CHEMISTRY

Description
Chemistry deals with the analysis, structure, properties, and synthesis of matter ranging in size from single atoms to biologically-active small molecules to DNA and proteins. A degree in chemistry prepares students for many career options: industry (research, analysis, production), teaching, graduate studies, or professional schools. Chemistry is also a valuable second major for students completing degrees in a number of science, math, or engineering disciplines.

Laboratory Fee and Deposit. Students who enroll in chemistry laboratory courses pay a special fee to defray the cost of materials and equipment. The special fee is applied to tuition in the amounts given in the Office of the University Registrar's website at registrar.unl.edu.

Breakage Costs. Glassware and equipment that are lost or damaged by the student are charged to the students N-card for 200-level, 300-level, and 400-level classes.

Program Assessment. In order to assist the department in evaluating the effectiveness of its programs, majors will be required in their senior year:

1. To take a standardized chemistry exam during their final year in the program. It will be administered during the middle of the spring semester at a time that is mutually agreeable to all graduating seniors.
2. To participate in an exit interview with a designated faculty member.
3. To submit a copy of the report written for CHEM 399 Undergraduate Research in Chemistry to the departmental office for evaluation.

The vice-chair will inform students of the scheduling and format of assessment activities. Results of participation in these assessment activities will in no way affect a students GPA or graduation.

College Requirements

College Admission

College Admission
The entrance requirements for the College of Arts and Sciences are the same as the UNL General Admission Requirements. Students who are admitted through the Admission by Review process may have certain conditions attached to their enrollment at UNL. These conditions are explained under “Removal of Deficiencies.”

In addition to these requirements, the College of Arts and Sciences strongly recommends a third and fourth year of languages. Four years of high school language will exempt students from the College of Arts and Sciences’ language requirement. It will also allow students to continue language study at a more advanced level, and give more opportunity to study abroad.

Transfer Students
To be considered for admission as a transfer student, Nebraska resident or nonresident, students must have an accumulated average of C (2.0 on a 4.0 scale) and a minimum C average in the last semester of attendance at another college. Transfer students who graduated from high school January 1997 and after must also meet the UNL General Admissions Requirements. Those transfer students who graduated before January 1997 must have completed in high school 3 years of English, 2 years of the same foreign language, 2 years of algebra, and 1 year of geometry.

Transfer students who have completed less than 12 credit hours of college study must submit either the ACT or SAT scores.

Ordinarily, hours earned at an accredited college are accepted by the University. The College, however, will evaluate all hours submitted on an application for transfer and reserves the right to accept or reject any of them. Sixty is the maximum number of hours the University will accept on transfer from a two-year college or international institution. Transfer credit in the major or minor must be approved by the departmental advisor on a Request for Substitution Form to meet specific course requirements, group requirements, or course level requirements in the major or minor. At least half of the hours in the major field must be completed at the University regardless of the number of hours transferred.

The College of Arts and Sciences will accept no more than 15 semester hours of C- and D grades from other schools. The C- and D grades cannot be applied toward requirements for a major or minor. This policy does not apply to the transfer of grades from UNO or UNK to UNL. All D grades may be transferred from UNO or UNK, but they are not applicable to a major or minor.

Readmitted Students
Students readmitted to the College of Arts and Sciences will follow the requirements stated in the bulletin for the academic year of readmission and reenrollment as a degree-seeking student in Arts and Sciences. In consultation with advisors, a student may choose to follow a bulletin for any academic year in which they are admitted to and enrolled as a degree-seeking student at UNL in the College of Arts and Sciences. Students must complete all degree requirements from a single bulletin year. Beginning in 1990-1991, the bulletin which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Admission Deficiencies/Removal of Deficiencies
Students must remove entrance deficiencies in geometry and foreign language before graduating from the College of Arts and Sciences and should consult a college advisor in the Academic and Career Advising Center in 107 Oldfather Hall for questions about admission deficiencies.

Removing Foreign Language Deficiencies
Students must complete the second semester of the first year language sequence to clear the deficiency and the second semester of the second year language sequence to complete the college graduation requirement in language.

Removing Geometry Deficiencies
A deficiency of one year of geometry can be removed by taking two high school geometry courses by Independent Study or by completing a geometry course from an accredited community college or a four-year institution. Neither of these options count for college credit.

College Degree Requirements

College General Education Requirements
The College of Arts and Sciences distribution requirements are designed to further the purposes of liberal education by encouraging study in several different areas. Courses satisfying these requirements may impart specialized knowledge or broadly connect the subject matter to other areas of knowledge.

All requirements are in addition to University ACE requirements. A student may not use a single course to satisfy more than one of the following five distribution requirements. A student cannot use a single course to satisfy both an ACE outcome and a College distribution

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All requirements are in addition to University ACE requirements. A student may not use a single course to satisfy more than one of the following five distribution requirements. A student cannot use a single course to satisfy both an ACE outcome and a College distribution
requirement. A student cannot use a course from their major to satisfy the Breadth Requirement (F), but may apply an ancillary requirement of the primary major or a course from their second major toward this requirement. Independent study or reading courses and internships cannot be used to satisfy distribution requirements. To see a complete list of excluded courses, run a degree audit through MyRED.

Courses from interdisciplinary programs will count in the same area as courses from the home/cross-listed department(s).

Bachelor of Arts or Bachelor of Science (16 credits + Language)

A. Written Communication: 3 hours
   To be selected from courses approved for ACE outcome 1.

B. Natural, Physical and Mathematical Sciences: 4 hours
   Select from biochemistry, biological sciences, chemistry, computer science, geology, meteorology, mathematics, physics and statistics. Must include one lab in the natural or physical sciences. Lab courses may be selected from biochemistry, biological sciences, chemistry, geology, meteorology and physics. Select courses from geography¹ and anthropology* may also be used to satisfy the lab requirement.

C. Humanities: 3 hours
   Select from: classics², English, history, modern languages and literatures³, philosophy, and religious studies³.

D. Social Sciences: 3 hours
   Select from: anthropology², communication studies, geography³, political science, psychology², or sociology.

