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 (http://registrar.unl.edu).

Breakage Costs. Glassware and equipment that are lost or damaged by the student are charged to the student’s 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 toward the end of their final semester at a time that all graduating students can attend.
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 student’s GPA or graduation.

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 one foreign language in high school. Four years of high school coursework in the same language will fulfill the College of Arts and Sciences’ language requirement. It will also allow students to continue language study at a more advanced level at UNL, and provide more opportunity to study abroad.

Advising
Academic and Career Advising
The Academic and Career Advising Center in 107 Oldfather is a centrally located and easily accessed resource for students in all majors in the College of Arts and Sciences. The professional academic advisors and career coaches offer 1-1 meetings on a walk-in and appointment basis weekdays. Advisors will provide assistance choosing majors and minors, understanding degree requirements and academic policies, completing paperwork, meeting deadlines, adding/dropping courses, and planning for graduation. In addition, career coaches can help students identify career options related to their interests and connect them with experiences like internships, research, and more that will prepare them for those career options. These specially trained advisors and coaches also serve as first point of contact in the College for all incoming freshmen and transfer students during New Student Enrollment.

Students in the College who have declared a major will be assigned an academic advisor who is their first point of contact for a variety of questions. Academic advisors help students be successful in adjusting to UNL overall as well as making progress toward degree completion. The assigned advisor may be located within the department of their primary major, or in the Advising Center. Students can identify their assigned advisor in MyRED on the academics tab. In addition, faculty advisors are experts in their discipline, including advanced coursework and requirements, opportunities for research, student organizations, and considering graduate school in the discipline. Students who have declared a pre-health or pre-law area of interest will also work with advisors in the Exploratory and Pre-Professional Advising Center (Explore Center) in 127 Love Library South, who are specially trained to guide students preparing to enter a professional school.

For complete and current information on advisors for majors, minors, or pre-professional areas, contact the Arts and Sciences Academic and Career Advising Center, 107 Oldfather Hall, 402-472-4190, http://cas.unl.edu/advising.

College Degree Requirements
College Distribution Requirements
Bachelor of Arts or Bachelor of Science (16 hours + Language)
The College of Arts and Sciences distribution requirements are designed to ensure a breadth of courses within the liberal arts degree. By engaging in study in several different areas within the College, students develop the ability to learn in a variety of ways and apply their knowledge from a variety of perspectives. All requirements are in addition to University ACE requirements.

- A student may not use a single course to satisfy both an ACE outcome and a College distribution requirement.
- A student may not use a single course to satisfy more than one College Distribution Requirement.
- A student may not use a course from their primary 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, directed readings, or internship courses cannot be used to satisfy a College Distribution Requirement.
- Cross-listed courses from interdisciplinary programs will be applied in the same area as courses from the home/cross-listed department.

College Distribution Requirements
CDR A - Written Communication 3
Select from courses approved for ACE outcome 1.

CDR B and BL - Natural, Physical, and Mathematical Sciences with Lab 4
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.

Some courses from geography and anthropology may also be used to satisfy the lab requirement above.  

<table>
<thead>
<tr>
<th>CDR C - Humanities</th>
<th>3</th>
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</table>

Select from classics, English, history, modern languages and literatures, philosophy, and religious studies.  

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<tr>
<th>CDR D - Social Science</th>
<th>3</th>
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</table>

Select from anthropology, communication studies, geography, political science, psychology, or sociology.  

<table>
<thead>
<tr>
<th>CDR E - Language</th>
<th>0-16</th>
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</table>

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, or modern languages and literatures. Instruction is currently available in Arabic, Chinese, Czech, French, German, Greek, Japanese, Latin, 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, but encouraged to continue on in their language study.

<table>
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<tr>
<th>CDR F - Additional Breadth</th>
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Select from natural, physical and mathematical sciences (Area B), humanities (Area C), or social sciences (Area D). Cannot be a course from the primary major.

| Credit Hours Subtotal: | 16-32 |

1. See 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 and below do not fulfill the CDR C.
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**

**Bachelor of Science Only (60 hours)**

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), biological sciences (excluding BIOS 100 or BIOS 203), chemistry (excluding CHEM 101), computer science (excluding CSCE 10), geography (selected courses), geology, life sciences, mathematics (excluding courses below MATH 104), meteorology, microbiology, 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.

