

CHEMISTRY (CHEM)

CHEM-COMP Senior Comprehensive Exam (NULL credits) (Both Fall & Spring Semesters)

Senior Comprehensive (cr)

CHEM-1010 Chemistry of the Biosphere (4 credits) (Discretion of Department)

Chemistry of the Biosphere (3) (D) This course is intended for students not majoring in the natural sciences or mathematics and is designed especially for students with no previous formal experience in chemistry. Emphasis is placed on the chemistry of the environment and humanity's impact on it. The course includes laboratory experience. Students must also take and successfully complete CHEM-1011 to fulfill the general education requirements. (NW, SM)

Corequisite(s): CHEM-1011.

General Education Categories: Understanding the Natural World

CHEM-1011 Chemistry of the Biosphere Laboratory (1 credit) (Discretion of Department)

Chemistry of the Biosphere Laboratory (1) (D) This laboratory course is designed to develop basic laboratory techniques and principles for students not majoring in the natural sciences or mathematics. Students must also take and successfully complete CHEM-1010 to fulfill the general education requirements. (NW, SM)

Corequisite(s): CHEM-1010.

General Education Categories: Scientific Method

CHEM-1200 General Chemistry I Lecture (3 credits) (Both Fall & Spring Semesters)

General Chemistry I (3) (B) This course is a thorough study of the fundamental principles of chemistry. Emphasis is placed on atomic structure, gas laws, energy changes, reaction stoichiometry, and electronic structure of atoms. Strong algebra skills will be necessary for successful completion of this course. Students must also take and successfully complete CHEM-1201 to fulfill the general education requirements. Co-requisite: CHEM-1201. (NW, SM)

General Education Categories: Understanding the Natural World

CHEM-1201 General Chemistry I Laboratory (1 credit) (Both Fall & Spring Semesters)

General Chemistry I Laboratory (1) (B) This laboratory course is designed to develop basic laboratory techniques and to complement the material covered in CHEM-1200. Students must also take and successfully complete CHEM-1200 to fulfill the general education requirements. (NW, SM)

Corequisite(s): CHEM-1200.

General Education Categories: Scientific Method

CHEM-1210 General Chemistry II Lecture (3 credits) (Spring Semester)

General Chemistry II (3) (S) This course is a continuation of CHEM-1200, with major emphasis placed on gas phase and solution equilibria, kinetics and the mechanisms of chemical reactions, thermodynamics and electrochemistry. Students must also take and successfully complete CHEM-1211 to fulfill the general education requirement. Co-requisite: CHEM-1211. (NW)

Prerequisite(s): CHEM-1201.

General Education Categories: Understanding the Natural World

CHEM-1211 General Chemistry II Lab (1 credit) (Spring Semester)

General Chemistry II Laboratory (1) (S) This laboratory course is designed to develop basic laboratory techniques and complement the material covered in CHEM-1210. Students must also take and successfully complete CHEM-1210 to fulfill the general education requirement. Co-requisite: CHEM-1210. (NW)

CHEM-2200 Organic Chemistry I Lecture (3 credits) (Fall Semester)

Organic Chemistry I (3) (F) This course represents the first semester of a year-long course and is designed to give the student an understanding of many fundamental concepts of organic chemistry. The student will gain an understanding of how compounds are synthesized, the mechanism of reaction and the accepted nomenclature through the study of alkanes and cycloalkanes, alkenes, alkynes and alkyl halides. Stereochemistry and the use of spectroscopy to identify compounds will also be covered.

Prerequisite(s): CHEM-1210.

Corequisite(s): CHEM-2201.

CHEM-2201 Organic Chemistry I Lab (1 credit) (Fall Semester)

Organic Chemistry I Laboratory (1) (F) This laboratory course is designed to develop skills in the basic techniques of organic chemistry. Students will gain experience in the purification of compounds using basic techniques, including extraction, distillation, recrystallization, and thin-layer chromatography. Students will learn to interpret NMR and IR spectra, to identify unknown samples, and to communicate scientific results in a professional manner.

Corequisite(s): CHEM-2200.

CHEM-2210 Organic Chemistry II Lecture (3 credits) (Spring Semester)

Organic Chemistry II (3) (S) This is a continuation of CHEM-2200. It represents the second semester of a year-long course. The student will gain an understanding of how compounds are synthesized, the mechanism of reaction, and the accepted nomenclature as we study the following types of organic compounds: alcohols, ethers, aldehydes, ketones, aromatic compounds, amines, and carboxylic acids and their derivatives.

Prerequisite(s): CHEM-2200.