E. Languages Classical and Modern: 0-6 hours
   Fulfilled by the completion of the 6-credit-hour second-year sequence in a single foreign language in one of the following departments: Classics and religious studies, modern languages and literatures, or anthropology. Instruction is currently available in Arabic, Chinese, Czech, French, German, Greek, Japanese, Latin, Omaha, Russian, and Spanish. A student who has completed the fourth-year level of one foreign language in high school is exempt from the languages requirement.

F. Additional Breadth Requirement (may not be used toward the primary major; may apply toward ancillary requirements and second majors): 3 hours
   Select from: natural, physical and mathematical sciences (Area B), humanities (Area C), or social sciences (Area D).

1. See your degree audit or a College of Arts and Sciences advisor for approved geography and anthropology courses that apply as natural science.

2. Language courses numbered 210 or below apply only for the foreign language requirement.

3. See degree audit or College of Arts and Sciences advisor for list of natural/physical science courses in anthropology, geography, and psychology that do not apply as social science.

Scientific Base

The bachelor of science degree requires students to complete 60 hours in mathematical, physical and natural sciences. Approved courses for scientific base credit come from the following College of Arts and Sciences disciplines: actuarial science, anthropology (selected courses), astronomy, biochemistry (excluding BIOL 101 Career Opportunities in Biochemistry), biological sciences (excluding CASC 160 Introduction to Dentistry and Dental Hygiene, BIOS 160 Introduction to Clinical Laboratory Science, BIOS 203 Bioethics), chemistry (excluding CHEM 101 Career Opportunities in Chemistry), computer science (excluding CSCE 10 Introduction to CSE), geography (selected courses), geology, life sciences, mathematics (excluding courses below MATH 104 Applied Calculus), meteorology, physics and statistics.

See your degree audit or a College of Arts and Sciences advisor for a complete list including individual classes that fall outside of the disciplines listed above. Up to 12 hours of scientific and technical courses offered by other colleges may be accepted toward this requirement with approval of a college advisor.

Foreign Languages/Language Requirement

Languages Exemption Policy

UNL and the College of Arts and Sciences will exempt or waive students from the UNL entrance requirement of two years of the same foreign language or from the College's language distribution requirement based on documentation only. The following are the options and procedures for documentation:

High School Transcripts

1. For the University entrance requirement, students must show an official high school transcript with two or more years of the same foreign language in high school.

2. For the College of Arts and Sciences College Distribution Requirement E-Language, students must show an official high school transcript with four or more years of the same foreign language in high school, or show evidence of graduation from a non-English-speaking foreign high school.

3. For the College of Arts and Sciences College Distribution Requirement E-Language, students whose native language is not English must show English as a Second Language study on an official high school transcript. Four years of ESL at the high school level (9th, 10th, 11th and 12th grades) will be the basis for a waiver of the CDR E Language requirement.

Proficiency Examination at UNL

1. For the University entrance requirement, students who do not have transcript documentation can request to take a proficiency exam in the language. (This is not the same test as the Modern Languages Placement Exam.) However, UNL will provide testing only in the languages it teaches. Currently, these languages are:

   - Arabic
   - French
   - German
   - Spanish
   - Russian
   - Czech
   - Japanese
   - Chinese

   The Department of Modern Languages will oversee the test and provide written documentation to the Arts and Sciences Advising Center that the student has passed the proficiency test at the 102 level.

2. For the College of Arts and Sciences College Distribution Requirement E-Language, the Department of Modern Languages will oversee the test at the 202 level. If the student passes the test, the department will sign the College Request for Waiver form and indicate the level of proficiency. The form is then forwarded to the Arts and Sciences Advising Center for approval.

Distance Education

1. For the University entrance requirement, students without transcript documentation who claim proficiency in a language not taught at
Pass apply as follows:

For students in Arts and Sciences, the University regulations for Pass/No Pass privilege state:

**Pass/No Pass Privilege**

- UNL C- and D grades can be applied toward requirements in a major or a minor. No Transfer C- and D grades can be applied toward requirements in a major or a minor. No UNL C- and D grades can be applied toward requirements in a major or a minor. Restrictions on C- and D Grades

- The College will accept no more than 15 semester hours of C- and D grades. Of the 15 semester hours of C- and D grades, at least 2.0 is required.

**Minimum Hours Required for Graduation**

A minimum of 120 semester hours of credit is required for graduation from the College of Arts and Sciences. A total grade point average of at least 2.0 is required.

**Grade Rules**

Restrictions on C- and D Grades

The College will accept no more than 15 semester hours of C- and D grades from other schools except for UNO and UNK. No transfer C- and D grades can be applied toward requirements in a major or a minor. No UNL C- and D grades can be applied toward requirements in a major or a minor.

Pass/No Pass Privilege

University regulations for the Pass/No Pass (P/N) privilege state:

- The Pass/No Pass option is designed for your use by seeking to expand your intellectual horizons by taking courses in areas where you may have had minimal preparation.

For students in Arts and Sciences, the University regulations for Pass/No Pass apply as follows:

- Neither the P nor the N grade contribute to your GPA.
- P is interpreted to mean C or above.
- A change to or from a Pass/No Pass may be made until mid-term (1/2 of the course).
- The Pass/No Pass or grade registration cannot conflict with the policy of the professor, department, college, or University governing the grading option.
- Changing to or from Pass/No Pass requires using the MyRED system to change the grading option or filing a Drop/Add form with the Office of the University Registrar, 107 Canfield Administration Building. After mid-term of the course, a student registered for Pass/No Pass cannot change to a grade registration unless the Pass/No Pass registration is in conflict with the policy of the professor, department, college, or University governing Pass/No Pass.

Pass/No Pass privileges in the College of Arts and Sciences are extended to students according to the following additional regulations:

- Pass/No Pass hours can count toward fulfillment of University ACE requirements and college distribution requirements up to the 24-hour maximum.
- Many Arts and Sciences departments and programs do not allow courses in the major or minor to be taken Pass/No Pass; students should refer to the department’s or program’s section of the bulletin for clarification. By college rule, departments can allow up to 6 hours of Pass/No Pass in the major or minor.
- Departments may specify that certain courses of theirs can be taken only on a P/N basis.
- The college will permit no more than a total of 24 semester hours of P/N grades to be applied toward degree requirements. This total includes all Pass grades earned at UNL and other U.S. schools. **NOTE:** This 24-hour limit is more restrictive than the University regulation.

