Chemistry

Overview

Chemistry is the study of the properties, composition, and transformations of all material substances. It is often called the "central science" since it draws from mathematics and physics and forms a necessary background to the study of all the earth sciences and all the biological disciplines, including the various medical professions. Sacramento City College chemistry courses are designed to meet the lower division requirements for a major in chemistry in transferring to a four-year institution. For students who plan to transfer, completion of the CSU General-Breadth or IGETC general education pattern is encouraged. It is highly recommended that students meet with a counselor because major and general education requirements vary for each college/university. These courses also fulfill general education requirements for allied health, biological sciences, physical sciences, computer science, and engineering.

The Chemical Technology Program trains students for a wide variety of scientific laboratory technician career opportunities. Students not only will be instructed in the theory and fundamentals of chemistry, but they will also be exposed to hands-on training with lab equipment and sophisticated state-of-the-art lab instrumentation. Students will be taught how to perform standard laboratory techniques, how to follow safety procedures, and how to prepare clear, thorough lab reports.

Throughout the program there will be emphasis on clear written communication and correct mathematical calculations. Students will be challenged to strengthen problem-solving and critical-thinking skills. They also will have opportunities to develop effective verbal communication, and to use software commonly employed in scientific labs.

Career Options

Chemists work as pharmaceutical or environmental chemists, educators, medical researchers, quality assurance and general scientists, and pharmacists. The preparation received in chemistry is an excellent background for careers in medicine, dentistry, engineering, the biological sciences, earth sciences, environmental studies, and science education.

There are several Career Opportunities for students earning a Chemistry Technician Certificate. These include: Winery Analysis Technician, Forensic Science Technician, Chemical Plant Technician, Chemical Instrument Specialist, Environmental Science, and Protection Specialist. With salaries on average of over $23.00 an hour.

*U.S. Bureau of Labor Statistics

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Associate Degrees

A.S. in Chemical Technology

The Chemical Technology Program trains students for a wide variety of scientific laboratory technician career opportunities. Students not only will be instructed in the theory and fundamentals of chemistry, but they will also be exposed to hands-on training with lab equipment and sophisticated state-of-the-art lab instrumentation. Students will be taught how to perform standard laboratory techniques, how to follow safety procedures, and how to prepare clear, thorough lab reports.

Throughout the program there will be emphasis on clear written communication and correct mathematical calculations. Students will be challenged to strengthen problem-solving and critical-thinking skills. They also will have opportunities to develop effective verbal communication and to use software commonly employed in scientific labs.

A student who satisfactorily completes the program will be awarded a Certificate of Achievement. Students who complete the program may also qualify for an Associate in Science degree by fulfilling the Graduation Requirements specified in this catalog.

Catalog Date: June 1, 2020

Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
CHEM 400	General Chemistry I	5
CHEM 401	General Chemistry II	5
CHEM 410	Quantitative Analysis	5[1]
CHEM 420	Organic Chemistry I (5)	4 - 5
or CHEM 425	Organic Chemistry with Biological Emphasis I (4)	
CHEM 421	Organic Chemistry II (5)	4 - 5
or CHEM 426	Organic Chemistry with Biological Emphasis II (4)	
A minimum of 3 units from the following:		3[2]
BUS 310	Business Communications (3)	
ENGWR 488	Honors College Composition and Research (4)	
or ENGWR 300	College Composition (3)	
ENGWR 301	College Composition and Literature (3)	
ENGWR 482	Honors Advanced Composition and Critical Thinking (3)	
or ENGWR 302	Advanced Composition and Critical Thinking (3)	
ESLW 340	Advanced Composition (4)	

COURSE CODE	COURSE TITLE	UNITS
Total Units:		**26 - 28**

[1]Offered in spring only.

[2]This corresponds to the General Education Area II English Composition requirement.

The Chemical Technology Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See SCC graduation requirements.

Enrollment Eligibility

To be eligible for enrollment in the program, the student must meet the following criteria:

- Students must complete high school intermediate algebra or MATH 120 or its equivalent with a grade of "C" or better.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- apply problem-solving and analytical thinking skills in the planning, execution, and interpretation of chemistry lab work.
- correctly use common chemistry laboratory instruments to process materials and/or collect data.
- demonstrate oral and written communication skills necessary to report and discuss chemistry laboratory processes with other scientifically trained personnel.
- demonstrate an understanding of safety practices, including proper chemical waste disposal procedures.

Career Information

Employment data indicates that there are a large number of science lab technicians employed in this region. Students who complete the Chemical Technology Program may work in environmental monitoring and pollution analysis, materials testing, medical testing, or quality control. They may work in laboratories supporting manufacturing, agriculture, medical research, the petrochemical industry, or government agencies.

A.S. in Chemistry

Chemistry is the study of the properties, composition, and transformations of all material substances. It is often called the “central science” since it draws from mathematics and physics and forms a necessary background to the study of all the earth sciences and all the biological disciplines, including the various medical professions. Sacramento City College chemistry courses are designed to meet the lower division requirements for a major in chemistry in transferring to a four-year institution. For students who plan to transfer, completion of the CSU General-Breadth or IGETC general education pattern is encouraged. It is highly recommended that students meet with a counselor because major and general education requirements vary for each college/university. These courses also fulfill general education requirements for allied health, biological sciences, physical sciences, computer science, and engineering.

