

**OFFICE: Geology/Mathematics/Computer Science 209**  
**TELEPHONE: (619) 594-5595 / FAX: (619) 594-4634**  
**E-MAIL: cheminfo@sciences.sdsu.edu**  
<http://www.sci.sdsu.edu/chemistry>

# Chemistry

In the College of Sciences

Accredited by the American Chemical Society.

## Faculty

Emeritus: Abbott, Bennett, Cobble, Grubbs, Hellberg, Isensee, Jensen, Jones, Joseph, Landis, Lebherz, Malik, Mathewson, O'Neal, Richardson, Ring, Stewart, Walba, Woodson  
Chair: Carrano  
Professors: Carrano, Dahms, Grotjahn, Metzger, Roeder, Stumph, Tong  
Associate Professors: Chatfield, Cole, Cooksy, Pullman, Smith  
Assistant Professors: Bergdahl, Burkey, Liang, Love, McAlpine, Roehrig, Sun

## Offered by the Department of Chemistry and Biochemistry

Doctor of Philosophy degree in chemistry.  
Master of Arts degree in chemistry.  
Master of Science degree in chemistry.  
Major in chemical physics with the B.S. degree in applied arts and sciences.  
Major in chemistry with the B.S. degree in applied arts and sciences with the Certificate of the American Chemical Society.  
    Emphasis in biochemistry.  
Major in chemistry with the B.A. degree in liberal arts and sciences, with or without the Certificate of the American Chemical Society.  
Teaching major in chemistry for the single subject teaching credential in science.  
Minor in chemistry.

## The Major

Through the study of chemistry students can better understand their environment and develop new materials that provide for a higher quality of life. Chemists are involved in a wide range of careers in research, development and the production of new goods. Basic chemical research provides society with discoveries of new substances and the means to predict their chemical and physical properties. In developmental chemistry, professionals find ways to put them to use. There are careers in methods of production to provide these materials to society in a cost-effective way. In each of these areas, there are subspecialties in analytical, biochemical, inorganic, organic, and physical chemistry.

The Department of Chemistry and Biochemistry offers five degree programs leading to the Bachelor of Arts degree, the Bachelor of Science degree, the Master of Arts degree, the Master of Science degree, and the Doctor of Philosophy degree (with the University of California, San Diego).

There are several options available in the undergraduate program for those wishing either a major or a minor in chemistry. A chemistry major with the Bachelor of Science degree and certificate of the American Chemical Society is designed to qualify students for many types of positions as chemists and for admission to graduate study.

The chemistry major with the Bachelor of Arts degree and certificate of the American Chemical Society is specifically designed to prepare students for careers and graduate work requiring a strong chemistry background. With an appropriate choice of electives, graduates can meet the requirements for admission to medical, dental and pharmaceutical schools. A minor in biology is recommended.

The use of chemistry electives allows a student to focus on a particular area in chemistry such as analytical chemistry, biochemistry, chemical physics, inorganic chemistry, organic chemistry, or physical chemistry.

## Chemistry Major

**With the B.S. Degree in Applied Arts and Sciences (Major Code: 19051) and Certificate of the American Chemical Society**

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements."

A minor is not required with this major.

**Preparation for the Major.** Chemistry 200, 201, 231, 251; Mathematics 150, 151, 252; and Physics 195, 195L, 196, 196L, 197, 197L. (44 units)

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major.** A minimum of 36 upper division units to include Chemistry 410A-410B, 417, 427, 431, 457, 520A-520B, 550, 560A, one unit of 498, and eight units of upper division electives in chemistry. Six of the eight units may be in related subjects with the approval of the department.

### Emphasis in Biochemistry

**Preparation for the Major.** Chemistry 200, 201, 231, 251; Biology 201A; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L, 197, and 197L. (48 units)

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major.** A minimum of 36 upper division units to include Chemistry 410A-410B, 431, 457, 550, 560A, 567; Chemistry 560B, or four units selected from Chemistry 562, 563, 564; one unit of Chemistry 498; and the remaining units selected from Chemistry 496, 497, 498, and any 500-level chemistry course; Biology 350, 352, 549, 551, 561, 561L, 563, 569, 570, 585, 590, 595. The addition of Chemistry 417, 427, and 520A qualifies this program for ACS certification.