Students who wish to apply P/N hours to their major and minor(s) must obtain approval on a form that is available in the Arts and Sciences Advising Center, 107 Oldfather Hall.

**Grading Appeals**

A student who feels that he/she has been unfairly graded must ordinarily take the following sequential steps in a timely manner, usually by initiating the appeal in the semester following the awarding of the grade:

1. Talk with the instructor concerned. Most problems are resolved at this point.
2. Talk to the instructor’s department chairperson.
3. Take the case to the Grading Appeal Committee of the department concerned. The Committee should be contacted through the department chairperson.
4. Take the case to the College Grading Appeals Committee by contacting the Dean’s Office, 1223 Oldfather Hall.

**Course Level Requirements**

Courses Numbered above 299

Thirty of the 120 semester hours of credit must be in courses numbered above 299. Of the 30 hours above 299, 15 hours (1/2) must be completed in residence at UNL. **NOTE:** ALEC 397E and ALEC 397K do not count toward these 30 hours.

**Graduate Courses**

Seniors in the University who have obtained in advance the approval of the dean for Graduate Studies may receive up to 12 hours credit for graduate courses taken in addition to the courses necessary to complete their undergraduate work, provided that such credits are earned within the calendar year prior to receipt of the baccalaureate. For procedures, inquire at the Office of Graduate Studies.

Course work taken prior to receipt of the baccalaureate may not always be accepted for transfer to other institutions as graduate work.

**Residency**

Residency Requirement and Open Enrollment and Summer Independent Study Courses

Students must complete at least 30 of the 120 total hours for their degree at UNL. Students must complete at least 1/2 of their major course work including 6 hours above 299 in their major, and 15 of the 30 hours required above 299 in residence. Credit earned during education abroad may be used toward the residency requirement if students register through UNL and participate in prior-approved education abroad.
programs. UNL open enrollment and summer independent study courses count toward residence.

**ACE Requirements**

Consistent with the mission and values of the University, ACE is based on a shared set of four institutional objectives and 10 student learning outcomes. The ACE program was approved by faculty in all eight undergraduate colleges and endorsed by the Faculty Senate, the student government, and the Academic Planning Committee in January 2008 for implementation in the fall 2009. ACE aligns with current national initiatives in general education.

Key characteristics of ACE demonstrate the benefits of the program to students:

- Students receive a broad education with exposure to multiple disciplines, critical life skills and important reasoning, inquiry, and civic capacities.
- ACE is simple and transparent for students, faculty and advisors. Students complete the equivalent of 3 credit hours for each of the ten student learning outcomes.
- Students connect and integrate their ACE experiences with their selected major.
- Students can transfer all ACE certified courses across colleges within the institution to meet the ACE requirement and any course from outside the institution that is directly equivalent to a UNL ACE-certified course. Courses from outside institutions without direct equivalents may be considered with appropriate documentation for ACE credit (see academic advisor).

ACE allows faculty to assess and improve their effectiveness and facilitate students’ learning.

**ACE Institutional Objectives and Student Learning Outcomes**

To meet the ACE Program requirement, a student will complete a minimum of 3 credit hours for each of the ten ACE Student Learning Outcomes (a total of 30 ACE credit hours). See the ACE website at: http://ace.unl.edu for the most current information and the most recently certified courses.

**Bulletin Rule**

Students must fulfill the requirements stated in the bulletin for the academic year in which they are first admitted to and enrolled as a degree-seeking student at UNL. In consultation with advisors, a student may choose to follow a subsequent bulletin for any academic year in which they are admitted to and enrolled as a degree-seeking student at UNL in the College of Arts and Sciences. Students must complete all degree requirements from a single bulletin year. Beginning in 1990-1991 the bulletin which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

**Learning Outcomes**

Majors in chemistry will be able to:

1. Explain basic chemical principles.
2. Perform calculations and data analyses to solve chemical problems.
3. Apply basic chemical principles to chemical systems.
4. Design chemical experiments to study chemical compounds and processes.
5. Employ laboratory techniques and instrumentation to perform chemical experiments.
6. Apply chemical hygiene and safety best practices.
7. Utilize computer-based tools to research and critically analyze chemical information.
8. Communicate integrated scientific knowledge and practice.
9. Secure entry into graduate programs, professional schools or professional positions that build upon the degree.

**Major Requirements**

**Bachelor of Science**

The bachelor of science (BS) is recommended for students planning graduate studies or professional careers in chemistry and is also an excellent choice for pre-medicine.

**Core Requirements**

**Career and Academic Planning**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
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<tbody>
<tr>
<td>CHEM 101</td>
<td>Career Opportunities in Chemistry</td>
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**Fundamental Chemistry & Quantitative Analysis**

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<td>CHEM 113</td>
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<td>CHEM 114</td>
<td>Fundamental Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 221</td>
<td>Elementary Quantitative Analysis</td>
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**Organic Chemistry**

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<td>CHEM 261</td>
<td>Organic Chemistry</td>
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<td>CHEM 262</td>
<td>Organic Chemistry</td>
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<td>CHEM 263</td>
<td>Organic Chemistry Laboratory</td>
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<tr>
<td>CHEM 264</td>
<td>Organic Chemistry Laboratory</td>
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**Biochemistry or Chemical Biology**

Select one of the following sets:

- CHEM 431 Structure and Metabolism
- CHEM 433 and Biochemistry Laboratory
- or CHEM 435 Chemical Biology
- & CHEM 433 and Biochemistry Laboratory

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<thead>
<tr>
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<tbody>
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<td></td>
<td>Credit Hours Subtotal:</td>
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**Physical Chemistry**

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<tbody>
<tr>
<td>CHEM 481</td>
<td>Physical Chemistry I</td>
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<tr>
<td>CHEM 482</td>
<td>Physical Chemistry II</td>
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<tr>
<td>CHEM 484</td>
<td>Physical Chemical Measurements</td>
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<td>Credit Hours Subtotal:</td>
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**Undergraduate Research**

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<th>Course</th>
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<tbody>
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<td>CHEM 399</td>
<td>Undergraduate Research in Chemistry (at least 2 cr)</td>
<td>2</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Total Credit Hours</td>
<td>40</td>
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</table>

**Specific Major Requirements**

**Capstone**

Select one of the following sets:

- CHEM 421 Analytical Chemistry
- & CHEM 423 and Analytical Chemistry Laboratory
- or CHEM 441 Inorganic Chemistry
- & CHEM 443 and Inorganic Chemistry Laboratory

<table>
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<td>Credit Hours Subtotal:</td>
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**Mathematics**
Bachelor of Arts

The bachelor of arts (BA) program is designed for students needing undergraduate training in chemistry as preparation for professional careers outside of chemistry and fits easily into pre-medical, pre-pharmacy, pre-health, and pre-law degree programs.