Catalog Date: June 1, 2020

Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
CHEM 400	General Chemistry I	5
CHEM 401	General Chemistry II	5
[CHEM 420	Organic Chemistry I (5)	8 - 10
and CHEM 421]	Organic Chemistry II (5)	
or [CHEM 425	Organic Chemistry with Biological Emphasis I (4)	
and CHEM 426]	Organic Chemistry with Biological Emphasis II (4)	
Total Units:		**18 - 20**

The Chemistry Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See SCC graduation requirements.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- understand the language and nomenclature of chemistry.
- utilize problem solving strategies involving data collection, dimensional analysis, interpretation, and drawing reasonable conclusions from data.
- demonstrate basic chemical laboratory skills.
- operate a variety of modern chemical instruments and accurately interpret spectral and chromatographic data.
- understand and apply fundamental chemical principles.

Career Information

Chemists work as pharmaceutical or environmental chemists, educators, medical researchers, quality assurance and general scientists, and pharmacists. The preparation received in chemistry is excellent background for careers in medicine, dentistry, engineering, the biological sciences, earth sciences, environmental studies, and science education.

Certificate of Achievement

Chemical Technology Certificate

The Chemical Technology Program trains students for a wide variety of scientific laboratory technician career opportunities. Students not only will be instructed in the theory and fundamentals of chemistry, but they will also be exposed to hands-on training with lab equipment and sophisticated state-of-the-art lab instrumentation. Students will be taught how to follow safety procedures, how to perform standard laboratory techniques, and how to prepare clear, thorough lab reports.

Throughout the program there will be emphasis on clear written communication and correct mathematical calculations. Students will be challenged to strengthen problem-solving and critical-thinking skills. They also will have opportunities to develop effective verbal communication and to use software commonly employed in scientific labs.

A student who satisfactorily completes the program will be awarded a Certificate of Achievement. Students who complete the program may also qualify for an Associate in Science degree by fulfilling the Graduation Requirements specified in this catalog.

Catalog Date: June 1, 2020

Certificate Requirements

COURSE CODE	COURSE TITLE	UNITS
CHEM 400	General Chemistry I	5
CHEM 401	General Chemistry II	5
CHEM 410	Quantitative Analysis	5[1]
CHEM 420	Organic Chemistry I (5)	4 - 5
or CHEM 425	Organic Chemistry with Biological Emphasis I (4)	
CHEM 421	Organic Chemistry II (5)	4 - 5
or CHEM 426	Organic Chemistry with Biological Emphasis II (4)	
A minimum of 3 units from the following:		3[2]
BUS 310	Business Communications (3)	
ENGWR 488	Honors College Composition and Research (4)	
or ENGWR 300	College Composition (3)	
ENGWR 301	College Composition and Literature (3)	
ENGWR 482	Honors Advanced Composition and Critical Thinking (3)	
or ENGWR 302	Advanced Composition and Critical Thinking (3)	
ESLW 340	Advanced Composition (4)	
Total Units:		**26 - 28**

[1]Offered in spring only.

[2]This requirement is to ensure that recipients of the Chemical Technology Certificate of Achievements have writing skills.

Enrollment Eligibility

To be eligible for enrollment in the program, the student must meet the following criteria:

- Students must complete high school intermediate algebra or MATH 120 or its equivalent with a grade of "C" or better.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- apply problem-solving and analytical thinking skills in the planning, execution, and interpretation of chemistry lab work.
- correctly use common chemistry laboratory instruments to process materials and/or collect data.
- demonstrate oral and written communication skills necessary to report and discuss chemistry laboratory processes with other scientifically trained personnel.
- demonstrate an understanding of safety practices, including proper chemical waste disposal procedures.

Career Information

Employment data indicates that there are a large number of science lab technicians employed in this region. Students who complete the Chemical Technology Program may work in environmental monitoring and pollution analysis, materials testing, medical testing, or quality control. They may work in laboratories supporting manufacturing, agriculture, medical research, the petrochemical industry, or government agencies.

Chemical Technology (CHEMT) Courses

CHEMT 201 Careers in Chemical Technology

Units: 1.5
Hours: 27 hours LEC
Prerequisite: None.
Advisory: ENGWR 300 with a grade of "C" or better
Catalog Date: June 1, 2020

This course provides the student with information needed to determine if chemical technology is a suitable career option. Definitions of chemical technology, history and development of the profession, and the diverse types of laboratory practice and employment settings are explored. Professional activities, requirements, ethics, and behaviors are also discussed. Students observe examples of chemical technology practice through field trips, videos, guestspeaker presentations, and/or use of online media resources. Attending a minimum of one field trip is required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- define chemical technology practice.
- describe the history and development of the field of chemical technology, including current trends.
- compare and contrast the diverse types of laboratory practice and employment settings within the field of chemical technology.

CHEMT 202 Chemical Technology Seminar

Units: 0.5
Hours: 9 hours LEC
Prerequisite: CHEMT 201 with a grade of "C" or better
Advisory: ENGWR 300 with a grade of "C" or better
Catalog Date: June 1, 2020

This course provides the student with more in-depth information needed to determine if chemical technology is a suitable career option. Students observe examples of chemical technology practice through field trips, videos, guest instructor presentations, job shadow, and/or use of online media resources.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- describe ethical responsibilities of chemical technicians.
- describe typical responsibilities of chemical technicians in the workplace.
- compare and contrast the diverse types of laboratory practice and employment settings within the field of chemical technology.

