop in which students work on problems related to CHEM 2300 coursework with help from a facilitator. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 2300.

CHEM 2400 Foundations of Biochemistry (2)
A detailed study of biochemical equilibria, thermodynamics, protein chemistry, and enzyme kinetics. This course will also introduce students to biochemical literature and bioinformatics as well as the use of protein visualization software. Prerequisites: CHEM 2300 or equivalent. 100 minutes of lecture/discussion per week.

CHEM 2402 Foundations of Biochemistry Recitation (1)
A workshop in which students work on problems related to CHEM 2400 coursework with help from a facilitator. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 2400.

CHEM 2500 Foundations of Food Science (1)
This course is designed to provide students with the fundamentals of food science including chemical, biological and physical basis of various foods. The chemical composition of foods, food microbiology, nutrition, food packaging, food processing, food engineering, food toxicology, and sensory science of foods will be explored. The use of each of these sub-fields in producing palatable, nutritious, sustainable and economical foods will be given particular attention. Prerequisites: CHEM 1000 and 1001. 50 minutes of lecture/discussion per week.

CHEM 2700 Special Topics in Chemistry (1-3)
Topics and prerequisites to be announced. May be repeated for different topics.

CHEM 2840 Service Learning in Chemistry: Participation (1-2)
Participation in chemistry-related service learning experiences that meet school and/or community needs. Beginning students will assist in the implementation of service learning projects. Advanced students will design and implement service learning projects. Schedule is negotiated by the student, instructor, and community partners. Course may be repeated up to six times with permission of the instructor. Offered on a credit, no-credit basis only. Interested students should contact the department office. Prerequisites: CHEM 1000 and 1001 or permission of instructor.

CHEM 2900 Research Methods in Chemistry (2)
This course introduces appropriate research techniques and computational technology for chemists. Topics include Microsoft Office (Word, Excel, and PowerPoint), ChemDraw, SciFinder, interpreting the chemical literature, research ethics, data and error analyses, and scientific writing and presentations. Prerequisites: CHEM 1000 and 2300. 100 minutes of lecture/discussion per week.

CHEM 2940 Research Methods in Biochemistry (2)
This course is designed to introduce students to basic research principles required for biochemists. Topics will include the use MS Office products for biochemical purposes (presentations, Excel calculations, Word formatting, etc.), introduction to the biochemical literature, introduction to the protein data bank, bioinformatics, research ethics, data and error analyses, and introduction to relevant software for chemical drawing and protein rendering. Prerequisites: CHEM 1000 and 2300. 100 minutes of lecture/discussion per week.

Upper Division

CHEM 3100 Quantitative Analytical Chemistry (4)
The practice and theory of chemical laboratory methods including techniques of gravimetric, volumetric, spectrophotometric analysis and separation, and introductory instrumental analysis with a focus on precision and accuracy of experimental data. It is strongly recommended that you retake CHEM 1100 (or equivalent) if you have not taken it within the last two years before starting CHEM 3100. Prerequisites: CHEM 1100 and 1001 or equivalent. 100 minutes of lecture/discussion and 300 minutes of laboratory per week.

CHEM 3300 Intermediate Organic Chemistry (3)
This course is a continuation of the study of the structure and reactivity of organic compounds and introduces the concepts of structure determination and multistep synthesis. Topics include molecular orbital theory, nucleophilic substitution and elimination reactions, electrophilic addition reactions, conjugation and aromaticity, electrophilic aromatic substitutions, spectroscopy, and nucleophilic additions. Prerequisites: CHEM 1001, 1100, and 2300. Corequisite: CHEM 3301. 150 minutes of lecture/discussion per week.

CHEM 3301 Organic Chemistry Laboratory I (2)
The first semester in a yearlong course on organic laboratory techniques. Topics include melting point, extraction, recrystallization, thin layer chromatography, column chromatography, distillation, UV-Vis spectroscopy, IR spectroscopy, and 1H NMR spectroscopy. Prerequisites: CHEM 1001, 1100, and 2300. Corequisite: CHEM 3300. 300 minutes of laboratory per week.

CHEM 3310 Advanced Organic Chemistry (2)
The course is a continuation the study of the structure, reactivity, synthesis, and analysis of organic compounds. Topics include nucleophilic addition-elimination reactions, electrophilic aromatic substitutions, pericyclic reactions, free radicals, polymers, organometallics, and special topics. Prerequisites: CHEM 3300 and 3301. 100 minutes of lecture/discussion per week.

