

# Chemistry

IN THE COLLEGE OF SCIENCES

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Certified by the American Chemical Society.

## Faculty

**Emeritus:** Abbott, Bennett, Carrano, Chatfield, Cobble, Dahms, Grubbs, Jensen, Jones, Joseph, Landis, Lebherz, Mathewson, Metzger, O'Neal, Richardson, Ring, Roeder, Stewart, Stumph, Walba, Woodson

**Chair:** Tong

**Professors:** Cooksy, Grotjahn, Huxford, Tong

**Associate Professors:** Bergdahl, Cole, Harrison, Love, Pullman, Smith, Swairjo, van der Geer

**Assistant Professors:** Forsberg, Gu, Gustafson, Holland, Purse, Sohl

## 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, or 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.

## Impacted Program

The chemistry major is an impacted program. To be admitted to the chemistry major, students must meet the following criteria:

- Complete preparation for the major;
- Complete a minimum of 60 transferable semester units;
- Have a minimum cumulative GPA of 2.0.

To complete the major, students must fulfill the degree requirements for the major described in the catalog in effect at the time they are accepted into the premajor at SDSU (assuming continuous enrollment).

## Major Academic Plans (MAPs)

Visit <http://www.sdsu.edu/mymap> for the recommended courses needed to fulfill your major requirements. The MAPs website was created to help students navigate the course requirements for their majors and to identify which General Education course will also fulfill a major preparation course requirement.

## Chemistry Major

With the B.S. Degree in Applied Arts and Sciences and Certificate of the American Chemical Society

**(Major Code: 19051) (SIMS Code: 772601)**

**(SIMS Code: 772613 - Georgia)**

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, 232, 232L, 251; Mathematics 150, 151, 252; and Physics 195, 195L, 196, 196L. (39 units) Recommended: Physics 197 and 197L.

Students completing the California Community College Associate in Science in Chemistry for Transfer (AS-T) will satisfy preparation for the major. If Chemistry 251 and Mathematics 252 were not completed prior to matriculation, it must be completed at SDSU.

**Graduation Writing Assessment Requirement.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 36 upper division units to include Chemistry 410A, 410B, 417, 427, 432, 432L, 457, 520A-520B, 550, 560, 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

**(SIMS Code: 772609) (SIMS Code: 772611 - Georgia)**

**Preparation for the Major.** Chemistry 200, 201, 232, 232L, 251; Biology 204, 204L; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L. (43 units) Recommended: Physics 197 and 197L.

**Graduation Writing Assessment Requirement.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 36 upper division units to include Chemistry 410A, 410B, 432, 432L, 457, 550, 560, 567; 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, 485, 549, 570, 590. 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) (SIMS Code: 772612)**

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." Candidates who wish to

graduate with 120 units must complete both American Institutions courses at the upper division level. No more than 49 units in chemistry courses can apply to the degree.

A minor is not required with this major.

**Preparation for the Major.** Chemistry 200, 201, 232, 232L, 251; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L. (39 units) Recommended: Physics 197 and 197L.

**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.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 30 upper division units in chemistry to include Chemistry 410A, 410B, 417, 427, 432, 432L, 457, 520A, 550, 560; one unit of Chemistry 498, and five units of electives selected from Chemistry 496, 498, or any 500-level course in chemistry.

## Chemistry Major

With the B.A. Degree in Liberal Arts and Sciences

(Major Code: 19051) (SIMS Code: 772602)

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." Candidates who wish to graduate with 120 units must complete both American Institutions courses at the upper division level. No more than 48 units in chemistry courses can apply to the degree.

**Preparation for the Major.** Chemistry 200, 201, 232, 232L, 251; Biology 203, 203L; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L. (43 units) Recommended: Physics 197 and 197L.

**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.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 24 upper division units in chemistry to include Chemistry 410A, 410B, 417, 432, 432L, 457, 550, and seven units of electives in chemistry. Chemistry 560 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.A. Degree in Applied Arts and Sciences

(Major Code: 19051) (SIMS Code: 772607)

One of the requirements for acceptance into the College of Education's post-baccalaureate credential program is to either pass the appropriate CSET 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 post-baccalaureate 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 must complete the requirements outlined in the catalog under Teacher Education or Dual Language and English Learner Education. Contact the School of Teacher Education or the Dual Language and English Learner Education Department for up-to-date information on prerequisites.

