

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 major in chemistry prepares students for many career options: industry (research, analysis, production), teaching, graduate studies, or professional schools.

The bachelor of science (BS) program offers two options: Professional, which is recommended for students planning graduate studies or professional careers in chemistry, and Chemical Biology, which is an excellent choice for students interested in a health-related professional school or employment in the industry. The bachelor of arts (BA) program is a broad chemistry major that pairs well with a minor or even a second major in other disciplines.

Options in the Major

Professional Option (BS Only)

The Professional Option coursework reflects standards set by the American Chemical Society and is excellent preparation for students interested in research and the possibility of pursuing advanced education in Chemistry.

Chemical Biology Option (BS Only)

The Chemical Biology Option combines a solid background in life science, chemistry, math, and physics with advanced coursework about the chemical principles that support biological function. The advanced courses are chemical biology, computational chemistry, natural product biosynthesis, and biochemical thermodynamics and kinetics.

Laboratory Fees. 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>). In addition, 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 expected 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 398 Undergraduate Research in Chemistry to the departmental office for evaluation.

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

Learning Outcomes

Graduates with a major in chemistry will be able to:

1. Fundamental Concepts.
 - a. Explain basic chemical principles.
 - b. Solve chemical problems.
2. Experimental Skills.

- a. Design experiments to study chemical systems.
 - b. Collect data using instruments and computer-based tools.
 - c. Analyze and interpret data.
 - d. Compare experimental results with the literature.
3. Responsible Conduct of Research.
 - a. Apply the principles of chemical hygiene.
 - b. Explain the principles of Green Chemistry and sustainability.
 4. Career.
 - a. Describe the importance of diversity, equity, inclusion, & respect.
 - b. Demonstrate effective oral and written skills.
 - c. Develop effective teamwork skills.
 - d. Identify career pathways for using the skills of the major.

Academic and Career Advising

Academic and Career Advising Center

Not sure where to go or who to ask? The Advising Center team in 107 Oldfather Hall can help. The Academic and Career Advising Center is the undergraduate hub for CAS students in all majors. Centrally located and easily accessed, students encounter friendly, knowledgeable people who are eager to help or connect students to partner resources. Students also visit the Advising Center in 107 Oldfather Hall to:

- Choose or change their major, minor, or degree program.
- Check on policies, procedures, and deadlines.
- Get a college approval signature from the Dean's representatives.

CAS Career Coaches are available by appointment (in-person or Zoom) and located in the CAS Academic and Career Advising Center, 107 Oldfather Hall. They help students explore majors and minors, gain experience, and develop a plan for life after graduation.

Assigned Academic Advisors

Academic advisors are critical resources dedicated to students' academic, personal, and professional success. Every CAS student is assigned an academic advisor based on their primary major. Since most CAS students have more than just a single major, it is important to get to know the advisor for any minors or additional majors. Academic advisors work closely with the faculty to provide the best overall support and the discipline specific expertise. They are available for appointments (in-person or Zoom) and through weekly virtual drop-ins. Assigned advisors are listed in MyRED (<https://its.unl.edu/myunl/>) and their offices may be located in or near the department of the major for which they advise.

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 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, visit <https://cas.unl.edu/major-advisors/> (<https://cas.unl.edu/major-advisors/>), or connect with the Arts and Sciences Academic and Career Advising Center, 107 Oldfather Hall, 402-472-4190, casadvising@unl.edu.

Career Coaching

The College believes that **Academics + Experience = Opportunities** and encourages students to complement their academic preparation with real-world experience, including internships, research, education abroad, service, and leadership. Arts and sciences students have access to a powerful network of faculty, staff, and advisors dedicated to providing

information and support for their goals of meaningful employment or advanced education. Arts and sciences graduates have unlimited career possibilities and carry with them important career competencies—communication, critical thinking, creativity, context, and collaboration. They have the skills and adaptability that employers universally value. Graduates are prepared to effectively contribute professionally and personally with a solid foundation to excel in an increasingly global, technological, and interdisciplinary world.