CHEM 3311 Organic Chemistry Laboratory II (2)
The second semester in a yearlong course on organic laboratory techniques. Topics include predicting and identifying reaction products, 13C NMR spectroscopy, 2D NMR spectroscopy, qualitative organic analysis, and developing and conducting research projects. Prerequisites: CHEM 3300 and 3301. Corequisite: CHEM 3310. 300 minutes of laboratory per week.

CHEM 3400 Biochemistry of Metabolic Pathways (2)
A study of metabolism focused primarily on the breakdown of glucose. The course will explore the principles of glycolysis, the citric acid cycle, and the electron transport chain. Principles of protein structure and function, ligand binding, and kinetics covered in CHEM 2400 will be reinforced. The use of protein visualization software and bioinformatics tools will expand. Prerequisites: CHEM 1600, 2400, and 3300, PHYS 2110 or 2210. 100 minutes of lecture per week.

CHEM 3401 Biochemistry Laboratory I (2)
This course will introduce students to basic laboratory techniques used in biochemistry. Students will analyze the effectiveness of different buffer systems, the effects of dilution on buffer capacity, learn different applications of polyacrylamide gels, measure enzyme kinetics, and evaluate the effect of reversible inhibitors on an enzyme. Corequisite: CHEM 3400. 300 minutes of laboratory per week.

CHEM 3500 Concepts of Food Analysis (4)
Study of the fundamental chemical principles of food analysis with the laboratory work including both the classical and the more recent sophisticated methods of chemical analysis. Prerequisites: CHEM 1000, 1100, and 1001. 100 minutes of lecture/discussion and 300 minutes of laboratory per week.

CHEM 3600 Physical Chemistry: Thermodynamics and Kinetics (3)
This course is designed as an introduction to chemical thermodynamics. This course will cover the laws of thermodynamics, thermochemistry, equilibrium processes, and kinetics. In the course of studying these broad areas, a computer algebra system will be used to generate plots, analyze the thermochemical data, and complete problems sets. Prerequisites: CHEM 1600, MATH 2020 or MATH 2320 or MATH 2520, PHYS 2120 or 2220. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 3602 Physical Chemistry Recitation (1)
A workshop in which students work on problems related to CHEM 3600 coursework with help from a facilitator. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 3600.

CHEM 3610 Physical Chemistry: Quantum and Statistical Mechanics (3)
This course is designed as an introduction to quantum and statistical mechanics. This course will cover concepts of quantum and statistical thermodynamic theories. In the course of studying these broad areas, a computer algebra system will be used to generate plots, analyze data, and complete problems sets. Prerequisites: CHEM 3600. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 3650 Biophysical Chemistry (4)
This course is designed as an introduction to biophysical chemistry. Topics include the laws of thermodynamics, thermochemistry, and equilibrium processes. This course incorporates spreadsheets to generate plots, analyze thermochemical data, and complete problems sets. Prerequisites: CHEM 1600, MATH 2020 or MATH 2320 or MATH 2520, PHYS 2120 or 2220. 150 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 3900 Seminar in Chemical Literature (2)
Seminar in the use of modern chemical literature and literature databases. Must be completed before enrolling in CHEM 4908. Prerequisite: CHEM 2900, 3310, and 3600 and at least 90 units. 100 minutes of lecture/discussion per week.

CHEM 3940 Seminar in Biochemical Literature (2)
Seminar in the use of modern biochemical literature and literature databases. Must be completed before enrolling in CHEM 4940. Prerequisite: CHEM 2940, 3310, 4400, and at least 90 units. 100 minutes of lecture/discussion per week.

CHEM 4010 Symmetry and Group Theory (2)
Introduction to methods in symmetry used in the chemical sciences. Applications include 3D chemical structures and spectroscopy. Prerequisite: CHEM 3300 or consent of instructor. 100 minutes of lecture/discussion per week.

CHEM 4020 Computational Chemistry (2)
Introduction to basic computational methods used in the chemical sciences. Applications include computational methods in electronic structure, 3D biomolecular modeling, magnetic/optical/spectroscopic properties of molecules, reaction thermochemistry, and reaction dynamics. Prerequisites: CHEM 2900 and 3300 or consent of instructor, 100 minutes of lecture/discussion per week.