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." Candidates who wish to graduate with 120 units must complete one of two American Institutions courses at the upper division level or satisfy the California state and local government portion of American Institutions by passing the California Government examination available through the Testing Services office.

A minor is not required for this major.

**Preparation for the Major.** Biology 203, 203L, 204, 204L; Chemistry 200, 201, 232, 232L, 251; Communication 103; Mathematics 150, 151; Physics 180A, 180B, 182A, 182B; Mathematics 252 OR Physics 195, 195L, 196, 196L, 197, 197L; Teacher Education 211B. (51 units)

**Graduation Writing Assessment Requirement.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 32 upper division units to include Chemistry 410A, 410B, 417 or 457, 432, 432L, 498 (1 unit), 520A, 550, 560; Astronomy 310; Geological Sciences 412; Physics 499 (History of Science and Technology).

### 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 the senior project supervisor.

## Chemical Physics Major

With the B.S. Degree in Applied Arts and Sciences

(Major Code: 19081) (SIMS Code: 772801)

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 201, 202, 232, 232L, 251; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L, 197, 197L. (42 units)

Recommended: A course in computer programming.

**Graduation Writing Assessment Requirement.** Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

**Major.** A minimum of 36 upper division units to include Chemistry 410A, 410B, 417, 550; Mathematics 342A, 342B; Physics 311, 350, 400A, 410; three units selected from Chemistry 432, 432L, 457, 510, 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

(Minor Code: 19051) (SIMS Code: 772601)

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 232, 232L, 251; and six units of upper division electives. Strongly recommended: Chemistry 410A, 410B\*.

Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general

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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)

Refer to *Courses and Curricula and University Policies sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.*

#### LOWER DIVISION COURSES

##### **CHEM 100. Introduction to General Chemistry with Laboratory (4) [GE]**

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 102. Introduction to General, Organic, and Biological Chemistry (5) [GE]**

Four lectures and three hours of laboratory.

Prerequisite: High school chemistry or Chemistry 100.

Concepts of general, organic, and biological chemistry necessary to understanding human biochemistry and pharmacology, including chemical bonding, stereochemistry, acidity, thermodynamics, carbohydrates, lipids, enzymes, proteins, and nucleic acids. Open only to students applying for entrance to the nursing major.

##### **CHEM 130. Elementary Organic Chemistry (3)**

Prerequisite: Chemistry 100 or 200.

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

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

Prerequisite: Chemistry 130.

Fundamental principles of the chemistry of life. This course is intended primarily for majors in nutrition and related fields. Not applicable for admission to the School of Nursing.

##### **CHEM 200. General Chemistry (5)**

Three lectures, one hour of discussion, and three hours of laboratory.

Prerequisites: Knowledge of introductory chemistry as demonstrated by completion of Chemistry 100 with a grade of C (2.0) or better; or satisfaction of the SDSU Mathematics/Quantitative Reasoning Assessment requirement and qualification on the Chemistry Department Placement Examination.

General principles of chemistry with emphasis on inorganic materials.

##### **CHEM 201. General Chemistry (5)**

Three lectures, one hour of discussion, and three hours of laboratory.

Prerequisite: Chemistry 200 or 202 with a grade of C (2.0) or better.

Continuation of Chemistry 200. General principles of chemistry with emphasis on fundamentals of chemical reactions.

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

Three lectures and three hours of laboratory.

Prerequisites: Knowledge of introductory chemistry as demonstrated by completion of Chemistry 100 with a grade of C (2.0) or better; or satisfaction of the SDSU Mathematics/Quantitative Reasoning Assessment requirement and qualification on the Chemistry Department Placement Examination.

General principles of chemistry with emphasis on inorganic and physical chemistry and chemistry basics for engineers. Not open to students with credit in Chemistry 200. Restricted to chemical physics and engineering majors.

##### **CHEM 210. Chemical Applications of Calculus and Physics (1)**

Chemical problems that utilize calculus and physics relevant to upper division chemistry. Chemical rate laws, chemical thermodynamics, and molecular quantum mechanics. Recommended if a grade of C- (1.7) or below was received in Mathematics 150, 151, 252, Physics 195, or 196.

##### **CHEM 232. Organic Chemistry (3)**

Prerequisites: Chemistry 201 with a grade of C (2.0) or better and credit or concurrent registration in Chemistry 232L.

Properties and synthesis of organic compounds including reaction mechanisms. Same course as lecture portion of Chemistry 231. Not open to students with credit in Chemistry 231.

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

Three hours of laboratory.