Core Requirements

Career and Academic Planning

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<tr>
<td>CHEM 101</td>
<td>Career Opportunities in Chemistry</td>
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Credit Hours Subtotal: 1

General Chemistry & Quantitative Analysis

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<tbody>
<tr>
<td>CHEM 109</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 110</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 221</td>
<td>Elementary Quantitative Analysis</td>
<td>4</td>
</tr>
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Credit Hours Subtotal: 12

Organic Chemistry

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<tr>
<td>CHEM 251</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 253</td>
<td>and Organic Chemistry I Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 252</td>
<td>Organic Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 254</td>
<td>and Organic Chemistry II Laboratory</td>
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Credit Hours Subtotal: 8

Physical Chemistry

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<th>Credit Hours</th>
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<tr>
<td>CHEM 471</td>
<td>Physical Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>or CHEM 481</td>
<td>Physical Chemistry I</td>
<td></td>
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</table>

Credit Hours Subtotal: 4

Total Credit Hours 25

Specific Major Requirements

Capstone

Select two of the following sets: 10

<table>
<thead>
<tr>
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<th>Credit Hours</th>
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<tbody>
<tr>
<td>CHEM 421</td>
<td>Analytical Chemistry</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 423</td>
<td>and Analytical Chemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 431</td>
<td>Structure and Metabolism</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 433</td>
<td>and Biochemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>or CHEM 434</td>
<td>Chemical Biology</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 433</td>
<td>and Biochemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 441</td>
<td>Inorganic Chemistry</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 443</td>
<td>and Inorganic Chemistry Laboratory</td>
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</table>

Credit Hours Subtotal: 10

Mathematics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 106</td>
<td>Calculus I</td>
<td>5</td>
</tr>
<tr>
<td>MATH 107</td>
<td>Calculus II</td>
<td>4-5</td>
</tr>
<tr>
<td>or MATH 238</td>
<td>Mathematical Methods for Biology and Medicine</td>
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</table>

Credit Hours Subtotal: 9-10

Physics

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PHYS 141</td>
<td>Elementary General Physics I</td>
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</tr>
<tr>
<td>PHYS 142</td>
<td>Elementary General Physics II</td>
<td>5</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 10

Total Credit Hours 29-30

NOTE: It is possible to transfer between the BS and BA programs despite the different sets of courses, but the student should visit the chemistry advisor to work out the details.

Additional Major Requirements

Grade Rules

C- and D Grades

A grade of C or above is required for all courses in the major, including any math or physics courses.

Pass/No Pass

No course taken Pass/No Pass will be counted toward the major with the exceptions of CHEM 101, CHEM 396, and/or CHEM 399.

Requirements for Minor Offered by Department

Plan A Minor (23-24 hours)

Completion of a chemistry sequence plus an addition twelve (12) hours of chemistry:

Select one of the following chemistry sequences: 11-12

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 109</td>
<td>General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 110</td>
<td>and General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
<td></td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Fundamental Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 114</td>
<td>and Fundamental Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
<td></td>
</tr>
</tbody>
</table>

Select an additional 12 hours of chemistry 1 12

Total Credit Hours 23-24

Plan B Minor (19-20 hours)

Completion of a chemistry sequence plus an additional eight (8) hours of chemistry:

Select one of the following chemistry sequences: 11-12

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 109</td>
<td>General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 110</td>
<td>and General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
<td></td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Fundamental Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 114</td>
<td>and Fundamental Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 221</td>
<td>and Elementary Quantitative Analysis</td>
<td></td>
</tr>
</tbody>
</table>

Select an additional 8 hours of chemistry 1 8

Total Credit Hours 19-20

Grade Rules

C- and D Grades
A grade of C or above is required for all courses in the minor, including any math or physics courses.

Pass/No Pass
No course taken Pass/No Pass will be counted toward the minor with the exceptions of CHEM 101, CHEM 396, and/or CHEM 399.

CHEM 101 Career Opportunities in Chemistry
Description: Introduction to chemistry careers and faculty research interests in the Department of Chemistry. This course is required for all chemistry majors (B.S. and B.A.) but is open to all students interested in learning about the chemistry program and its relationship to careers.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 105 Chemistry in Context I
Crosslisted with: CHEM 105H
Description: The extraordinary chemistry of ordinary things. The chemical model of solids, liquids, gases, molecules, and salts. How these models are used to explore chemical aspects of biological, social, or economic situation. Credit toward the degree may be earned in only one of: CHEM 105, 109, 111, 113, or 195. Students planning to take CHEM 251 and 252, or CHEM 261 and 262, should register for CHEM 109 and 110, or CHEM 113 and 114 (the general chemistry sequence). CHEM 105 is the first part of a two-semester sequence, along with CHEM 106, to constitute the "Chemistry in Context" series.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 327, HORT 327, TLMT 327; ASCI 240, ASCI 240H; NRES 319
ACE: ACE 4 Science

CHEM 105H Chemistry in Context I
Crosslisted with: CHEM 105
Description: The extraordinary chemistry of ordinary things. The chemical model of solids, liquids, gases, molecules, and salts. How these models are used to explore chemical aspects of biological, social, or economic situation. Credit toward the degree may be earned in only one of: CHEM 105, 109, 111, 113, or 195. Students planning to take CHEM 251 and 252, or CHEM 261 and 262, should register for CHEM 109 and 110, or CHEM 113 and 114 (the general chemistry sequence). CHEM 105 is the first part of a two-semester sequence, along with CHEM 106, to constitute the "Chemistry in Context" series.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 327, HORT 327, TLMT 327; ASCI 240, ASCI 240H; NRES 319
ACE: ACE 4 Science

