Program Description

Modern chemistry occupies a central position among the sciences. The goal of chemical science is to discover the fundamental regularities by which matter in its multitude of aggregations interacts with energy in its many forms. Mathematical models and physical principles are utilized in the interpretation of chemical concepts. The organization of chemical knowledge leads to an understanding of natural phenomena in the real world of earth and life sciences.

The departmental academic program is designed to provide essential preparation for students to pursue professional careers and/or advanced studies in chemistry or related disciplines, such as Agricultural Chemistry, Biochemistry, Clinical Chemistry, Environmental Chemistry, and Forensics Chemistry. The department offers course work for chemistry majors to meet the requirements of medical and other professional schools in the health sciences, including dentistry, pharmacy, and veterinary medicine. It also cooperates with other departments and the School of Social Sciences and Education in developing a balanced program of academic and professional preparation for chemistry majors who seek teaching credentials.

The Department of Chemistry is on the approved list of the American Chemical Society. A program leading to the chemistry major can be designed to meet the standards prescribed for the certificate of the American Chemical Society by its Committee on Professional Training.

The Department of Chemistry offers four tracks leading to a major in Chemistry:

- Major in Chemistry
- Major in Chemistry with a Concentration in Biochemistry
- Major in Chemistry with a Concentration in Management and Marketing
- Major in Chemistry Certified by the American Chemical Society

Requirements for the Bachelor of Science Degree in Chemistry

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Units</th>
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<tbody>
<tr>
<td>Major Requirements</td>
<td>93 - 96</td>
</tr>
<tr>
<td>Chemistry Courses</td>
<td>63</td>
</tr>
<tr>
<td>Cognates</td>
<td>30 - 33</td>
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<tr>
<td>Minor Requirement</td>
<td>0</td>
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<tr>
<td>Other University Requirements</td>
<td>72 - 77</td>
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<tr>
<td>CSUB 101</td>
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<tr>
<td>American Institutions</td>
<td>5</td>
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<tr>
<td>Area A</td>
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<td>Area B</td>
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<td>Area C</td>
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<td>Area D</td>
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<tr>
<td>Theme I</td>
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<tr>
<td>Theme 2</td>
<td>5</td>
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<tr>
<td>Theme 3</td>
<td>5</td>
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<tr>
<td>GRE</td>
<td>5</td>
</tr>
<tr>
<td>GWAR (Test) or Class</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>
A minor is not required  0
*everything but Area B2 satisfied in major and cognates

Additional Units  7 - 15 units

Total Units Required in Major  180 units

Requirements for the Major in Chemistry (90 Units)

Lower Division [15 units]*
CHEM 211, 212, 213 [Satisfies Areas B1 and B3]
Prerequisite for CHEM 211: CHEM 101 or satisfactory score on Chemistry Placement Test

Upper Division [50 units]*
1. CHEM 331, 332, 350, 361, 362, 363, 390, and 490. [32 units]
2. One course out of CHEM 421, 422 [4 units]
3. Two courses out of CHEM 451, 452, 453 [6 units]
4. A minimum of six additional units of upper division course work with pre-approval of academic advisor. [6 units]

Cognates [30 units]*
1. MATH 201, 202, 203 or MATH 211, 212, 203 [15 units] [Satisfies Area B4]
2. PHYS 201, 202, 203 or PHYS 221, 222, 223 [15 – 18 units]

*The minimum GPA for these 95 units is 2.0

Requirements for the Bachelor of Science Degree in Chemistry with a Concentration in Biochemistry

Major Requirements  100 – 103 units
Chemistry Courses  65*
Cognates  35 – 38

Minor Requirement  0 units

Other University Requirements  67 - 72 units
CSUB 101  2
American Institutions  5
Area A  15
Area B  0**
Area C  15
Area D  15
Theme I  0**
Theme 2  5
Theme 3  5
GRE  5
GWAR (Test) or Class  0 - 5
A minor is not required  0

*13 upper division units may be in Biology
**satisfied in major or cognate

Additional Units  2 - 13 units

Total Units Required in Major  180 units

Requirements for the Major in Chemistry with a Concentration in Biochemistry (105 Units)

Lower Division [15 units]*
CHEM 211, 212, 213 [Satisfies Areas B1 and B3]
Prerequisite for CHEM 211: CHEM 101 or satisfactory score on Chemistry Placement Test.