CHEMT 299 Experimental Offering in Chemical Technology

Units: 0.5 - 4
Prerequisite: None.
Catalog Date: June 1, 2020

CHEMT 301 Chemical Technology Supplemental Lab

Units: 1
Hours: 54 hours LAB
Prerequisite: None.
Corequisite: CHEM 300
Transferable: CSU (effective Summer 2020)
Catalog Date: June 1, 2020

This is a supplemental course that is intended to provide additional laboratory skills that are required for the Chemical Technology Level 1 certificate.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- demonstrate oral and written communication skills necessary to report and discuss chemistry laboratory processes with other scientifically trained personnel.
- perform basic chemical laboratory procedures using common laboratory equipment and able to analyze the data collected.
- acquire knowledge of solution and concentration, acids and bases, pH, dimensional analysis, computer, and basic statistics for lab data.
- demonstrate an understanding of safety practices, including proper chemical waste disposal procedures.

CHEMT 429 Research in Chemistry

Units: 1
Hours: 54 hours LAB
Prerequisite: CHEM 410 with a grade of "C" or better
Transferable: CSU (effective Summer 2020)
Catalog Date: June 1, 2020

This course involves an individual student or small groups of students in a supervised research in various topics in chemistry. Research in chemistry offers students a chance to do research and/or experimentation that is more typical of industry and graduate student work, under the guidance of supervising faculty. This course will in part fulfill the program requirement of the Chemical Technician, Advanced Certificate.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- discuss, plan and outline a proposal of study with fellow researchers qualified within the discipline.
- demonstrate the ability to conduct a variety of qualitative and quantitative, inorganic and organic laboratory techniques using a variety of chemistry instrumentation such as; atomic absorption spectroscopy, gas chromatography, high-performance liquid chromatography, gas chromatography–mass spectrometry.
- analyze and evaluate scientific data in the laboratory by methods such as; measured versus theoretical comparisons (evaluation of accuracy) , reproducibility of results (precision evaluation) and benefits of aggregate data vs. individual data.
- participate in regular research discussions with fellow researchers concerning theoretical background to the research, results and conclusions from experimental work, and develop plans for ongoing research.
- prepare and maintain a structured laboratory notebook.
- analyze and interpret chromatographic data.

- set up and perform basic organic chemical isolation and purification procedures.
- prepare a written and/or oral report, summarizing the results achieved from research work.

CHEMT 499 Experimental Offering in Chemical Technology

Units: 0.5 - 4
Prerequisite: None.
Catalog Date: June 1, 2020

Chemistry (CHEM) Courses

CHEM 110 Preparatory Chemistry

Units: 2
Hours: 36 hours LEC
Prerequisite: None.
Catalog Date: June 1, 2020

This course covers the most fundamental concepts of chemistry and is intended primarily to prepare students for UCD's Chemistry 2A (General Chemistry). This course is graded on a Pass/No Pass basis.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply chemical theories to a variety of elements and compounds.
- solve chemical word problems involving pressure, temperature, volume, concentration, moles, and grams.
- draw structures for chemical compounds based on molecular formulae.

CHEM 299 Experimental Offering in Chemistry

Units: 0.5 - 4
Prerequisite: None.
Catalog Date: June 1, 2020

CHEM 300 Beginning Chemistry

Units: 4
Hours: 54 hours LEC; 54 hours LAB
Prerequisite: MATH 100 with a grade of "C" or better, or placement through the assessment process.
Advisory: Concurrent enrollment in CHEM 317, and meeting eligibility for ENGWR 300
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
Catalog Date: June 1, 2020

This is a lecture and laboratory course that covers the fundamental concepts of chemistry. This course assumes no previous knowledge of chemistry, presenting both chemical problem solving and laboratory skills. This course is intended primarily to prepare students for CHEM 400.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- acquire basic science study skills in learning chemistry concepts.
- demonstrate basic understanding of matter, energy, atomic theory and structure, chemical composition, chemical reactions, chemical bonding, stoichiometry, intermolecular forces, and solutions.
- perform basic chemical laboratory procedures using common laboratory equipment and to analyze the data collected.
- apply knowledge of quantitative chemical methods to chemical calculations, including application of the mole concept to stoichiometry and the use of dimensional analysis.
- name selected elements, ions, common ionic compounds, and binary covalent compounds, given their chemical formulae, and develop chemical formulas from chemical names.
- solve basic chemical word problems.

CHEM 305 Introduction to Chemistry

Units: 5
Hours: 72 hours LEC; 54 hours LAB
Prerequisite: MATH 100 with a grade of "C" or better OR MATH 103 and MATH 104 with grades of "C" or better, or equivalent.
Advisory: ENGWR 101 with a grade of "C" or better; Concurrent enrollment in CHEM 317.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
C-ID: C-ID CHEM 101
Catalog Date: June 1, 2020

This course presents the fundamental principles of chemistry including types of matter, physical and chemical processes, chemical bonds, atomic and molecular structure, nuclear chemistry, stoichiometry, states of matter, intermolecular forces, solutions, types of chemical reactions, acids and bases, thermodynamics, kinetics, equilibrium, and a brief introduction to organic chemistry. It is primarily designed for majors in the allied health fields (nursing, dental hygiene, physical therapy, etc.), natural resources, environmental technology, and physical education. Online homework assignments may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- demonstrate a knowledge of introductory chemical concepts and relate them to everyday life and the health sciences.
- develop chemical formulas from chemical names and vise versa for elements, ions, acids, ionic compounds, and molecular compounds.
- apply knowledge of quantitative chemical methods to chemical calculations, including application of the mole concept to stoichiometry and the use of dimensional analysis.
- demonstrate the ability to perform basic chemical laboratory procedures using common laboratory equipment and to analyze the data collected.
- formulate balanced chemical reaction equations and predict states of matter from solubility rules.
- develop a general knowledge of the make-up of the atom and how it relates to periodic trends in chemical properties and chemical bonding.
- characterize the three states of matter, the role of intermolecular forces in liquids and solids, and quantitative relationships of variables affecting behavior of gases.
- identify the properties of acids and bases (and their conjugates) with the ability to convert back and forth between acid concentration and pH.
- demonstrate a basic understanding of nuclear chemistry and its applications to medicine.
- interpret simple organic chemical formulas and structures in relationship to VSEPR theory.

