



### Program

**BS in Chemistry**

**BS in Biochemistry**

**BA in Chemistry**

**American Chemical Society**

**Certificate in Chemistry**

**Minor in Chemistry**

**Pre-professional Programs:**

**Dentistry**

**Medicine**

**Optometry**

**Pharmacy**

**Pre-physical Therapy**

**Single Subject Teaching**

**Credential in Science**

Behind the scenes in almost any area—medicine, transportation, agriculture, the environment, computing, entertainment, law, psychology, and the arts—is an army of chemists and chemical technicians who help prepare materials, analyze evidence, create new substances, and answer the “What is it?” questions that are presented each day. They help clean the environment, cure the ill, convict the guilty, and keep us fed, clothed, sheltered, and healthy. And we will continue to need more of these kinds of services to help clean our environment, defeat the next epidemic, and improve our energy efficiency.

The bachelor's degrees in Chemistry and Biochemistry includes a broad selection of courses in the sciences and in mathematics that provides an excellent background for careers in a wide range of fields in science or teaching, or as preparation for professional schools, especially medicine (including dentistry and pharmacy).

Upon completion of the series of courses prescribed by American Chemical Society guidelines, students may be certified as professional chemists and awarded the American Chemical Society Certificate in Chemistry.

### Faculty and Facilities

The Committee on Professional Training of the American Chemical Society has approved the chemistry faculty, facilities, and curriculum. This is a clear statement of the quality of our program and our graduates to anyone in the field.

The permanent faculty have Ph.D.'s in chemistry, representing the major areas of the science. The small size of most major courses assures students of friendly, close contact with the faculty, allowing for hands-on learning of techniques and instrumentation. Short-term research projects with faculty are accessible to all chemistry students. The Department of Chemistry and Biochemistry is housed in the Physical Science Building and includes nine laboratories and a number of specialized instrument and project rooms.

### Career Outlook

A bachelor's degree in chemistry is the minimum requirement for starting a career as a chemist. Graduate training is necessary for most research and college teaching positions. Nearly two-fifths of all chemists are involved in research and development—extending scientific knowledge and creating new products. Nearly one-fifth work in production and inspection activities. Others work as analysts in forensics or environmental laboratories, professors in colleges and universities, as consultants in industry and government agencies, and marketing or sales representatives.

Growth in demand for industrial products (plastics, man-made fibers, pharmaceuticals, and fertilizers), the recognition of the need for pollution control, and improved health care programs will increase opportunities for chemists. In addition, new and more efficient fuels or fuel cells must be developed to stem energy shortages. Larger enrollments in chemistry education in the future will increase the need for chemists to teach at universities, community colleges, and high schools.

## Chemistry and Biochemistry

College of Natural Sciences  
Interim Dean: Margaret A. Owens

**Department of Chemistry and Biochemistry**

**Physical Science Building 216**

**530-898-5259**

**e-mail: chem@csuchico.edu**

**http://www.csuchico.edu/chem/**

**Chair: Randy Miller**

**Undergraduate Advisors:**

**Assigned by the Chair**

**Credential Advisor: Christopher Nichols**

## The Bachelor of Science in Chemistry

### Total Course Requirements for the Bachelor's Degree: 128 units

See "Requirements for the Bachelor's Degree" in the *University Catalog* for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

A suggested Major Academic Plan (MAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major advisor or view it and other current advising information at <http://em.csuchico.edu/aap/ProgramSearch>.

### General Education Requirements: 48 units

See "General Education Requirements" in the University Catalog and the Class Schedule for the most current information on General Education Requirements and course offerings. The course requirements marked below with an asterisk (\*) may also be applied toward General Education.

### Diversity Course Requirements: 6 units

See "Diversity Requirement" in the University Catalog. Most courses taken to satisfy these requirements may also apply to General Education.

### U.S. History, Constitution, and American Ideals: 6 units

See "U.S. History, Constitution, and American Ideals" under "Bachelor's Degree Requirements". This requirement is normally fulfilled by completing HIST 130 and POLS 155 or approved equivalents. Courses used to satisfy this requirement do not apply to General Education.

### Literacy Requirement:

See "Mathematics and Writing Requirements" in the University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C- are required to repeat the course and earn a C- or better to receive WP credit. See the Class Schedule for the designated WP courses for each semester. You must pass ENGL 130 (or its equivalent) with a C- or better before you may register for a WP course.

### Course Requirements for the Major: 70-72 units

Completion of the following courses, or their approved transfer equivalents, are required of all candidates for this degree. Additional required courses, depending upon the selected option or advising pattern, are outlined following the major core program requirements.

#### Lower-Division Requirements: 36 units

##### Chemistry Requirement: 12 units

###### 3 courses required:

CHEM 111 General Chemistry 4.0 FS \*  
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

CHEM 112 General Chemistry 4.0 FS  
Prerequisites: CHEM 111 with a grade of C- or higher.

CHEM 270 Organic Chemistry 4.0 FS  
Prerequisites: CHEM 112.

##### Mathematics Requirement: 12 units

###### 3 courses required:

MATH 120 Analytic Geometry and Calculus 4.0 FS \*  
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.

MATH 121 Analytic Geometry and Calculus 4.0 FS  
Prerequisites: MATH 120.

MATH 220 Analytic Geometry and Calculus 4.0 FS  
Prerequisites: MATH 121.

##### Physics Requirement: 12 units

###### 3 courses required:

PHYS 204A Mechanics 4.0 FS \*  
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 121 (second semester of calculus) or equivalent.

PHYS 204B Electricity and Magnetism 4.0 FS  
Prerequisites: MATH 121, PHYS 204A with a grade of C- or higher.

PHYS 204C Heat/Wave Motion/Sound/Light 4.0 FS  
Prerequisites: MATH 121, PHYS 204A with a grade of C- or higher.

##### Upper-Division Requirements: 34-36 units

###### 14 courses required:

CHEM 320 Quantitative Analysis 4.0 FS  
Prerequisites: CHEM 112 with a grade of C- or higher..

CHEM 331 Physical Chemistry 3.0 FA  
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B OR PHYS 204A, PHYS 204B, & PHYS 204C.

CHEM 332 Physical Chemistry 3.0 SP  
Prerequisites: CHEM 331.

CHEM 361 Intermediate Inorganic Chem 2.0 FA  
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B or PHYS 204A, PHYS 204B, & PHYS 204C.