**Language Requirement**

UNL and the College of Arts and Sciences place great value on academic exposure and proficiency in a second language. The UNL entrance requirement of two years of the same foreign language or the College’s language distribution requirement (CDR E) will rarely be waived and only with relevant documentation. See the main College of Arts and Sciences page for more details.

**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 domestic institutions except for UNO and UNK. All courses taken at UNO and UNK impact the UNL transcript. No transfer of 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. International coursework (including education abroad) with a final grade equivalent to a C- or lower will not be validated by College of Arts and Sciences departments to be department applicable.

**Pass/No Pass Privilege**

The College of Arts and Sciences adheres to the University regulations for the Pass/No Pass (P/N) privilege with 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.
- Most arts and sciences departments and programs do not allow courses graded Pass/No Pass to apply to the major or minor. Students should refer to the department’s or program’s section of the catalog 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.

**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 at the 300 or 400 Level**

Thirty (30) of the 120 semester hours of credit must be in courses numbered at the 300 or 400 level. Of those 30 hours, 15 hours (1/2) must be completed in residence at UNL.
Residency Requirement
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 coursework including 6 hours at the 300 or 400 level in their major, and 15 of the 30 hours required at the 300 or 400 level in residence. Credit earned during education abroad may be used toward the residency requirement only if students register through UNL.

ACE Requirements
Consistent with the mission and values of the University, ACE is based on a shared set of four institutional objectives and ten 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.

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.

Catalog to Use
Students must fulfill the requirements stated in the catalog 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 catalog 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 catalog year. Beginning in 1990-1991 the catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Learning Outcomes
Graduates of 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) program 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
CHEM 101 Career Opportunities in Chemistry 1
Credit Hours Subtotal: 1

Fundamental Chemistry & Quantitative Analysis
CHEM 113 Fundamental Chemistry I 4
CHEM 114 Fundamental Chemistry II 3
CHEM 221 Elementary Quantitative Analysis 4
Credit Hours Subtotal: 11

Organic Chemistry
CHEM 261 Organic Chemistry 3
CHEM 262 Organic Chemistry 3
CHEM 263 Organic Chemistry Laboratory 2
CHEM 264 Organic Chemistry Laboratory 2
Credit Hours Subtotal: 10

Biochemistry or Chemical Biology
Select one sequence of the following: 5
CHEM 431 & CHEM 433 Structure and Metabolism and Biochemistry Laboratory
CHEM 435 & CHEM 433 Chemical Biology and Biochemistry Laboratory
Credit Hours Subtotal: 5

Physical Chemistry
CHEM 481 Physical Chemistry I 4
CHEM 482 Physical Chemistry II 4
CHEM 484 Physical Chemical Measurements 3
Credit Hours Subtotal: 11

Undergraduate Research
CHEM 399 Undergraduate Research in Chemistry (at least 2 cr) 2
Credit Hours Subtotal: 2

Total Credit Hours 40

Specific Major Requirements
Capstone
Select one sequence of the following: 5
CHEM 421 & CHEM 423 Analytical Chemistry and Analytical Chemistry Laboratory
CHEM 441 & CHEM 443 Inorganic Chemistry and Inorganic Chemistry Laboratory
Credit Hours Subtotal: 5

Mathematics
MATH 106 Calculus I 5
MATH 107 Calculus II 4
MATH 208 Calculus III 4
Credit Hours Subtotal: 13

Physics
PHYS 211 General Physics I 4
PHYS 212 General Physics II 4
(With recommendations of PHYS 221 & PHYS 222)
Credit Hours Subtotal: 8

Total Credit Hours 26
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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 101</td>
<td>Career Opportunities in Chemistry</td>
<td>1</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 1

General Chemistry & Quantitative Analysis

<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>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>
</tbody>
</table>

Credit Hours Subtotal: 12

Organic Chemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 251</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 253</td>
<td>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>Organic Chemistry II Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 8

Physical Chemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<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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</tbody>
</table>

Credit Hours Subtotal: 4

Total Credit Hours 25

Specific Major Requirements

Capstone

Select two sequences of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 421</td>
<td>Analytical Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 423</td>
<td>Analytical Chemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 431</td>
<td>Structure and Metabolism</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 433</td>
<td>Biochemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>or CHEM 431 Chemical Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 433</td>
<td>Biochemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 441</td>
<td>Inorganic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 443</td>
<td>Inorganic Chemistry Laboratory</td>
<td></td>
</tr>
</tbody>
</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</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 9

Physics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 141</td>
<td>Elementary General Physics I</td>
<td>5</td>
</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

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 additional twelve (12) hours of chemistry.

