

CHEMISTRY (CHEM)

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.

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: A grade of C or better in CHEM 1010 or CHEM 1003, or MATH 1209 or MATH 1030 or MATH 1040 or MATH 1050 or MATH 1055 or MATH 1060 or MATH 2200 or KINE 2018 or PSYC 2018 or SOC 2208, or satisfactory performance on the chemistry placement exam or equivalent. 150 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: a C or better in CHEM 1010 or 1003 or MATH 1209 or MATH 1030 or MATH 1040 or MATH 1050 or MATH 1055 or MATH 1060 or MATH 2200 or KINE 2018 or PSYC 2018 or SOC 2208, or satisfactory performance on the chemistry placement exam or equivalent.

Typically Offered: Fall, Spring, Summer

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, including safety, measurement, chemical reactivity, percent recovery/yield, volumetric glassware, serial dilution, pH and titration curves, acid-base titration, simple equilibrium, simple calorimetry, anion chemistry, and cation chemistry. This intensive course is equivalent to most year-long general chemistry laboratory courses. Prerequisite: A grade of C or better in CHEM 1000. 300 minutes of laboratory per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1000.

Typically Offered: Fall, Spring, Summer

Course Fee: Yes

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.

Requisite(s): Corequisite: CHEM 1000

CHEM 1003 Foundations of Chemistry for Healthcare Professionals (4)

An introduction to selected topics in general, organic, and biochemistry. Topics include atomic structure, the periodic table, electronegativity, ionic and covalent bonding, empirical and molecular formulas, gas laws, unit conversion as it relates to health careers, Lewis structures and VSEPR, organic structures, polarity, solvents, precipitation reactions, acid-base reactions, pH, redox, osmosis and gradients, energy (ATP, sugars, etc), and membranes. Not acceptable for the Chemistry or Biochemistry major or minor. This course is intended for students who are considering healthcare careers such as nursing and is not appropriate for students planning to apply to medical school. Prerequisite: Students must demonstrate college readiness in mathematics through a Category 1 or Category 2 proficiency placement in mathematics to enroll in this course. Students with a Category 3 or Category 4 proficiency in mathematics must complete MATH 1209 or MATH 1010 or MATH 1030 or MATH 1050 or MATH 1055 or MATH 2200 or MATH 2205 or KINE 2018 or PSYC 2018 or SOC 2208 with a grade of C or better prior to enrolling in this course. Not acceptable for the major or minor. 200 minutes of lecture per week.

Requisite(s): Prerequisite: demonstrate college readiness in MATH through a Cat 1 or 2 or students with a Cat 3 or 4 proficient in MATH must complete MATH 1209 or 1010 or 1030 or 1050 or 1055 or 2200 or 2205 or KINE 2018 or equivalent with a grade of C or better.

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 or minor. Satisfies general education requirement Area B1 Physical Sciences.

General Education Attribute(s): GE (B1) Physical Sciences

Course Fee: Yes

CHEM 1010 Preparation for College Chemistry (3)

A one-semester course based on a systematic, semi-empirical approach to the submicroscopic world of chemistry. The development of modern ideas concerning atomic and molecular structure, stoichiometry, nomenclature, and principles of compound formation will be covered. Emphasis will be on the development of the skills necessary for success in chemistry. Science majors should consult with their advisors before enrolling in this course. Not acceptable for the major or minor. 150 minutes of lecture/discussion per week.

Course Fee: Yes

CHEM 1012 Preparation for College Chemistry Recitation (1)

A workshop in which students work on problems related to CHEM 1010 coursework with help from a facilitator. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 1010.

Requisite(s): Corequisite: CHEM 1010.

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 wine making to introduce chemical principles. 100 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major or minor. Satisfies general education requirement Area B1 Physical Sciences.

General Education Attribute(s): GE (B1) Physical Sciences

Course Fee: Yes

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 or minor. Satisfies general education requirement Area B1 Physical Sciences.

General Education Attribute(s): GE (B1) Physical Sciences

Course Fee: Yes

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 course focuses on dynamic chemical equilibrium and its application to the chemical analysis process, to acid-base equilibrium problems including buffers, to precipitation/solubility equilibrium, and to electrochemistry (oxidation-reduction reactions). Prerequisite: A grade of C or better in CHEM 1000 or equivalent. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1000.

Typically Offered: Fall, Spring

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.

Requisite(s): 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: A grade of C or better in CHEM 1000 (C) or equivalent and MATH 1040 or MATH 1050 or MATH 1055 or MATH 2010 or MATH 2310 or MATH 2510. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1000 (C) or equivalent and MATH 1040 or MATH 1050 or MATH 1055 or MATH 2010 or MATH 2310 or MATH 2510.