CHEM 106 Chemistry in Context II
Description: How organic chemistry and biochemistry complement one another. Chemical aspects of biological, social, or economic situations. Continuation of CHEM 105. CHEM 106 will not serve as a prerequisite for any chemistry course. Students planning to take CHEM 251-252 or 263-264, should take CHEM 109-110 or 113-114 (general chemistry sequence). CHEM 106 is the second part of a two-semester sequence, along with CHEM 105, to constitute the "Chemistry in Context" series.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: ASCI 320, ASCI 320H

CHEM 109 General Chemistry I
Crosslisted with: CHEM 109H
Prerequisites: MATH 103 or a Math Placement Test score for MATH 104 or 106
Description: Lecture and laboratory serving as an introduction to chemical reactions, the mole concept, properties of the states of matter, atomic structure, periodic properties, chemical bonding, and molecular structure.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 327, HORT 327, TLMT 327; AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455; ASCI 340; BIOC 205; CHME 114; CHME 202, CHME 202H; FDST 401, FDST 801; FORS 300; FORS 411; MATL 360, MATL 360H; NRES 319
ACE: ACE 4 Science

CHEM 109H General Chemistry I
Crosslisted with: CHEM 109
Prerequisites: MATH 103 or a Math Placement Test score for MATH 104 or 106
Description: Lecture and laboratory serving as an introduction to chemical reactions, the mole concept, properties of the states of matter, atomic structure, periodic properties, chemical bonding, and molecular structure.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 327, HORT 327, TLMT 327; AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455; ASCI 340; BIOC 205; CHME 114; CHME 202, CHME 202H; FDST 401, FDST 801; FORS 300; FORS 411; MATL 360, MATL 360H; NRES 319
ACE: ACE 4 Science
CHEM 110 General Chemistry II
Crosslisted with: CHEM 110H
Prerequisites: CHEM 109
Description: Lecture and laboratory serving as an introduction to intermolecular forces, kinetics, chemical equilibrium, thermodynamics, and electrochemistry.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455; ASCI 340; BSEN 355; CHEM 221, CHEM 221H; CHEM 251, CHEM 251H; CHEM 255; CHEM 263; FORS 300; FORS 411
ACE: ACE 4 Science

CHEM 110H General Chemistry II
Crosslisted with: CHEM 110
Prerequisites: CHEM 109
Description: Lecture and laboratory serving as an introduction to intermolecular forces, kinetics, chemical equilibrium, thermodynamics, and electrochemistry.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455; ASCI 340; BSEN 355; CHEM 221, CHEM 221H; CHEM 251, CHEM 251H; CHEM 255; CHEM 263; FORS 300; FORS 411
ACE: ACE 4 Science

CHEM 111 Chemistry for Engineering and Technology
Crosslisted with: CHEM 110
Prerequisites: CHEM 109
Description: Fundamentals of chemistry for engineering. Credit towards the degree may be earned in only one: CHEM 105, 109, 111, 113, or 195. Not open to chemical engineering majors. CHEM 111 is a one semester introduction to the fundamentals of chemistry course for engineering students.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: BSEN 355; MATL 360, MATL 360H

CHEM 113H Fundamental Chemistry I
Crosslisted with: CHEM 113
Description: Fundamentals of chemistry for students in physical sciences or chemical engineering. Includes atomic and molecular structure, chemical bonding, states of matter, solutions, and acid-base reactions. Intended for students who plan to take upper-level courses in chemistry.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CHEM 114, CHEM 114H; CHME 114; CHME 202, CHME 202H
ACE: ACE 4 Science

CHEM 114 Fundamental Chemistry II
Crosslisted with: CHEM 114H
Prerequisites: CHEM 113. Parallel: CHEM 221
Description: Chemical kinetics, oxidation-reduction reactions and electrochemistry, ionic solution equilibria, thermodynamic concepts, and chemistry of selected elements. CHEM 221 is the associated laboratory course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BSEN 355; CHEM 251, CHEM 251H; CHEM 255; CHEM 263

CHEM 114H Fundamental Chemistry II
Crosslisted with: CHEM 114
Prerequisites: CHEM 113. Parallel: CHEM 221
Description: Chemical kinetics, oxidation-reduction reactions and electrochemistry, ionic solution equilibria, thermodynamic concepts, and chemistry of selected elements. CHEM 221 is the associated laboratory course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BSEN 355; CHEM 251, CHEM 251H; CHEM 255; CHEM 263

CHEM 116 Quantitative Chemistry Laboratory
Crosslisted with: CHEM 116H
Description: Elementary quantitative laboratory instruction in analytical methods and preparations including titrimentry, gravimetry, separations, and use of pH meter and spectrophotometer, qualitative chemical analysis. Credit may not be earned in both CHEM 116 and 221.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

CHEM 116H Quantitative Chemistry Laboratory
Crosslisted with: CHEM 116
Description: Elementary quantitative laboratory instruction in analytical methods and preparations including titrimetry, gravimetry, separations, and use of pH meter and spectrophotometer, qualitative chemical analysis. Credit may not be earned in both CHEM 116 and 221.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
CHEM 131 The Science of Food
Crosslisted with: CHEM 131H, FDST 131, FDST 131H, NUTR 131, NUTR 131H
Description: General scientific concepts in biology, chemistry, and physics using food as a model. What food is from both chemical and nutritional perspectives, and the fate of food from when it leaves the farm to when it becomes a part of the individual. Assists students in making intelligent decisions about many food related controversial issues (e.g., food irradiation, food additives, health foods).
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: FDST 301
ACE: ACE 4 Science

CHEM 131H The Science of Food
Crosslisted with: CHEM 131, FDST 131, FDST 131H, NUTR 131, NUTR 131H
Description: General scientific concepts in biology, chemistry, and physics using food as a model. What food is from both chemical and nutritional perspectives, and the fate of food from when it leaves the farm to when it becomes a part of the individual. Assists students in making intelligent decisions about many food related controversial issues (e.g., food irradiation, food additives, health foods).
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: FDST 301
ACE: ACE 4 Science

CHEM 191H Freshman Honors Chemistry I
Description: Seminar in which special topics in chemistry are taught at a level appropriate for the student population.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 192H Freshman Honors Chemistry II
Description: Seminar in which special topics in chemistry are taught at a level appropriate for the student population.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 195 Today's Chemistry in Education
Crosslisted with: CHEM 195H
Description: Interactive, practical approach to learning chemistry and its relationship to today's world. Intended for elementary and middle-level education majors. Uses the Operation Chemistry model to help students learn the essential chemistry content and teaching practices for elementary-level classrooms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455