CHEM 362 Intermediate Inorganic Chem 2.0 SP  
Prerequisites: CHEM 361.

CHEM 370 Organic Chemistry 3.0 FS  
Prerequisites: CHEM 270 with a grade of C- or higher.

CHEM 370M Organic Chemistry Laboratory 2.0 SP  
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.

CHEM 381 Integrated Chemistry Lab I 3.0 FA WP  
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 270, CHEM 331 (may be taken concurrently), CHEM 361 (may be taken concurrently).

CHEM 382 Integrated Chemistry Lab II 2.0 SP  
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 332.

Corequisites: CHEM 382R.  
CHEM 382R Integrated Chem Discussion 1.0 SP  
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 332.

CHEM 400 Senior Seminar in Chemistry 1.0 SP

CHEM 420 Instrumental Analysis 2.0 FA  
Prerequisites: CHEM 332, CHEM 382.

Corequisites: CHEM 483.

CHEM 451 Biochemistry 3.0 FS  
Prerequisites: CHEM 370 with a grade of C- or higher.

CHEM 483 Integrated Chemistry Lab III 2.0 FA  
Prerequisites: CHEM 381, CHEM 382.

Corequisites: CHEM 420.

#### 1-3 units selected from:

CHEM 398 Special Topics 1.0-3.0 FS

CHEM 399 Special Problems 1.0-3.0 FS  
Prerequisites: CHEM 112, faculty permission.

CHEM 435 Chemical Thermodynamics 3.0 FS  
Prerequisites: CHEM 332.

CHEM 452 Biochemistry 3.0 SP  
Prerequisites: CHEM 451.

CHEM 455L Biochemistry Laboratory 2.0 FS  
Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M; or faculty permission.

CHEM 473 Synthetic Organic Chemistry 1.0-3.0 FA  
Prerequisites: CHEM 370; CHEM 370L or CHEM 370M.

CHEM 474 Physical Organic Chemistry 3.0 SP  
Prerequisites: CHEM 332, CHEM 370.

CHEM 475 Advanced Organic Laboratory 2.0 FS  
Prerequisites: CHEM 370.

CHEM 477 Seminar Organic Spectroscopy 1.0 FS  
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.

CHEM 490 Research in Chemistry 1.0-2.0 FS  
Prerequisites: CHEM 332.

CHEM 491 Research Project 3.0 FA  
Prerequisites: Open by invitation to chemistry majors with a GPA of 3.0 or higher; faculty permission.

CHEM 492 Research Project 3.0 SP  
Prerequisites: CHEM 491. Not open to students who have completed CHEM 499H; faculty permission.

CHEM 495 Selected Topics in Chemistry 1.0-3.0 FS  
Prerequisites: CHEM 332, CHEM 361, CHEM 382, CHEM 420.

CHEM 496 Selected Topics in Chemistry 1.0-3.0 SP  
Prerequisites: CHEM 331, CHEM 370, CHEM 451.

CHEM 499H Honors Research Project 3.0 FS WP  
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 320, CHEM 331, CHEM 332, CHEM 370M, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C; faculty permission.

### Electives Requirement:

To complete the total units required for the bachelor's degree, select additional elective courses from the total University offerings. You should consult with an advisor regarding the selection of courses which will provide breadth to your University experience and possibly apply to a supportive second major or minor.

### Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade except those courses specified by the department as Credit/No Credit grading only.

### Advising Requirement:

Advising is mandatory for all majors in this degree program. Consult your department chair or undergraduate advisor for specific information.

### Honors in the Major

Honors in the Major is a program of independent work in your major. It requires 6 units of honors course work completed over two semesters.

The Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original performance or research project. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the University for submission in professional journals, presentation at conferences, or academic competition. Such experience is valuable for graduate school and professional life. Your honors work will be recognized at your graduation, on your permanent transcripts, and on your diploma. It is often accompanied by letters of commendation from your mentor in the department or the department chair.

Some common features of Honors in the Major program are

1. You must take 6 units of Honors in the Major course work. All 6 units are honors classes (marked by a suffix of H), and at least 3 of these units are independent study (399H, 499H, 599H) as specified by your department. You must complete each class with a minimum grade of B.
2. You must have completed 9 units of upper-division course work or 21 overall units in your major before you can be admitted to Honors in the Major. Check the requirements for your major carefully, as there may be specific courses that must be included in these units.
3. Your cumulative GPA should be at least 3.5 or within the top 5% of majors in your department.
4. Your GPA in your major should be at least 3.5 or within the top 5% of majors in your department.
5. Most students apply for or are invited to participate in Honors in the Major during the second semester of their junior year. Then they complete the 6 units of course work over the two semesters of their senior year.
6. Your honors work culminates with a public presentation of your honors project.

While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your major department or major advisor to apply.

## The Bachelor of Science in Biochemistry

### Total Course Requirements for the Bachelor's Degree: 120 units

See "Requirements for the Bachelor's Degree" in the *University Catalog* for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

A suggested Major Academic Plan (MAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major advisor or view it and other current advising information at <http://em.csuchico.edu/aap/ProgramSearch>.

**Please see General Education, Diversity, U.S. History, Constitution, and American Ideals, and Literacy Requirements under the BS in Chemistry.**

BIOL 151 may be used to fulfill General Education Breadth Area B2.

### Course Requirements for the Major: 73-75 units

Completion of the following courses, or their approved transfer equivalents, are required of all candidates for this degree.

#### Lower-Division Requirements: 36 units

##### 9 courses required:

BIOL 151	Prin of Cell and Molec Biology	4.0	FS
Prerequisites: Recommend CHEM 111 or concurrent enrollment.			
CHEM 111	General Chemistry	4.0	FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)			
CHEM 112	General Chemistry	4.0	FS
Prerequisites: CHEM 111 with a grade of C- or higher.			
CHEM 270	Organic Chemistry	4.0	FS
Prerequisites: CHEM 112.			
MATH 120	Analytic Geometry and Calculus	4.0	FS *
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.			
MATH 121	Analytic Geometry and Calculus	4.0	FS
Prerequisites: MATH 120.			
MATH 220	Analytic Geometry and Calculus	4.0	FS
Prerequisites: MATH 121.			
PHYS 202A	General Physics	4.0	FS *
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 051 and MATH 118 at CSU, Chico).			

PHYS 202B	General Physics	4.0	FS
Prerequisites: PHYS 202A.			