## Chemistry Major

**With the B.A. Degree in Liberal Arts and Sciences (Major Code: 19051) and Certificate of the American Chemical Society**

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." No more than 48 units in chemistry courses can apply to the degree.

A minor is not required with this major.

**Preparation for the Major.** Chemistry 200, 201, 231, 251; Mathematics 150, 151, 252; and Physics 195, 195L, 196, 196L, 197, 197L. (44 units)

**Language Requirement.** Competency (successfully completing the third college semester or fifth college quarter) is required in one foreign language to fulfill the graduation requirement. Refer to section of this catalog on "Graduation Requirements."

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major.** A minimum of 30 upper division units in chemistry to include Chemistry 410A-410B, 417, 427, 431, 457, 520A, 550, 560A; one unit of Chemistry 498, and five units of electives selected from Chemistry 496, 498, or any 500-level course in chemistry.

**NOTE:** See the following for recommended sequence of courses for the **B.S. and B.A. Degrees and Certificate.**

**OUTLINE FOR THE B.S. DEGREE AND CERTIFICATE**

	<i>Units</i>			<i>Units</i>	
	<i>1st Sem.</i>	<i>2nd Sem.</i>		<i>1st Sem.</i>	<i>2nd Sem.</i>
<i>First year</i>			<i>Second year</i>		
Chemistry 200 .....	5	–	Chemistry 231 .....	4	–
Chemistry 201 .....	–	5	Chemistry 251 .....	–	5
Mathematics 150, 151 .....	5	4	Chemistry 431 .....	–	4
Physics 195, 195L .....	–	4	Mathematics 252 .....	4	–
Rhetoric and Writing Studies 100 .....	3	–	Physics 196, 196L .....	4	–
Rhetoric and Writing Studies 200 .....	–	3	Physics 197, 197L .....	–	4
Communication 103 .....	3	–	General Education .....	3	3
	<u>16</u>	<u>16</u>		<u>15</u>	<u>16</u>
	<i>Units</i>			<i>Units</i>	
	<i>1st Sem.</i>	<i>2nd Sem.</i>		<i>1st Sem.</i>	<i>2nd Sem.</i>
<i>Third year</i>			<i>Fourth year</i>		
Chemistry 410A-410B .....	4	3	Chemistry 417 .....	–	2
Chemistry 427 .....	–	1	Chemistry 457 .....	2	–
Chemistry 520A-520B .....	3	3	Chemistry 498 .....	1	–
Chemistry 560A .....	3	–	Chemistry 550 .....	2	–
American Institutions .....	3	3	Chemistry Electives .....	5	3
General Education .....	3	6	General Education .....	6	9
	<u>16</u>	<u>16</u>		<u>16</u>	<u>14</u>

**OUTLINE FOR THE B.A. DEGREE AND CERTIFICATE**

	<i>Units</i>			<i>Units</i>	
	<i>1st Sem.</i>	<i>2nd Sem.</i>		<i>1st Sem.</i>	<i>2nd Sem.</i>
<i>First year</i>			<i>Second year</i>		
Chemistry 200 .....	5	–	Chemistry 231 .....	4	–
Chemistry 201 .....	–	5	Chemistry 251 .....	–	5
Mathematics 150 .....	–	5	Chemistry 431 .....	–	4
Physics 195, 195L .....	–	4	Mathematics 151, 252 .....	4	4
Rhetoric and Writing Studies 100 .....	3	–	Physics 196, 196L .....	4	–
Rhetoric and Writing Studies 200 .....	–	3	General Education .....	3	3
Communication 103 .....	3	–			
General Education .....	3	–			
	<u>17</u>	<u>17</u>		<u>15</u>	<u>16</u>
	<i>Units</i>			<i>Units</i>	
	<i>1st Sem.</i>	<i>2nd Sem.</i>		<i>1st Sem.</i>	<i>2nd Sem.</i>
<i>Third year</i>			<i>Fourth year</i>		
Chemistry 410A-410B .....	4	3	Chemistry 417 .....	–	2
Chemistry 427 .....	–	1	Chemistry 457 .....	2	–
Chemistry 520A .....	3	–	Chemistry 498 .....	1	–
Chemistry 560A .....	–	3	Chemistry 550 .....	2	–
Physics 197, 197L .....	4	–	Chemistry Elective .....	2	3
American Institutions .....	3	3	General Education .....	6	9
General Education .....	–	6			
	<u>14</u>	<u>16</u>		<u>16</u>	<u>14</u>

## Chemistry Major

### With the B.A. Degree in Liberal Arts and Sciences (Major Code: 19051)

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." No more than 48 units in chemistry courses can apply to the degree.