Select one sequence of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHEM 109</td>
<td>General Chemistry I</td>
<td>4</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>4</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

Total Credit Hours 23-24

Excluding CHEM 101, CHEM 131, CHEM 195, CHEM 396, and CHEM 399.

Plan B Minor (19-20 hours)

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

Select one sequence of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHEM 109</td>
<td>General Chemistry I</td>
<td>4</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>4</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

Total Credit Hours 19-20

Excluding CHEM 101, CHEM 131, CHEM 195, CHEM 396, and CHEM 399.

Grade Rules

C- and D Grades

A grade of C or above is required for all courses in the minor.

Pass/No Pass

No course taken Pass/No Pass will be counted toward the minor.
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
Prerequisites: MATH 101, or placement into MATH 102 or above.
Notes: 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 251 and 261, should register for CHEM 109 and 110, or CHEM 113 and 114 (the general chemistry sequence). The first part of a two-semester sequence, along with CHEM 106, to constitute the "Chemistry in Context" series.
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 situations.
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; CHEM 106; NRES 319
ACE: ACE 4 Science

CHEM 106 Chemistry in Context II
Prerequisites: CHEM 105
Notes: Continuation of CHEM 105. Will not serve as a prerequisite for any chemistry course. Students planning to take CHEM 251-252 or CHEM 253-264, should take CHEM 109-110 or CHEM 113-114 (general chemistry sequence). The second part of a two-semester sequence, along with CHEM 105, to constitute the "Chemistry in Context" series.
Description: How organic chemistry and biochemistry complement one another. Chemical aspects of biological, social, or economic situations.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: ASCI 320

CHEM 109 General Chemistry I
Prerequisites: MATH 103 or a Math Placement Test score for MATH 104 or 106
Notes: Credit toward the degree may be earned in only one of: CHEM 105, 109, 111, 113 or 195.
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 240; BIOL 205; BSEN 326, CIVE 326; BSEN 326H, CIVE 326H; CHEM 110; CHEM 191H; CHEM 192H; CHME 114; CHME 202; FDST 205; FDST 280; FORS 300; FORS 411; GEOL 210; GEOL 410; GEOL 418; GEOL 818; NRES 419, NRES 819, WATS 418; GEOL 418L; GEOL 818L, NRES 419L, NRES 819L, WATS 418L; MATL 260; MATL 360; NRES 319
ACE: ACE 4 Science

CHEM 110 General Chemistry II
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 327, HORT 327, TLMT 327; AGRO 455, AGRO 855, NRES 455, NRES 855, SOIL 455; ASCI 340; BSEN 244; BSEN 326, CIVE 326; BSEN 326H, CIVE 326H; BSEN 355; CHEM 221; CHEM 251; CHEM 255; CHEM 261; CHEM 291H; FDST 205; FORS 300; GEOL 418; GEOL 818; NRES 419, NRES 819, WATS 418; GEOL 418L; GEOL 818L, NRES 419L, NRES 819L, WATS 418L
ACE: ACE 4 Science

CHEM 111 Chemistry for Engineering and Technology
Prerequisites: Math Placement Test score for MATH 106.
Notes: Credit towards the degree may be earned in only one: CHEM 105, 109, 111, 113 or 195. Not open to chemical engineering majors.
Description: A one semester introduction to the fundamentals of chemistry for engineering students.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: BSEN 326, CIVE 326; BSEN 326H, CIVE 326H; BSEN 355; CHEM 191H; CHEM 192H; GEOL 418, GEOL 818, NRES 419, NRES 819, WATS 418; MATL 260; MATL 360
CHEM 113 Fundamental Chemistry I  
**Prerequisites:** Math Placement Test score for MATH 106.  
**Notes:** Credit towards the degree may be earned in only one: CHEM 105, 109, 111, 113 or 195.  
**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:** BIOC 205; BSEN 326; CIVE 326; BSEN 326H; CIVE 326H; CHEM 110; CHEM 114; CHEM 192H; CHME 202; GEOL 210; GEOL 410; GEOL 418; GEOL 818, NRES 419, NRES 819, WATS 418; GEOL 418L, GEOL 818L, NRES 419L, NRES 819L, WATS 418L  
**ACE:** ACE 4 Science  