Upper Division [50 units]*
1. CHEM 331, 332, 333, 340, 365, 390, 440, and 490. [37 units]
2. 13 additional units of upper division course work in chemistry and/or biology selected with pre-approval of academic advisor. [13 units]
Cognates [35 units]*
1. Two courses selected from BIOL 201, 202 or 203 [10 units]
2. MATH 201, 202 or MATH 211 and 212 [10 units] [Satisfies Area B4]
3. PHYS 201, 202, 203 or PHYS 221, 222, 223 [15 – 18 units]
*The minimum GPA for these 100 units is 2.0

Requirements for the Bachelor of Science Degree in Chemistry with a Concentration in Management and Marketing

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Units</th>
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<tr>
<td>Major Requirements</td>
<td>105 units</td>
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<td>Chemistry Courses</td>
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<td>Cognates</td>
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<td>Minor Requirement</td>
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<tr>
<td>Other University Requirements</td>
<td>72 – 77 units</td>
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<tr>
<td>CSUB 101</td>
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<td>American Institutions</td>
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<td>Area C</td>
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<td>Area D</td>
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<tr>
<td>Theme I</td>
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<tr>
<td>Theme 2</td>
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<td>Theme 3</td>
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<td>GRE</td>
<td>5</td>
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<tr>
<td>GWAR (Test) or Class</td>
<td>0 – 5</td>
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<tr>
<td>A minor is not required</td>
<td>0</td>
</tr>
<tr>
<td>*satisfied in major or cognate</td>
<td></td>
</tr>
<tr>
<td>Additional Units</td>
<td>0 - 3 units</td>
</tr>
<tr>
<td>Total Units Required in Major</td>
<td>180 – 182 units</td>
</tr>
</tbody>
</table>

Requirements for the Major in Chemistry with a Concentration in Management and Marketing (105 Units)

Lower Division [15 units]*
CHEM 211, 212, 213 [Satisfies Areas B1 and B3]
Prerequisite for CHEM 211: CHEM 101 or satisfactory score on Chemistry Placement Test.

Upper Division [40 units]*
1. CHEM 331, 332, 340, 350, 361, 362, 390, and 490. [33 units]
2. One course out of CHEM 421, 422 [4 units]
3. One course out of CHEM 451, 452, 453 [3 units]

Cognates [25 units]*
1. MATH 211 and 212 or MATH 201, 202 [10 units] [Satisfies Area B4]
2. PHYS 201, 202, 203

Concentration in Management and Marketing [25 units]*

Required Classes:
- MGMT 300 – Organizational Behavior
- MGMT 310 – Human Resources Management
- MKTG 300 – Marketing Principles

Elective Courses (minimum of two, patterns below just suggestions)

Management Focus:
- MGMT 309 – Career and Managerial Skills
- MGMT 430 – Negotiation, ADR, and Conflict Management

Logistics/Operations Focus:
Requirements for the Bachelor of Science Degree in Chemistry Certified by the American Chemical Society

Major Requirements 105 – 108 units
- Chemistry Courses 75
- Cognates 30 – 33

Minor Requirement 0 units

Other University Requirements 72 - 77 units
- CSUB 101 2
- American Institutions 5
- Area A 15
- Area B 5*
- Area C 15
- Area D 15
- Theme I 0*
- Theme 2 5
- Theme 3 5
- GRE 5
- GWAR (Test) or Class 0 - 5
- A minor is not required 0

*everything but Area B2 satisfied in major

Additional Units 0 - 3 units

Total Units Required in Major 180 - 185 units

Requirements for the Major in Chemistry Certified by the American Chemical Society (105 Units)

Lower Division [15 units]*
- CHEM 211, 212, 213 [Satisfies Areas B1 and B3]
  