CHEM 195H Today's Chemistry in Education
Crosslisted with: CHEM 195
Description: Interactive, practical approach to learning chemistry and its relationship to today's world. Intended for elementary and middle-level education majors. Uses the Operation Chemistry model to help students learn the essential chemistry content and teaching practices for elementary-level classrooms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455

CHEM 221 Elementary Quantitative Analysis
Crosslisted with: CHEM 221H
Prerequisites: CHEM 110 or parallel CHEM 114
Description: Introduction to principles of quantitative analytical chemistry, including ionic equilibria and solution stoichiometry. Lab instruction includes titrimetry, gravimetry, separations, and use of pH meter and spectrophotometer. This is the laboratory course for CHEM 114 as well as a stand-alone course in quantitative analysis. Credit may not be earned in both CHEM 221 and 116.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455

CHEM 221H Elementary Quantitative Analysis
Crosslisted with: CHEM 221
Prerequisites: CHEM 110 or parallel CHEM 114
Description: Introduction to principles of quantitative analytical chemistry, including ionic equilibria and solution stoichiometry. Lab instruction includes titrimetry, gravimetry, separations, and use of pH meter and spectrophotometer. This is the laboratory course for CHEM 114 as well as a stand-alone course in quantitative analysis. Credit may not be earned in both CHEM 221 and 116.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455

CHEM 251 Organic Chemistry I
Crosslisted with: CHEM 251H
Prerequisites: CHEM 110 or 114 with a minimum grade of C. This course is designed to be taken parallel with CHEM 253
Description: Chemistry of carbon compounds. Applications to the biological sciences, agriculture and pre-professional programs including premedical and pre-dental. Emphasizes basic principles. This course is designed to be taken parallel with CHEM 253 Organic Chemistry Laboratory. CHEM 251 and 252, with their corresponding labs of CHEM 253 and 254, form a continuous basic course in organic chemistry.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455
CHEM 251H Organic Chemistry I
Crosslisted with: CHEM 251
Prerequisites: CHEM 110 or 114 with a minimum grade of C. This course is designed to be taken parallel with CHEM 253
Description: Chemistry of carbon compounds. Applications to the biological sciences, agriculture and pre-professional programs including premedical and pre-dental. Emphasizes basic principles. This course is designed to be taken parallel with CHEM 253 Organic Chemistry Laboratory. CHEM 251 and 252, with their corresponding labs of CHEM 253 and 254, form a continuous basic course in organic chemistry.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455

CHEM 252 Organic Chemistry II
Crosslisted with: CHEM 252H
Description: Chemistry of carbonyl compounds. Aspects of aromatic chemistry, heterocycles, carbohydrates and nitrogen compounds, with some emphasis on the organic compounds found in nature.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 252H Organic Chemistry II
Crosslisted with: CHEM 252
Description: Chemistry of carbonyl compounds. Aspects of aromatic chemistry, heterocycles, carbohydrates and nitrogen compounds, with some emphasis on the organic compounds found in nature.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 253 Organic Chemistry I Laboratory
Crosslisted with: CHEM 253H
Description: Basic techniques of organic chemistry. Structure, identification, physical properties of compounds, molecular modeling, and introduction to the spectroscopic characteristics of organic compounds.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CHEM 253H Organic Chemistry I Laboratory
Crosslisted with: CHEM 253
Description: Basic techniques of organic chemistry. Structure, identification, physical properties of compounds, molecular modeling, and introduction to the spectroscopic characteristics of organic compounds.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CHEM 254 Organic Chemistry II Laboratory
Crosslisted with: CHEM 254H
Description: Synthesis of representative organic compounds. Qualitative analysis of organic compounds. Naturally occurring compounds.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CHEM 254H Organic Chemistry II Laboratory
Crosslisted with: CHEM 254
Description: Synthesis of representative organic compounds. Qualitative analysis of organic compounds. Naturally occurring compounds.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CHEM 255 Biological Organic Chemistry
Prerequisites: CHEM 110 or 114
Description: One-semester organic chemistry course in which biological molecules and biochemical reactions will be used to explain and illustrate the central concepts of organic chemistry. This course should not be taken by majors in Chemistry or Chemical Engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 257 Biological Organic Chemistry Laboratory
Prerequisites: CHEM 255 or concurrent
Description: Basic techniques in organic chemistry with a focus on biomolecules. Structure, identification, and physical properties of compounds, accompanied with molecular modeling and introduction to spectroscopy.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CHEM 261 Organic Chemistry
Crosslisted with: CHEM 261H
Prerequisites: CHEM 110 or 114 with minimum grades of C. This course was designed to be taken in parallel with CHEM 263
Description: CHEM 261 and 262, together with lab courses 263 and 264, form a continuous basic course covering the important compounds of carbon. This course was designed to be taken in parallel with CHEM 263 Organic Chemistry Laboratory. Students having credit in CHEM 251 or its equivalent may not receive credit in CHEM 261.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHEM 262, CHEM 262H; CHEM 264; CHEM 264A

CHEM 264H Organic Chemistry II Laboratory
Crosslisted with: CHEM 264
Description: Synthesis of representative organic compounds. Qualitative analysis of organic compounds. Naturally occurring compounds.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CHEM 265 Biological Organic Chemistry
Prerequisites: CHEM 255 or concurrent
Description: Basic techniques in organic chemistry with a focus on biomolecules. Structure, identification, and physical properties of compounds, accompanied with molecular modeling and introduction to spectroscopy.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

CHEM 267 Biological Organic Chemistry Laboratory
Prerequisites: CHEM 265 or concurrent
Description: Basic techniques in organic chemistry with a focus on biomolecules. Structure, identification, and physical properties of compounds, accompanied with molecular modeling and introduction to spectroscopy.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB
CHEM 261H Organic Chemistry
Crosslisted with: CHEM 261
Description: CHEM 261 and 262, together with lab courses 263 and 264, form a continuous basic course covering the important compounds of carbon. This course was designed to be taken in parallel with CHEM 263 Organic Chemistry Laboratory. Students having credit in CHEM 251 or its equivalent may not receive credit in CHEM 261.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHEM 262, CHEM 262H; CHEM 264; CHEM 264A