Corequisite(s): CHEM-2211.

CHEM-2211 Organic Chem II Lab (1 credit) (Spring Semester)

Organic Chemistry II Laboratory (1) (S) This laboratory course involves the synthesis of organic compounds, the characterization of synthetic products using spectroscopic analysis, and the development of an understanding of the techniques and design strategies applied in the field of synthetic organic chemistry.

Prerequisite(s): CHEM-2201.

Corequisite(s): CHEM-2210.

CHEM-2801 Intro to Chemistry/Biochemistry Research (1 credit) (Fall Semester)

Introduction to Chemistry/Biochemistry Research (1) (F) This course provides an opportunity for students to engage in research as a freshman or sophomore. Students will be introduced to hands-on chemical or biochemical research in collaboration with a faculty member. Training in experimental laboratory technique, record keeping, data analysis, and an introduction to the use of scientific literature will be provided. This course may be taken up to four times. It does not count towards the chemistry minor.

Prerequisite(s): Freshman or sophomore standing.

**CHEM-2811 Intro to Chemistry/Biochemistry Research
(1 credit) (Spring Semester)**

Introduction to Chemistry/Biochemistry Research (1) (S) This course provides an opportunity for students to engage in research as a freshman or sophomore. Students will be introduced to hands-on chemical or biochemical research in collaboration with a faculty member. Training in experimental laboratory technique, record keeping, data analysis, and an introduction to the use of scientific literature will be provided. This course may be taken up to four times. It does not count towards the chemistry minor

Prerequisite(s): Freshman or sophomore standing.

**CHEM-3050 Scientific Glassblowing
(2 credits) (Infrequently)**

Scientific Glassblowing (2) (I) This course examines the principles and theory associated with glassblowing. It provides the student with a working knowledge of common glassblowing techniques, with emphasis on those appropriate to the repair and production of scientific glassware. The student will have hands-on experience with glassblowing. Permission of instructor required. Note: This course does not fulfill any requirements for a major or minor in chemistry.

**CHEM-3150 Computational Chemistry
(3 credits) (Discretion of Department)**

Computational Chemistry (3) (D) This course provides an introduction to the methods and applications of computational chemistry. Topics include molecular mechanics, Hartree-Fock theory, semi-empirical methods, density functional theory, basis sets, geometry optimization, transition state searches, and molecular property calculations. Hands-on exercises and projects accompany the lectures.

Prerequisite(s): CHEM-1210, MATH-1350, and PHYS-2110 or permission of the instructor.

**CHEM-3250 Environmental Chemistry
(3 credits) (Discretion of Department)**

Environmental Chemistry (3) (D) The goal of this course is to introduce the student to the fundamental chemical principles of the environment. Special care will be placed on important reactions that affect the atmosphere, the hydrosphere, and the lithosphere. The contribution of industrial effluents will be evaluated on the basis of their local and global impact.

Prerequisite(s): CHEM-2200.

**CHEM-3300 Quantitative Analysis
(3 credits) (Fall Semester)**

Quantitative Analysis (3) (F) The student will develop an in-depth knowledge of basic statistics, gravimetric and volumetric analyses, chemical equilibrium, acid-base chemistry, and spectrophotometry. In particular, advantage will be taken of an understanding of the processes underlying chemical equilibria to achieve quantitative analysis. Emphasis will be placed on using Excel spreadsheets for data analyses, including statistics.

Prerequisite(s): CHEM-1210, CHEM-1211, Corequisite: CHEM-3301.

**CHEM-3301 Quantitative Analysis Laboratory
(1 credit) (Fall Semester)**

Quantitative Analysis Laboratory (1) (S) The student will learn and use the basic wet chemistry techniques of volumetric and gravimetric analysis. Hands-on introduction to spectroscopy experimentation and analysis is included.

Corequisite(s): CHEM-3300.

**CHEM-3311 Instrumental Analysis Laboratory
(1 credit) (Spring Semester)**

Instrumental Analysis Laboratory (1) (S) The student will gain hands-on introduction to spectroscopy and chromatography experimentation with chemistry instruments. Experiments will be conducted using atomic absorption, gas chromatography, HPLC, mass spectroscopy, NMR, FTIR, and electrochemistry instrumentation.

Prerequisite(s): CHEM-3300, CHEM-3301.

**CHEM-3400 Inorganic Chemistry
(3 credits) (Spring Semester)**

Inorganic Chemistry (3) (S) A modern study of bonding, structure and mechanism of reactions of inorganic compounds. Thermodynamics, kinetics, and theory of structure and bonding are unifying concepts to examine trends in reactivity, structure, and properties of the elements and their compounds in relation to their position in the periodic table. These periodic trends will provide a foundation for an initial understanding of inorganic chemistry. The applications of inorganic chemistry to material science, the environment, biology and medicine will be explored.