  Prerequisite for CHEM 211: CHEM 101 or satisfactory score on Chemistry Placement Test

Upper Division [59 units]*
- 1. CHEM 331, 332, 333, 340, 350, 361, 362, 363, 390, 451, 452, 453, and 490. [51 units]
- 2. One course out of CHEM 421, 422 [4 units]
- 3. Five additional units of upper division course work selected with pre-approval of academic advisor. [5 units]

Cognates [30 units]†
- 1. MATH 201, 202, 203 or MATH 211, 212, 203 [15 units] [Satisfies Area B4]
- 2. PHYS 201, 202, 203 or PHYS 221, 222, 223 [15 – 18 units]

*The minimum GPA for these 105 units is 2.0

Program Student Learning Objectives and Assessment

The student learning objectives for all chemistry degree options and the program assessment plan as well as assessment results are found at www.csub.edu/chemistry/assessment.

Requirements for the Minor in Chemistry [20 units]
Although no minor is required for the BS degree, a minor in chemistry is available, consisting of 20 units, 10 of which must be in upper division courses.

**Teaching Credential: Science Teacher Preparation Program Leading to a Degree in Natural Sciences, Primary Concentration in Chemistry**

The California Commission on Teacher Credentialing (CCTC) has authorized CSUB to offer a single subject matter preparation program in Natural Sciences leading to a Bachelor of Arts degree. This course work satisfies the subject matter requirements for a “Secondary Teaching Credential in Science.” The program consists of three components: I. Primary Concentration (major); II. Secondary Concentration (minor); and III. Breadth (cognates). Program completion leads to a BA degree in Natural Sciences with a major in the area of primary concentration and a minor in the secondary concentration. Additional information may be obtained from the Chemistry Department office (661-654-3027).

For a detailed description of the course requirements, please turn to the Natural Sciences section in this catalog.

**Academic Regulations**

A grade of “C-” in chemistry as well as cognate courses is the minimal grade acceptable for progression into subsequent chemistry courses. Students who fail to achieve at least a “C-” may repeat the course. If a course is satisfactorily completed, the prior unsatisfactory grade will no longer bar a student from continuing in the Chemistry program.

**COURSE DESCRIPTIONS**

*Lower Division*

**CHEM 100A Chemistry in Your Life (5)**
A general education course introducing basic concepts of chemistry to the non-science major. The course focuses on the impact of chemistry on daily activities including environmental and other societal concerns. 200 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major.

**CHEM 100B CSI: Crime Scene Investigation Chemistry (5)**
A general education course introducing basic concepts of chemistry to the non-science major using examples from forensic science. The course focuses on the use of crime-scene case studies, Sherlock Homes stories, and true accounts of drug deals, murders, and thefts to introduce chemical principles. 200 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major.

**CHEM 100C Chemistry and the Environment (5)**
A general education course introducing basic concepts of chemistry to the non-science major using examples from environmental studies. The course focuses on the use of global warming studies, ozone hole studies, and accounts of the environmental impact of chemistry to introduce chemical principles. 200 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major.

**CHEM 100D Chemistry of Beer and Wine (5)**
A general education course introducing basic concepts of chemistry to the non-science major using examples from the beer and wine industries. The course focuses on the use of the processes of beer brewing and wine making to introduce chemical principles. 200 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major.
CHEM 100E Molecular Gastronomy: The Chemistry of Cooking (5)
A general education course introducing basic concepts of chemistry to the non-science major using examples from cooking and baking. The course focuses on the use of the processes of cooking to introduce chemical principles. 200 minutes of lecture/discussion and 150 minutes of laboratory per week. Not acceptable for the major.

CHEM 101 Preparation for College Chemistry (4)
A one-quarter course based on a systematic, semi-empirical approach to the submicroscopic world of chemistry. The development of modern ideas concerning atomic and molecular structure, principles of compound formation, and chemical reactivity will be emphasized. Emphasis will be on the development of the skills necessary for success in chemistry. Science majors should consult with their advisors before enrolling in this course. 200 minutes of lecture/discussion per week.