CHEM 306 Introduction to Organic and Biological Chemistry

Units: 5
Hours: 72 hours LEC; 54 hours LAB
Prerequisite: CHEM 305 with a grade of "C" or better
Advisory: ENGWR 300 or ESLR 320 with a grade of "C" or better and concurrent enrollment of CHEM 317
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
C-ID: C-ID CHEM 102
Catalog Date: June 1, 2020

CHEM 306 is a continuation of CHEM 305. It is designed to provide a basic overview of organic chemistry and biochemistry. The organic chemistry portion includes the chemistry and properties of organic functional groups and their applications in biological systems. The biochemistry portion emphasizes the structure and function of carbohydrates, lipids, and proteins and their regulation in the body. This course is primarily designed for majors in the allied health fields (nursing, dental hygiene, physical therapy, etc.), natural resources, environmental technology, and physical education. Online homework may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- construct and name the organic molecules.
- differentiate between the various organic functional groups and describe their physical and chemical properties as well as their intermolecular forces.
- compare the structure, function, and uses of important carbohydrates, lipids, and proteins.
- perform basic organic and biochemical laboratory experiments such as organic synthesis, enzyme activity, and lipid extraction.
- evaluate and present a current biochemical topic.
- demonstrate a knowledge of the interdisciplinary and real world applications of organic chemistry and biochemistry.

CHEM 309 Integrated General, Organic, and Biological Chemistry

Units: 5
Hours: 72 hours LEC; 54 hours LAB
Prerequisite: MATH 100 or 104 with a grade of "C" or better, or placement through the assessment process.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
C-ID: C-ID CHEM 101
Catalog Date: June 1, 2020

This course is an intensive survey of general, organic, and biological chemistry specifically designed for nursing majors and other allied health-related fields. Topics include general chemistry, organic chemistry, and biological chemistry as applied to the chemistry of the human body. This course satisfies the requirements of those health-career programs that require one or two semesters of chemistry.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply significant figures to measurements of mass, volume, distance, pressure, and temperature and apply unit analysis and/or 1 equation with 1 unknown algebra to calculations with unit conversions, density, molar mass, Avogadro's number, solution concentrations, dosages, dilutions, pH, specific heat, calorimetry, and reaction energies.
- relate atomic structure to nuclear decay and nuclear medicine.
- distinguish between ionic bonds, non-polar covalent bonds, polar covalent bonds, and intermolecular forces (IMFs).
- apply Valence Shell Electron Pair Repulsion (VSEPR) Theory and electronegativity to organic compounds to determine molecular polarity, IMFs, and non-covalent interactions of biological molecules.
- name and write the chemical formulae of cations, anions, inorganic compounds, and organic compounds.
- identify and predict the movement in the phenomena of diffusion, osmosis, dialysis, tonicity, and transport through cell membranes.
- apply IMFs and/or non-covalent interactions to relative physical properties of organic compounds and the secondary, tertiary, and quaternary structure of proteins, nucleic acids, membranes, and lipoproteins.
- convert between Lewis structures, condensed structures, and bond-line structures of organic compounds and biological molecules.
- recognize structural and stereoisomers in organic compounds and biological molecules.
- identify functional groups in organic compounds and biological molecules to predict their physical and chemical properties.
- recognize and predict the chemical reactivity of inorganic and organic acids and bases with emphasis on buffer systems.
- apply reaction kinetics, thermodynamics, and equilibrium to functional group reactions of biochemical pathways and buffers systems.
- compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids.

- explain and interpret the processes of DNA replication and transcription and mRNA translation.
- identify the functional group reactions (hydration, dehydration, oxidation, reduction, hydrolysis, synthetic dehydration, and isomerization) the catabolic pathways of glycolysis, beta-oxidation of fatty acids, citric acid cycle, electron transport chain, and oxidative phosphorylation.

CHEM 317 Strategies for Problem Solving in Chemistry

Units: 1
Hours: 18 hours LEC
Prerequisite: None.
Corequisite: CHEM 300, 305, 306, 309, 420, 421, 425, or 426
Transferable: CSU
Catalog Date: June 1, 2020

This course will focus on developing analytical reasoning strategies, critical thinking skills, and problem-solving abilities for both quantitative and qualitative problems in chemistry. The course is designed to support students in beginning chemistry (CHEM 300), introductory chemistry applied to the health sciences (CHEM 305), organic and biochemistry applied to the health sciences (CHEM 306), integrated general, organic, and biological Chemistry (CHEM 309), organic chemistry with a biological emphasis (CHEM 425 and CHEM 426), and organic chemistry for chemistry majors (CHEM 420 and CHEM 421). Strategies and content will be specific to the area of chemistry. Each section of CHEM 317 is associated with a specific chemistry course taken from the list above.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply analytical reasoning and critical thinking skills as these relate to the study of chemistry.
- demonstrate quantitative, qualitative, and descriptive problem solving skills as they relate to the study of chemistry.
- apply study habits that enable mastery of chemistry.
- demonstrate and increase competence in his/her problem solving strategies through practice.

