

# Chemistry

## Overview

American River College's chemistry program offers you a high quality education whether you are seeking to transfer to a 4-year college, obtain an Associate's Degree, or seeking to obtain career technical education. The highly trained faculty in the Chemistry Department is committed to rigorous academic standards, large selection of classes, student-friendly atmosphere, and interactive classes. Our diverse faculty is dedicated to teaching and learning. They have backgrounds that cover all aspects of chemistry. The department provides hands-on experiential learning as well as access to a nationally award-winning peer assisted tutorial program (Beacon).

Division Dean	<a href="#">Dr. Rina Roy (/about-us/contact-us/faculty-and-staff-directory/rina-roy)</a>
Department Chair	<a href="#">Michael Payne (/about-us/contact-us/faculty-and-staff-directory/michael-payne)</a> <a href="#">Kristin Casale (/about-us/contact-us/faculty-and-staff-directory/kristin-casale)</a>
HomeBase	<a href="#">STEM (/academics/homebases/stem)</a>
Division	<a href="#">Science &amp; Engineering Division Office (/academics/science-and-engineering-division-office)</a>
Phone	(916) 484-8107

## Associate Degree

### A.S. in General Science

This program provides a broad study in the fields of biological and physical sciences in preparation for transfer to a four-year program and continuation of studies in upper division science courses.

Catalog Date: January 1, 2021

### Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
A minimum of 18 units from the following:		18 <sup>1</sup>
<b>Physical Science Courses</b>		
ASTR 300	Introduction to Astronomy (3)	
ASTR 310	The Solar System (3)	
ASTR 320	Stars, Galaxies, and Cosmology (3)	
ASTR 330	Introduction to Astrobiology (3)	
ASTR 400	Astronomy Laboratory (1)	
ASTR 481	Honors Astronomy: Stars, Galaxies, and Cosmology (4)	
ASTR 495	Independent Studies in Astronomy (1 - 3)	
ASTR 499	Experimental Offering in Astronomy (0.5 - 4)	
CHEM 305	Introduction to Chemistry (5)	
CHEM 306	Introduction to Organic and Biological Chemistry (5)	
CHEM 309	Integrated General, Organic, and Biological Chemistry (5)	
CHEM 310	Chemical Calculations (4)	
CHEM 400	General Chemistry I (5)	
CHEM 401	General Chemistry II (5)	
CHEM 420	Organic Chemistry I (5)	
CHEM 421	Organic Chemistry II (5)	
CHEM 423	Organic Chemistry - Short Survey (5)	
CHEM 495	Independent Studies in Chemistry (1 - 3)	
CHEM 499	Experimental Offering in Chemistry (0.5 - 4)	
GEOG 300	Physical Geography: Exploring Earth's Environmental Systems (3)	
GEOG 301	Physical Geography Laboratory (1)	
GEOG 305	Global Climate Change (3)	
GEOG 306	Weather and Climate (3)	
GEOG 307	Environmental Hazards and Natural Disasters (3)	
GEOG 308	Introduction to Oceanography (3)	
GEOG 309	Introduction to Oceanography Lab (1)	
GEOG 391	Field Studies in Geography: Mountain Landscapes (1 - 4)	
GEOG 392	Field Studies in Geography: Coastal Landscapes (1 - 4)	
GEOG 393	Field Studies in Geography: Arid Landscapes (1 - 4)	
GEOG 394	Field Studies in Geography: Volcanic Landscapes (1 - 4)	
GEOG 495	Independent Studies in Geography (1 - 3)	
GEOG 499	Experimental Offering in Geography (0.5 - 4)	
GEOL 300	Physical Geology (3)	
GEOL 301	Physical Geology Laboratory (1)	
GEOL 305	Earth Science (3)	
GEOL 306	Earth Science Laboratory (1)	
GEOL 310	Historical Geology (3)	
GEOL 311	Historical Geology Laboratory (1)	
GEOL 320	Global Climate Change (3)	