CHEM 4100 Chemical Separations (1)
Principles of modern instrumental analysis methods including gas chromatography, HPLC, and mass spectrometry. Prerequisite: CHEM 1600 and 3300. 50 minutes of lecture/discussion per week per week.

CHEM 4101 Chemical Separations Laboratory (1)
Techniques of modern instrumental analysis methods including gas chromatography, HPLC, and mass spectrometry. Corequisite: CHEM 4100. 150 minutes of laboratory per week.

CHEM 4110 Spectroscopy (1)
This course is designed to provide students with fundamental knowledge of common instrumental techniques utilized in chemical analysis. This will involve a detailed examination of the theoretical basis for the utility of each technique, and practical considerations for operating this instrumentation. The techniques covered will include UV/Vis, IR, and Fluorescence Spectroscopy as well as Atomic Absorption, and Mass Spectrometry. Prerequisite: CHEM 3300. 50 minutes of lecture/discussion per week.

CHEM 4120 Nuclear Magnetic Resonance (1)
This course is an introduction to nuclear magnetic resonance. Concepts of nuclear spins, J-coupling, chemical shift, vector and product operator representations, pulse sequences, and simple 1D and 2D NMR experiments will be discussed. Incorporation of MS Excel will be used to generate plots, analyze data, and complete problems sets. Prerequisite: CHEM 3300. 50 minutes of lecture/discussion per week.

CHEM 4121 Spectroscopy Laboratory (1)
Introduces students to the major concepts of instrumental analysis and to some of the instrumental techniques most commonly used in analytical and bioanalytical chemistry. It emphasizes the use of modern, commercial instrumentation to perform quantitative and qualitative analyses of the physical properties and chemical composition of samples. This course is designed to provide students with a practical understanding of common instrumental techniques utilized in chemical analysis. This will involve sample preparation and method development for UV/Vis, IR, and Fluorescence Spectroscopy as well as Atomic Absorption, Mass Spectrometry, and NMR. Corequisite: CHEM 4110 and 4120. 150 minutes of laboratory per week.

CHEM 4200 Inorganic Chemistry (3)
This course is designed to introduce students to the theory and practice of modern inorganic chemistry. This includes fundamentals of electronic spectra in inorganic chemistry, uses of molecular symmetry in IR spectroscopy, catalytic cycles, interhalogen species, organometallic compounds of p, d, and f block elements, acid-base chemistry in both aqueous and non-aqueous systems, Valence-bond and molecular orbital theory of more than diatomics, f- block periodicity, and diagonal relationships. Prerequisite: CHEM 2200, 3300, and 3301 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 4210 Bioinorganic Chemistry (2)
This course is designed to introduce students to the theory and practice of modern bioinorganic chemistry. Topics include the binding, stability, and folding of metal ions and proteins, cofactors, metal clusters, transport and storage of metal ions and metal clusters in biological systems, biominerals, biomineralization, electron transfer, respiration, and photosynthesis. Prerequisites: CHEM 3300, 3301, and 3400. 100 minutes of lecture/discussion per week.

CHEM 4400 Biochemistry of Nucleic Acids (2)
Structures and mechanistic features of enzymes involved in DNA and RNA replication or synthesis, the structural determinants related to gene expression, and the chemical processes involved in gene mutation and recombination. Regulation of gene expression, signal transduction, genome replication, recombination, and repair. Prerequisite: CHEM 3400. Corequisite for Biochemistry Majors: CHEM 4401. 100 minutes of lecture.

CHEM 4401 Biochemistry Laboratory II (2)
An introduction to nucleic acid laboratory techniques. Students will be introduced to gene amplification, plasmid DNA generation, antibiotic resistance in bacteria, site directed mutagenesis of DNA, cloning, agarose gel electrophoresis, and detection of DNA and RNA using northern and southern blotting. Corequisite: CHEM 4400. 300 minutes of laboratory per week.

CHEM 4410 Protein Chemistry (2)
An in-depth view of protein structure and the correlation of structural properties to biological function. Topics include chemical properties of polypeptides, protein biosynthesis, post-translational modifications, protein-protein interactions, structure-function relationships, evolutionary and genetic origins of proteins, and biological mechanisms. This course also introduces students to the area of bioinformatics. Prerequisites: CHEM 3400 or approval of instructor. 100 minutes of lecture/discussion per week.