Prerequisite(s): CHEM-2210, CHEM-2211.

**CHEM-3401 Inorganic Chemistry Laboratory
(1 credit) (Spring Semester)**

Inorganic Chemistry Laboratory (1) (S) This course will provide practical experience in the synthesis and characterization of inorganic molecules. Students will perform multi-step syntheses using modern synthetic techniques. A variety of chemical and spectroscopic characterization methods will be used.

**CHEM-3500 Biochemistry I
(3 credits) (Fall Semester)**

Biochemistry I (3) (F) This course is designed to meet the needs of majors and pre-health professionals through the introduction of the structure and function of the major biochemical classes, biocatalysis, biological membranes and biosignaling, metabolism, and metabolic and hormonal regulation. Co-requisite: CHEM-3501.

Prerequisite(s): CHEM-2210, CHEM-2211.

**CHEM-3501 Biochemistry I Laboratory
(1 credit) (Fall Semester)**

Biochemistry I Laboratory (1) (F) In this course, students will gain experience in wet laboratory and in silico computational experimental techniques, as well as computerized data reduction and analysis. Students will become familiar with initial rate determination of Michaelis constants and characterization of reversible and irreversible inhibition. Further, students will gain hands-on experience in modeling enzyme-ligand bonding and structure-based drug design. Note: All Chemistry and Biochemistry majors need to take this lab as a coreq for CHEM-3500.

**CHEM-3510 Biochemistry II
(3 credits) (Spring Semester)**

Biochemistry II (3) (S) This course is a continuation of CHEM-3500 and introduces the fundamentals of molecular biological DNA information technologies, bioenergetics, the catabolism and anabolism of fatty acids, amino acids and nucleic acids, gene and chromosome structure, and genetic and epigenetic gene expression. Note: All Chemistry and Biochemistry majors need to take this lab as a corequisite.

Prerequisite(s): CHEM-3500.

CHEM-3511 Biochemistry II Laboratory**(1 credit) (Spring Semester)**

Biochemistry II Laboratory (1) (S) This course provides advanced skills in biochemical problem solving via scientific literature searches, experimental design and execution, data acquisition and analysis, composition of professional scientific reports, and oral presentation. Experimental techniques may include protein and DNA purification, enzyme assay, protein characterization, chromatography and electrophoresis. Experience operating instruments typically includes spectrophotometers, electrophoresis equipment, thermal cyclers, fraction collectors, and plate readers. (WC)

Prerequisite(s): CHEM-3500 and CHEM-3501.

General Education Categories: Written Communication

CHEM-3650 Polymer Chemistry**(3 credits) (Discretion of Department)**

Polymer Chemistry (3) (D) This course deals with the design, preparation, and properties of macromolecules. Upon successful completion of this course, students will understand various methods of polymer synthesis, including step-growth polymerization and chain-growth polymerization. Students will understand the mechanism of polymer formation, reactions of polymers and the physical properties of various polymers.

Prerequisite(s): CHEM-2210.

CHEM-3800 Physical Chemistry I**(3 credits) (Spring Semester)**

Physical Chemistry I (3) (S) This course is an introduction to thermodynamics and chemical kinetics. Topics include gas laws, temperature, heat, work, the Laws of Thermodynamics, phase diagrams, chemical equilibria, rate laws, elementary reactions and reaction mechanisms. Co-requisite: CHEM-3801.

Prerequisite(s): CHEM-1210, CHEM-1211, MATH-1350, and PHYS-2110.

CHEM-3801 Physical Chemistry I Laboratory**(1 credit) (Spring Semester)**

Physical Chemistry I Laboratory (1) (S) This course provides students with hands-on laboratory experience exploring concepts introduced in CHEM 380. Experiments exemplify the Laws of Thermodynamics and properties of materials. Students perform professional scientific reporting and data analysis, conduct a search of the relevant scientific literature, and employ scientific instrumentation for data collection.

Corequisite(s): CHEM-3800.

CHEM-3980 Special Topics**(3 credits) (Discretion of Department)**

Special Topics Advanced topics not included in the regular catalog, usually treated in a lecture/discussion format. May be taken more than once if subject matter varies sufficiently.