### Upper-Division Requirements: 37-39 units

#### 13 courses required:

BIOL 360	Genetics	4.0	FS
Prerequisites: BIOL 153 or permission of instructor.			
BIOL 371	Microbiology	4.0	FS WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher; BIOL 151, BIOL 152, BIOL 153, or faculty permission.			
CHEM 320	Quantitative Analysis	4.0	FS
Prerequisites: CHEM 112 with a grade of C- or higher..			
CHEM 331	Physical Chemistry	3.0	FA
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B OR PHYS 204A, PHYS 204B, & PHYS 204C.			
CHEM 361	Intermediate Inorganic Chem	2.0	FA
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B or PHYS 204A, PHYS 204B, & PHYS 204C.			
CHEM 370	Organic Chemistry	3.0	FS
Prerequisites: CHEM 270 with a grade of C- or higher.			
CHEM 370M	Organic Chemistry Laboratory	2.0	SP
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.			
CHEM 381	Integrated Chemistry Lab I	3.0	FA WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 270, CHEM 331 (may be taken concurrently), CHEM 361 (may be taken concurrently).			
CHEM 400	Senior Seminar in Chemistry	1.0	SP
CHEM 451	Biochemistry	3.0	FS
Prerequisites: CHEM 370 with a grade of C- or higher.			
CHEM 452	Biochemistry	3.0	SP
Prerequisites: CHEM 451.			
CHEM 455L	Biochemistry Laboratory	2.0	FS
Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M; or faculty permission.			

#### 1 course selected from:

BIOL 411	Cell Biology	4.0	FA
Prerequisites: BIOL 153, BIOL 360.			
BIOL 412	Bacterial Physiology	4.0	SP
Prerequisites: BIOL 371, BIOL 360, CHEM 270. CHEM 451 is recommended.			
BIOL 414	Plant Physiology	4.0	FS
Prerequisites: BIOL 108 or BIOL 153; CHEM 108 or CHEM 270; or faculty permission.			
BIOL 416	Vertebrate Physiology	4.0	FS
Prerequisites: BIOL 152, BIOL 153; CHEM 108 or CHEM 270.			
BIOL 417	Cell Physiology	3.0	SP
Prerequisites: BIOL 153; CHEM 108 or CHEM 270.			
BIOL 464	Medical Genetics	3.0	SP
Prerequisites: BIOL 360.			
BIOL 466	Immunology	4.0	SP
Prerequisites: BIOL 153.			
BIOL 470	Medical Bacteriology	5.0	FA WP
Prerequisites: BIOL 371, BIOL 466, CHEM 270. Immunization against tetanus and diphtheria required.			
BIOL 472	Microbial Genetics	4.0	FA
Prerequisites: BIOL 360. BIOL 371 is recommended.			
BIOL 476	General Virology	4.0	SP
Prerequisites: BIOL 153. Recommended: BIOL 371.			
CHEM 332	Physical Chemistry	3.0	SP
Prerequisites: CHEM 331.			

### Electives Requirement:

To complete the total units required for the bachelor's degree, select additional elective courses from the total University offerings. You should consult with an advisor regarding the selection of courses which will provide breadth to your University experience and possibly apply to a supportive second major or minor.

### Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade except those courses specified by the department as Credit/No Credit grading only.

### Advising Requirement:

Advising is mandatory for all majors in this degree program. Consult your department chair or undergraduate advisor for specific information.

## The Bachelor of Arts in Chemistry

This academic program was approved effective Fall 2009.

### Total Course Requirements for the Bachelor's Degree: 120 units

See "Requirements for the Bachelor's Degree" in the *University Catalog* for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

A suggested Major Academic Plan (MAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major advisor or view it and other current advising information at <http://em.csuchico.edu/aap/ProgramSearch>.

This degree is appropriate for students pursuing single subject matter preparation in science with a concentration in chemistry. This degree is also an excellent preparation for students considering chemistry-related interdisciplinary fields. Students who choose this program should consult with their major advisor.

Please see **General Education, Diversity, U.S. History, Constitution, and American Ideals, and Literacy Requirements under the BS in Chemistry.**

### Course Requirements for the Major: 58-64 units

Completion of the following courses, or their approved transfer equivalents, are required of all candidates for this degree.

#### Lower-Division Requirements: 32-36 units

##### 6 courses required:

CHEM 111	General Chemistry	4.0	FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)			
CHEM 112	General Chemistry	4.0	FS
Prerequisites: CHEM 111 with a grade of C- or higher.			
CHEM 270	Organic Chemistry	4.0	FS
Prerequisites: CHEM 112.			
MATH 120	Analytic Geometry and Calculus	4.0	FS *
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.			
MATH 121	Analytic Geometry and Calculus	4.0	FS
Prerequisites: MATH 120.			
MATH 220	Analytic Geometry and Calculus	4.0	FS
Prerequisites: MATH 121.			

##### 2-3 courses selected from:

PHYS 202A	General Physics	4.0	FS *
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 051 and MATH 118 at CSU, Chico).			
PHYS 202B	General Physics	4.0	FS
Prerequisites: PHYS 202A.			

Or the following group of course requirements may be substituted for the above:

PHYS 204A	Mechanics	4.0	FS *
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 121 (second semester of calculus) or equivalent.			
PHYS 204B	Electricity and Magnetism	4.0	FS
Prerequisites: MATH 121, PHYS 204A with a grade of C- or higher.			
PHYS 204C	Heat/Wave Motion/Sound/Light	4.0	FS
Prerequisites: MATH 121, PHYS 204A with a grade of C- or higher.			

**Note:** One full sequence (PHYS 202AB or PHYS 204ABC) must be completed.

### Upper-Division Requirements: 26-28 units

##### 8 courses required:

CHEM 320	Quantitative Analysis	4.0	FS
Prerequisites: CHEM 112 with a grade of C- or higher..			
CHEM 331	Physical Chemistry	3.0	FA
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B OR PHYS 204A, PHYS 204B, & PHYS 204C.			
CHEM 361	Intermediate Inorganic Chem	2.0	FA
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B or PHYS 204A, PHYS 204B, & PHYS 204C.			
CHEM 370	Organic Chemistry	3.0	FS
Prerequisites: CHEM 270 with a grade of C- or higher.			
CHEM 370M	Organic Chemistry Laboratory	2.0	SP
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.			
CHEM 381	Integrated Chemistry Lab I	3.0	FA WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 270, CHEM 331 (may be taken concurrently), CHEM 361 (may be taken concurrently).			
CHEM 400	Senior Seminar in Chemistry	1.0	SP
CHEM 451	Biochemistry	3.0	FS
Prerequisites: CHEM 370 with a grade of C- or higher.			

