

Chemistry**CHEM****Degrees:**

- A.S. – Chemistry
- A.S. – Chemical Technology

Certificate of Achievement:
Chemical Technology
Division of Science and Allied Health

James Collins, Dean
South Gym 220
916-558-2271

Chemistry**Associate in Science Degree****Program Information**

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.

Career Opportunities

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.

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.

Required Program

	Units
CHEM 400 General Chemistry.....	5
CHEM 401 General Chemistry	5
CHEM 420 Organic Chemistry (5)	8-10
and CHEM 421 Organic Chemistry (5)]	
or CHEM 425 Organic Chemistry with Biological Emphasis I (4)	
and CHEM 426 Organic Chemistry with Biological Emphasis II (4)]	

Total Units Required**18-20****Suggested Electives**

MATH 400, 401; PHYS 410, 420, 430; STAT 300

Associate in Science (A.S.) Degree

The Associate in Science 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.

Chemical Technology**Associate in Science Degree****Certificate of Achievement****Program Information**

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.

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.

Career Opportunities

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.

Gainful Employment

For more information about program costs, graduation rates, median debt of program graduates, and other important information regarding gainful employment, please visit: <http://www.losrios.edu/gainful-emp-info/gedt.php?major=051402C02>

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.

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

¹Offered in spring only.

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

Suggested Electives

CHEM 494, COMM 301, 321, 331, 361; ECON 304; ENGWR 300, 301, 302; ESLW 340; HCD 310; STAT 300, 480; WEXP 498

Associate in Science (A.S.) Degree

The Associate in Science 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.

Certificate of Achievement

The Certificate of Achievement may be obtained by completion of the required program with grades of "C" or better.

Chemistry (CHEM)

NOTE: The University of California has a credit restriction on certain combinations of chemistry courses. See a counselor for detailed information on the current UC Articulation Agreement.

CHEM 110 Preparatory Chemistry 2 Units

Prerequisite: None.
Hours: 36 hours LEC

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.

CHEM 299 Experimental Offering in Chemistry .5-4 Units

Prerequisite: None
Hours: 72 hours LEC
See Experimental Offerings

CHEM 300 Beginning Chemistry 4 Units

Prerequisite: MATH 100 with a grade of "C" or better; or placement through the assessment process.

Advisory: Concurrent enrollment in CHEM 317.

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 54 hours LAB

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.

CHEM 305 Introduction to Chemistry 5 Units

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.

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 72 hours LEC; 54 hours LAB

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, 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.

CHEM 306 Introduction to Chemistry 5 Units

Prerequisite: CHEM 305 with a grade of "C" or better

Advisory: ENGWR 101 with a grade of C or better and concurrent enrollment of CHEM 317

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 72 hours LEC; 54 hours LAB

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.

Chemistry Course Sequence

Non-Science Majors

CHEM 320
Environmental
Chemistry

OR

CHEM 330
Adventures in
Chemistry

OR

CHEM 336
Art and
Chemistry

Optional Support Class

CHEM 317
Problem Solving

Supports: CHEM
300, 305, 309,
420, 425

Science Majors

CHEM 300
Beginning Chemistry
OR
Chemistry Diagnostic Exam
within 12 months of
enrollment in CHEM 400

CHEM 400
General
Chemistry

CHEM 401
General
Chemistry

CHEM 420^{a,b}
Organic Chemistry

CHEM 421^{a,b}
Organic Chemistry

CHEM 410
Quantitative
Analysis

CHEM 425^b
Organic Chemistry
with Biological
Emphasis

CHEM 426^b
Organic Chemistry
with Biological
Emphasis

Career-Technical Education

CHEM 326
Water and
Wastewater
Treatment
Chemistry

Allied Health

CHEM 305^c
Introduction to
Chemistry

CHEM 306^c
Introduction to
Chemistry

CHEM 309^c
Integrated General,
Organic & Biological
Chemistry

BIOL 430 or 440
Anatomy & Physiology or Microbiology

CHEM 305 is the minimum pre-requisite.

CHEM 306 or CHEM 309 are strongly
recommended for BIO 440.

BIOL 402
Cell & Molecular
Biology

NOTES:

a Chemistry and Chemical Engineering Majors

b Pre-med, Pharmacy, Dentistry and Pre-vet Majors

c CHEM 309 is recommended if a student would like to take CHEM 306, BUT it has been two or more years since they took CHEM 305.

CHEM 309 Integrated General, Organic, and Biological Chemistry 5 Units

Prerequisite: MATH 100 or 104 with a grade of "C" or better with, or placement through the assessment process.