CHEM 150 General, Organic, and Biochemistry I (5)
Basic principles of chemistry including the composition of matter, periodic properties, chemical bonding and solution equilibria are introduced using examples from biological systems. Prerequisite: CHEM 101 or a satisfactory score on the Chemistry Placement Test. Recommended corequisite: CHEM 151. 150 minutes of lecture/discussion and 150 minutes of laboratory. Not acceptable to the major.

CHEM 151 Problem Solving in General, Organic, and Biochemistry I (1–2)
Problems out of CHEM 150 are discussed and solved. Must be taken concurrently with CHEM 150. 50 to 100 minutes of discussions.

CHEM 203 General, Organic and Biochemistry II (5)
Descriptive chemistry of carbon compounds including structure, reactivity and mechanism. Major focus is on organic compounds of biological and physiological importance as well as metabolism. Prerequisite: CHEM 150 or equivalent within the past five years. 150 minutes of lecture/discussion and 150 minutes of laboratory. Not acceptable to the major.

CHEM 211 Principles of General Chemistry I (5)
Introduction to atomic structure, quantum theory, periodic properties, chemical reactions, stoichiometry, gas laws and theories, molecular structure and bonding, states of matter, solutions, acids and bases, chemical equilibrium, thermodynamics, oxidation-reduction, electro-chemistry, chemical kinetics, nuclear chemistry, organic chemistry, descriptive chemistry, and coordination chemistry. Prerequisites: Math 85 or equivalent, and a satisfactory score on the Chemistry Placement Test or CHEM 101. 200 minutes of lecture/discussion and 150 minutes of laboratory. (CHEM 211 + 212 + 213 = CAN CHEM SEQ A)

CHEM 212 Principles of General Chemistry II (5)
A continuation of CHEM 211. Prerequisite: CHEM 211 or equivalent. 200 minutes of lecture/discussion and 150 minutes of laboratory per week. (CHEM 211 + 212 + 213 = CAN CHEM SEQ A)

CHEM 213 Principles of General Chemistry III (5)
A continuation of CHEM 212. Prerequisite: CHEM 212 or equivalent. 150 minutes of lecture/discussion and 300 minutes of laboratory. (CHEM 211 + 212 + 213 = CAN CHEM SEQ A)

Chem 241 Introduction to Biotechnology (2)
Introductory coverage of biotechnology including a broad survey of contemporary applications, and the future outlook of the field. The focus will be to develop an understanding of how biological systems can be manipulated to create applications in medicine, food production, forensics, industry,
and environmental remediation. These areas will be covered with a particular emphasis on modern applications and societal implications. 100 minutes of lecture/discussion per week.

**CHEM 277 Special Topics in Chemistry (1 – 5)**
Topics and prerequisites to be announced. May be repeated for different topics.

**CHEM 281 Problem Solving in Chemistry (1 – 2)**
A workshop in which students work on problems related to their chemistry coursework with help from a facilitator. This workshop is designed to accompany specific chemistry courses which must be taken concurrently. Consult the electronic course description for the acceptable companion course(s).

**Upper Division**

**Chem 300 Environmental Chemistry (3)**
A detailed study of current topics of environmental chemistry including air pollution, the ozone layer, greenhouse effect, renewable energy, toxic organic compounds, water chemistry and water pollution.
Prerequisites: CHEM 213. 150 minutes of lecture/discussion per week.

**CHEM 310 Concepts of Geochemistry (5)**
Distribution of elements within the earth, their mobilities and interactions during crustal processes. Methods of investigation, application to geologic and environmental studies and petroleum and minerals exploration. Field and laboratory investigations and presentations. Same as GEOL 310.
Prerequisites: CHEM 213, GEOL 303 or CHEM 351 and some geology course work. (Recommended: MATH 202) A field trip may be required. 200 minutes of lecture/discussion and 150 minutes of laboratory per week. Consult the Course Schedule for specific details.

**CHEM 331 Concepts of Organic Chemistry I (5)**
A detailed study of the structure and reactivity of organic compounds. Prerequisite: CHEM 213 or equivalent. 200 minutes of lecture/discussion and 150 minutes of laboratory per week.