##### 1 course selected from:

CHEM 332	Physical Chemistry	3.0	SP
Prerequisites: CHEM 331.			
CHEM 362	Intermediate Inorganic Chem	2.0	SP
Prerequisites: CHEM 361.			
CHEM 452	Biochemistry	3.0	SP
Prerequisites: CHEM 451.			
CHEM 455L	Biochemistry Laboratory	2.0	FS
Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M; or faculty permission.			

##### 1 course selected from:

CHEM 411	Chemistry Teaching Methods	3.0	SP
Prerequisites: CHEM 112, CHEM 270. CHEM 320 is recommended.			
CHEM 440	Environmental Chemistry	3.0	SP
Prerequisites: CHEM 112.			

**Note:** With permission of the Department of Chemistry and Biochemistry, other courses may be substituted.

### Electives Requirement:

To complete the total units required for the bachelor's degree, select additional elective courses from the total University offerings. You should consult with an advisor regarding the selection of courses which will provide breadth to your University experience and possibly apply to a supportive second major or minor.

### Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade except those courses specified by the department as Credit/No Credit grading only.

## American Chemical Society Certificate in Chemistry

### Course Requirements for the Certificate: 73 units

The following courses, or their approved transfer equivalents, are required of all candidates for this certificate.

Students who complete this program will be awarded a degree in chemistry which will be certified by the American Chemical Society as well as a certificate from CSU, Chico. (Note: ACS requirements change only rarely, but interested students should verify requirements with the Chair of the Department of Chemistry and Biochemistry.) Current requirements include the BS in Chemistry and the following 3 units.

##### 3 units selected from:

CHEM 473	Synthetic Organic Chemistry	1.0-3.0	FA
Prerequisites: CHEM 370; CHEM 370L or CHEM 370M.			
CHEM 474	Physical Organic Chemistry	3.0	SP
Prerequisites: CHEM 332, CHEM 370.			
CHEM 475	Advanced Organic Laboratory	2.0	FS
Prerequisites: CHEM 370.			
CHEM 452	Biochemistry	3.0	SP
Prerequisites: CHEM 451.			
CHEM 455L	Biochemistry Laboratory	2.0	FS
Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M; or faculty permission.			
CHEM 490	Research in Chemistry	1.0-2.0	FS
Prerequisites: CHEM 332.			
CHEM 491	Research Project	3.0	FA
Prerequisites: Open by invitation to chemistry majors with a GPA of 3.0 or higher; faculty permission.			
CHEM 492	Research Project	3.0	SP
Prerequisites: CHEM 491. Not open to students who have completed CHEM 499H; faculty permission.			
CHEM 499H	Honors Research Project	3.0	FS WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 320, CHEM 331, CHEM 332, CHEM 370M, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C; faculty permission.			

With permission of the Chemistry and Biochemistry Department, other courses may be substituted.

## Pre-Professional Programs

### Pre-Dentistry: 34 units recommended

Entrance into dental school requires from two to four years of pre-dental training. Ordinarily a pre-dental student should plan on pursuing a bachelor's degree program. It is not necessary that this degree be in one of the sciences.

Highlighted text indicates a change from the original publication.

Details about entrance requirements differ considerably from one dental school to another. Further information should be sought from one of the pre-dental advisors and from the booklet entitled, *Entrance Requirements of American Dental Schools*.

The following list represents the California State University equivalent of the requirements and recommendations common to practically all of the American Dental Schools.

**Recommended Courses**

BIOL 151	Prin of Cell and Molec Biology	4.0	FS
Prerequisites: Recommend CHEM 111 or concurrent enrollment.			
BIOL 152	Prin Ecol, Evol, Org Biology	4.0	SP
Prerequisites: BIOL 151 or faculty permission; recommend CHEM 112 or concurrent enrollment.			
CHEM 111	General Chemistry	4.0	FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)			
CHEM 112	General Chemistry	4.0	FS
Prerequisites: CHEM 111 with a grade of C- or higher.			
CHEM 270	Organic Chemistry	4.0	FS
Prerequisites: CHEM 112.			
CHEM 370	Organic Chemistry	3.0	FS
Prerequisites: CHEM 270 with a grade of C- or higher.			
ENGL 130	Academic Writing	3.0	FS *
Prerequisites: English Placement Test.			
PHYS 202A	General Physics	4.0	FS *
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 051 and MATH 118 at CSU, Chico).			
PHYS 202B	General Physics	4.0	FS
Prerequisites: PHYS 202A.			

**Pre-Medicine**

It is recommended that pre-medical students plan to obtain a degree in a field of science, such as chemistry or biology. While students may apply for admission to medical school any time after their junior year, the majority of those admitted have completed a four-year degree, and a sizable number are admitted only after additional graduate work. The bachelors degree in Chemistry or Biochemistry, therefore, is also appropriate for those seeking advanced training in graduate schools or employment in fields related to medicine. See also the Pre-Medicine program under Biological Sciences.

**Lower-Division Courses**

BIOL 151	Prin of Cell and Molec Biology	4.0	FS
Prerequisites: Recommend CHEM 111 or concurrent enrollment.			
BIOL 152	Prin Ecol, Evol, Org Biology	4.0	SP
Prerequisites: BIOL 151 or faculty permission; recommend CHEM 112 or concurrent enrollment.			
CHEM 111	General Chemistry	4.0	FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)			
CHEM 112	General Chemistry	4.0	FS
Prerequisites: CHEM 111 with a grade of C- or higher.			
CHEM 270	Organic Chemistry	4.0	FS
Prerequisites: CHEM 112.			
MATH 120	Analytic Geometry and Calculus	4.0	FS *
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.			
MATH 121	Analytic Geometry and Calculus	4.0	FS
Prerequisites: MATH 120.			
PHYS 202A	General Physics	4.0	FS *
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 051 and MATH 118 at CSU, Chico).			
PHYS 202B	General Physics	4.0	FS
Prerequisites: PHYS 202A.			