Students should contact the career coaches in the Arts and Sciences Academic and Career Advising Center in 107 Oldfather Hall, or their assigned advisor, for more information. The CAS career coaches help students explore career options, identify ways to build experience and prepare to apply for internships, jobs, or graduate school, including help with resumes, applications, and interviewing.

ACE Requirements

Students must complete one course for each of the ACE Student Learning Outcomes below. Certified course choices are published in the degree audit, or visit the ACE (<http://ace.unl.edu>) website (<http://ace.unl.edu>) for the most current list of certified courses.

ACE Student Learning Outcomes

ACE 1: Write texts, in various forms, with an identified purpose, that respond to specific audience needs, integrate research or existing knowledge, and use applicable documentation and appropriate conventions of format and structure.

ACE 2: Demonstrate competence in communication skills.

ACE 3: Use mathematical, computational, statistical, logical, or other formal reasoning to solve problems, draw inferences, justify conclusions, and determine reasonableness.

ACE 4: Use scientific methods and knowledge to pose questions, frame hypotheses, interpret data, and evaluate whether conclusions about the natural and physical world are reasonable.

ACE 5: Use knowledge, historical perspectives, analysis, interpretation, critical evaluation, and the standards of evidence appropriate to the humanities to address problems and issues.

ACE 6: Use knowledge, theories, and research perspectives such as statistical methods or observational accounts appropriate to the social sciences to understand and evaluate social systems or human behaviors.

ACE 7: Use knowledge, theories, or methods appropriate to the arts to understand their context and significance.

ACE 8: Use knowledge, theories, and analysis to explain ethical principles and their importance in society.

ACE 9: Exhibit global awareness or knowledge of human diversity through analysis of an issue.

ACE 10: Generate a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.

College Degree Requirements

College Distribution Requirements

The College of Arts and Sciences distribution requirements are designed to ensure a range of courses across disciplines 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, and no course can be used to fulfill 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, with the exception of CDR Diversity. Courses used to meet CDR Diversity may also meet CDR Writing, CDR Humanities, or CDR Social Science.
- Internship (395 or 495), independent study or readings (396 or 496), research (398 or 498), and thesis (399, 399H, 499, or 499H) will not satisfy distribution requirements.
- Other courses with a 9 in the middle number (ex. PSYC 292) will not satisfy distribution requirements unless approved by an advisor.
- Cross-listed courses from interdisciplinary programs will be applied in the same area as courses from the lead department.

CDR: Written Communication

Select from courses approved for ACE outcome 1.

CDR: Natural, Physical, and Mathematical Sciences¹

Select a course from ASTR, BIOS, CHEM, GEOL, LIFE, METR, MATH, PHYS, or ANTH 242, GEOG 155, GEOG 281, POLS 250, or PSYC 273.

CDR: Laboratory²

Laboratory courses may be embedded in a 4-5 credit course used in CDR Natural, Physical, and Mathematical Science (example GEOG 155), or stand alone (example LIFE 120L).

CDR: Humanities³

Select a course from ARAB, CHIN, CLAS, CZEC, ENGL, FILM, FREN, GERM, GREK, HIST, JAPN, LATN, PHIL, RELG, RUSS, or SPAN.

CDR: Social Science⁴

Select a course from ANTH, COMM, GEOG, NSST, POLS, PSYC, or SOCI.