COURSE CODE	COURSE TITLE	UNITS
GEOL 325	Environmental Hazards and Natural Disasters (3)	
GEOL 330	Introduction to Oceanography (3)	
GEOL 331	Introduction to Oceanography Lab (1)	
GEOL 345	Geology of California (3)	
GEOL 390	Field Studies in Geology (1 - 4)	
GEOL 495	Independent Studies in Geology (1 - 3)	
GEOL 499	Experimental Offering in Geology (0.5 - 4)	
PHYS 310	Conceptual Physics (3)	
PHYS 311	Basic Physics (3)	
PHYS 312	Conceptual Physics Laboratory (1)	
PHYS 350	General Physics (4)	
PHYS 360	General Physics (4)	
PHYS 410	Mechanics of Solids and Fluids (5)	
PHYS 421	Electricity and Magnetism (4)	
PHYS 431	Heat, Waves, Light and Modern Physics (4)	
PHYS 495	Independent Studies in Physics (1 - 3)	
PHYS 499	Experimental Offering in Physics (0.5 - 4)	
<b>Biological Science Courses</b>		
ANTH 300	Biological Anthropology (3)	
ANTH 301	Biological Anthropology Laboratory (1)	
ANTH 303	Introduction to Forensic Anthropology (3)	
ANTH 370	Primatology (3)	
ANTH 372	Primatology Field Studies (2)	
ANTH 480	Honors Biological Anthropology (3)	
ANTH 495	Independent Studies in Anthropology (1 - 3)	
ANTH 499	Experimental Offering in Anthropology (0.5 - 4)	
BIOL 300	The Foundations of Biology (3)	
BIOL 301	Evolution (3)	
BIOL 303	Survey of Biology (4)	
BIOL 305	Natural History (4)	
BIOL 310	General Biology (4)	
BIOL 322	Ethnobotany (3)	
BIOL 332	Introduction to Ornithology (4)	
BIOL 342	The New Plagues: New and Ancient Infectious Diseases Threatening World Health (3)	
BIOL 352	Conservation Biology (3)	
BIOL 370	Marine Biology (4)	
BIOL 375	Marine Ecology (3)	
BIOL 390	Natural History Field Study (0.5 - 4)	
BIOL 400	Principles of Biology (5)	
BIOL 410	Principles of Botany (5)	
BIOL 415	Introduction to Biology: Biodiversity, Evolution, and Ecology (5)	
BIOL 420	Principles of Zoology (5)	
BIOL 430	Anatomy and Physiology (5)	
BIOL 431	Anatomy and Physiology (5)	
BIOL 440	General Microbiology (4)	
BIOL 442	General Microbiology and Public Health (5)	
BIOL 482	Honors Marine Biology (4)	
BIOL 495	Independent Studies in Biology (1 - 3)	
BIOL 499	Experimental Offering in Biology (0.5 - 4)	
BIOT 301	Biotechnology and Human Health (3)	
BIOT 305	Introduction to Bioinformatics (1)	
BIOT 307	Biotechnology and Society (2)	
BIOT 311	Biotechnology Laboratory Methods - Molecular Techniques (2)	
BIOT 312	Biotechnology Laboratory Methods - Microbial and Cell Culture Techniques (2)	
BIOT 499	Experimental Offering in Biology (0.5 - 4)	
NATR 300	Introduction to Natural Resource Conservation and Policy (4)	
NATR 302	Introduction to Wildlife Biology (4)	
NATR 303	Energy and Sustainability (3)	
NATR 304	The Forest Environment (3)	
NATR 305	Fisheries Ecology and Management (4)	
NATR 306	Introduction to Rangeland Ecology and Management (3)	
NATR 307	Principles of Sustainability (4)	
NATR 310	Study Design and Field Methods (4)	
NATR 320	Principles of Ecology (4)	
NATR 322	Environmental Restoration (2)	
NATR 324	Field Studies: Birds and Plants of the High Sierra (1.5)	
NATR 330	Native Trees and Shrubs of California (4)	
NATR 332	Wildflowers of California (3)	
NATR 346	Water Resources and Conservation (3)	
NATR 495	Independent Studies in Natural Resources (1 - 3)	
NATR 499	Experimental Offering in Natural Resources (0.5 - 4)	
PSYC 310	Biological Psychology (3)	
PSYC 311	Biological Psychology Laboratory (1)	