CHEM 4420 Plant Biochemistry (2)
This course is designed to provide students with fundamental knowledge of plant life including the requirements for membranes, flow of energy, metabolism and reproduction. Particular attention will be given to biochemical processes unique to plant systems with the aim to obtain an integrative overview of plant biochemistry. Examples include processes such as cell wall biochemistry, pigment biosynthesis and degradation, secondary metabolism, senescence, defense mechanisms, amino acid biosynthesis, and small molecule transport. Genomics-based experimental tools such as proteomics and metabolomics are discussed. Prerequisite: CHEM 3400. 100 minutes of lecture/discussion per week.

CHEM 4500 Food Chemistry (3)
Properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. Basic elements of molecules, such as structure and reactive groups, are presented in regard to how they affect the properties of foods and pharmaceuticals. Reactions such as Maillard browning and lipid oxidation are discussed regarding mechanisms, products and controlling processes. Prerequisites: CHEM 3300 and 3301. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 4510 Advanced Nutrition and Metabolism (2)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Prerequisite: CHEM 3300. 100 minutes of lecture/discussion per week.

CHEM 4700 Special Topics in Chemistry (1-3)
Topics and prerequisites to be announced. May be repeated for different topics.

CHEM 4800 Honors Research (1-3)
Individual study on a current research problem with faculty supervision, preparation of a paper. Course may be repeated twice with permission of the instructor. A maximum of three units may be used for major department credit. Units in excess of three may be used for upper division elective credit. Prerequisite: Invitation by faculty.

CHEM 4830 Instruction in Chemistry (1)
Experience supporting teaching activities in the laboratory and/or guiding problem solving sessions. Interested students should speak with the department chair in advance to coordinate. A maximum of one unit may be used for major department credit. May be repeated for credit. Prerequisite: Approval by faculty.

CHEM 4840 Service Learning in Chemistry: Leadership (1-2)
Leadership in chemistry-related service learning experiences that meet school and/or community needs. Students will lead a team in the design and implementation of service learning projects. Schedule is negotiated by the student, instructor, and community partners. Course may be repeated up to six times with permission of the instructor. Offered on a credit, no-credit basis only. Interested students should contact the department office. Prerequisite: CHEM 2940 or permission of instructor. Units cannot be applied as elective units to the major.

CHEM 4850 Food Industrial Practicum (1-3)
Enhancement of student's practical knowledge of food science by participating in projects sponsored by industrial and/or governmental agencies. A maximum of three units may be used for major department credit. Prerequisite: Permission of instructor.

CHEM 4860 Internship in Chemistry (1-3)
Students are assigned to various industries, institutions, or agencies and work under joint supervision of supervisors and the course instructor. Participation in staff and internship conferences. Assigned readings and projects where appropriate. (Arrangements should be made one quarter in advance with the department.) Course may be repeated twice with permission of instructor and department chair. Offered on a credit, no-credit basis only. Units cannot be applied as elective units to the major.

CHEM 4870 Cooperative Education (1-3)
The Cooperative Education Program offers a sponsored learning experience in a work setting, integrated with a field analysis seminar. The field experience is contracted by the Cooperative Education Office on an individual basis, subject to approval by the department. The field experience, including the seminar and reading assignments, is supervised by the cooperative education coordinator and the faculty liaison (or course instructor) working with the field supervisor. Students are expected to enroll in the course for at least two quarters. The determination of course credits, evaluation, and grading are the responsibility of the departmental faculty. Offered on a credit, no-credit basis only. Department will determine application of credit.

CHEM 4890 Experiential Prior Learning (1-3)
Evaluation and assessment of learning that has occurred as a result of prior off-campus experience relevant to the curriculum of the department. Course may be repeated twice with permission of the instructor. Normally a maximum of three units may be used for major department credit. Units in excess of three may be used for upper-division elective credit. Available by petition only, on a credit, no-credit basis. Not open to postgraduate students. Interested students should contact the department office.

CHEM 4908 Senior Seminar in Chemistry (3)
Presentation of papers and discussion on either a topic or a group of related topics by faculty and students. Prerequisite: Senior status and completion of UDC and UDD; CHEM 3900 (C) or CHEM 3940 (C) and a major or minor in chemistry.

CHEM 4948 Senior Seminar in Biochemistry (3)
Presentation of papers and discussion on either a topic or a group of related topics by faculty and students. Prerequisite: Senior status and completion of UDC and UDD; CHEM 3900 (C) or CHEM 3940 (C) and a major or minor in chemistry.