CHEM 114 Fundamental Chemistry II  
**Prerequisites:** CHEM 113.  
**Notes:** Parallel: CHEM 221 is the associated laboratory course.  
**Description:** Chemical kinetics, oxidation-reduction reactions and electrochemistry, ionic solution equilibria, thermodynamic concepts, and chemistry of selected elements.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** BIOC 244; BSEN 355; CHEM 251; CHEM 255; CHEM 261; CHEM 291H; GEOL 418, GEOL 818, NRES 419, NRES 819, WATS 418; GEOL 418L, GEOL 818L, NRES 419L, NRES 819L, WATS 418L  

CHEM 131 The Science of Food  
**Crosslisted with:** FDST 131, NUTR 131  
**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 131L; FDST 205; FDST 280  
**ACE:** ACE 4 Science  

CHEM 191H Freshman Honors Chemistry I  
**Prerequisites:** Freshman standing; Good standing in the University Honors Program; CHEM 109, 111 or 113 parallel.  
**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  
**Prerequisites:** Freshman standing; Good standing in the University Honors Program; CHEM 109, 111 or 113 with a minimum grade of "B"; CHEM 110 or 114 parallel.  
**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  
**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  

CHEM 221 Elementary Quantitative Analysis  
**Prerequisites:** CHEM 110 or parallel CHEM 114  
**Notes:** 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.  
**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.  
**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 292H  

CHEM 251 Organic Chemistry I  
**Prerequisites:** CHEM 110 or 114 with a minimum grade of C.  
**Notes:** It is suggested that CHEM 253 be taken parallel with CHEM 251. CHEM 251 and 252, with their corresponding labs of CHEM 253 and 254, form a continuous basic course in organic chemistry.  
**Description:** Chemistry of carbon compounds. Applications to the biological sciences, agriculture and pre-professional programs including premedical and pre-dental. Emphasizes basic principles.  
**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; ASCI 320; BIOS 302; BIOS 312; BIOS 313; BIOS 314; BIOS 326; BIOS 443; BIOS 843, VBMS 843, MBI 443; CHEM 252; CHEM 253; CHEM 254; CHEM 292H; VBMS 403
CHEM 252 Organic Chemistry II
Prerequisites: CHEM 251 and 253.
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
Prerequisite for: CHEM 254

CHEM 253 Organic Chemistry I Laboratory
Prerequisites: CHEM 251 or parallel.
Notes: CHEM 221 recommended. Shares a quiz section with CHEM 251 and normally accompanies it.
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
Prerequisite for: CHEM 252, CHEM 254

CHEM 254 Organic Chemistry II Laboratory
Prerequisites: CHEM 251, 253; CHEM 252 or parallel.
Notes: Shares a quiz section with CHEM 252 and normally accompanies it.
Description: Synthesis of representative organic compounds. Qualitative analysis of organic compounds. Naturally occurring compounds.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LAB
Prerequisite for: CHEM 252; CHEM 254; CHEM 254A

CHEM 255 Biological Organic Chemistry
Prerequisites: CHEM 110 or 114
Notes: This course should not be taken by majors in Chemistry or Chemical Engineering.
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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BIOS 302; BIOS 312; BIOS 313; BIOS 314; BIOS 326; BIOS 443, BIOS 843, VBMS 843, MBIO 443

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
Prerequisite for: CHEM 252; CHEM 254; CHEM 254A

CHEM 256 Organic Chemistry
Prerequisites: CHEM 110 or 114 with minimum grades of C.
Notes: It is suggested that CHEM 263 be taken parallel with CHEM 261. Students having credit in CHEM 251 or its equivalent may not receive credit in 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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BIOS 302; BIOS 312; BIOS 313; BIOS 314; BIOS 326; BIOS 443, BIOS 843, VBMS 843, MBIO 443; CHEM 252; CHEM 254; CHEM 262; CHEM 263; CHEM 263A; CHEM 292H