COURSE CODE	COURSE TITLE	UNITS
PSYC 495	Independent Studies in Psychology (1 - 3)	
PSYC 499	Experimental Offering in Psychology (0.5 - 4)	
Total Units:		18

<sup>1</sup> must be transfer-level and must include one laboratory course in a physical science and one laboratory course in a biological science

The General Science 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 ARC graduation requirements.

## Student Learning Outcomes

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

- evaluate new and accepted ideas about the natural universe using scientific methods.
- analyze a wide variety of natural phenomena using basic definitions and fundamental theories of biological or physical sciences.
- apply appropriate quantitative and qualitative methods to interpret and analyze pertinent data.
- outline the basic concepts and fundamental theories of a natural science.
- articulate orally and/or in writing the importance of continuous examination and modification of accepted ideas as a fundamental element in the progress of science.
- discuss ethical components of scientific decision making and apply personal and social values within the process of decision making in scientific endeavors.

## Chemistry (CHEM) Courses

### CHEM 83 Strategies for Problem Solving in General, Organic and Biological Chemistry

Units:	0.75
Hours:	40.5 hours LAB
Prerequisite:	None.
Corequisite:	CHEM 309
Catalog Date:	January 1, 2021

This course develops analytical reasoning strategies, critical thinking skills, and problem-solving abilities for both quantitative and qualitative problems in chemistry. It is designed to support students enrolled in CHEM 309 at American River College. Pass/No Pass only.

#### Student Learning Outcomes

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

- apply analytical reasoning and critical thinking skills as they 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.
- build expertise and increased competence in problem solving strategies through practice.

### CHEM 84 Strategies for Problem Solving in General Chemistry I

Units:	0.75
Hours:	40.5 hours LAB
Prerequisite:	None.
Corequisite:	CHEM 400
Catalog Date:	January 1, 2021

This course develops analytical reasoning strategies, critical thinking skills, and problem-solving abilities for both quantitative and qualitative problems in chemistry. It is designed to support students enrolled in CHEM 400 at American River College, with content that will be specific to CHEM 400. Pass/No Pass only.

#### Student Learning Outcomes

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

- apply analytical reasoning and critical thinking skills as they 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.
- build expertise and increased competence in their problem-solving strategies through practice.

### CHEM 86 Strategies for Problem Solving in Organic Chemistry I

Units:	0.75
Hours:	40.5 hours LAB
Prerequisite:	None.
Corequisite:	CHEM 420
Catalog Date:	January 1, 2021

This course develops analytical reasoning strategies, critical thinking skills, and problem-solving abilities for both quantitative and qualitative problems in chemistry. It is designed to support students enrolled in CHEM 420 at American River College. Pass/No Pass Only.

#### Student Learning Outcomes

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

- apply analytical reasoning and critical thinking skills as they 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.
- build expertise and increased competence in problem-solving strategies through practice.

## CHEM 87 Strategies for Problem Solving in Organic Chemistry II

Units: 0.75  
 Hours: 40.5 hours LAB  
 Prerequisite: None.  
 Corequisite: CHEM 421  
 Catalog Date: January 1, 2021

This course develops analytical reasoning strategies, critical thinking skills, and problem-solving abilities for both quantitative and qualitative problems in chemistry. It is designed to support students enrolled in CHEM 421 at American River College.

### Student Learning Outcomes

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

- apply analytical reasoning and critical thinking skills as they 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.
- build expertise and increased competence in problem-solving strategies through practice.

## CHEM 130 Chemistry for Funeral Service

Units: 4  
 Hours: 72 hours LEC  
 Prerequisite: None.  
 Corequisite: BUS 340, FSE 310, and FSE 320  
 Enrollment Limitation: Acceptance into the Funeral Service Education program.  
 Catalog Date: January 1, 2021

This course is a survey of the basic principles of chemistry as they relate to funeral service. Topics include chemical principles involved in sanitation, disinfection, public health, and embalming practices. It also covers the development and use of personal, professional, and community sanitation practices, as well as use of and precautions related to potentially harmful chemicals that are currently used in the field of funeral service.