CDR: Human Diversity in U.S. Communities

Select from the following approved courses also listed in your degree audit: ANTH 130, ANTH 412, ANTH 447, ANTH 473, ARAB/RELG 313, COMM 311, COMM 315, COMM/ETHN 335, COMM 364, COMM/ETHN 365, COMM 465, ENGL/WMNS 212, ENGL/ETHN 245N, ENGL/WMNS 312, ENGL/ETHN 345D, ENGL/ETHN/WMNS 345N, ENGL/ETHN 346, ENGL 376, ENGL 380, ENGL/ETHN 445, ETHN 100, ETHN 201, ETHN 202, ETHN 204, ETHN 484, FILM/ETHN 344, GEOG 271, GEOG 403, GLST/ANTH/MODL 214, GLST 350, HIST/ETHN/WMNS 115, HIST/ETHN 234, HIST/ETHN 246, HIST 251, HIST/ETHN 340, HIST 351/ETHN 341, HIST/ETHN/WMNS 356, HIST/ETHN 357, HIST/WMNS 402, HRHA 350, MODL 260, PHIL 105, PHIL 106, PHIL/WMNS 218, PHIL 323, PHIL 325, POLS/ETHN 333, POLS/WMNS 338, POLS 340, POLS 347, POLS 433, PSYC/ETHN 310, PSYC 330, PSYC/WMNS 421, PSYC/ETHN 425, RELG/HIST 134, RELG/ETHN/HIST 226, RELG/HIST 227, SOCI 101, SOCI 180, SOCI/WMNS 200, SOCI/ETHN 217, SPAN 206, SPAN 486, WMNS 101, WMNS 201, WMNS 202, WMNS 210

CDR: Language

BA Students⁵

Fulfilled by the completion of the 4th level of a single language (either in H.S. or in college). Language study at UNL is available in: ARAB, CHIN, CZEC, FREN, GERM, GREK, JAPN, LATN, SPAN, or SLPA.

BS Students⁶

Fulfilled by the completion of the 2nd level of a single language (either in H.S. or in college). Language study at UNL is available in: ARAB, CHIN, CZEC, FREN, GERM, GREK, JAPN, LATN, SPAN, or SLPA.

¹ Excluded courses: BIOC 101, BIOS 100, BIOS 180, CHEM 101, MBIO 101, PHYS 201, MATH 100A, MATH 101, MATH 101P, MATH 102, MATH 103, and MATH subject area credit at the 100 level or below.

² ANTH 242L, ASTR 224, BIOS 101L, BIOS 110L, BIOS 111, BIOS 116, BIOS 213L, BIOS 214, CHEM 105L, CHEM 106L, CHEM 109L, CHEM 110L, CHEM 113L, GEOG 155, GEOL 101, GEOL 103, LIFE 120L, LIFE 121L, METR 100, PHYS 141, PHYS 142, PHYS 153, PHYS 221, or PHYS 222.

³ ARAB, CHIN, CZEC, FREN, GERM, GREK, JAPN, LATN, and SPAN courses must be numbered 300 or above. ENGL courses must be ENGL 170, ENGL 180, or ENGL 200 level and above. Excluded courses: CLAS 116, ENGL 254, ENGL 300, ENGL 354, SPAN 300A, SPAN 303, and SPAN 304.

⁴ Excluded courses: ANTH 242/ANTH 242L, GEOG 155, GIST 111, GIST 311, POLS 101, POLS 250, PSYC 100, PSYC 273.

⁵ ARAB 202, CHIN 202, CZEC 202, FREN 202 or FREN 210, GERM 202, GREK 301 and GREK 302, JAPN 201 and JAPN 202, LATN 301 and LATN 302, SPAN 202 or SPAN 210 or SPAN 300A or SLPA 202.

⁶ ARAB 102, CHIN 102, CZEC 102, FREN 102, GERM 102, GREK 102 or GREK 151, JAPN 102, LATN 102, SPAN 102 or SPAN 110 or SPAN 300A, or SLPA 102.

Language Requirement

The University of Nebraska–Lincoln and the College of Arts and Sciences place great value on academic exposure and proficiency in a second language. The University of Nebraska–Lincoln entrance requirement is successful completion of two levels of the same world language, and the College of Arts and Sciences degree requirement (CDR: Language) is proficiency through 4 levels for BA students, or 2 levels for BS students. Levels are defined as years in High School, or semesters in college as documented on an official transcript.

Students who believe they are proficient in a language, but who do not have academic records of that proficiency, should consult with their academic advisor to explore alternative assessments which may include a proficiency examination by a UNL faculty member for languages taught at UNL, or through an approved private service for languages not taught at UNL (expenses for this service would be the student's responsibility.)