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.

Requisite(s): 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). Credit/no-credit grading.

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. Prerequisite: A grade of C or better in CHEM 1100, CHEM 1600, and CHEM 2300. May be repeated up to a maximum of 2 units.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1100, CHEM 1600, and CHEM 2300.

Repeatable for Credit: Yes, up to 2 units

CHEM 2100 Quantitative Chemical Analysis for Laboratory Sciences (4)

This course is an Introduction to the theory and practice of quantitative analytical chemistry. Specific equilibria that will be studied, among others, are the solubility product, acid-base reactions, complexation, and redox reactions. The effect of activity and multiple connected chemical equilibria will be investigated. Concepts will be applied to data collection and analysis and include error analysis. Theoretical concepts learned in the lecture will be supported by the application of concepts in the laboratory. This course does not apply to the chemistry or biochemistry major. Prerequisite: a grade of C or better in CHEM 1001 and CHEM 1100 or equivalent. 150 minutes of lecture/discussion and 150 minutes of laboratory per week.

Requisite(s): Prerequisite: CHEM 1100 and CHEM 1001 or equivalent.

Course Fee: Yes

CHEM 2110 Foundations of Quantitative Chemical Analysis (3)

This is an introduction to the theory and practice of quantitative analytical chemistry and analytical laboratory techniques. Topics include common analytical instrumentation, statistics for error and data analysis, various chemical equilibria systems including acid-base and electrochemistry, discussions on ionic strength, activity, and multiple connected chemical equilibria systems, and various electrochemistry topics including redox reactions, titrations, potentiometry, and electrolysis. Theoretical concepts learned in the lecture will be supported by the application of concepts in the laboratory. Prerequisite: a grade of C or better in CHEM 1100, and CHEM 1001. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1100, and CHEM 1001.

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, oxidation-reduction reactions, acid-base chemistry, aspects of symmetry and group theory, periodic element survey of main groups, transition metals, f-block metals, transition metal complexes, and nuclear chemistry. Prerequisite: A grade of C or better in CHEM 1100. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1100.

Typically Offered: Spring Even Year

CHEM 2240 Foundations of Bioinorganic Chemistry (3)

This course introduces core concepts of inorganic chemistry focusing on metals and selected nonmetals in biology. This includes oxidation-reduction reactions, acid-base chemistry, coordination chemistry, periodicity, bioinorganic thermodynamics, aspects of symmetry and group theory, crystal and ligand field theory, and fundamental transition metal chemistry as it applies to biological systems. Prerequisite: A C or better in CHEM 1100. 150 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A C or better in CHEM 1100.

Typically Offered: Fall, Spring

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 mechanisms & reactivity (including nucleophilic substitution and elimination). Prerequisite: A grade of C or better in CHEM 1000. 150 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1000.

Typically Offered: Fall, Spring

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.

Requisite(s): 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: A grade of C or better in CHEM 1100, 1600, and 2300; MATH 2010 or MATH 2310 or MATH 2510. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 1100, 1600, and 2300; MATH 2010 or MATH 2310 or MATH 2510.

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. Credit/no-credit grading.

Corequisite: CHEM 2400. 50 minutes of discussion.

Requisite(s): 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: A grade of C or better in CHEM 1000 and CHEM 1001. 50 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 1000 and CHEM 1001

CHEM 2700 Special Topics in Chemistry (1-3)

Topics and prerequisites to be announced. May be repeated for credit with different topics up to a maximum of 9 units.

Repeatable for Credit: Yes, up to 9 units

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. Offered on a credit, no-credit basis only. Interested students should contact the department office. Prerequisite: A grade of C or better in CHEM 1000 and CHEM 1001 or permission of instructor. May be repeated for credit up to a maximum of 12 units.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1000 and CHEM 1001 or permission of instructor.

Repeatable for Credit: Yes, up to 12 units

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. Prerequisite: A grade of C or better in CHEM 1000 and CHEM 2300. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1000 and CHEM 2300.

Course Fee: Yes

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. Prerequisite: A grade of C or better in CHEM 1000 and CHEM 2300. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1000 and CHEM 2300.

Typically Offered: Fall, Spring

Course Fee: Yes

CHEM 3100 Quantitative Analytical Chemistry (5)

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: A grade of C or better in CHEM 1100 and CHEM 1001 and MATH 1050 or higher and be a Chemistry or Biochemistry major or Chemistry Minor. 150 minute of lecture/discussion and 300 minute of laboratory per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 1100 and CHEM 1001 and MATH 1050 or higher and be a Chemistry or Biochemistry major or Chemistry Minor.