**Upper-Division Courses**

CHEM 320	Quantitative Analysis	4.0	FS
Prerequisites: CHEM 112 with a grade of C- or higher..			
CHEM 370	Organic Chemistry	3.0	FS
Prerequisites: CHEM 270 with a grade of C- or higher.			
CHEM 370L	Organic Chem Laboratory	1.0	FS
Prerequisites: CHEM 370 may be taken as a prerequisite or concurrently with CHEM 370L.			
CHEM 451	Biochemistry	3.0	FS
Prerequisites: CHEM 370 with a grade of C- or higher.			

**Recommended Upper-Division Electives**

BIOL 360	Genetics	4.0	FS
Prerequisites: BIOL 153 or permission of instructor.			
BIOL 416	Vertebrate Physiology	4.0	FS
Prerequisites: BIOL 152, BIOL 153; CHEM 108 or CHEM 270.			
BIOL 426	Embryology	4.0	SP
Prerequisites: BIOL 152, BIOL 153, or faculty permission.			

BIOL 430	Comparative Anat: Vertebrates	4.0	FA
Prerequisites: BIOL 152, BIOL 153.			

**Pre-Optometry**

The requirements for optometry schools vary widely. The student should see the pre-optometry advisor in the Department of Chemistry and Biochemistry and the catalog of the school of his/her choice. The prospective student is encouraged to consult the Department Chair for further information.

**Pre-Pharmacy**

The requirements for pharmacy schools vary widely. The student should see the pre-pharmacy advisor in the Department of Chemistry and Biochemistry and the catalog of the school of his/her choice. The prospective student is encouraged to consult the Department Chair for further information.

**Pre-Physical Therapy**

See the listings under Biological Sciences.

**Forensic Science and Graduate Programs in Criminalistics**

Entry-level employment and graduate programs in criminalistics commonly require a major in one of the physical or biological sciences, including a year of general chemistry and a course in quantitative analysis. Please see the Anthropology section for a program in Forensic Identification.

**The Minor in Chemistry**

**Course Requirements for the Minor: 23 units**

The following courses, or their approved transfer equivalents, are required of all candidates for this minor.

**Lower-Division Courses: 12 units**

**3 courses required:**

CHEM 111	General Chemistry	4.0	FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)			
CHEM 112	General Chemistry	4.0	FS
Prerequisites: CHEM 111 with a grade of C- or higher.			
CHEM 270	Organic Chemistry	4.0	FS
Prerequisites: CHEM 112.			

**Upper-Division Courses: 11 units**

**3 courses required:**

CHEM 320	Quantitative Analysis	4.0	FS
Prerequisites: CHEM 112 with a grade of C- or higher..			
CHEM 370	Organic Chemistry	3.0	FS
Prerequisites: CHEM 270 with a grade of C- or higher.			
CHEM 370L	Organic Chem Laboratory	1.0	FS
Prerequisites: CHEM 370 may be taken as a prerequisite or concurrently with CHEM 370L.			

**3 units selected from:**

CHEM 331	Physical Chemistry	3.0	FA
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B OR PHYS 204A, PHYS 204B, & PHYS 204C.			
CHEM 347	Radiation/Radioisotopes	1.0-3.0	FS
Prerequisites: Completion of 4 units of physics or physical science and 5 units of chemistry.			
CHEM 360	Descriptive Inorganic Chem	3.0	Inq
Prerequisites: CHEM 112.			
CHEM 398	Special Topics	1.0-3.0	FS
CHEM 399	Special Problems	1.0-3.0	FS
Prerequisites: CHEM 112, faculty permission.			
CHEM 411	Chemistry Teaching Methods	3.0	SP
Prerequisites: CHEM 112, CHEM 270. CHEM 320 is recommended.			
CHEM 440	Environmental Chemistry	3.0	SP
Prerequisites: CHEM 112.			
CHEM 445	Environmental Toxicology	2.0	SP
Prerequisites: CHEM 108 or CHEM 270.			
CHEM 451	Biochemistry	3.0	FS
Prerequisites: CHEM 370 with a grade of C- or higher.			
CHEM 475	Advanced Organic Laboratory	2.0	FS
Prerequisites: CHEM 370.			
CHEM 477	Seminar Organic Spectroscopy	1.0	FS
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.			
CHEM 491	Research Project	3.0	FA
Prerequisites: Open by invitation to chemistry majors with a GPA of 3.0 or higher; faculty permission.			

## The Single Subject Matter Preparation Program in Science With a Concentration in Chemistry

Note: At the time of catalog publication, this program is under review at the California State University Chancellor's Office and the California Commission on Teacher Credentialing. Please contact the Chemistry and Biochemistry Department Office at (530)898-5259, PHSC 216, about the current status.

### Course requirements for the Single Subject Matter Preparation Program, 72-86 units, in conjunction with the Professional Education Program, leads to a Single Subject Teaching Credential.

In most majors, candidates for this credential will normally fulfill the single subject matter preparation program by completing the appropriate education option in the major. Any exceptions to this procedure are noted at the end of this section. In addition to the single subject matter preparation program, completion of an additional professional education program is required to qualify for a California teaching credential. Professional education (credential) programs are available through the School of Education. For prerequisites and other admission requirements to professional education programs, see the "Education" chapter of this catalog.

Your departmental credential advisor is responsible for verifying that the subject matter preparation program has been completed. If you are interested in obtaining a teaching credential, confer with the appropriate credential advisor early in your University career. Department credential advisors can assist you in planning an educational program that meets both major and credential requirements.

Subject matter preparation requirements are governed by state legislative action and approval of the California Commission on Teacher Credentialing. Requirements may change between catalogs. Please consult with your departmental credential advisor for current information.

**Completion of one of the degree programs, the BA in Chemistry, BS in Chemistry or the BS in Biochemistry, and the additional courses listed below, along with a professional education program, fulfills all requirements for the single subject matter preparation program in science with a concentration in chemistry.**

#### 5 courses required:

BIOL	151	Prin of Cell and Molec Biology	4.0	FS
Prerequisites: Recommend CHEM 111 or concurrent enrollment.				
BIOL	152	Prin Ecol, Evol, Org Biology	4.0	SP
Prerequisites: BIOL 151 or faculty permission; recommend CHEM 112 or concurrent enrollment.				
CHEM	411	Chemistry Teaching Methods	3.0	SP
Prerequisites: CHEM 112, CHEM 270. CHEM 320 is recommended.				
GEOS	102	Physical Geology	3.0	FS *
Prerequisites: High school chemistry or physics is recommended; students with no previous science courses are advised to enroll in GEOS 101. No college credit for those who have passed GEOS 101.				
GEOS	300	Earth System Science	3.0	FA WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher; CHEM 107 or CHEM 111; PHYS 202A, PHYS 202B or PHYS 204A, PHYS 204B or PHYS 204C.				