**Preparation for the Major.** Chemistry 200, 201, 231; Biology 201A, 201B; Mathematics 150, 151, 252; and Physics 195, 195L, 196, 196L, 197, 197L. (47 units)

**Language Requirement.** Competency (successfully completing the third college semester or fifth college quarter) is required in one foreign language to fulfill the graduation requirement. Refer to section of this catalog on "Graduation Requirements."

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major.** A minimum of 24 upper division units in chemistry to include Chemistry 410A-410B, 417, 431, 457, 550, and seven units of electives in chemistry. Chemistry 560A-560B is recommended for all premedical students.

**Minor.** A minor in biology is expected for preprofessional students.

## Chemistry Major (Teaching Credential Only)

### In preparation for the Single Subject Teaching Credential in Science/Chemistry

#### With the B.S. Degree in Applied Arts and Sciences (Major Code: 19051)

One of the requirements for acceptance into the College of Education's postbaccalaureate credential program is to either pass the appropriate PRAXIS and SSAT examinations or complete an approved academic program. The single subject teaching credential in science preparation program described below satisfies the academic requirements for a student planning to teach integrated science and chemistry at the secondary level. Entrance into the postbaccalaureate credentialing program in part requires certification of subject matter competency by this department. This certification requires completion of the academic program with the required grades, submission of a satisfactory portfolio, and the recommendation of the department. Contact the subject matter preparation program adviser. In addition, all candidates for a Single Subject Teaching credential at San Diego State University with the Cross-Cultural, Language, and Academic Development (CLAD) emphasis must complete the requirements outlined in the catalog under Teacher Education or Policy Studies. Contact the School of Teacher Education or the Policy Studies in Language and Cross-Cultural Education Department for up-to-date information on prerequisites.

**General Education Requirements.** Students will complete a minimum of 49 units in General Education to include a minimum of nine upper division units. No more than 12 units may be used for General Education credit from any one department or academic unit. No more than 7 units from one department can be used in Sections II, III, and IV combined (Foundations, American Institutions, and Explorations).

#### I. Communication and Critical Thinking (9 units)

You may *not* use Credit/No Credit grades in this section.

1. **Oral Communication (3 units)** to be satisfied by Africana Studies 140, Chicana and Chicano Studies 111A, or Communication 103.
2. **Composition (3 units)** to be satisfied by Africana Studies 120, Chicana and Chicano Studies 111B, or Rhetoric and Writing Studies 100.
3. **Intermediate Composition and Critical Thinking (3 units)** to be satisfied by Africana Studies 200 or Rhetoric and Writing Studies 200.

#### II. Foundations (28 units)

A. **Natural Sciences and Quantitative Reasoning (13 units):**

1. **Physical Sciences (6 units)** to be satisfied by Chemistry 200 and Physics 180A or 195.

2-3. **Life Sciences and Laboratory (4 units)** to be satisfied by Biology 201A.

4. **Mathematics/Quantitative Reasoning (3 units)** to be satisfied by Mathematics 150.

B. **Social and Behavioral Sciences (6 units).**

C. **Humanities (9 units):**

Complete a course in each of three of the following four areas (1. Literature; 2. Art, Classics, Humanities, Music, and Theatre; 3. Philosophy and Religious Studies; 4. Foreign Language) in the Humanities section of the Foundations component of the regular General Education program. Refer to General Education course offerings in the Graduation Requirements section of the catalog. One semester of a foreign language is recommended.

#### III. American Institutions

Three units of the six units of coursework which meet the American Institutions graduation requirement may be used in General Education, excluding courses numbered 500 and above.

#### IV. Explorations (9 units)

**Courses in this area must not be taken sooner than the semester in which you achieve upper division standing (60 units passed). Upper division courses in the major department may not be used to satisfy General Education.**

A. **Upper division Social and Behavioral Sciences (3 units).** Linguistics 420 is recommended.

B. **Upper division Humanities to be satisfied by History 441 (3 units).**

C. **Upper division Humanities (3 units).** A course in cultural diversity is required. Refer to Part C of Explorations under the General Education requirements section in the catalog.