### Student Learning Outcomes

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

- describe selected facts of general chemistry as a basis for studying organic and biochemistry.
- explain the essential characteristics of autolysis, hydrolysis, fermentation, and putrefication in the area of chemistry of decomposition.
- identify the characteristic features of solutions, suspensions, emulsions, and the processes of diffusion as they relate to the embalming process.
- describe the characteristic features of organic compounds.
- compare the characteristics of carbohydrates, lipids, and proteins in the area of basic biochemistry.
- describe representative chemicals in embalming fluids (arterial, cavity, and accessory) and give their respective functions.
- list the potentially harmful chemicals used in the preparation room and the precautions to be taken with each.

## CHEM 305 Introduction to Chemistry

Units: 5  
 Hours: 72 hours LEC; 54 hours LAB  
 Prerequisite: MATH 100 or 132 with a grade of "C" or better  
 Advisory: Eligible for ENGRD 310 or ENGRD 312 AND ENGRW 300; OR ESLR 340 AND ELSW 340.  
 Transferable: CSU; UC (Credit Limitation: No credit if taken after CHEM 400)  
 General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C  
 C-ID: C-ID CHEM 101; Part of C-ID PHYS 140  
 Catalog Date: January 1, 2021

This course covers general principles of chemistry, such as unit analysis, atomic structure, nomenclature, mole concept, stoichiometry, and gases. It also introduces organic chemistry and biochemistry. This course is primarily designed for allied health majors.

### Student Learning Outcomes

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

- analyze and set up measurements of physical quantities and convert units of physical quantities via the use of dimensional analysis
- name and write formulas of elements, ions, acids, and ionic and molecular compounds
- describe atomic theory and interpret the periodic table
- apply the mole concept toward stoichiometry-related problems and chemical reactions
- identify the variables used to describe properties of a gas
- formulate qualitatively and quantitatively the effect of change of one or more variables on one another
- describe chemical bonds, intermolecular forces in the liquid state, solubility of substances, and the concept of osmosis, and their applications
- demonstrate the properties of acids and bases and convert acid concentration to pH and vice-versa
- classify, distinguish, and contrast the classes and structural features of organic and biological compounds

## 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:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU; UC (Credit Limitation: No credit if taken after CHEM 400)
General Education:	CSU Area B1; CSU Area B3
C-ID:	C-ID CHEM 102
Catalog Date:	January 1, 2021

This course is a continuation of CHEM 305. It covers the organic functional groups and reactions involved in the chemistry of life (biochemistry) as applied to the health sciences.

## Student Learning Outcomes

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

- identify, name, and draw structures of organic compounds including hydrocarbons, alcohols, organic acids, esters, amines, and amides
- defend predicted physical properties of hydrocarbons, alcohols, organic acids, esters, amines, and amides based on their chemical structure
- classify reactions involving hydrocarbons, alcohols, organic acids, esters, amines, and amides
- predict products from reactions involving hydrocarbons, alcohols, organic acids, esters, amines, and amides
- compare the physical and chemical properties of carbohydrates, lipids, proteins, enzymes, and nucleic acids
- compare and contrast the structures and functions of carbohydrates, lipids, proteins, enzymes, and nucleic acids in the body
- compare and contrast the processes of DNA replication and transcription, RNA translation, and common types of mutations
- predict the chemical reactions used in carbohydrate and lipid metabolism
- evaluate the energy yield from carbohydrate and lipid metabolism in the body

## CHEM 309 Integrated General, Organic, and Biological Chemistry

Units:	5
Hours:	72 hours LEC; 54 hours LAB
Prerequisite:	MATH 100, 129, or 132 with a grade of "C" or better, or placement through the assessment process.
Advisory:	One year of high school chemistry with a grade of "C" or better; AND MATH 120 or MATH 133; AND eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300, OR ESLR 340 AND ESLW 340.
Transferable:	CSU; UC
General Education:	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
Catalog Date:	January 1, 2021

This course is an intensive survey of general, organic, and biological chemistry specifically designed for students majoring in nursing and other health-related fields. Topics include general chemistry, organic chemistry, and biological chemistry as they apply to the chemistry of the human body. This course satisfies the requirements of those health-career programs which require one semester of chemistry. Students enrolled in this course are strongly encouraged to co-enroll in CHEM 83.