#### The Faculty

**David B. Ball**, 1974, Professor, PhD, UC Santa Barbara.  
**Daniel D. Clark**, 2005, Assist Professor, PhD, Utah State U.  
**Daniel J. Edwards**, 2005, Assist Professor, PhD, UC Davis.  
**Randy M. Miller**, 1988, Chair, Professor, PhD, UC Davis.  
**Christopher J. Nichols**, 1999, Assoc Professor, PhD, UCLA.  
**Lisa S. Ott**, 2008, Assist Professor, PhD, Colorado State U.  
**James M. Postma**, 1982, Professor, PhD, UC Davis.  
**Erik C. Wasinger**, 2007, Assist Professor, PhD, Stanford U.  
**Jinsong Zhang**, 2006, Assist Professor, PhD, U Montana.

#### Emeritus Faculty

**Donald B. Alger**, 1968, Professor Emeritus, PhD, Washington State U.  
**Larry L. Kirk**, 1981, Professor Emeritus, PhD, UC Santa Barbara.  
**Barbara Oviedo Mejia**, 1973, Professor Emerita, PhD, UC Davis.  
**Rodney H. Quacchia**, 1969, Professor Emeritus, PhD, U Washington.

## Chemistry Course Offerings

Please see the section on "Course Description Symbols and Terms" in the University Catalog for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All

courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

#### CHEM 100 Chemistry and Current Issues 3.0 Fa/Spr

Designed for non-science majors, this course will examine contemporary science issues and use this context to provide an understanding of the basic chemical processes that govern our lives. Students will learn how scientists study chemical processes, decipher them, and develop them to meet our needs. The importance of the relationship between science and technology and the public's understanding of these issues will also be explored. 2.0 hours activity, 2.0 hours lecture. This is an approved General Education course. (001819)

#### CHEM 105 Nursing Chemistry 4.0 Fall

Prerequisites: Previous chemistry course recommended.  
 A brief introduction of the general principles of chemistry specifically related to nursing, followed by a brief survey of organic and biochemistry with an emphasis on practical applications to the nursing profession. A completely online course for experienced nurses completing a BS in Nursing. (001825)

#### CHEM 107 General Chemistry for Applied Sciences 4.0 Fa/Spr

Prerequisites: Intermediate Algebra.  
 A survey of the principles of chemistry, primarily for students in agriculture, industry and technology, and pre-nursing. 3.0 hours laboratory, 3.0 hours lecture. This is an approved General Education course. (001826)

#### CHEM 107X General Chemistry Problem Session 1.0 Fa/Spr

Corequisites: CHEM 107.  
 Designed to supplement CHEM 107 with additional applications of general chemistry for applied sciences. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. (001827)

#### CHEM 108 Organic Chemistry for Applied Sciences 4.0 Fa/Spr

Prerequisites: CHEM 107 or CHEM 111 or equivalent.  
 A survey of organic chemistry primarily for agriculture, industry and technology, and pre-nursing students. 3.0 hours laboratory, 3.0 hours lecture. (001828)

#### CHEM 111 General Chemistry 4.0 Fa/Spr

Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)  
 Principles of chemistry for students in science, medical, and related professions. Atomic structure, chemical bonding, stoichiometry, periodic table, gases, solids, liquids, solutions, and equilibrium. 3.0 hours laboratory, 3.0 hours lecture. This is an approved General Education course. (001816)

#### CHEM 111X General Chemistry Problem Session 1.0 Fa/Spr

Corequisites: CHEM 111.  
 Designed to supplement CHEM 111 with additional applications of general chemistry. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. (001830)

#### CHEM 112 General Chemistry 4.0 Fa/Spr

Prerequisites: CHEM 111 with a grade of C- or higher.  
 A continuation of CHEM 111. Chemical energetics, rates of reaction, acids and bases, solubility, oxidation-reduction, and nuclear chemistry. 3.0 hours laboratory, 3.0 hours lecture. (001817)

#### CHEM 112X General Chemistry Problem Session 1.0 Fa/Spr

Corequisites: CHEM 112.  
 Designed to supplement CHEM 112 with additional applications of general chemistry. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. (001832)

#### CHEM 180 Scientific Glass Blowing 1.0 Spring

Prerequisites: CHEM 107 or CHEM 111.  
 Instruction and practice in scientific glass-blowing. 3.0 hours laboratory. Credit/no credit grading only. (001839)

#### CHEM 270 Organic Chemistry 4.0 Fa/Spr

Prerequisites: CHEM 112.  
 An introduction to the theory and mechanism of organic reactions. To be followed by CHEM 370, which completes the two-semester sequence for science majors. 3.0 hours laboratory, 3.0 hours lecture. (001840)