CHEM 261 Organic Chemistry
Prerequisites: CHEM 251 and 253.
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
Prerequisite for: CHEM 254

CHEM 262 Organic Chemistry
Prerequisites: CHEM 261
Notes: It is suggested that CHEM 264 be taken parallel with CHEM 262.
Description: Continuation of CHEM 261.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: CHEM 254; CHEM 264; CHEM 264A

CHEM 263 Organic Chemistry Laboratory
Prerequisites: CHEM 261 or parallel.
Notes: It is suggested that CHEM 263 be taken parallel with CHEM 261.
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: LAB
Prerequisite for: CHEM 252; CHEM 254; CHEM 264; CHEM 264A

CHEM 264 Organic Chemistry Laboratory
Prerequisites: CHEM 262 or parallel; CHEM 263.
Notes: It is suggested that CHEM 264 be taken parallel with CHEM 262.
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: LAB
CHEM 264A Organic Chemistry Laboratory
**Prerequisites:** CHEM 262 or parallel; CHEM 263 or CHEM 263A.
**Notes:** It is suggested that CHEM 264A be taken parallel with CHEM 262.
**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
**Prerequisites:** Sophomore standing; Good standing in the University Honors Program; CHEM 110 or 114 with a minimum grade of "B"; CHEM 221 or 251 or 261 parallel.
**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
**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
**Prerequisites:** Permission.
**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 821
**Prerequisites:** CHEM 471/871 or CHEM 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
**Prerequisite for:** CHEM 423, CHEM 823, CHEM 824, CHEM 825A, CHEM 825B, CHEM 825D, CHEM 825E, CHEM 825G, CHEM 991A
**ACE:** ACE 10 Integrated Product
CHEM 433 Biochemistry Laboratory
Crosslisted with: BIOC 433, BIOC 833, BIOS 433, BIOS 833, CHEM 833
Prerequisites: BIOC 431/831 or parallel; 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
Offered: FALL/SPR
Prerequisite for: BIOC 437, BIOC 837, BIOS 437, BIOS 837; BIOC 898; CHEM 982; CHEM 884; CHEM 886; CHEM 482, CHEM 882; CHEM 484, CHEM 884; CHEM 484A, CHEM 884A; CHEM 991J; PHYS 422, PHYS 822, ECEN 422, ECEN 822

CHEM 434 Plant Biochemistry
Crosslisted with: AGRO 434, BIOC 434, BIOS 434, AGRO 834, BIOC 834, BIOS 834, CHEM 834
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
Notes: Credit toward the undergraduate or graduate degree cannot be earned in both CHEM 435/835 and 431/831 and/or CHEM 432/832 or their equivalents.
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 Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BIOC 433, BIOC 833, BIOS 433, BIOS 833, CHEM 433, CHEM 833

CHEM 441 Inorganic Chemistry
Crosslisted with: CHEM 841
Prerequisites: CHEM 221 with a minimum grade of C; CHEM 252 or 262.
Notes: CHEM 443 is recommended to be taken parallel.
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
Prerequisite for: CHEM 421, CHEM 821; CHEM 845
ACE: ACE 10 Integrated Product

CHEM 443 Inorganic Chemistry Laboratory
Crosslisted with: CHEM 843
Prerequisites: CHEM 441 or parallel.
Notes: It is suggested that CHEM 443 be taken in parallel with CHEM 441.
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
Prerequisite for: CHEM 845

CHEM 463 Advanced Organic Preparations
Crosslisted with: CHEM 863
Prerequisites: CHEM 252 and CHEM 254.
Notes: 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
Prerequisites: CHEM 221; MATH 107; and PHYS 142 or 212.
Notes: Credit may not be earned in both CHEM 471/871 and CHEM 481/881.
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
Prerequisite for: BIOC 486, BIOC 886, BIOS 486, BIOS 886, CHEM 486, CHEM 886, CHEM 421, CHEM 821