CHEM 320 Environmental Chemistry

Units: 4
Hours: 54 hours LEC; 54 hours LAB
Prerequisite: None.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
Catalog Date: June 1, 2020

This course explores the relationships between human beings and their living and nonliving environments with regard to the chemical substances that are encountered in everyday life. The role of chemistry in both creating environmental problems as well as providing solutions will be examined. At the conclusion of the course, the student will be able to use everyday tools in understanding and dealing with environmental problems and become a more critical consumer of products affecting the environment. The laboratory is designed to familiarize the student with the methods of science while investigating the presence and interaction of chemicals in the environment.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- evaluate environmental processes from the perspective of basic chemical principles of matter and energy.
- deduce the impact of human activity on environmental processes, including air, water, and biological systems, based on basic chemical principles.
- examine environmental information provided by popular culture, including consumer products, advertisements, movies, newspaper stories, etc., with respect to environmental claims.
- interpret laboratory data generated during laboratory experiments.
- apply safe handling practices to both laboratory chemicals and consumer products.

CHEM 326 Water and Wastewater Treatment Chemistry

Units: 3
Hours: 36 hours LEC; 54 hours LAB
Prerequisite: MET 365 or MET 366 with a grade of "C" or better
Advisory: MET 375 or MET 376 with a grade of "C" or better or concurrent enrollment in MET 375 or MET 376
Catalog Date: June 1, 2020

This course includes basic chemical principles particularly relevant to water and wastewater treatment. Key principles discussed include basic atomic structure, chemical bonding, equations and reactions, reaction rates and equilibrium, acids and bases, oxidation-reduction, and an introduction to organic chemistry. Components of this course may be offered on-line. Students may be required to have access to a computer and the Internet and have some familiarity with a computer.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- describe the basic structure of the atom.
- apply the Laws of Conservation of Mass and Conservation of Energy to chemical systems.
- classify a chemical reaction as precipitation, acid-base, or redox given a chemical equation.
- predict the products of a precipitation, acid-base, or oxidation-reduction reaction given the reactants in an aqueous system.
- classify given organic compounds based on key functional groups (e.g., hydrocarbons, amines, alcohols, aldehyde, ketone, etc.).

CHEM 330 Adventures in Chemistry

Units: 4
Hours: 54 hours LEC; 54 hours LAB
Prerequisite: None.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
Catalog Date: June 1, 2020

This course is a survey of the fundamental concepts and contemporary applications of chemistry. Students will explore the real world applications of chemistry in the home, the environment, health, fitness, nutrition, medicine, and modern technology. The course is designed for non-science majors.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- demonstrate an understanding of core chemical concepts including but not limited to classification and measurement of matter, atomic structure, chemical bonding, molecular structure, acid/base and reduction/oxidation reactions, and nuclear chemistry.
- recognize the function of chemicals in everyday items using knowledge of basic chemistry and chemical nomenclature.
- evaluate various physical and chemical tests.
- show simple unit conversions and calorie calculations.
- apply basic science study skills.

CHEM 333 The Science of Coffee

Units: 3
Hours: 54 hours LEC
Prerequisite: None.
Transferable: CSU; UC (effective Summer 2020)
General Education: AA/AS Area IV; IGETC Area 5A (effective Fall 2020)
Catalog Date: June 1, 2020

This course is an exploration of how science can be applied to everyday life: making a good cup of coffee. Students will investigate many phenomena including the law of conservation of mass, acids and bases, pH, mass transfer, colloid science, fluid dynamics, specific heat capacity, refractive index, Snell's law and intermolecular forces. Students will use their understanding of these phenomena to optimize several variables that impact the taste of coffee in pursuit of brewing the best cup of coffee. This course may include an optional field trip.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply the scientific method to investigate matter and energy.
- measure the chemical and physical properties of materials and model these measurements to predict the properties of the materials under new conditions.
- design a method that simultaneously optimizes multiple variables
- analyze scientific principles important in natural phenomena
- interpret the results of experiments and apply the results to formulate new experiments
- diagram a process with multiple inputs and outputs

CHEM 336 Art and Chemistry

Units: 4
Hours: 54 hours LEC; 54 hours LAB
Prerequisite: None.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
Catalog Date: June 1, 2020

This course is an exploration of the chemistry of art and art media. Students will investigate, through a variety of lecture and laboratory activities, the scientific basis of paints, dyes, photography, fresco, metalworking, fabric, polymers, glass work, art preservation/restoration, art forgery, and chemical hazards in art. Chemical concepts such as the atomic nature of matter, molecules, elements, compounds, chemical bonding, chemical reactions, intermolecular forces, acids and bases, solubility, spectroscopy, oxidation and reduction, and carbon chemistry will be discussed as they apply to the chemical nature of art.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply the basic principles of chemistry to the major classes of artist's materials (paints, clay, metals, dyes, fabric, photography, etc).
- apply the principles of the scientific method to investigate the characteristics of various artist's materials.
- predict the characteristics of various artist's materials using basic chemistry.
- explain the relationship between advances in chemistry/technology and art materials, especially throughout the 19th and 20th centuries.
- interpret content labeling of substances commonly used in art using knowledge of basic chemistry and chemical nomenclature.
- assess a particular art material or process using library and internet resources.
- analyze basic safety issues regarding the use of common artist's materials.
- evaluate some instrumental and analytical techniques used in art conservation and art analysis.