**CHEM 332 Concepts of Organic Chemistry II (5)**
A continuation of CHEM 331. Prerequisite: CHEM 331 or equivalent. 200 minutes of lecture/discussion and 150 minutes of laboratory per week.

**CHEM 333 Concepts of Organic Chemistry III (5)**
A continuation of CHEM 332. Prerequisite: CHEM 332 or equivalent. 150 minutes of lecture/discussion and 300 minutes of laboratory per week.

**CHEM 340 Concepts of Biochemistry (5)**
Biochemical equilibria and thermodynamics, biologically important chemical compounds, metabolism of carbohydrates, fats and proteins. Prerequisite: CHEM 332 or equivalent. 150 minutes of lecture/discussion and 300 minutes of laboratory per week.

**Chem 341 Concepts of Biotechnology (3)**
In depth coverage of biotechnology with a particular focus on the molecular manipulation of genetic elements for specific applications. Review of the fundamental aspects of cell biology and biochemistry and discussion of a variety of biotechnological applications. Our discussion will emphasize medically related biotechnology such as the production of pharmaceuticals, gene therapy, stem cell research, and the human genome project. Prerequisites: Chem 241 or Chem 340. 150 minutes of lecture/discussion per week.

**CHEM 350 Quantitative Analytical Chemistry (5)**
The practice and theory of chemical laboratory methods including techniques of gravimetric, volumetric, spectrophotometric analysis and separation, and introductory instrumental analysis with a focus on precision and accuracy of experimental data. Prerequisite: CHEM 213 or equivalent. Two lectures, one discussion and two laboratories.

CHEM 361 Concepts of Physical Chemistry, Thermodynamics (4)
Introduction to topics such as chemical thermodynamics, properties of solutions, phase equilibria and electrochemistry. Prerequisites: MATH 202, PHYS 201 and CHEM 213 or consent of instructor. 150 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 362 Concepts of Physical Chemistry, Kinetics (3)
Introduction to topics such as chemical kinetics, elementary statistical thermodynamics and transport properties. Prerequisites: MATH 202, PHYS 201 and CHEM 213 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 363 Concepts of Physical Chemistry, Quantum Mechanics (4)
Introduction to topics such as quantum chemistry, atomic and molecular spectroscopy. Prerequisites: MATH 202, PHYS 201 and CHEM 213 or consent of instructor. 150 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 365 Concepts of Biophysical Chemistry (6)
Introduction to topics such as chemical thermodynamics, properties of solutions, phase equilibria, chemical kinetics, quantum chemistry, and electrochemistry with examples drawn from biochemistry. Prerequisites: MATH 212, PHYS 201 and CHEM 213 or consent of instructor. 200 minutes of lecture/discussion and 300 minutes of laboratory per week.

CHEM 390 Seminar in Chemical Literature (3)
Seminar in the use of modern chemical literature and literature data bases. Must be completed before enrolling in CHEM 490. Pre-requisite: at least 135 units and CHEM 340 or CHEM 361. 150 minutes of lecture/discussion per week.

CHEM 401 Concepts of Chemical Symmetry (3).
Introduction to methods in symmetry used in the chemical sciences. Applications include 3D chemical structures and spectroscopy. Prerequisite: CHEM 332 or consent of instructor. 150 minutes of lecture/discussion per week.