Experiential Learning Requirement

All undergraduates in the College of Arts and Sciences must complete an Experiential Learning (EL) designated course. This may include 0-credit courses designed to document co-curricular activities recognized as Experiential Learning. Students should consult their assigned Academic Advisor and Career Coach for assistance identifying experiential learning opportunities relevant to their academic program, interests and goals.

The bachelor of science degree requires students to complete 60 hours in mathematical, physical, and natural sciences from disciplines within the College of Arts and Sciences or required in its majors: ACTS, ASTR,

BIOC, BIOS, CHEM, CSCE, GEOL, LIFE, MBIO, METR, MATH, PHYS, STAT or ANTH 242, ANTH 242L, ANTH 341, ANTH 385, ANTH 386, ANTH 389, ANTH 416, ANTH 422, ANTH 430, ANTH 442, ANTH 443, ANTH 444, ANTH 448, ANTH 473, ANTH 484, ANTH 487D, ENVR 201, GEOG 155, GEOG 217, GEOG 281, GEOG 308, GEOG 317, GEOG 408, GEOG 417, GEOG 418, GEOG 419, GEOG 421, GEOG 422, GEOG 425, GEOG 427, GEOG 432, GEOG 444, GEOG 461, GEOG 467, PHIL 211, POLS 250, PSYC 273, PSYC 368, PSYC 370, PSYC 450, PSYC 451, PSYC 456, PSYC 458, PSYC 460, PSYC 461, PSYC 463, PSYC 464, or PSYC 465.

Excluded courses include: BIOC 101, BIOS 100, BIOS 180, CHEM 101, MATH 100A, MATH 101, MATH 101P, MATH 102, MATH 103, MBIO 101, PHYS 201 as well as any course numbered 395, 495, 399, 399H, 499, or 499H. MATH subject area credit at the 100 level or below is also excluded.

Up to 12 hours of scientific and technical courses offered by other colleges may be accepted toward this requirement with approval of the College of Arts and Sciences. See your assigned academic advisor to start the approval process.

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 cumulative 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 University of Nebraska–Lincoln 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 the College of Arts and Sciences departments to be degree applicable.

Pass/No Pass Privilege

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

- Neither the P nor the N grade factor into your GPA.
 - 'P' is interpreted to mean a grade of C or above. A grade of C- or lower results in a "N".
 - A change to or from a Pass/No Pass may be made until mid-term (1/2 of the course - see the academic calendar for specific dates per term).
 - The Pass/No Pass or grade registration cannot conflict with the policy of the professor, department, college, or University policy governing the grading options.
 - Changing to or from the Pass/No Pass grading option requires using MyRED, or processing a Schedule Adjustment Form.
 - For undergraduates, the University maximum of 24 'Pass' credit hours and/or college and department limits will apply. These limits do not include courses offered on a 'Pass/No Pass' basis only. Consult your advisor or the Undergraduate Catalog (<https://catalog.unl.edu/undergraduate/>) for restrictions on the number of 'Pass' hours you can apply toward your degree.
 - The 'Pass/No Pass' grading option cannot be used for the removal of 'C-', 'D+', 'D', 'D-', or 'F' grade factors.
- NOTE: See Course Repeats (<https://registrar.unl.edu/academic-standards/course-repeats/>)

College of Arts and Sciences policy on the Pass/No Pass (P/N) privilege:

- Pass hours can count toward fulfillment of University ACE requirements and college distribution requirements up to the 24-hour maximum.
- Most arts and sciences majors and minors do not permit any courses graded Pass/No Pass to apply, or limit them to no more than 6 hours. Students should refer to the major section of the catalog for clarification.
- Departments may specify that certain courses of theirs can be taken on a P/N-only or on a graded-only basis.

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 the University of Nebraska–Lincoln.