**Preparation for the Major.** Africana Studies 140, Chicana and Chicano Studies 111A, or Communication 103; Africana Studies 120, Chicana and Chicano Studies 111B, or Rhetoric and Writing Studies 100; Africana Studies 200 or Rhetoric and Writing Studies 200; Astronomy 101, 109; Biology 201A, 201B; Chemistry 200, 201, 231, 251; Geological Sciences 100, 101; Mathematics 150, 151; Physics 180A, 180B, 182A, 182B and Mathematics 252 **OR** Physics 195, 195L, 196, 196L, 197, 197L. (65 units)

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major.** A minimum of 36 upper division units to include Chemistry 410A, 410B, 417, 431, 457, 498 (1-3 units), 520A, 550, 560A, 571; Oceanography 541. The remaining four to six units must be selected from Chemistry 497, 499 (with approval of department), 520B, 560B, 567, 596, and Physics 311. This major does not qualify for ACS certification.

#### Additional Requirements for Subject Matter Preparation Certification

**Satisfactory Grades.** At most one course with a C- or lower among the courses listed under Preparation for the Major, and at most one course with a C- or lower among the courses listed under the Major. If a course is repeated, the highest grade will count.

**Formative Assessment.** Completion of a satisfactory, preliminary portfolio two semesters prior to graduation. Contact the subject matter preparation adviser for information.

**Summative Assessment.** Completion of a satisfactory, final portfolio, and a positive recommendation from a committee consisting of the senior project supervisor, the Department of Chemistry and Biochemistry chair, and the subject matter preparation program adviser with input from the student's upper division laboratory instructors.

## Chemical Physics Major

### With the B.S. Degree in Applied Arts and Sciences (Major Code: 19081)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." Individual master plans for

each student are filed with the chemistry and physics undergraduate advisers and the Office of Advising and Evaluations.

A minor is not required with this major.

**Preparation for the Major.** Chemistry 200, 201, 231, 251; Mathematics 150, 151, and 252; Physics 195, 195L, 196, 196L, 197, 197L. (44 units)

Recommended: A course in computer programming.

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major.** A minimum of 39 upper division units to include Chemistry 410A-410B, 417, 550; Mathematics 342A, 342B; Physics 311, 350, 400A, 410; six units selected from Chemistry 431, 457, 510, 515, Physics 357, 360, 400B, Chemistry 538 or Physics 538; and Research Project: Chemistry 497 (3 units) or Chemistry 498 (3 units) or Physics 498A and 498B (3 units).

### Chemistry Minor

The following courses are prerequisite to the chemistry minor and do not count toward the 15 units required for the minor: Chemistry 200, 201. (10 units.)

The minor in chemistry consists of 15 units in chemistry to include Chemistry 231 and 251; and six units of upper division electives. Chemistry 410A-410B\* are strongly recommended.

Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed in residence at San Diego State University.

\* Additional prerequisites in mathematics and physics required for these courses.

### Courses (CHEM)

#### LOWER DIVISION COURSES

#### **CHEM 100. Introduction to General Chemistry with Laboratory (4) I, II**

Three lectures and three hours of laboratory.

Elementary principles of chemistry used to illustrate nature and development of modern scientific thought. Not open to students with credit in Chemistry 105 or 200.

#### **CHEM 105. Preparation for General Chemistry (4) I, II**

Three lectures and three hours of laboratory.

Prerequisite: Elementary algebra. Algebra test will be given in first week of class. Students who do not earn a passing grade will be required to drop the course.

Elemental principles of chemistry approached from problem-solving perspective necessary for success in Chemistry 200. Not open to students with credit in Chemistry 100 or 200.

#### **CHEM 130. Elementary Organic Chemistry (3) I, II**

Prerequisite: Chemistry 100, 105, or 200.

Introduction to compounds of carbon including both aliphatic and aromatic substances. Not open to students with credit in Chemistry 230, 231, or 232.

#### **CHEM 160. Introductory Biochemistry (3) II**

Prerequisite: Chemistry 130.

Fundamental principles of the chemistry of living processes. This course intended primarily for majors in nursing, nutrition, and related fields.

#### **CHEM 200. General Chemistry (5) I, II (CAN CHEM 2) (200 + 201: CAN CHEM SEQ A)**

Three lectures and six hours of laboratory.

Prerequisites: High school chemistry or a grade of "C" or better in Chemistry 105, and two years of high school algebra.