## Student Learning Outcomes

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

- analyze the fundamental features of chemistry including measurement of physical properties such as mass, volume, density, pressure, temperature, solutions, concentrations, and dilutions.
- apply the concept of unit analysis towards medical dosage calculations.
- differentiate between physical and chemical properties of matter.
- name and write chemical formulae of cations, anions and inorganic and organic compounds.
- evaluate various types of chemical reactions, both organic and inorganic.
- qualitatively compare spontaneous and nonspontaneous processes.
- analyze the phenomena of diffusion, osmosis, dialysis, and transport mechanisms of particles through cell membranes based on their physical properties.
- describe intermolecular forces and apply them in the understanding of basic principles of biochemistry and physical characteristics of organic compounds.
- differentiate between functional groups when they appear in an organic structure.
- relate the physical and chemical properties of compounds containing functional groups.
- differentiate typical acid and base formulae and compare the behavior associated with acids and bases.
- apply Le Chatelier's equilibrium principles in the understanding of blood buffers.
- distinguish various functions of four major classes of biomolecules in living cells.
- distinguish key structural features and properties of these classes of biomolecules.
- compare the processes of DNA replication, transcription, and translation.
- compare major biochemical components in common catabolic pathways for carbohydrates and fatty acids and compare the output from those processes.

## CHEM 310 Chemical Calculations

Units:	4
Hours:	54 hours LEC; 54 hours LAB
Prerequisite:	MATH 100, 129, or 132 with a grade of "C" or better
Corequisite:	MATH 120 or 133
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU
General Education:	AA/AS Area IV
Catalog Date:	January 1, 2021

This course introduces calculations, terminology, chemical techniques, and laboratory techniques. It provides intensive problem solving skills necessary for CHEM 400.

## Student Learning Outcomes

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

- solve chemical calculation problems, for example, unit conversion and theoretical yield calculations, in a clear and logical fashion.
- describe and explain organizational trends of the periodic table, for example, atomic mass, periods and groups, metals, nonmetals, metalloids, and atom size.
- describe the structure of an atom and predict common ions formed.
- formulate the name of inorganic compounds (molecular and ionic) and acids.
- identify the type of chemical reaction given reactant(s) and product(s) and balance the chemical reaction using coefficients.

- predict the products of inorganic chemical reactions using solubility rules.
- use the ideal gas law and the gas laws to predict temperature, pressure, volume, mass, or molar quantity of a gas.
- perform calculations involving mass percents, molarity, solution stoichiometry, and pH.
- complete lab experiments in a safe and timely manner, after receiving written and/or verbal instructions.
- demonstrate the proper use of laboratory glassware and equipment by collecting and recording scientific measurements in data tables with the correct number of units and significant figures (i.e. graduated cylinder, balances, thermometer, buret, pipet, and metric ruler), and the recording of observations (physical and chemical changes and properties).

## CHEM 400 General Chemistry I

Units:	5
Hours:	54 hours LEC; 108 hours LAB
Prerequisite:	MATH 120, 125, 129, or 133 with a grade of "C" or better AND one of the following: 1) CHEM 310 with a grade of "C" or better; or, 2) Previous chemistry course with a grade of "C" or better AND a passing score on the Chemistry Assessment Test from the Assessment Center at American River College.
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
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:	January 1, 2021

This course covers the basic principles of chemistry with an emphasis on chemical calculations, chemical reactions including balancing of complicated reduction-oxidation (REDOX) reactions, stoichiometry, gas laws, thermochemistry, atomic structure and bonding theories, ionic equations, solutions, intermolecular forces and phases of matter, and acid/base chemistry including titrations and pH. Laboratory work is devoted to investigations of the theoretical work discussed in lecture.