Course Fee: Yes

CHEM 3110 Advanced Quantitative Chemical Analysis (3)

This course is a continuation of the theory and practice of quantitative analytical chemistry and analytical laboratory techniques. Topics include solubility and complex formation equilibria, polyprotic acid-base systems, gravimetric and titrimetric methods, advanced discussions on activity and multiple connected equilibria, and a foundation for the use and theory of spectrophotometric and separation instrumentation. The chemical laboratory methods will include various analytical techniques with a focus on precision and accuracy of experimental data. Prerequisites: A grade of C or better in CHEM 2110 and be a Chemistry or Biochemistry Major or Chemistry Minor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 2110 and be a Chemistry or Biochemistry Major or Chemistry Minor.

Typically Offered: Spring

CHEM 3300 Intermediate Organic Chemistry (3)

This course is a continuation of the study of the structure and reactivity of organic compounds using a mechanistic approach and introduces the concepts of structure determination and multistep synthesis. Topics include molecular orbital theory, nucleophilic substitution and elimination reactions, electrophilic addition reactions to alkenes/alkynes, conjugation & aromaticity, electrophilic aromatic substitutions, arenediazonium salts, spectroscopy (UV-Vis, IR, ¹H NMR, ¹³C NMR, and MS), oxidation/reduction, protecting groups, and nucleophilic additions (alkyllithium & Grignard reagents, aldol addition/condensation, Michael addition, acetals, imines/enamines). Prerequisites: a grade of C or better in CHEM 1001, CHEM 1100, and CHEM 2300; prerequisite or corequisite: CHEM 3301. 150 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: a grade of C or better in CHEM 1001, CHEM 1100, and CHEM 2300; prerequisite or corequisite: CHEM 3301.

Typically Offered: Fall, Spring

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: a grade of C or better in CHEM 1001, CHEM 1100, and CHEM 2300; prerequisite or corequisite: CHEM 3300. 300 minutes of laboratory per week.

Requisite(s): Prerequisites: a grade of C or better in CHEM 1001, CHEM 1100, and CHEM 2300; prerequisite or corequisite: CHEM 3300.

Typically Offered: Fall, Spring

Course Fee: Yes

CHEM 3310 Advanced Organic Chemistry (2)

The course covers advanced concepts in the study of the structure, reactivity, synthesis, and analysis of organic compounds. Topics include nucleophilic addition-elimination reactions, electrophilic & nucleophilic aromatic substitutions, pericyclic reactions, free radicals, polymers, organometallics, and special topics (asymmetric synthesis, catalysis, etc.). Prerequisites: A grade of C or better in CHEM 3300 and CHEM 3301. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 3300 and CHEM 3301.

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: a grade of C or better in CHEM 3300 and CHEM 3301; prerequisite or corequisite: CHEM 3310. 300 minutes of laboratory per week.

Requisite(s): Prerequisites: a grade of C or better in CHEM 3300 and CHEM 3301; prerequisite or corequisite: CHEM 3310

Typically Offered: Fall, Spring

Course Fee: Yes

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: A grade of C or better in CHEM 1600, CHEM 2400, CHEM 3300, PHYS 2110 or PHYS 2210. 100 minutes of lecture per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 1600, CHEM 2400, and CHEM 3300, PHYS 2110 or PHYS 2210.

Typically Offered: Fall, Spring

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. Prerequisite or corequisite: CHEM 3400. 300 minutes of laboratory per week.

Requisite(s): Prerequisite/Corequisite: CHEM 3400

Typically Offered: Fall, Spring

Course Fee: Yes

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: A grade of C or better in CHEM 1000, CHEM 1100, and CHEM 1001. 100 minutes of lecture/discussion and 300 minutes of laboratory per week.

Requisite(s): Prerequisite: CHEM 1000 (C) or CHEM 211 (C-); and CHEM 1100 (C) or CHEM 213 (C-); and CHEM 1001 (C) or CHEM 213L (C-).

Course Fee: Yes

CHEM 3510 Food Science (1)

This course is designed to provide students with the principles 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: A grade of C or better in BIOL 2230, CHEM 2400 and CHEM 2900 or CHEM 2940. 50 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in BIOL 2230, CHEM 2400, and CHEM 2900 or CHEM 2940.

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: A grade of C or better in CHEM 1600, MATH 2020 or MATH 2320 or MATH 2520, PHYS 2110 or PHYS 2210. 100 minutes of lecture/discussion and 150 minutes of laboratory per week. Corequisite of CHEM 3602 is strongly recommended.