CHEM-4200 Physical Chemistry II**(3 credits) (Fall Semester)**

Physical Chemistry II (3) (F) The nature of atoms and molecules, chemical bonding, molecular structure, and the link between molecular properties and bulk thermodynamic properties of matter are investigated via the fundamental concepts of quantum mechanics and statistical mechanics. Co-requisite: CHEM-4201.

Prerequisite(s): CHEM-1210, CHEM-1211, MATH-1350, PHYS-2110.

CHEM-4201 Physical Chemistry II Laboratory**(1 credit) (Fall Semester)**

Physical Chemistry II Laboratory (1) (F) This course will provide students with hands-on laboratory experience exploring concepts introduced in CHEM-4200. Experiments involve atomic absorption spectroscopy, gas-phase rotational vibration spectroscopy, and electronic spectroscopy. Students perform professional scientific reporting and data analysis, conduct a search of the relevant scientific literature, and employ scientific instrumentation for data collection.

Corequisite(s): CHEM-4200.

CHEM-4350 Advanced Organic Chemistry I**(3 credits) (Discretion of Department)**

Advanced Organic Chemistry I (3) (D) This course (subtitled Structure and Mechanism) is intended to build on, organize and interrelate the factual information obtained in the introductory sophomore course and serves as a basis for the study in greater depth of individual organic reactions and of the methods by which chemists obtain information about chemical processes. Includes an in-depth study of the mechanisms of major organic reactions. Focus on substitution, addition, elimination, radical, and pericyclic mechanisms.

Prerequisite(s): CHEM-2210.

CHEM-4450 Topics in Biochemistry**(3 credits) (Fall Semester)**

Topics in Biochemistry (3) (F) In this course, topics relevant to modern biochemistry and molecular biology are explored utilizing concepts and terminology studied in Biochemistry I. Topics include mechanisms of catalysis in cells, derivations of rate equations, pH-rate profiles, as well as advances in the biochemistry of cells, including cell function, cellular regulation & signaling, DNA and RNA replication, energy utilization, and cancer. Note: All Biochemistry majors must take CHEM-4475 as a coreq.

Prerequisite(s): CHEM-3510 or BIOL-4475.

CHEM-4451 Topics in Biochemistry Laboratory**(1 credit) (Fall Semester)**

Topics in Biochemistry Laboratory (1) (F) This course will introduce students to advanced biochemistry lab skills including protein and DNA purification, enzyme assays, protein characterization, electrophoresis, and chromatography in the further investigation of topics covered in CHEM-4550. Equipment operation can include spectrophotometers, thermocyclers, fraction collectors, plate readers, and electrophoresis units. Co-requisite: CHEM-4450.

Prerequisite(s): CHEM-3500, CHEM-3501.

CHEM-4457 Methods of Teaching Secondary Science**(2 credits) (Spring Semester)**

Methods of Teaching Secondary Science (2) (S) This course acquaints the student with special techniques, current technologies in teaching strategies, and devices for teaching the natural sciences and evaluating student progress in the classroom and laboratory. Students demonstrate an understanding of concepts and practices of engineering, technology, and the application of science that can be used in developing instruction for students in the chemistry classroom. Content also includes the planning and presentation of laboratory work and material; the use and maintenance of equipment; and the selection and purchase of laboratory supplies. Some consideration will be given to the journals, handbooks, and other technical literature useful in teaching science.

CHEM-4650 Organometallic Chemistry**(3 credits) (Discretion of Department)**

Organometallic Chemistry (3) (D) This course is an examination of the basic foundations of organometallic chemistry including symmetry methods, bonding, magnetism, and reaction mechanisms.

Prerequisite(s): CHEM-2210.

CHEM-4801 Research I**(1 credit) (Both Fall & Spring Semesters)**

Research I (1) (F) This course is an independent or collaborative investigation of a problem in any of the areas of chemistry or biochemistry. Minimum of five hours laboratory work and consultation per week. Students will conduct a comprehensive literature search and submit a research proposal. Recommended for all junior and senior majors. This course is by permission of the instructor only.

CHEM-4802 Research I**(1 credit) (Both Fall & Spring Semesters)**

Research I (1) (F) This course is an independent or collaborative investigation of a problem in any of the areas of chemistry or biochemistry. Minimum of five hours laboratory work and consultation per week. Students will conduct a comprehensive literature search and submit a research proposal. Recommended for all junior and senior majors. This course is by permission of the instructor only.

CHEM-4803 Research I**(1 credit) (Both Fall & Spring Semesters)**

Research I (1) (F) This course is an independent or collaborative investigation of a problem in any of the areas of chemistry or biochemistry. Minimum of five hours laboratory work and consultation per week. Students will conduct a comprehensive literature search and submit a research proposal. Recommended for all junior and senior majors. This course is by permission of the instructor only.