CHEM 400 General Chemistry I

Units: 5

Hours: 54 hours LEC; 108 hours LAB
Prerequisite: CHEM 300 with a grade of "C" or better completed within one year prior to enrollment in CHEM 400 or placement through the assessment process (ACS California Chemistry Diagnostic Exam) completed within one year prior to enrollment in CHEM 400 (students having taken CHEM 310, CHEM 305, or another chemistry course must complete the assessment process within one year prior to enrollment in CHEM 400) AND MATH 120 or MATH 124 with a grade of "C" or better, or placement through the assessment process. Both prerequisites will be checked at the beginning of the first class meeting.
Advisory: ENGWR 300 and ESLR 320 with grades of "C" or better; All students enrolling in this course are strongly advised to take the chemistry and math assessment exams administered through the Assessment Center, regardless of prior coursework. These exams provide a better idea of a student's readiness for college level general chemistry, since they measure the actual chemistry and math capabilities of the student as they enroll in the course, rather than at the completion of their preparatory coursework.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
C-ID: C-ID CHEM 110; Part of C-ID CHEM 120S
Catalog Date: June 1, 2020

CHEM 400 covers the fundamental principles and concepts of chemistry including chemical nomenclature, balancing reactions, stoichiometry, thermochemistry, acid/base and reduction/oxidation (redox) reactions. Also covered are theories addressing atomic and molecular structure and bonding, as well as the physical and chemical properties of gases, liquids, solids, and solutions, including intermolecular forces. One hour per week will be devoted to discussion/problem solving sessions. Laboratory experiments are primarily quantitative, requiring good technique and critical thinking. CHEM 400 is for students majoring in biology, chemistry, pre-dentistry, pre-medicine, pre-pharmacy, and engineering. Online homework may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- evaluate chemical theories and their relationship to chemical properties. For example, understand modern atomic theory (including basic principles of quantum theory) as it applies to the electronic organization of atoms, chemical bonding, and periodic properties.
- demonstrate problem solving and critical thinking skills in the application of basic chemical principles to the solution of problems with multiple steps and/or intermediate conclusions and successfuly apply reasonable approximations to the solution of experimental and theoretical problems.
- analyze significant figures, correct units of measurement, experimental errors as they apply to chemical calculations such as stoichiometry and thermochemistry
- conduct laboratory experiments, successfully selecting and operating common laboratory equipment to quantitatively and qualitatively demonstrate chemical principles with results recorded in a properly formatted laboratory notebook.

CHEM 401 General Chemistry II

Units: 5
Hours: 54 hours LEC; 108 hours LAB
Prerequisite: CHEM 400 with a grade of "C" or better
Advisory: ENGRD 310, ENGWR 101, and MATH 370; with a grade of "C" or better; or placement through the assessment process
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
C-ID: Part of C-ID CHEM 120S
Catalog Date: June 1, 2020

CHEM 401 is a continuation of CHEM 400. This course includes topics in kinetics, thermodynamics, gas-phase equilibrium, ionic equilibrium, solubility, acid/base chemistry, buffers, electrochemistry, chemistry of coordination compounds, and nuclear chemistry. A brief introduction to organic chemistry is also included. Critical thinking and writing skills will be practiced in this course. CHEM 401 is for students in biology, chemistry, pre-dentistry, pre-medicine, pre-pharmacy, engineering, and other physical sciences. The laboratory includes both quantitative and qualitative experiments and some qualitative analysis. Written laboratory reports are required. It is highly recommended that CHEM 400 and 401 be taken during consecutive semesters. Some sections may require on-line homework.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- explain the basic concepts and theories of kinetics, equilibrium, thermodynamics, electrochemistry, acid/base chemistry, coordination chemistry, nuclear chemistry, and introductory organic chemistry; and cite examples of their importance and relevancy in the world.
- evaluate and solve quantitative and qualitative problems in kinetics, equilibrium, thermodynamics, electrochemistry, acid/base chemistry, coordination chemistry, and nuclear chemistry through mathematical application of basic principles.
- demonstrate the ability to conduct a variety of qualitative and quantitative inorganic laboratory experiments using a variety of chemistry instrumentation such as pH meters, spectrophotometers, and automated data loggers.
- analyze and evaluate scientific data in the laboratory by methods such as measured versus theoretical comparisons (evaluation of accuracy) and reproducibility of results (precision evaluation), hand and electronic graphing, benefits of aggregate or group data vs. individual student data, Beer's Law analysis, etc.
- organize and prepare written laboratory reports describing and interpreting the results of practical laboratory exercises, including answering thought-provoking questions on the experiment.

CHEM 410 Quantitative Analysis

Units: 5
Hours: 54 hours LEC; 108 hours LAB
Prerequisite: CHEM 401 with a grade of "C" or better
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
Catalog Date: June 1, 2020

This is a course in chemical quantitative analysis. Emphasis is placed on the proper design, control, and handling of experimental data obtained through the use of various analytical methods. For example, volumetric, spectrophotometric, and chromatographic methods are employed. Students will calibrate glassware and instruments, design and validate experimental methods, keep a detailed laboratory notebook, and prepare and deliver scientific reports. This course is for students planning careers in chemistry, biochemistry, chemical engineering, forensics, pre-pharmacy, biology, molecular biology, and microbiology.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- design an experimental method in response to a given analytical problem.
- uncover the underlying chemical theories of a specified analytical problem.
- evaluate the validity of experimental data.

- demonstrate safe, accurate, and precise laboratory skills.
- draft a laboratory notebook in conformance with a given standard operating procedure.
- critique in writing and orally the results obtained from an experiment.
- apply fundamental laboratory skills at a level commensurate with a science professional.