Requisite(s): Prerequisites: A grade of C or better in CHEM 1600, MATH 2020 or MATH 2320 or MATH 2520, PHYS 2110 or PHYS 2210. Corequisite of CHEM 3602 is strongly recommended.

Course Fee: Yes

CHEM 3602 Physical Chemistry Recitation (1)

A workshop in which students will review calculus related to CHEM 3600 coursework with help from a facilitator. Strongly recommended for students that received a B or lower in Calculus I and/or took Calculus I more than 2 years ago. 50 minutes of discussion. Credit/no-credit grading. Corequisite: CHEM 3600.

Requisite(s): 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: A grade of C or better in CHEM 3600. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 3600.

Course Fee: Yes

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: A grade of C or better in CHEM 1600, MATH 2020 or MATH 2320 or MATH 2520, PHYS 2120 or PHYS 2220. 150 minutes of lecture/discussion and 150 minutes of laboratory per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 1600, MATH 2020 or MATH 2320 or MATH 2520, PHYS 2120 or PHYS 2220.

Course Fee: Yes

CHEM 3908 Seminar in Chemical Literature (3) 

Students will develop expository and argumentative reading and writing skills for different rhetorical contexts, including researching the chemical literature, reading, and writing an academic research paper on a chemical topic. One-third of the course focuses on disciplined inquiry leading to self-discovery and self-knowledge. Courses contain frequent reading and writing assignments. 150 minutes of lecture/discussion. This course must be completed before enrolling in CHEM 4908. This course satisfies the SELF and GEAR requirements of the CSUB GE Program. Prerequisite: At least 90 units, completion of area A2, and a grade of C or better in CHEM 2900, and CHEM 3600, and one of the following: CHEM 3110 or CHEM 3310 or CHEM 4200.

Requisite(s): Prerequisites: At least 90 units, completion of area GE A2, and a grade of C or better in CHEM 2900, and CHEM 3600, and one of the following: CHEM 3110 or CHEM 3310 or CHEM 4200.

General Education Attribute(s): GEAR and SELF

CHEM 3948 Seminar in Biochemical Literature (3) 

Students will develop expository and argumentative reading and writing skills for different rhetorical contexts, including researching the chemical literature, reading, and writing an academic research paper on a chemical topic. One-third of the course focuses on disciplined inquiry leading to self-discovery and self-knowledge. Courses contain frequent reading and writing assignments. 150 minutes of lecture/discussion. This course must be completed before enrolling in CHEM 4908. This course satisfies the SELF and GEAR requirements of the CSUB GE Program. Prerequisite: At least 90 units, completion of area A2, and a grade of C or better in CHEM 2900, and CHEM 3600, and one of the following: CHEM 3110 or CHEM 3310 or CHEM 4200.

Requisite(s): Prerequisite: At least 90 units, completion of area A2, and a grade of C or better in CHEM 2940, and CHEM 3400, and one of the following: CHEM 3110 or CHEM 3310 or CHEM 3500.

General Education Attribute(s): GEAR and SELF

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: A grade of C or better in CHEM 3300 or consent of instructor. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 3300 or consent of instructor.

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: A grade of C or better in CHEM 2900 and CHEM 3300 or consent of instructor. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 2900 and CHEM 3300 or consent of instructor

CHEM 4100 Chemical Separations (1)

Principles of modern instrumental analysis methods including gas chromatography, HPLC, and mass spectrometry. Prerequisite: A grade of C or better in CHEM 1600 and CHEM 3300 and CHEM 3301. 50 minutes of lecture/discussion per week per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 1600 and CHEM 3300 and CHEM 3301.

CHEM 4101 Chemical Separations Laboratory (1)

Techniques of modern instrumental analysis methods including gas chromatography, HPLC, and mass spectrometry. Prerequisite: A grade of C or better in CHEM 3300 and CHEM 3301. Prerequisite or corequisite: CHEM 4100. 150 minutes of laboratory per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 3300 and CHEM 3301. Prerequisite/Corequisite: CHEM 4100.

Course Fee: Yes

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: A grade of C or better in CHEM 3300. 50 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 3300 or consent of instructor.

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: A grade of C or better in CHEM 3300. 50 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 3300 or consent of instructor.

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. Prerequisite or corequisite: A grade of C or better in CHEM 3301 and CHEM 4110 and CHEM 4120. 150 minutes of laboratory per week.

Requisite(s): Prerequisite/Corequisite: A grade of C or better in CHEM 3301 and CHEM 4110 and CHEM 4120.