Residency Requirement

The term "Residency" refers to courses taken at UNL. Students must complete at least 30 of the 120 total hours for their degree at the University of Nebraska–Lincoln. Students must complete at least 18 hours of their major coursework, and 15 of the 30 hours required at the 300 or 400 level, at UNL.

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 the University of Nebraska–Lincoln. 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 the University of Nebraska–Lincoln 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.

Transfer Students: Students who have transferred from a community college may be eligible to fulfill the requirements as stated in the catalog for an academic year in which they were enrolled at the community college prior to attending the University of Nebraska–Lincoln. This decision should be made in consultation with academic advisors, provided the student a) was enrolled in a community college during the catalog year they are utilizing, b) maintained continuous enrollment at the previous institution for 1 academic year or more, and c) continued enrollment at the University of Nebraska–Lincoln within 1 calendar year from their last term at the previous institution. Students must complete

all degree requirements from a single catalog year and within the time frame allowable for that catalog year.

Major Requirements**Bachelor of Science**

The bachelor of science (BS) program offers two options: Professional, which is recommended for students planning graduate studies or professional careers in chemistry, and Chemical Biology, which is an excellent choice for students interested in a health-related professional school or employment in the industry.

Core Requirements**Career and Academic Planning**

CHEM 101	Career Opportunities in Chemistry	1
Credit Hours Subtotal:		1

Fundamental Chemistry

Select one sequence (CHEM 113/114 Recommended). 7

CHEM 113A & CHEM 113L & CHEM 114	Fundamental Chemistry I and Fundamental Chemistry I Laboratory and Fundamental Chemistry II	
or CHEM 109 & CHEM 109	General Chemistry I and General Chemistry I Laboratory and General Chemistry II	
& CHEM 110		
Credit Hours Subtotal:		7

Quantitative Analysis

CHEM 221A & CHEM 221L	Elementary Quantitative Analysis and Elementary Quantitative Analysis Laboratory	5
Credit Hours Subtotal:		5

Total Credit Hours 13

Professional Option**Organic Chemistry**

CHEM 261 & CHEM 263	Mechanistic Organic Chemistry I and Mechanistic Organic Chemistry I Laboratory	5
CHEM 262 & CHEM 264	Mechanistic Organic Chemistry II and Mechanistic Organic Chemistry II Laboratory	5
Credit Hours Subtotal:		10

Biochemistry or Chemical Biology

CHEM 435 or BIOC 431 / CHEM 431	Chemical Biology Biochemistry I: Structure and Metabolism	3
CHEM 437 or BIOC 433 / CHEM 433	Chemical Biology Laboratory Biochemistry Laboratory	2
Credit Hours Subtotal:		5

Advanced Chemistry (ACE 10)

Select one sequence:		5
CHEM 421 & CHEM 423	Analytical Chemistry and Analytical Chemistry Laboratory	
or CHEM 441 & CHEM 443	Inorganic Chemistry and Inorganic Chemistry Laboratory	

Credit Hours Subtotal:	5
Physical Chemistry	
CHEM 481 Physical Chemistry I	4
CHEM 482 Physical Chemistry II	7
& CHEM 484 and Physical Chemical Measurements	
Credit Hours Subtotal:	11
Research	
CHEM 398 Undergraduate Research in Chemistry	2
Credit Hours Subtotal:	2
Ancillary Courses: Math and Physics	
MATH 106 Calculus I	5
MATH 107 Calculus II	4
MATH 208 Calculus III ¹	4
PHYS 211 General Physics I	4
PHYS 212 General Physics II	4
Credit Hours Subtotal:	21
Total Credit Hours	54

¹ It is recommended that Professional Option students take MATH 221 in addition to MATH 208.