<b>CHEM 320</b>	<b>Quantitative Analysis</b>	<b>4.0 Fa/Spr</b>
Prerequisites: CHEM 112 with a grade of C- or higher. Precision and accuracy in measurements, interpretation of data by statistical analysis, and development of good quantitative techniques. Analysis by gravimetry, titrimetry, potentiometry, chromatography, and spectrometry. 2.0 hours discussion, 6.0 hours laboratory. (001847)		
<b>CHEM 331</b>	<b>Physical Chemistry</b>	<b>3.0 Fall</b>
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B OR PHYS 204A, PHYS 204B, & PHYS 204C. Thermodynamics of solids, liquids, gases, and solutions; electrochemistry, kinetics, chemical equilibria, introduction to quantum mechanics, and chemical statistics. (001882)		
<b>CHEM 332</b>	<b>Physical Chemistry</b>	<b>3.0 Spring</b>
Prerequisites: CHEM 331. A continuation of CHEM 331. (001883)		
<b>CHEM 345</b>	<b>Toxicology</b>	<b>1.0 Spring</b>
Prerequisites: CHEM 108 or CHEM 270. A brief introduction to the principles of toxicology and presentation of facts about current issues related to toxic substances. (001879)		
<b>CHEM 347</b>	<b>Radiation and Radioisotopes</b>	<b>1.0–3.0 Fa/Spr</b>
Prerequisites: Completion of 4 units of physics or physical science and 5 units of chemistry. This course is a special topic offered for 1.0-3.0 units. You must register directly with a supervising faculty member. Radiochemical techniques, detection, and measurement of radiation, or radiation safety. You may take this course more than once for a maximum of 3.0 units. (001862)		
<b>CHEM 350</b>	<b>Introductory Biochemistry</b>	<b>3.0 Fa/Spr</b>
Prerequisites: CHEM 108. A survey of biochemistry, principally for agriculture, child development, and nursing students. Normally not open to chemistry or biological sciences majors. (001849)		
<b>CHEM 350L</b>	<b>Introductory Biochemistry Laboratory</b>	<b>1.0 Fa/Spr</b>
Prerequisites: Concurrent enrollment in or prior completion of CHEM 350. Fundamental laboratory studies and examination of the major classes of biological compounds. Principally for agriculture, child development, and nursing students. Normally not open to chemistry or biological sciences majors. 3.0 hours laboratory. (001850)		
<b>CHEM 360</b>	<b>Descriptive Inorganic Chemistry</b>	<b>3.0 Inquire</b>
Prerequisites: CHEM 112. A systematic study of inorganic substances, with emphasis on environmental aspects of the chemical behavior of the elements and their compounds. (001848)		
<b>CHEM 361</b>	<b>Intermediate Inorganic Chemistry</b>	<b>2.0 Fall</b>
Prerequisites: CHEM 320, MATH 220; PHYS 202A & PHYS 202B or PHYS 204A, PHYS 204B, & PHYS 204C. Emphasis on description and theory of inorganic substances. Atomic structure, ionic and covalent bonding, acid-base concepts of inorganic substances, structure, bonding, thermodynamics, and reaction mechanisms of transition metal complexes. (001887)		
<b>CHEM 362</b>	<b>Intermediate Inorganic Chemistry</b>	<b>2.0 Spring</b>
Prerequisites: CHEM 361. A continuation of CHEM 361. (001888)		
<b>CHEM 370</b>	<b>Organic Chemistry</b>	<b>3.0 Fa/Spr</b>
Prerequisites: CHEM 270 with a grade of C- or higher. Lecture continuation of the theory and mechanisms of organic reaction. (001852)		
<b>CHEM 370L</b>	<b>Organic Chemistry Laboratory</b>	<b>1.0 Fa/Spr</b>
Prerequisites: CHEM 370 may be taken as a prerequisite or concurrently with CHEM 370L. Laboratory continuation of the theory and mechanisms of organic reactions. Completes the two-semester sequence for science majors. 3.0 hours laboratory. (001856)		
<b>CHEM 370M</b>	<b>Organic Chemistry Laboratory</b>	<b>2.0 Spring</b>
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370. Laboratory continuation of the theory and mechanisms of organic reactions. Completes the two-semester sequence for chemistry majors. 6.0 hours laboratory. (001853)		
<b>CHEM 381</b>	<b>Integrated Chemistry Laboratory I</b>	<b>3.0 Fall</b>
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 270, CHEM 331 (may be taken concurrently), CHEM 361 (may be taken concurrently). Integrated application of concepts and techniques in analytical, inorganic, and physical chemistry with supervised studies in individual literature searches, including the use of Chemical Abstracts, Patent Indexes, and other reference compilations. 2.0 hours activity, 6.0 hours laboratory. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors. (001885)		
<b>CHEM 382</b>	<b>Integrated Chemistry Laboratory II</b>	<b>2.0 Spring</b>
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 332. Corequisites: CHEM 382R. A continuation of CHEM 381. 6.0 hours laboratory. (001886)		
<b>CHEM 382R</b>	<b>Integrated Chemistry Discussion</b>	<b>1.0 Spring</b>
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 332. Integrated applications of concepts and techniques in analytical, inorganic, and physical chemistry. (015868)		
<b>CHEM 390</b>	<b>Special Problems in Science Education</b>	<b>1.0–3.0 Fa/Spr</b>
Prerequisites: CHEM 111, faculty permission. This course is a supervised study in science outreach to K-14 schools and is offered for 1.0-3.0 units. You must register with a supervising faculty member. 3.0 hours supervision. You may take this course more than once for a maximum of 3.0 units. Credit/no credit grading only. (001866)		
<b>CHEM 398</b>	<b>Special Topics</b>	<b>1.0–3.0 Fa/Spr</b>
This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See the Class Schedule for the specific topic being offered. (001872)		
<b>CHEM 399</b>	<b>Special Problems</b>	<b>1.0–3.0 Fa/Spr</b>
Prerequisites: CHEM 112, faculty permission. This course is an independent study of special problems and is offered for 1.0-3.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units. Credit/no credit grading only. (001873)		
<b>CHEM 400</b>	<b>Senior Seminar in Chemistry</b>	<b>1.0 Spring</b>
Presentation and discussion of topics from chemical literature. 2.0 hours activity. (001869)		
<b>CHEM 411</b>	<b>Chemistry Teaching Methods</b>	<b>3.0 Spring</b>
Prerequisites: CHEM 112, CHEM 270. CHEM 320 is recommended. This is a special course for science majors and minors who plan on pursuing a career in chemistry education at the secondary school level. Topics include laboratory and stockroom management, planning and running high school-level chemistry laboratory experiments, and mastery of chemistry content related to the high school curriculum. Students also have the opportunity to function as teaching assistants in lower-division chemistry laboratories. 2.0 hours activity, 2.0 hours lecture. (020153)		
<b>CHEM 420</b>	<b>Instrumental Analysis</b>	<b>2.0 Fall</b>
Prerequisites: CHEM 332, CHEM 382. Corequisites: CHEM 483. Theory and procedures used in separations and instrumental analysis. (001892)		
<b>CHEM 425</b>	<b>Basic Instrumental Analysis</b>	<b>3.0 Spring</b>
Prerequisites: CHEM 111, CHEM 112. Basic theory and practices of analytical instruments. Care and use of instruments; interpretation of results. 2.0 hours activity, 2.0 hours discussion. (001904)		
<b>CHEM 435</b>	<b>Chemical Thermodynamics</b>	<b>3.0 Fa/Spr</b>
Prerequisites: CHEM 332. Principles of thermodynamics, application to methods in chemical problems, introduction to the use of statistical thermodynamics, and calculations of thermodynamic functions from spectroscopic data. (001924)		
<b>CHEM 440</b>	<b>Environmental Chemistry</b>	<b>3.0 Spring</b>
Prerequisites: CHEM 112. A general study of the chemistry of the geosphere, hydrosphere, and atmosphere; special focus on the sources and fates of inorganic environmental pollutants. (001881)		

## Chemistry and Biochemistry

### CHEM 445 Environmental Toxicology 2.0 Spring

Prerequisites: CHEM 108 or CHEM 270.