Prerequisites: Chemistry 201 with a grade of C (2.0) or better and credit or concurrent registration in Chemistry 232.

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)**

Three lectures and six hours of laboratory.

Prerequisites: Chemistry 201 and credit or concurrent registration in Mathematics 124 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 299. Special Study (1-4)**

Prerequisite: Consent of instructor.

Individual study. Maximum credit six units.

#### UPPER DIVISION COURSES

(Intended for Undergraduates)

##### **CHEM 300. Forensic Science (3) [GE]**

Prerequisite: Chemistry 100 or completion of General Education requirement in Foundations of Learning 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) [GE]** (Offered only at IVC)

Prerequisite: Completion of the General Education requirement in Foundations II.A., Natural Sciences and Quantitative Reasoning.

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. Open only to liberal studies majors. Not applicable to chemistry majors.

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

Prerequisites: Biology 203, 203L and Chemistry 232, 232L.

Basic concepts of modern integrated biochemistry, cell and molecular biology. Not open to students with credit in Chemistry 560. Applicable to chemistry major or minor only with approval from department.

##### **CHEM 410A. Physical Chemistry (4)**

Three lectures and three hours of laboratory.

Prerequisites: Chemistry 232, 232L, 251; Mathematics 252; Physics 195, 195L, and 196, 196L. Recommended: Physics 197 and 197L. For chemistry teaching major only: The mathematics and physics requirements may be replaced by Mathematics 150, 151, 252 and Physics 180A, 180B OR Mathematics 150, 151, and Physics 195, 195L, 196, 196L.

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

##### **CHEM 410B. Physical Chemistry (3)**

Three lectures.

Prerequisites: Chemistry 232, 232L, 251, 410A.

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)**

Six hours of laboratory.

Prerequisites: Chemistry 251, 410A, and credit or concurrent registration in Chemistry 410B.

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)**

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 432. Organic Chemistry (3)**

Prerequisites: Chemistry 232 with a grade of C (2.0) or better and credit or concurrent registration in Chemistry 432L.

Continuation of Chemistry 232. Same course as lecture portion of Chemistry 431. Not open to students with credit in Chemistry 431.

**CHEM 432L. Organic Chemistry Laboratory (1)**

Three hours of laboratory.

Prerequisites: Chemistry 232L with a grade of C (2.0) or better and credit or concurrent registration in Chemistry 432.

Continuation of Chemistry 232L. Same course as laboratory portion of Chemistry 431. Not open to students with credit in Chemistry 431.

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

Six hours of laboratory.

Prerequisites: Chemistry 251, 432, 432L, 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 disciplines of chemistry.

**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**

Prerequisites: Chemistry 232, 232L, 251.

Individual laboratory investigation. Maximum credit six units applicable to all chemistry major and minor degrees.

**CHEM 498. Senior Project (1-3)**

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)**

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 520A-520B. Inorganic Chemistry (3-3)**

Prerequisite: 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 531. Synthetic Organic Chemistry (3)**

Prerequisites: Chemistry 432, 432L.

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

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

(Same course as Physics 538)

Prerequisites: Chemistry 200 or 202; and credit or concurrent registration in Chemistry 410B or Physics 360 or Mechanical Engineering 350.

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

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

Prerequisites: Chemistry 232, 232L, and credit or concurrent registration in Chemistry 410A; credit or concurrent registration in Chemistry 457 for undergraduate students only. Chemistry majors in the teaching credential program (BA in Applied Arts and Sciences) can replace Chemistry 457 with credit or concurrent registration in Chemistry 417. Chemical Physics majors can replace Chemistry 457 with credit or concurrent registration in Physics 311.

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

**CHEM 560. General Biochemistry (3)**

Prerequisites: Chemistry 232, 232L, and credit or concurrent registration in Chemistry 410A, 432, 432L.

The structure, function, metabolism, and thermodynamic relationships of chemical entities in living systems. Not open to students with credit in Chemistry 365.

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

Prerequisite: Chemistry 365 or 560.

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.

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

Prerequisite: Chemistry 365 or 560.

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.

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

Prerequisite: Chemistry 365 or 560.

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)**

One lecture and six hours of laboratory.

Prerequisite: Chemistry 560.

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. Topics in Environmental Chemistry (1-3)**

Prerequisites: Chemistry 232, 232L, 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. Maximum credit three units.

**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. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

**GRADUATE COURSES**

Refer to the *Graduate Bulletin*.