General principles of chemistry with emphasis on inorganic materials. Students with credit for either Chemistry 100 or 105, and 200 will receive a total of five units of credit toward graduation.

#### **CHEM 201. General Chemistry (5) I, II (CAN CHEM 4) (200 + 201: CAN CHEM SEQ A)**

Three lectures and six hours of laboratory.

Prerequisite: Chemistry 200.

Continuation of Chemistry 200. General principles of chemistry with emphasis on inorganic materials and qualitative analysis.

#### **CHEM 202. General Chemistry for Engineers (4) I, II**

Three lectures and three hours of laboratory.

Prerequisites: Two years of high school algebra. High school chemistry or a grade of C or better in Chemistry 105.

General principles of chemistry with emphasis on inorganic and physical chemistry and chemistry basics for engineers. Students with credit in Chemistry 100, 105 and 202 will receive a total of four units of credit toward graduation. Not open to students with credit in Chemistry 200. Restricted to engineering majors.

#### **CHEM 231. Organic Chemistry (4) I, II**

Three lectures and three hours of laboratory.

Prerequisite: Chemistry 201.

Properties and synthesis of organic compounds including reaction mechanisms. First half of a one-year course. Not open to students with credit in Chemistry 232 or 232L.

#### **CHEM 232. Organic Chemistry (3) I, II**

Prerequisites: Chemistry 201 and consent of instructor.

Same course as Chemistry 231 without laboratory. Not open to students with credit in Chemistry 231.

#### **CHEM 232L. Organic Chemistry Laboratory (1) I, II**

Three hours of laboratory.

Prerequisites: Chemistry 201 and consent of instructor.

Properties and synthesis of organic compounds including methods of separation and purification techniques. Same course as laboratory portion of Chemistry 231. Not open to students with credit in Chemistry 231.

#### **CHEM 251. Analytical Chemistry (5) II**

Three lectures and six hours of laboratory.

Prerequisites: Chemistry 201 and credit or concurrent registration in Mathematics 122 or 150.

Introduction to the theory and practice of analytical chemistry including gravimetric, volumetric, and instrumental methods.

#### **CHEM 296. Experimental Topics (1-4)**

Selected topics. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

#### **CHEM 297. Introduction to Chemical Research (1-3)**

Prerequisite: Consent of instructor.

Individual laboratory investigation. Maximum credit six units.

#### **CHEM 299. Special Study (1-4)**

Prerequisite: Consent of instructor.

Individual study. Maximum credit six units.

#### UPPER DIVISION COURSES (Intended for Undergraduates)

#### **CHEM 300. Mysteries and Molecules (3)**

Prerequisites: Chemistry 100 or completion of General Education requirement in Foundations II.A. Natural Sciences and Quantitative Reasoning.

Techniques and case studies of mysteries solved by molecular analysis: chemical and DNA analysis of crime scenes, biochemical explanations of mysterious deaths and accidents, molecular hallmarks of forgery, chemical methods in crime deterrence, chemical causes of fires and structure failure. Not applicable to chemistry majors.

**CHEM 308. Chemistry as a Unifying Science (3)**

Prerequisites: Biology 100 or 203; Geological Sciences 104 or Natural Science 100; Natural Science 412A or 412D.

Atomic-molecular theory of matter; use of concepts of chemistry to explain observable phenomena in everyday life, including physical properties and chemical changes; connections between chemistry and biology, earth science, and physical science; alternative conceptions about science. Capstone science course for liberal studies majors. Open only to liberal studies majors. Not applicable to chemistry majors.

**CHEM 361. Fundamentals of Biochemistry (3)**

Prerequisites: Chemistry 231 and 365.

The chemistry of intermediary metabolism and its regulation. Not open to students with credit in Chemistry 560B, 562, or 563. (Formerly numbered Chemistry 361B.)

**CHEM 365. Biochemistry, Cell and Molecular Biology I (3)**

Prerequisites: Biology 201A and Chemistry 231.

Basic concepts of modern integrated biochemistry, cell and molecular biology. Not open to students with credit in Chemistry 361A or 560A.

**CHEM 368. Enzymes and Macromolecular Interactions (1)**

Prerequisite: Credit or concurrent registration in Chemistry 365.

Enzymology of bisubstrate reactions, allosteric enzymes and biochemical control mechanisms, enzyme mechanisms, nucleic acid structure, replication, and function, sequencing, PCR, cellular protein synthesis, oligosaccharide synthesis. Not open to students with credit in Chemistry 361A or 560A.