CHEM 420 Organic Chemistry I

Units: 5
Hours: 54 hours LEC; 108 hours LAB
Prerequisite: CHEM 401 with a grade of "C" or better.
Advisory: Concurrent enrollment in CHEM 317.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
C-ID: C-ID CHEM 150; Part of C-ID CHEM 160S
Catalog Date: June 1, 2020

This is a lecture-laboratory course designed to introduce students to the study of basic concepts of organic chemistry. Lecture topics include chemistry of alkanes, cycloalkanes, alkenes, alkyl halides, alcohols, and ether with emphasis on stereochemistry, reaction mechanisms, and spectroscopy. Laboratory work includes basic techniques of separation and identification. Students will be introduced to a variety of modern instrumentation (GC, HPLC, FT-IR, GC-MS) in the laboratory.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- integrate the fundamental concepts of general chemistry into the structure and reactivity of organic compounds.
- explain the fundamental concepts of organic chemistry and predict the products of chemical reactions.
- design multiple-step syntheses to prepare organic compounds.
- deduce the structure of organic compounds from chemical reactivity and spectroscopic data.
- prepare a structured laboratory notebook.
- set up and perform basic organic chemical isolation and purification procedures; operate a variety of modern instrumentation (GC, GC-MS, HPLC, FT-IR); analyze and interpret experimental data.

CHEM 421 Organic Chemistry II

Units: 5
Hours: 54 hours LEC; 108 hours LAB
Prerequisite: CHEM 420 with a grade of "C" or better
Advisory: CHEM 317 with a grade of "C" or better
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
C-ID: C-ID CHEM 160; Part of C-ID CHEM 160S
Catalog Date: June 1, 2020

This course is a lecture-laboratory course that is a continuation of CHEM 420. Lecture topics include the chemistry of ethers, epoxides, conjugated dienes, aromatic compounds, carbonyl compounds, enolate condensation, amines, phenols, polymerization reactions, and selected biologically important compounds. The course also includes continued application of spectroscopic methods (IR, NMR, UV-vis and MS) applied to organic chemistry. Laboratory emphasis is on the preparation, isolation, quantitation, purification, identification, and mechanism elucidation using both traditional and instrumental techniques. Students will continue to expand their ability to operate and utilize a variety of modern chemical instrumentation: Gas Chromatography, High Performance Liquid Chromatography, Fourier Transform Infraeed Spectroscopy, and Gas Chromatography-Mass Spectroscopy.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- name organic compounds according to IUPAC (International Union of Pure and Applied Chemistry) nomenclature rules.
- integrate the fundamental concepts of general chemistry and first semeseter organic chemistry into second semester organic chemistry.
- apply the theories of structure and reactivity to the following functional groups: conjugated dienes, ethers, aromatic compounds, carboxylic acids and their derivatives, aldehydes, ketones, amines, phenols, diazonium salts, and some biologically important polyfunctional groups.
- predict the major product(s) of chemical reactions and relate theory to real life examples.
- design multi-step syntheses to prepare organic compounds.
- set up and perform basic organic chemistry laboratory experiments and operate a variety of modern chemical instruments.
- analyze and interpret experimental and chromatographic data.
- deduce the structure of organic compounds from chemical reactivity and spectroscopic data.
- prepare and maintain a structured laboratory notebook.
- explain reaction mechanisms using the relative stability of reaction intermediates.

CHEM 423 Organic Chemistry - Short Survey

Units: 5
Hours: 72 hours LEC; 54 hours LAB
Prerequisite: CHEM 401 with a grade of "C" or better
Transferable: UC (effective Summer 2020)
General Education: CSU Area B1 (effective Fall 2020); CSU Area B3 (effective Fall 2020); IGETC Area 5A (effective Fall 2020); IGETC Area 5C (effective Fall 2020)
Catalog Date: June 1, 2020

This course is a survey of carbon containing compounds with emphasis on organic compounds of biological interest. Topics include the chemistry of organic functional groups, infrared spectroscopy, and mechanisms of reactions. This course is designed primarily for students majoring in the life sciences, nutrition and dietetics, and related fields. This course is not recommended for students majoring in

chemistry, chemical engineering, medicine, dentistry, pharmacy, or chiropractics.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- understand the reactivity of organic functional groups based on structural and bonding theories.
- name key fundamental groups and classes of organic molecules using the system developed by the International Union of Pure and Applied Chemistry (IUPAC).
- predict mechanisms and intermediates of fundamental reactions of organic chemistry.
- use spectroscopic methods and calculations of unsaturation numbers to identify key functional groups in organic compounds.
- differentiate between structural isomers and stereoisomers, and resonance forms of molecules.
- analyze the effects of reagents, solvents, catalysts, temperature, and pressure in organic reactions.
- develop potential sequences of reactions to convert one functional group to another, or to synthesize simple organic molecules.
- evaluate biochemical molecules (carbohydrates, proteins, nucleic acids, and lipids) and biochemical processes using fundamental principles of organic chemistry.