CHEM 410 Concepts of Computational Chemistry (3).
Introduction to basic computational methods used in the chemical sciences. Applications include computational methods in electronic structure, 3D biomolecular modeling, magnetic/optical/spectroscopic properties of molecules, reaction thermochemistry, and reaction dynamics. Prerequisites: CHEM 332 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 421 Concepts of Bioinorganic Chemistry (4)
An analysis of the major theories of biologically important metals with particular emphasis on the bio-distribution of metal ions. Structure and function of metal enzymes and metal DNA complexes and organometallic compounds; model compounds and medicinal inorganic chemistry. Pre-requisite: CHEM 332 or consent of instructor. 150 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 422 Concepts of Physical Inorganic Chemistry (4)
An analysis of the major theories of chemical bonding with particular emphasis on transition metal complexes. Structure, physiochemical properties and reactivity of classical metal complexes and organometallic compounds; mechanisms of inorganic reactions in aqueous and nonaqueous media.
Pre-requisite: CHEM 332 or consent of instructor. 150 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 430 Concepts of Macromolecular Chemistry (3)
Structure, properties, synthesis and analysis of synthetic and natural macromolecules; includes an introduction to supramolecular chemistry and self-assembly. Pre-requisite: CHEM 333 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 440 Advanced Biochemistry (5)
Principles underlying interactions of biological systems on the cellular, subcellular and molecular levels; membrane transport models, protein structure, function and kinetics. Prerequisites: CHEM 340 and CHEM 353 or consent of instructor. 150 minutes of lecture/discussion and 300 minutes of laboratory per week.

CHEM 451 Instrumental Analysis, NMR (3)
Principles of Nuclear Magnetic Resonance (NMR) spectroscopy and its application in modern instrumental analysis. Pre-requisite: CHEM 332 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 452 Instrumental Analysis, Separations (3)
Principles and techniques of modern instrumental analysis methods including gas chromatography, HPLC, and mass spectrometry. Pre-requisite: CHEM 332 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 453 Instrumental Analysis, Spectroscopy (3)
Principles and techniques of modern instrumental analysis methods including UV-Vis spectroscopy, IR spectroscopy and electrochemistry. Pre-requisite: CHEM 332 or consent of instructor. 100 minutes of lecture/discussion and 150 minutes of laboratory per week.

CHEM 477 Special Topics in Chemistry (1 – 5)
Topics and prerequisites to be announced. May be repeated for different topics.

CHEM 480 Honors Research (5)
Individual study on a current research problem with faculty supervision, preparation of a paper. Course may be repeated twice with permission of the instructor. Normally a maximum of five units may be used for major department credit. Units in excess of five may be used for upper division elective credit. Prerequisite: Invitation by faculty.

CHEM 489 Experiential Prior Learning (1 – 5)
Evaluation and assessment of learning which has occurred as a result of prior off-campus experience relevant to the curriculum of the department. Course may be repeated twice with permission of the instructor. Normally a maximum of five units may be used for major department credit. Units in excess of five may be used for upper-division elective credit. Available by petition only, on a credit, no-credit basis. Not open to postgraduate students. Interested students should contact the department office.

CHEM 490 Senior Seminar (3)
Presentation of papers and discussion on either a topic or a group of related topics by faculty and students. Prerequisite: Major or minor in chemistry and CHEM 390. 150 minutes of lecture/discussion per week.

CHEM 495 Instruction in Chemistry (1 – 5)
Experience supporting teaching activities in the laboratory and/or guiding problem solving sessions. Interested students should speak with the department chair in advance to coordinate. Normally, a maximum of six units may be used for major department credit. May be repeated for credit.

**CHEM 496 Internship in Chemistry (1 – 5)**
Students are assigned to various industries, institutions, or agencies and work under joint supervision of supervisors and the course instructor. Participation in staff and internship conferences. Assigned readings and projects where appropriate. (Arrangements should be made one quarter in advance with the department.) Course may be repeated twice with permission of instructor and department chair. Normally a maximum of six units may be used for major department credit. Units in excess of five may be used for upper division elective credit. Offered on a credit, no-credit basis only. May be repeated for credit.

**CHEM 497 Cooperative Education (1 – 5)**
The Cooperative Education Program offers a sponsored learning experience in a work setting, integrated with a field analysis seminar. The field experience is contracted by the Cooperative Education Office on an individual basis, subject to approval by the department. The field experience, including the seminar and reading assignments, is supervised by the cooperative education coordinator and the faculty liaison (or course instructor) working with the field supervisor. Students are expected to enroll in the course for at least two quarters. The determination of course credits, evaluation, and grading are the responsibility of the departmental faculty. Offered on a credit, no-credit basis only. Department will determine application of credit.