**CHEM 410A-410B. Physical Chemistry (4-3) I, II**

410A: Three lectures and three hours of laboratory.

410B: Three lectures.

Prerequisites: Chemistry 231 and 251; Mathematics 252; and credit or concurrent registration in Physics 197 and 197L. Chemistry 410A is prerequisite to 410B.

Theoretical principles of chemistry with emphasis on mathematical relations. Theory and practice in acquisition and statistical analysis of physical measurements on chemical systems.

**CHEM 417. Advanced Physical Chemistry Laboratory (2) II**

Six hours of laboratory.

Prerequisites: Chemistry 251, 410B. Recommended: Chemistry 457, and 550.

Experimental physical chemistry. Emphasis on interpretation and statistical evaluation of instrument-derived results, record keeping, report writing, and individual initiative in observing results.

**CHEM 427. Inorganic Chemistry Laboratory (1) II**

Three hours of laboratory.

Prerequisite: Credit or concurrent registration in Chemistry 520A.

Laboratory course designed to introduce students to techniques used in synthesis, characterization, and manipulation of inorganic compounds and materials.

**CHEM 431. Organic Chemistry (4) I, II**

Three lectures and three hours of laboratory.

Prerequisite: Chemistry 231.

Continuation of Chemistry 231. Not open to students with credit in Chemistry 432 and 432L.

**CHEM 432. Organic Chemistry (3) I, II**

Prerequisites: Chemistry 231 and consent of instructor.

Continuation of Chemistry 231. Same course as Chemistry 431 without laboratory. Not open to students with credit in Chemistry 431.

**CHEM 432L. Organic Chemistry Laboratory (1) I, II**

Three hours of laboratory.

Prerequisites: Chemistry 231 and consent of instructor.

Continuation of laboratory portion of Chemistry 231. Not open to students with credit in Chemistry 431.

**CHEM 457. Instrumental Methods of Chemical Analysis Laboratory (2) I**

Six hours of laboratory.

Prerequisites: Chemistry 251, 431 and credit or concurrent registration in Chemistry 410B; concurrent registration in Chemistry 550.

Application of instrumental methods of chemical separations and analysis frequently used in all subdisciplines of chemistry.

**CHEM 467L. Biochemistry, Cell and Molecular Biology Laboratory (2) I, II**

Six hours of laboratory.

Prerequisites: Biology 366, 366L, credit or concurrent registration in Biology 467. Recommended: Biology 350.

Intermediate laboratory approaches in biochemistry, cell biology and molecular biology. Not applicable to chemistry major or minor. Not open to students with credit in Biology 592.

**CHEM 496. Selected Topics in Chemistry (1-4)**

Prerequisite: Consent of instructor.

Selected topics in modern chemistry. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit six units.

**CHEM 497. Undergraduate Research (1-3) Cr/NC I, II, S**

Prerequisites: Chemistry 231 and 251.

Individual laboratory investigation. Maximum credit six units.

**CHEM 498. Senior Project (1-3) I, II**

Prerequisite: Three one-year courses in chemistry.

Individual literature and/or laboratory investigation and report on a problem. Maximum credit three units.

**CHEM 499. Special Study (1-4) I, II**

Prerequisite: Consent of instructor.

Individual study. Maximum credit six units.

**UPPER DIVISION COURSES  
(Also Acceptable for Advanced Degrees)**

**CHEM 510. Advanced Physical Chemistry (3)**

Prerequisite: Chemistry 410B.

Problems in chemical thermodynamics, statistical mechanics, chemical kinetics, quantum chemistry and molecular structure and spectroscopy, with applications.

**CHEM 515. Computational Chemistry (3)**

Prerequisites: Chemistry 410A and 410B.

Overview of modern computational chemistry. Use of computational chemistry tools and their application to problems of chemical interest.

**CHEM 520A-520B. Inorganic Chemistry (3-3) I, II**

Prerequisite: Credit or concurrent registration in Chemistry 410A. Chemistry 520A is prerequisite to 520B.

Nature of chemical bond and an advanced systematic study of representative and transition elements and their compounds.

**CHEM 530. Physical Organic Chemistry (3)**

Prerequisites: Chemistry 410A and 431. Recommended: Credit or concurrent registration in Chemistry 410B.