### Student Learning Outcomes

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

- successfully complete laboratory experiments (involving evaluation of experimental data and confirmation of physical constants) in a safe and timely manner, after receiving written and/or verbal instructions.
- demonstrate the proper collection and recording of scientific measurements in tables with the correct units and number of significant figures (i.e. measuring mass, volume, temperature, length, and pressure), and the recording and evaluation of observations (physical and chemical changes and properties).
- analyze and then solve chemical calculation problems that involve solids, solutions, or gases, in a clear and logical fashion; for example, stoichiometry, acid-base, and colligative property problems.
- analyze and then solve chemical calculation problems that involve heat energy transfers in calorimeters or chemical reactions; for example, determining the heat of fusion, heat of solution, heat of reaction, and heat capacity.
- construct balanced chemical equations from written descriptions of chemical reactions.
- synthesize data into computer-generated graphical outputs and make predictions by interpolation using linear and non-linear regression analyses.
- evaluate errors related to experimental procedures and assess their effects on experimental results.
- predict the products of inorganic chemical reactions using solubility rules and the activity series, by assessing electrolyte strength, and by employing the fundamental rules of acid/base chemistry.
- apply chemical naming rules to inorganic molecular and ionic compounds, acids, and simple straight-chain hydrocarbons.
- predict changes in solution properties based on colligative property calculations; for example, changes in boiling point, freezing point, vapor pressure, and osmotic pressure.
- explain how and why substances dissolve in other substances and perform calculations to evaluate solution concentration in various units (molar, molal, % mass, mole fraction).
- use the ideal gas law and the empirical or combined gas laws to predict temperature, pressure, volume, mass, or molar quantity of a gas.
- explain and predict observable properties of gases (pressure, temperature, volume) from an understanding of the behavior of the individual particles in a gas.
- produce Lewis structures of simple molecules and polyatomic ions and predict their shape and relative polarity.
- label the parts of a phase diagram, use it to predict the temperature and pressure at which phase changes will occur, and construct heating curves that include phase changes.
- analyze the structure of an atom and explain the origin of atomic emission spectra.

## 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:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU; UC
General Education:	CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
C-ID:	Part of C-ID CHEM 120S
Catalog Date:	January 1, 2021

This course is a continuation of the principles of chemistry with emphasis on equilibria, bonding, thermodynamics, kinetics, and electrochemistry. A brief introduction to organic chemistry is included. Laboratory work is devoted to qualitative analysis and experiments dealing with the theoretical work discussed in lecture.

### 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, coordination chemistry, and nuclear chemistry.
- cite examples of the importance and relevancy of chemical concepts.
- solve quantitative problems in kinetics, equilibrium, thermodynamics, electrochemistry, coordination chemistry, and nuclear chemistry through the mathematical application of basic principles.
- evaluate and solve qualitative problems using the basic principles of kinetics, equilibrium, thermodynamics, electrochemistry, coordination chemistry, and nuclear chemistry.
- conduct a variety of qualitative and quantitative inorganic laboratory experiments utilizing a variety of chemistry instrumentation such as spectrophotometry and pH meters.
- analyze experimental data to compare and contrast theoretical value versus experimental values.
- design appropriate laboratory procedures for open-ended inquiry experiments.
- prepare written laboratory reports describing and interpreting hands-on laboratory experiments.
- demonstrate safe laboratory practices and proper materials handling.

## CHEM 420 Organic Chemistry I

Units:	5
Hours:	54 hours LEC; 108 hours LAB
Prerequisite:	CHEM 401 with a grade of "C" or better

Transferable: CSU; UC (CHEM 420 & 423 combined: maximum credit - one course)  
C-ID: C-ID CHEM 150; Part of C-ID CHEM 160S  
Catalog Date: January 1, 2021

This course is designed to prepare students who are majoring in chemistry or chemical engineering, for transfer to a four-year institution, or to prepare students for entrance into professional schools in the fields of medicine, pharmacy, or dentistry. Emphasis is on the application of modern principles regarding structure, reactivity, methods of synthesis and physical properties of carbon compounds.