Typically Offered: Spring

Course Fee: Yes

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: A grade of C or better in CHEM 2200 or CHEM 2240, CHEM 3300 and CHEM 3301 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 2200 or CHEM 2240, CHEM 3300, and CHEM 3301 or consent of instructor.

Course Fee: Yes

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: A grade of C or better in CHEM 3300, CHEM 3301, and CHEM 3400. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 3300, CHEM 3301, and CHEM 3400.

Course Fee: Yes

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: A grade of C or better in CHEM 3400. Corequisite for Biochemistry majors: CHEM 4401. 100 minutes of lecture.

Requisite(s): Prerequisite: A grade of C or better in CHEM 3400.

Corequisite for Biochemistry Majors: CHEM 4401

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. Prerequisite or corequisite: CHEM 4400. 300 minutes of laboratory per week.

Requisite(s): Prerequisite/Corequisite: CHEM 4400 (C).

Typically Offered: Fall, Spring

Course Fee: Yes

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: A grade of C or better in CHEM 3400 or approval of instructor. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 3400 or approval of instructor

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: A grade of C or better in CHEM 3400. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 3400.

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: A grade of C or better in CHEM 3300 and CHEM 3301. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

Requisite(s): Prerequisites: A grade of C or better in CHEM 3300 and CHEM 3301.

Course Fee: Yes

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: A grade of C or better in CHEM 3300. 100 minutes of lecture/discussion per week.

Requisite(s): Prerequisite: A grade of C or better in CHEM 3300.

Typically Offered: Spring

CHEM 4700 Special Topics in Chemistry (1-3)

Topics and prerequisites to be announced. May be repeated for credit with different topics up to a maximum of 9 units. Nine units may go towards the UD major electives with permission of department.

Repeatable for Credit: Yes, up to 9 units

CHEM 4800 Honors Research (1-3)

Individual study on a current research problem with faculty supervision, preparation of a final report and a presentation. Course may be repeated 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 non-major upper division elective credit. Prerequisite: CHEM 1001 and invitation by faculty.

Requisite(s): Prerequisite: CHEM 1001 and invitation by faculty.

Repeatable for Credit: Yes, up to 9 units

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. Prerequisite: Approval by faculty. May be repeated for credit up to a maximum of 3 units; 3 units may go towards UD major electives with permission of department.

Repeatable for Credit: Yes, up to 3 units

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. Offered on a credit, no-credit basis only. Interested students should contact the department office. Prerequisite: A grade of C or better in CHEM 2940 or permission of instructor. Units cannot be applied as elective units to the major. May be repeated for credit up to a maximum of 12 units with permission of the instructor.

Requisite(s): Prerequisite: A grade of C or better in CHEM 2940 or permission of instructor.

Repeatable for Credit: Yes, up to 12 units

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. May be repeated for credit up to a maximum of 9 units; 3 units may go towards UD major elective with permission of department.

Repeatable for Credit: Yes, up to 9 units

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 semester in advance with the department.) Offered on a credit, no-credit basis only. Units cannot be applied as elective units to the major. May be repeated up to a maximum of 9 units.

Repeatable for Credit: Yes, up to 9 units

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 semesters. 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. May be repeated up to a maximum of 9 units.

Requisite(s): Prerequisite: sophomore standing or higher.

Repeatable for Credit: Yes, up to 9 units

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. Available by petition only, on a credit, no-credit basis. Not open to postgraduate students. Interested students should contact the department office. May be repeated up to a maximum of 9 units; 9 units may go towards UD elective credit with permission of department.

Repeatable for Credit: Yes, up to 9 units

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: At least 90 units and completion of JYDR; a grade of C or better in CHEM 3900 or CHEM 3940 or CHEM 3908 or CHEM 3948; and a major or minor in chemistry. Satisfies general education requirement Senior Capstone.

Requisite(s): Prerequisite: At least 90 units and completion of JYDR; a grade of C or better in CHEM 3900 or CHEM 3940 or CHEM 3908 or CHEM 3948; and a major or minor in chemistry.

General Education Attribute(s): Capstone

Typically Offered: Fall, Spring

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: at least 90 units and completion of JYDR; a grade of C or better in CHEM 3900 or CHEM 3940 or CHEM 3908 or CHEM 3948; and a major in biochemistry or minor in chemistry. Satisfies general education requirement Senior Capstone.

Requisite(s): Prerequisite: At least 90 units and completion of JYDR; a grade of C or better in CHEM 3900 or CHEM 3940 or CHEM 3908 or CHEM 3948; and a major or minor in chemistry.

General Education Attribute(s): Capstone

Typically Offered: Fall, Spring