Electronic and physical properties of organic molecules; structure-reactivity correlations: Electronic structure of molecules (qualitative molecular orbital theory); stereochemistry; and linear free energy relationships.

**CHEM 531. Synthetic Organic Chemistry (3)**

Prerequisite: Chemistry 431.

Modern methods, strategies, and mechanisms in advanced organic synthesis. Retrosynthetic analysis of and synthetic routes towards biologically important compounds.

### **CHEM 537. Organic Qualitative Analysis (4)**

Two lectures and six hours of laboratory.

Prerequisites: Chemistry 431 and credit or concurrent registration in Chemistry 410A. Recommended: Chemistry 417 and 457.

Chemical, physical, and spectral methods discussed and employed to determine structure of organic compounds. Purification and separation techniques stressed.

### **CHEM 538. Polymer Science (3)**

(Same course as Physics 538.)

Prerequisites: Chemistry 200 or 202; and Chemistry 410B or Physics 360 or Mechanical Engineering 350 or 352.

Structure, synthesis, physical properties, and utilities of polymers.

### **CHEM 550. Instrumental Methods of Chemical Analysis (2) I**

Prerequisites: Chemistry 231 and credit or concurrent registration in Chemistry 410A; concurrent registration in Chemistry 457 for undergraduate students only. Chemical Physics majors can replace the Chemistry 457 corequisite with credit or concurrent registration in Physics 311.

Theory and application of those instrumental methods of chemical separation and analysis most frequently used in all subdisciplines of chemistry.

### **CHEM 551. Advanced Analytical Chemistry (3) II**

Prerequisite: Chemistry 550.

Expanded treatment of instrumental methods for separation and quantification not covered in Chemistry 550. Non-instrumental separations, quantitative organic microanalysis, sampling theory and techniques, reaction rate applications and interpretation of experimental data.

### **CHEM 560A-560B. General Biochemistry (3-3) I, II**

Prerequisites: Chemistry 431 and credit or concurrent registration in Chemistry 410A.

The structure, function, metabolism, and thermodynamic relationships of chemical entities in living systems. Chemistry 560A is not open to students with credit in Chemistry 365. Chemistry 560B is not open to students with credit in Chemistry 361, 562 or 563.

### **CHEM 562. Intermediary Metabolism (2)**

Prerequisites: Chemistry 560A or Chemistry 365 and 368.

Catabolic and biosynthetic pathways of carbohydrate, lipid, amino acid, and nucleotide metabolism; TCA cycle, mitochondrial and chloroplast electron transport chains, ATP generation and their interactions and control. Not open to students with credit in Chemistry 361 or 560B.

### **CHEM 563. Nucleic Acid Function and Protein Synthesis (2)**

Prerequisites: Chemistry 560A or Chemistry 365 and 368.

DNA replication, RNA transcription, RNA processing, and protein translation, including chemical mechanisms of synthesis and cellular mechanisms of regulating gene expression; genomics, recombinant DNA, and DNA topology. Not open to students with credit in Chemistry 361 or 560B.

### **CHEM 564. Receptor Biochemistry and Protein Modification (2)**

Prerequisites: Chemistry 560A or Chemistry 365 and 368.

Biochemical study of receptors, second messengers, and cellular proteins that participate in extracellular and intracellular communication, with focus on protein structures, post-translational modifications, and biochemical mechanisms that regulate receptors and effector enzymes.

### **CHEM 567. Biochemistry Laboratory (3) II**

One lecture and six hours of laboratory.

Prerequisite: Chemistry 560A.

Theory and practice of procedures used in study of life at molecular level. Includes purification and characterization of enzymes, isolation of cell components, and use of radioactive tracer techniques.

### **CHEM 571. Environmental Chemistry (3)**

Prerequisites: Chemistry 231 and 251; consent of instructor for all other majors.

Fundamentals of chemistry applied to environmental problems. Chemistry of ecosystems; analysis of natural constituents and pollutants; sampling methods; transport of contaminants; regulations and public policy.

### **CHEM 596. Advanced Special Topics in Chemistry (1-3)**

Prerequisite: Consent of instructor.

Advanced selected topics in modern chemistry. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit of six units of 596 applicable to a bachelor's degree. Maximum combined credit of six units of 596 and 696 applicable to a 30-unit master's degree.

---

## **GRADUATE COURSES**

**Refer to Bulletin of the Graduate Division.**

---