CHEM 425 Organic Chemistry with Biological Emphasis I

Units: 4
Hours: 54 hours LEC; 54 hours LAB
Prerequisite: CHEM 401 with a grade of "C" or better
Advisory: Concurrent enrollment in CHEM 317.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
C-ID: Part of C-ID CHEM 160S
Catalog Date: June 1, 2020

The CHEM 425, 426 series is designed to fulfill the requirements of students planning professional school studies in the health and biological sciences. It will also satisfy the needs of students majoring in the life sciences and related areas. This course is intended for students not majoring in chemistry and not planning to take additional courses in organic chemistry beyond the CHEM 425, 426 series. Lecture topics include the preparation, properties, and reactions of alkanes, alkenes, alkynes, alkyl halides, alcohols, and radical chemistry, with emphasis on applications in the biological sciences. Also included are stereoisomerism and spectroscopy. Laboratory work covers standard laboratory practices including extraction, crystallization, organic synthesis, reaction analysis, gas chromatography, thin layer chromatography, and infrared spectroscopy.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- develop an integrated understanding of the nomenclature and molecular structure of specific types of organic compounds, associate reactions with specific functional group chemistry, and predict the chemical reactions of specific organic molecules given their chemical structures.
- demonstrate deductive intuition relating to the mechanistic reaction synthesis themes and characteristic reactivities of the major classes of organic compounds studied.
- deduce outcomes of given reactions and, given a target product, outline the synthetic steps necessary to produce that compound.
- investigate and analyze interdisciplinary and real world applications of organic chemistry as applied to biological systems.
- cite and compile physical property and toxicological data from literature for chemicals used in the laboratory.
- document, set up, perform, and evaluate experiments employing standard organic chemistry techniques.
- utilize instrumental methods such as gas chromatography to determine the composition of a mixture of compounds, and infrared spectroscopy and refractometry for investigating the identity of compounds.

CHEM 426 Organic Chemistry with Biological Emphasis II

Units: 4
Hours: 54 hours LEC; 54 hours LAB
Prerequisite: CHEM 420 or 425 with a grade of "C" or better
Advisory: Concurrent enrollment in CHEM 317.
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A
C-ID: Part of C-ID CHEM 160S
Catalog Date: June 1, 2020

This course is a continuation of CHEM 425. It focuses on the preparation, properties, reactions, spectroscopy (IR, HNMR, CNMR, and UV), and mass spectrometry of organic compounds, including benzene and benzene derivatives, aldehydes, ketones, dicarbonyl compounds, carboxylic acids, carboxylic acid derivatives, and amines. Applications in the biological sciences are emphasized. Biological macromolecule organic chemistry (carbohydrates, proteins, etc.) is also presented. Laboratory work includes qualitative analysis, distillation, multi-step organic synthesis, and use of analytical instrumentation (FTIR, GC, and GC-MS) for characterization of compounds.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- demonstrate the ability to name, associate, and draw organic molecules, including but not limited to carbonyl compounds, aromatic compounds, amines, and biomolecules.
- utilize knowledge of specific reagents associated with reactions involving different classes of compounds and predict the products of reactions.
- analyze, outline, and integrate multiple mechanistic reaction themes and reaction pathways.
- assemble complex laboratory apparatus to perform experiments such as multi-step synthesis, execute and document experiments, independently operate instrumentation and analyze subsequent data to characterize and quantify products.
- apply reasoning towards understanding how organic chemistry principles are associated with pathways and pharmacology of biological systems.
- summarize and outline factual information about current chemical topics, and compile and cite peer reviewed chemical literature.

CHEM 484 Advanced General Chemistry - Honors

Units: 1
Hours: 54 hours LAB
Prerequisite: CHEM 400 with a grade of "C" or better
Enrollment Limitation: Eligibility for the Honors Program.
Transferable: CSU; UC
General Education: CSU Area B1; CSU Area B3
Catalog Date: June 1, 2020

Honors Advanced General Chemistry provides advanced studies of chemical concepts introduced in CHEM 400 and related concepts, including advanced laboratory work. This honors course uses an intensive methodology designed to challenge motivated students. For this course, each student does research on a particular project with an advisor who is a chemistry professor.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- demonstrate an advanced understanding of the principles involved in general inorganic chemistry.
- confirm a variety of chemical theories experimentally.

CHEM 494 Topics in Chemistry

Units: 0.5 - 3
Hours: 9 - 54 hours LEC
Prerequisite: Determined by topic
Transferable: CSU
Catalog Date: June 1, 2020

This course is designed to enable science majors and non-science majors to learn about special topics in chemistry, such as recent developments or current issues. UC transfer credit may be awarded only after the course has been evaluated by the enrolling UC campus. The units completed for this course cannot be counted toward the minimum 60 units required for admissions.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- discuss knowledge of the material presented in the course.
- compare and contrast issues related to the topic of the course.
- develop analytical reasoning and critical thinking skills as they relate to the field of chemistry.
- acquire and interpret data.

CHEM 495 Independent Studies in Chemistry

Units: 1 - 3
Hours: 54 - 162 hours LAB
Prerequisite: None.
Transferable: CSU
Catalog Date: June 1, 2020

This course involves an individual student or small groups of students in study, research, or activities beyond the scope of regular offered courses, pursuant to an agreement among college, faculty members, and students. Independent studies in chemistry offers students a chance to do research and/or experimentation that is more typical of industry and graduate student work.
UC transfer credit will be awarded only after the course has been evaluated by the enrolling UC campus. The units completed for this course cannot be counted towards the minimum 60 units required for admissions.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- discuss and outline a proposal of study (that can be accomplished within one semester term) with a supervising instructor qualified within the discipline.
- demonstrate competence in the skills essential to mastery of the major discipline of study that are necessary to accomplish the independent study.
- prepare a written and/or oral report summarizing the results achieved from the independent study.

CHEM 499 Experimental Offering in Chemistry

Units: 0.5 - 4
Prerequisite: None.
Transferable: CSU; UC
Catalog Date: June 1, 2020

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Science, Math and Engineering

(/academics/meta-majors/science-math-and-engineering)

This program is part of the Science, Math and Engineering meta major.

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