CHEM 262 Organic Chemistry
Crosslisted with: CHEM 262H
Prerequisites: CHEM 261
Description: Continuation of CHEM 261.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHME 473, CHME 873, CHME 473H

CHEM 262H Organic Chemistry
Crosslisted with: CHEM 262
Prerequisites: CHEM 261
Description: Continuation of CHEM 261.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHME 473, CHME 873, CHME 473H

CHEM 263 Organic Chemistry Laboratory
Prerequisites: CHEM 110 or CHEM 114 with minimum grades of C.
Description: Students following the professional curriculum in chemistry should elect this course.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
Prerequisite for: CHEM 264

CHEM 263A Organic Chemistry Laboratory
Description: Students having credit in CHEM 251 or its equivalent should elect this course.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC
Prerequisite for: CHEM 264A

CHEM 264 Organic Chemistry Laboratory
Prerequisites: CHEM 261 and 263
Description: Continuation of CHEM 263. Lab work in qualitative organic analysis.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

CHEM 264A Organic Chemistry Laboratory
Prerequisites: CHEM 261 and 263A
Description: Continuation of CHEM 263A.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 291H Honors: Sophomore Chemistry I
Description: Seminar in which special topics in chemistry are taught at a level appropriate for the student population.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 292H Honors: Sophomore Chemistry II
Description: Seminar in which special topics in chemistry are taught at a level appropriate for the student population.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 396 Independent Study
Crosslisted with: CHEM 396H
Credit Hours: 1-12
Min credits per semester: 1
Max credits per semester: 12
Max credits per degree: 12
Format: IND

CHEM 396H Independent Study
Crosslisted with: CHEM 396
Credit Hours: 1-12
Min credits per semester: 1
Max credits per semester: 12
Max credits per degree: 12
Format: IND

CHEM 399 Undergraduate Research in Chemistry
Crosslisted with: CHEM 399H
Description: Open to undergraduates desiring to undertake a special research project under the direction of a member of the departmental faculty. The grade will be awarded following the submission of a written progress and/or final report.
Credit Hours: 1-12
Min credits per semester: 1
Max credits per semester: 12
Max credits per degree: 12
Format: IND

CHEM 399H Undergraduate Research in Chemistry
Crosslisted with: CHEM 399
Description: Open to undergraduates desiring to undertake a special research project under the direction of a member of the departmental faculty. The grade will be awarded following the submission of a written progress and/or final report.
Credit Hours: 1-12
Min credits per semester: 1
Max credits per semester: 12
Max credits per degree: 12
Format: IND
CHEM 421 Analytical Chemistry
Crosslisted with: CHEM 421H, CHEM 821
Prerequisites: CHEM 471/871 or 481/881; parallel CHEM 423/823
Description: Chemical and physical properties applied to quantitative chemical analysis. Solution equilibria, stoichiometry, and instrumental theory and techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

CHEM 421H Analytical Chemistry
Crosslisted with: CHEM 421, CHEM 821
Prerequisites: CHEM 471/871 or 481/881; parallel CHEM 423/823
Description: Chemical and physical properties applied to quantitative chemical analysis. Solution equilibria, stoichiometry, and instrumental theory and techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

CHEM 423 Analytical Chemistry Laboratory
Crosslisted with: CHEM 823
Description: Lab designed to accompany CHEM 421/821. Applications of analytical chemical principles to laboratory problems.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LAB

CHEM 431 Structure and Metabolism
Crosslisted with: BIOC 431, BIOC 831, BIOS 431, BIOS 831, CHEM 831
Prerequisites: CHEM 252 or CHEM 262 with a grade of C or better. LIFE 120 and BIOS 206 are recommended
Description: Structure and function of proteins, nucleic acids, carbohydrates and lipids; nature of enzymes; major metabolic pathways of catabolism; and biochemical energy production. First course of a two-semester, comprehensive biochemistry course sequence.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHME 473, CHME 873, CHME 473H; VBMS 410

CHEM 432 Metabolism and Biological Information
Crosslisted with: BIOC 432, BIOC 432H, BIOC 832, BIOS 432, BIOS 432H, CHEM 432, CHEM 832, BIOS 832
Prerequisites: BIOC 431/831 with a grade of C or better, BIOS 206 or AGRO 215.
Notes: Continuation of BIOC 431/831.
Description: Major metabolic pathways of anabolism, structural and biochemical aspects of biological information flow and use in biotechnology.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BIOC 934, BIOS 934, CHEM 934

CHEM 433 Biochemistry Laboratory
Crosslisted with: BIOC 433, BIOC 433H, BIOC 833, BIOS 433, BIOS 833, CHEM 833
Prerequisites: BIOC 431/831 (or concurrent enrollment) or CHEM 435/835.
Description: Introduction to techniques used in biochemical and biotechnology research, including measurement of pH, spectroscopy, analysis of enzymes, chromatography, fractionation of macromolecules, electrophoresis, and centrifugation.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

CHEM 434 Plant Biochemistry
Crosslisted with: AGRO 434, BIOC 434, BIOS 434
Prerequisites: BIOC/BIOS/CHEM 431/831.
Description: Biochemical metabolism unique to plants. Relationships of topics previously acquired in general biochemistry to biochemical processes unique to plants. Biochemical mechanisms behind physiological processes discussed in plant or crop physiology.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 435 Chemical Biology
Crosslisted with: CHEM 835
Prerequisites: Chem 252 or 262, and Chem 221
Description: Fundamentals of chemical biology with an emphasis on the underlying principles of biomolecular structures, macromolecular-small molecule interactions, including mechanistic aspects of enzymes and cofactors, use of modified enzymes to alter biochemical pathways, and the use of chemical tools for understanding biological processes. Credit toward the undergraduate or graduate degree cannot be earned in both CHEM 435/835, and 431/831 and/or 432/832 or their equivalents.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CHEM 441 Inorganic Chemistry
Crosslisted with: CHEM 441H, CHEM 841
Prerequisites: CHEM 221 with at least a C; CHEM 252 or CHEM 262. Parallel: CHEM 443/843 or permission
Description: CHEM 441/841 and the accompanying lab course, CHEM 443/843, constitute a basic course in inorganic chemistry. Structure, bonding, properties, and reactions of inorganic compounds with emphasis on the relationships and trends that are embodied in the periodic table of the elements.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