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C

Course Transferable to UC/CSU

Hours: 72 hours LEC; 54 hours LAB

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.

CHEM 317 Strategies for Problem Solving in Chemistry 1 Unit

Prerequisite: None.

Corequisite: CHEM 300, 305, 306, 309, 420, 421, 425, or 426

Course Transferable to CSU

Hours: 18 hours LEC

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.

CHEM 320 Environmental Chemistry 4 Units

Prerequisite: None.

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 54 hours LAB

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.

CHEM 330 Adventures in Chemistry 4 Units

Prerequisite: None.

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 54 hours LAB

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.

CHEM 336 Art and Chemistry 4 Units

Prerequisite: None.

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 54 hours LAB

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.

CHEM 400 General Chemistry I 5 Units

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.

Advisory: 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.

General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 72 hours LAB; 18 hours DIS

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. (C-ID CHEM 110; Part of C-ID CHEM 120S)

CHEM 401 General Chemistry II 5 Units

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
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 72 hours LAB; 18 hours DIS

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. One hour per week will be devoted to a discussion/problem solving session. 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. (C-ID CHEM 120S; Part of C-ID CHEM 120S)

CHEM 410 Quantitative Analysis 5 Units

Prerequisite: CHEM 401 with a grade of "C" or better
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 108 hours LAB

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.

CHEM 420 Organic Chemistry I 5 Units

Prerequisite: CHEM 401 with a grade of "C" or better.
Advisory: Concurrent enrollment in CHEM 317.
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 108 hours LAB

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. (C-ID CHEM 150; Part of C-ID CHEM 160S)

CHEM 421 Organic Chemistry II 5 Units

Prerequisite: CHEM 420 with a grade of "C" or better
Advisory: CHEM 317 with a grade of "C" or better.
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 108 hours LAB

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 InfraRed Spectroscopy, and Gas Chromatography-Mass Spectroscopy. (C-ID CHEM 160S; Part of C-ID CHEM 160S)

CHEM 425 Organic Chemistry with Biological Emphasis I 4 Units

Prerequisite: CHEM 401 with a grade of "C" or better
Advisory: With concurrent enrollment in CHEM 317.
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 54 hours LAB

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. Lecture topics include the preparation, properties, and reactions of alkanes, alkenes, alkynes, alkyl halides, alcohols, radical chemistry, and ethers with emphasis on applications in the biological sciences. Also included is the study of stereoisomerism, nuclear magnetic resonance spectroscopy, and infrared spectroscopy. Laboratory work covers standard laboratory practices including extraction, crystallization, chromatography (gas, thin layer, and column), polarimetry, organic synthesis, reaction analysis, and Fourier Transform Attenuated Total Reflectance spectroscopy (ATR-IR) with emphasis on biological applications. (Part of C-ID CHEM 160S)

CHEM 426 Organic Chemistry with Biological Emphasis II 4 Units

Prerequisite: CHEM 420 or 425 with a grade of "C" or better
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A

Course Transferable to UC/CSU

Hours: 54 hours LEC; 54 hours LAB

This course, a continuation of CHEM 425, focuses on the preparation, properties, reactions, spectroscopy (IR, C-13 NMR, 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, and proteins) and the organic chemistry of metabolic pathways are also presented. Laboratory work includes qualitative analysis, multi-step organic synthesis, analytical use of instrumentation (ATR-FTIR, GC, and GC-MS), natural product extraction, and instrumental characterization of compounds extracted. (Part of C-ID CHEM 160S)

**CHEM 484 Advanced General Chemistry – 1 Unit
Honors**

Prerequisite: CHEM 400 with a grade of "C" or better
General Education: AAVAS Area IV; CSU Area B1; CSU Area B3
Enrollment Limitation: Eligibility for the Honors Program.
Course Transferable to UC/CSU
Hours: 54 hours LAB

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. One field trip is required for this course.

CHEM 494 Topics in Chemistry .5-3 Units

Prerequisite: Determined by topic
Course Transferable to UC/CSU
Hours: 54 hours LEC

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.

**CHEM 495 Independent Studies in 1-3 Units
Chemistry**

Prerequisite: None.
Course Transferable to UC/CSU
Hours: 162 hours LAB

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.

**CHEM 499 Experimental Offering in .5-4 Units
Chemistry**

Prerequisite: None
Course Transferable to UC/CSU
Hours: 54 hours LEC; 36 hours LAB

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 toward the minimum 60 units required for admissions. See Experimental Offerings.