CHEM 481 Physical Chemistry I
Crosslisted with: CHEM 881
Prerequisites: CHEM 221 with grade of at least C; MATH 208; PHYS 212.
Notes: Credit may not be earned in both CHEM 471/871 and CHEM 481/881.
Description: CHEM 481/881 and 482/882 with accompanying lab 484/884 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 Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: BIOC 486; BIOC 886, BIOS 486, BIOS 886, CHEM 486, CHEM 886, CHEM 482, CHEM 882; CHEM 484, CHEM 884; CHEM 484A, CHEM 884A; CHEM 991J; PHYS 422, PHYS 822, ECEN 422, ECEN 822
CHEM 482 Physical Chemistry II
Crosslisted with: CHEM 882
Prerequisites: CHEM 481/881
Notes: This course should parallel CHEM 484/884. Continuation of 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.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: CHEM 484, CHEM 884; CHEM 484A, CHEM 884A; CHEM 845; CHEM 987A; CHEM 987B; CHEM 991J; CHME 925; MATL 962; MATL 972
CHEM 484 Physical Chemical Measurements
Crosslisted with: CHEM 884
Prerequisites: CHEM 481/881; CHEM 482/882 or parallel.
Notes: It is suggested that CHEM 484/884 be taken in parallel with CHEM 482/882.
Description: Applications of physical measurements and principles to study chemical systems and processes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CHEM 484A Physical Chemical Measurements
Crosslisted with: CHEM 884A
Prerequisites: CHEM 481/881; CHEM 482/882 or parallel.
Notes: It is suggested that CHEM 484A/884A be taken in parallel with CHEM 482/882.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
CHEM 486 Advanced Topics in Biophysical Chemistry
Crosslisted with: BIOC 486, BIOC 886, BIOS 486, BIOS 886, CHEM 886
Prerequisites: CHEM 471/871 or CHEM 481/881.
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 you plan other experiences to enrich your undergraduate education such as internships, education abroad, undergraduate research, learning communities, and service learning and community-based learning.

Chemistry (B.A.)
Chemistry (B.S.)

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
- Design and implement research experiments
- Understand and practice proper laboratory safety procedures
- Read, understand, and critically review scientific information
- Define problems and identifying causes
- Comprehend and critically evaluate complex information
- Compose convincing arguments and present logical information
- Confidently navigate complex, ambiguous projects and environments
- Demonstrate ethical conduct in research activities
- Document and replicate processes and procedures

Jobs of Recent Graduates
- Product Associate, LI-COR Biosciences - Lincoln NE
- Associate Scientist I, Teva Pharmaceutical - Salt Lake City UT
- Principle Scientist I, Novartis - Lincoln NE
- Pharmacy Intern I, Methodist Women's Hospital - Omaha NE
- Chemistry Lab Technician, Arkansas State University - Joneboro AR
- Technical Services, Epic Systems Corporation - Madison WI
- Chemical Contractor, Zoetis - Lincoln NE
- Quality Management Chemist, Cargill - Blair NE
- Chemical Analyst, Purac America - Lincolnshire IL
- Civilian Scientist, United States Navy - China Lake CA
- Patent Agent, Suiter Swantz - Omaha NE
- Quality Team Member, Ardent Mills - Ogden UT
- Quality Tech, Cargill - Lake City MN
- Laboratory Technician, Enthone - Bridgeview IL
- Scientist, Celerion - Lincoln NE

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

Graduate & Professional Schools
- Doctor of Dental Surgery, University of Nebraska Medical Center College of Dentistry - Lincoln NE
- Master's Degree, Chemistry, University of Nebraska-Lincoln - Lincoln NE
- Doctor of Pharmacy, University of Nebraska Medical Center - Omaha NE
- Ph.D., Chemistry, University of Nebraska-Lincoln - Lincoln NE
- Medical Doctor, University of Nebraska Medical Center - Omaha NE
• Ph.D., Organic Chemistry, University of California-Riverside -
• Doctor of Optometry, Southern College of Optometry - Memphis TN
• Master's Degree, Molecular Genetics, Ohio State University - Columbus OH
• Ph.D., Analytical Chemistry, Ohio State University - Columbus OH
• Doctor of Physical Therapy, Missouri State University - Springfield MO
• Master's Degree, Science Teaching, University of Nebraska-Lincoln - Lincoln NE
• Medical Doctor, University of Nebraska Medical Center - Omaha NE
• Doctor of Pharmacy, University of Nebraska Medical Center - Omaha NE