CHEM 441H Inorganic Chemistry
Crosslisted with: CHEM 441, CHEM 841
Description: CHEM 441/841 and the accompanying lab course, CHEM 443/843, constitute a basic course in inorganic chemistry. Structure, bonding, properties, and reactions of inorganic compounds with emphasis on the relationships and trends that are embodied in the periodic table of the elements.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

CHEM 443 Inorganic Chemistry Laboratory
Crosslisted with: CHEM 843
Description: Introduction to typical inorganic chemistry laboratory techniques through the preparation and characterization of inorganic compounds.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

CHEM 463 Advanced Organic Preparations
Crosslisted with: CHEM 863
Description: For students who wish additional laboratory work in organic chemistry.
Credit Hours: 1-5
Min credits per semester: 1
Max credits per semester: 5
Max credits per degree: 5
Format: LAB

CHEM 471 Physical Chemistry
Crosslisted with: CHEM 871
Description: Conceptual and mathematical foundations of classical and statistical thermodynamics. Applications of thermodynamics to phase and chemical equilibria. Thermodynamics of solutions of small molecules and of polymers. Biological applications of thermodynamics. Introduction to chemical and biochemical spectroscopy.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

CHEM 481 Physical Chemistry I
Crosslisted with: CHEM 881
Prerequisites: CHEM 221 with grade of at least C; MATH 208; PHYS 212.
Description: CHEM 481/881 and 482/882 with accompanying lab form a continuous basic course in physical chemistry for students interested in chemistry as a profession. Introduction to quantum mechanics and statistical mechanics; application to problems in atomic and molecular structure and to spectroscopy. Credit may not be earned in both CHEM 471/871 and 481/881.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

CHEM 482 Physical Chemistry II
Crosslisted with: CHEM 482H, CHEM 882
Prerequisites: CHEM 481/881
Description: Thermodynamics and statistical mechanics and their application to the study of solids, liquids, gases, solutions, phase equilibria, and chemical equilibria. Chemical kinetics and reaction dynamics. This course should parallel CHEM 484/884. Continuation of CHEM 481/881.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

CHEM 482H Physical Chemistry II
Crosslisted with: CHEM 482, CHEM 882
Prerequisites: CHEM 481/881
Description: Thermodynamics and statistical mechanics and their application to the study of solids, liquids, gases, solutions, phase equilibria, and chemical equilibria. Chemical kinetics and reaction dynamics. This course should parallel CHEM 484/884. Continuation of CHEM 481/881.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

CHEM 484 Physical Chemical Measurements
Crosslisted with: CHEM 884
Prerequisites: CHEM 481/881. Parallel with CHEM 482/882.
Description: Applications of physical measurements and principles to study chemical systems and processes. Lab designed to accompany CHEM 482.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LAB

CHEM 484A Physical Chemical Measurements
Crosslisted with: CHEM 884A
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LAB
CHEM 486 Advanced Topics in Biophysical Chemistry
Crosslisted with: BIOC 486, BIOC 886, BIOS 486, BIOS 886, CHEM 886
Description: Applications of thermodynamics to biochemical phenomena, optical properties of proteins and polynucleotides, and kinetics of rapid reactions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 498 Undergraduate Research
Prerequisites: BIOC 433 and permission
Description: Research on a specific biochemical project under the supervision of a biological chemistry faculty member.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: LEC

PLEASE NOTE
This document represents a sample 4-year plan for degree completion with this major. Actual course selection and sequence may vary and should be discussed individually with your college or department academic advisor. Advisors also can help plan other experiences to enrich your undergraduate education such as internships, education abroad, undergraduate research, learning communities, and service learning and community-based learning.

Career Information
The following represents a sample of the internships, jobs and graduate school programs that current students and recent graduates have reported.

Transferable Skills
- Comprehend and critically evaluate complex information
- Use quantitative analytical computational techniques
- Make predictions using mathematical, statistical, and scientific modeling methods
- Understand and use proper laboratory and technical skills and instruments
- Define problems and identifying causes
- More...
  - Support and communicate claims using clear evidence
  - Simplify complex information and present it to others
  - Apply mathematical and scientific skills to solve real-world problems
  - Document and replicate processes and procedures
  - Design and implement research experiments

Jobs of Recent Graduates
- Product Associate, LI-COR Biosciences - Lincoln NE
- Associate Scientist I, Teva Pharmaceutical - Salt Lake City UT
- Principle Scientist 1, Novartis - Lincoln NE
- Pharmacy Intern I, Methodist Women's Hospital - Omaha NE
- Chemistry Lab Technician, Arkansas State University - Joneboro AR
- More...
  - Technical Services, Epic Systems Corporation - Madison WI
  - Chemical Contractor, Zoetis - Lincoln NE

- Quality Management Chemist, Cargill - Blair NE
- Chemical Analyst, Purva America - Lincolnshire IL
- Civilian Scientist, United States Navy - China Lake CA

Internships
- Intern, Colorado Bureau of Investigation - CO
- Research and Development Intern, Gelita - Sergeant Bluff IA
- Distinguished Life Sciences Scholar, Beckman/Distinguished Life Sciences Scholars - Lincoln NE

Grad Schools
- DDS, University of Nebraska Medical Center College of Dentistry - Lincoln NE
- Chemistry, UNL - Lincoln NE
- College of Pharmacy, University of Nebraska Medical Center - Omaha NE
- Chemistry, University of Nebraska-Lincoln - Lincoln NE
- Medical School, University of Nebraska Medical Center - Omaha NE
- More...
  - PhD in Organic Chemistry, University of California-Riverside -
  - Doctor of Optometry, Southern College of Optometry - Memphis TN
  - Molecular Genetics, Ohio State University - Columbus OH
  - Ph.D. Analytical Chemistry, Ohio State University - Columbus OH
  - Doctorate of Physical Therapy, Missouri State University - Springfield MO

- PhD in Organic Chemistry, University of California-Riverside -
- Doctor of Optometry, Southern College of Optometry - Memphis TN
- Molecular Genetics, Ohio State University - Columbus OH
- Ph.D. Analytical Chemistry, Ohio State University - Columbus OH
- Doctorate of Physical Therapy, Missouri State University - Springfield MO