CHEM-4811 Research II**(1 credit) (Both Fall & Spring Semesters)**

Research II (1) (S) This course involves independent or collaborative investigation of a problem in any of the areas of chemistry or biochemistry with a minimum of eight hours laboratory work and consultation per week. Students will prepare a comprehensive, well-documented research report at the end of the semester. Recommended for all junior and senior majors.

Prerequisite(s): CHEM-4801, which must be completed in the preceding semester, and with permission of the instructor.

CHEM-4812 Research II**(1 credit) (Both Fall & Spring Semesters)**

Research II (1) (S) This course involves independent or collaborative investigation of a problem in any of the areas of chemistry or biochemistry with a minimum of eight hours laboratory work and consultation per week. Students will prepare a comprehensive, well-documented research report at the end of the semester. Recommended for all junior and senior majors.

Prerequisite(s): CHEM-4802, which must be completed in the preceding semester, and with permission of the instructor.

CHEM-4813 Research II**(1 credit) (Both Fall & Spring Semesters)**

Research II (1) (S) This course involves independent or collaborative investigation of a problem in any of the areas of chemistry or biochemistry with a minimum of eight hours laboratory work and consultation per week. Students will prepare a comprehensive, well-documented research report at the end of the semester. Recommended for all junior and senior majors.

Prerequisite(s): CHEM-4803, which must be completed in the preceding semester, and with permission of the instructor.

CHEM-4900 Chemistry & Biochem Colloquium**(1 credit) (Both Fall & Spring Semesters)**

Chemistry and Biochemistry Colloquium (1) (B) Weekly meetings at which recent developments in chemistry and biochemistry will be presented by staff, students, and guest lecturers. Students enrolled in this course are expected to attend all presentations to receive credit. In-class training will include the topics of résumé writing, oral-visual presentations, ethics in science, and other subjects. All seniors must take CHEM-4903 and give an approved oral presentation to peers and faculty during the scheduled Colloquium time in order to satisfy graduation requirements for oral and visual communication. Four semesters are required of all Chemistry and Biochemistry majors. (for CHEM-4903 only OC, VC)

CHEM-4901 Chem & Biochem Colloquium 2**(1 credit) (Both Fall & Spring Semesters)**

Chemistry and Biochemistry Colloquium (1) (B) Weekly meetings at which recent developments in chemistry and biochemistry will be presented by staff, students, and guest lecturers. Students enrolled in this course are expected to attend all presentations to receive credit. In-class training will include the topics of résumé writing, oral-visual presentations, ethics in science, and other subjects. All seniors must take CHEM-4903 and give an approved oral presentation to peers and faculty during the scheduled Colloquium time in order to satisfy graduation requirements for oral and visual communication. Four semesters are required of all Chemistry and Biochemistry majors. (for CHEM-4903 only OC, VC)

CHEM-4902 Chem & Biochem Colloquium 3**(1 credit) (Both Fall & Spring Semesters)**

Chemistry and Biochemistry Colloquium (1) (B) Weekly meetings at which recent developments in chemistry and biochemistry will be presented by staff, students, and guest lecturers. Students enrolled in this course are expected to attend all presentations to receive credit. In-class training will include the topics of résumé writing, oral-visual presentations, ethics in science, and other subjects. All seniors must take CHEM-4903 and give an approved oral presentation to peers and faculty during the scheduled Colloquium time in order to satisfy graduation requirements for oral and visual communication. Four semesters are required of all Chemistry and Biochemistry majors. (for CHEM-4903 only OC, VC)

CHEM-4903 Chem & Biochem Colloquium 4**(1 credit) (Both Fall & Spring Semesters)**

Chemistry and Biochemistry Colloquium (1) (B) Weekly meetings at which recent developments in chemistry and biochemistry will be presented by staff, students, and guest lecturers. Students enrolled in this course are expected to attend all presentations to receive credit. In-class training will include the topics of résumé writing, oral-visual presentations, ethics in science, and other subjects. All seniors must take CHEM-4903 and give an approved oral presentation to peers and faculty during the scheduled Colloquium time in order to satisfy graduation requirements for oral and visual communication. Four semesters are required of all Chemistry and Biochemistry majors. (for CHEM-4903 only VC)

General Education Categories: Oral Communication, Visual Communication

CHEM-4980 Special Topics**(4 credits) (Discretion of Department)**

Special Topics Advanced topics not included in the regular catalog, usually treated in a lecture/discussion format. May be taken more than once if subject matter varies sufficiently.