## Student Learning Outcomes

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

- name saturated and unsaturated hydrocarbons, alkyl halides, and alcohols
- analyze the relationship between the molecular structure of an organic molecule and its physical properties and chemical reactivity
- analyze reaction mechanisms to predict products of organic chemistry reactions
- propose reaction mechanisms for common organic chemistry reactions
- identify a compound given its molecular formula, infrared spectrum, and nuclear magnetic resonance (NMR) spectrum
- design multi-step organic syntheses
- analyze organic compounds through the operation of instruments such as the refractometer, Fourier transform infrared spectroscopy (FTIR), nuclear magnetic resonance spectroscopy (NMR), gas chromatography (GC), and polarimeter
- perform laboratory techniques such as separation, synthesis, purification, identification, and characterization of organic compounds utilizing both macro- and micro-scale procedures
- evaluate 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  
Transferable: CSU; UC  
C-ID: Part of C-ID CHEM 160S  
Catalog Date: January 1, 2021

This course covers general physical and chemical properties of aromatic compounds, ethers, carbonyl compounds, amines, carbonyl derivatives, and biological compounds of interest. It also includes mass spectrometry, ultraviolet-visible (UV-VIS) spectroscopy, and carbon-13 nuclear magnetic resonance (NMR). Special attention is given to development of reaction mechanisms, methods of organic synthesis, and instrumental analysis as they apply to organic chemistry.

## Student Learning Outcomes

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

- relate principles of chemical reactions and mechanisms to organic functional groups
- propose reaction mechanisms for common organic chemistry reactions
- plan the synthesis of organic compounds utilizing the specific reactions of functional groups
- describe biochemical processes using organic reactions
- determine the structure of organic compounds by evaluating mass spectra, NMR spectra, UV-VIS, and infrared (IR) spectra
- perform laboratory experiments using both macro- and micro-scale procedures
- evaluate experimental data

## 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: CSU; UC ((CHEM 420 & 423 combined: maximum credit - one course))  
General Education: CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C  
Catalog Date: January 1, 2021

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, Infra Red spectroscopy, and mechanisms of reactions. This course is designed primarily for students majoring in the life sciences, nutrition/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:

- validate structural and bonding theories towards the reactivity of the functional groups of organic chemistry.
- name alkanes, alkenes, alkynes, alcohols, ethers, acids, esters, aldehydes, ketones, amides, amines, and aromatic molecules using the International Union of Pure and Applied Chemistry (IUPAC) system.
- predict mechanisms and intermediates in the understanding of organic reactions.
- identify organic compounds through the interpretation of Infra Red spectral data and degree of unsaturation.
- differentiate between structural isomers, stereoisomers, and resonance forms.
- analyze the effect of reagents, solvents, catalysts, temperature, and pressure in reactions.
- develop the conversion of one organic functional group to another.
- propose route synthesis of simple organic molecules.
- evaluate concepts of organic chemistry towards understanding of biochemistry topics such as carbohydrates, proteins, and lipids.

## CHEM 495 Independent Studies in Chemistry

Units: 1 - 3  
Hours: 54 - 162 hours LAB  
Prerequisite: None  
Transferable: CSU

Catalog Date: January 1, 2021

Independent Study is an opportunity for the student to extend classroom experience in this subject, while working independently of a formal classroom situation. Independent study is an extension of work offered in a specific class in the college catalog. To be eligible for independent study, students must have completed the basic regular catalog course at American River College. They must also discuss the study with a professor in this subject and secure approval. Only one independent study for each catalog course will be allowed.

## CHEM 499 Experimental Offering in Chemistry

Units: 0.5 - 4  
Prerequisite: None.  
Transferable: CSU  
Catalog Date: January 1, 2021

### Faculty

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