A brief introduction to the principles of toxicology and presentation of facts about current issues related to toxic substances, with special expanded emphasis on environmental aspects of topics presented in CHEM 345. (001880)

### CHEM 451 Biochemistry 3.0 Fa/Spr

Prerequisites: CHEM 370 with a grade of C- or higher.

A general study of the chemistry of biomolecules. Conformation and function of enzymes and other proteins; metabolism, energy generation, and storage; brief discussion of chemistry of DNA replication, transcription and translation, and of important physiological processes. (001900)

### CHEM 452 Biochemistry 3.0 Spring

Prerequisites: CHEM 451.

Advanced topics in biochemistry. Biosynthesis of lipids, steroids, amino acids, and nucleotides. Comprehensive study of the chemical role of DNA and RNA in replication, transcription, protein synthesis, and viral activity. (001901)

### CHEM 455L Biochemistry Laboratory 2.0 Fa/Spr

Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M; or faculty permission.

Separation, identification, and/or analysis of biological materials by modern procedures, such as spectrophotometry, chromatography (gas, paper, TLC, column, ion exchange), electrophoresis, enzymology, fluorimetry, and high-speed centrifugation. 6.0 hours laboratory. (001902)

### CHEM 473 Synthetic Organic Chemistry 1.0–3.0 Fall

Prerequisites: CHEM 370; CHEM 370L or CHEM 370M.

This course is offered for 1.0-3.0 units. Modern synthetic reactions and processes, with emphasis on rearrangement reactions, stereospecific methods, and synthetic design. You may take this course more than once for a maximum of 3.0 units. (001895)

### CHEM 474 Physical Organic Chemistry 3.0 Spring

Prerequisites: CHEM 332, CHEM 370.

Resonance and orbital theory; mechanisms, kinetics, and thermodynamics of organic reactions. (001893)

### CHEM 475 Advanced Organic Laboratory 2.0 Fa/Spr

Prerequisites: CHEM 370.

Application of modern techniques and spectroscopy in organic synthesis, product identification, reaction mechanisms, and natural product chemistry. 6.0 hours laboratory. (001860)

### CHEM 477 Seminar in Organic Spectroscopy 1.0 Fa/Spr

Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.

Solving problems in organic chemistry using NMR, IR, UV, and mass spectral analysis. (001905)

### CHEM 483 Integrated Chemistry Lab III 2.0 Fall

Prerequisites: CHEM 381, CHEM 382.

Corequisites: CHEM 420.

A continuation of CHEM 382 with a special emphasis on special projects and instrumentation. 6.0 hours laboratory. (001889)

### CHEM 490 Research in Chemistry 1.0–2.0 Fa/Spr

Prerequisites: CHEM 332.

This course is an independent study offered for 1.0-2.0 units. You must register directly with a supervising faculty member. Original laboratory or library investigation under individual faculty supervision. You may take this course more than once for a maximum of 4.0 units. (001875)

### CHEM 491 Research Project 3.0 Fall

Prerequisites: Open by invitation to chemistry majors with a GPA of 3.0 or higher; faculty permission.

A research project within chemistry or an interdisciplinary project which involves chemistry. Students will be involved with design, library, laboratory, and data analysis aspects of a research problem. (001921)

### CHEM 492 Research Project 3.0 Spring

Prerequisites: CHEM 491. Not open to students who have completed CHEM 499H; faculty permission.

A continuation of CHEM 491. (001922)

### CHEM 495 Selected Topics in Physical, Analytical, Inorganic Chemistry 1.0–3.0 Fa/Spr

Prerequisites: CHEM 332, CHEM 361, CHEM 382, CHEM 420.

This course is a special topic offered for 1.0-3.0 units. You must register directly with a supervising faculty member. Presentation of topics of current interest, such as in Physical: theories of x-ray diffraction, spectroscopy, NMR, etc.; Inorganic: reaction mechanisms, non-aqueous solvents; Analytical: ion exchange, selective ion electrodes. Three-hour laboratory optional. You may take this course more than once for a maximum of 3.0 units. (001914)

### CHEM 496 Selected Topics in Organic and Biochemistry 1.0–3.0 Spring

Prerequisites: CHEM 331, CHEM 370, CHEM 451.

This course is a special topic offered for 1.0-3.0 units. You must register directly with a supervising faculty member. Presentation of topics of current interest, such as in Organic: heterocyclic, polymer, organometallic, and natural product chemistry; Biochemistry: biosynthesis and metabolism, enzymes, biophysical chemistry, and bioenergetics. You may take this course more than once for a maximum of 2.0 units. (001918)

### CHEM 499H Honors Research Project 3.0 Fa/Spr

Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 320, CHEM 331, CHEM 332, CHEM 370M, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C; faculty permission.

Open by invitation to chemistry majors who have a GPA of 3.5 or higher. Not open to students who have credit for CHEM 491 or CHEM 492. This is an "Honors in the Major" course. You may take this course more than once for a maximum of 6.0 units. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors. ABC/no credit grading only. (001927)

### CHEM 600 Special Topics in Chemistry 1.0–3.0 Fa/Spr

Prerequisites: CHEM 331, CHEM 332, faculty permission.

This course is a special topic offered for 1.0-3.0 units. Students must register directly with a supervising faculty member. Presentation of selected topics of current interest, with emphasis on recent developments. You may take this course more than once for a maximum of 3.0 units. (001928)

### CHEM 610 Chemistry Seminar 1.0 Fa/Spr

Presentation and discussion of reports on current literature and special studies in chemistry. (001949)

### CHEM 697 Independent Study 1.0–4.0 Fa/Spr

Prerequisites: Faculty permission.

This course is a graduate-level independent study offered for 1.0-4.0 units. You must register directly with a supervising faculty member. Investigation involving scientific literature and laboratory or field experimentation. Maximum of 8 units of credit may be used for a master's degree. You may take this course more than once for a maximum of 6.0 units. (001950)

### CHEM 699T Master's Thesis 1.0–6.0 Fa/Spr

This course is offered for 1.0-6.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units. (001951)