Chemical Biology Option

Life Science

LIFE 120 Fundamentals of Biology I	4
& 120L and Fundamentals of Biology I laboratory	
LIFE 121 Fundamentals of Biology II	4
& 121L and Fundamentals of Biology II Laboratory	
Credit Hours Subtotal:	8

Organic Chemistry

CHEM 251 Organic Chemistry I	4
& CHEM 253 and Organic Chemistry I Laboratory	
CHEM 252 Organic Chemistry II	4
& CHEM 254 and Organic Chemistry II Laboratory	
Credit Hours Subtotal:	8

Chemical Biology

CHEM 435 Chemical Biology (Fall only)	3
CHEM 437 Chemical Biology Laboratory (Spring only)	2
CHEM 438 Computational Chemical Biology	3
or CHEM 453 Biosynthetic Pathways	
Credit Hours Subtotal:	8

Advanced Chemistry (ACE 10)

Select one sequence. 5

CHEM 421 Analytical Chemistry	
& CHEM 423 and Analytical Chemistry Laboratory	
or CHEM 441 Inorganic Chemistry	
and Inorganic Chemistry Laboratory	
& CHEM 443	
Credit Hours Subtotal:	5

Physical Chemistry

CHEM 471 Physical Chemistry	4
Credit Hours Subtotal:	4

Experiential Learning ¹

Select one of the following options:	0-1
CASC 95 Internship in Arts and Sciences	

CASC 98 Undergraduate Research Experience	
or CHEM 398 Undergraduate Research in Chemistry	
Credit Hours Subtotal:	0-1
Ancillary Courses: Math and Physics	
MATH 106 Calculus I	5
MATH 107 Calculus II	4
Select one sequence.	8-10
PHYS 141 Physics for Life Sciences I	
& PHYS 142 and Physics for Life Sciences II	
or PHYS 211 General Physics I	
and General Physics II	
& PHYS 212	
Credit Hours Subtotal:	17-19
Total Credit Hours	50-53

¹ Experience must be related to Chemical Biology and approved by the advisor to meet the requirement.

Bachelor of Arts

The bachelor of arts (BA) program is designed for students interested in broad undergraduate training in chemistry and pairs well with a minor or additional major.

Career and Academic Planning

CHEM 101 Career Opportunities in Chemistry	1
Credit Hours Subtotal:	1

General Chemistry

Select one sequence (CHEM 109/110 Recommended) 7

CHEM 109A General Chemistry I	
& CHEM 109L and General Chemistry I Laboratory	
& CHEM 110A and General Chemistry II (Recommended)	
or CHEM 111 Fundamental Chemistry I	
and Fundamental Chemistry I Laboratory	
& CHEM 113 and Fundamental Chemistry II	
& CHEM 114	
Credit Hours Subtotal:	7

Quantitative Analysis

CHEM 221A Elementary Quantitative Analysis	5
& CHEM 221L and Elementary Quantitative Analysis Laboratory	
Credit Hours Subtotal:	5

Organic Chemistry

CHEM 251 Organic Chemistry I	4
& CHEM 253 and Organic Chemistry I Laboratory	
CHEM 252 Organic Chemistry II	4
& CHEM 254 and Organic Chemistry II Laboratory	
Credit Hours Subtotal:	8

Physical Chemistry

CHEM 471 Physical Chemistry	4
Credit Hours Subtotal:	4

Advanced Chemistry

Select two sequences of the following: 10

CHEM 421 & CHEM 423	Analytical Chemistry and Analytical Chemistry Laboratory (ACE 10)	
CHEM 435 & CHEM 437	Chemical Biology and Chemical Biology Laboratory	
or BIOC 431 & BIOC 433	Biochemistry I: Structure and Metabolism and Biochemistry Laboratory	
CHEM 441 & CHEM 443	Inorganic Chemistry and Inorganic Chemistry Laboratory (ACE 10)	
Credit Hours Subtotal:		10
Ancillary Requirements: Math and Physics		
MATH 106	Calculus I	5
MATH 107	Calculus II	4
Select one sequence:		8-10
PHYS 141 & PHYS 142	Physics for Life Sciences I and Physics for Life Sciences II	
or PHYS 211 & PHYS 212	General Physics I and General Physics II	
Credit Hours Subtotal:		17-19
Total Credit Hours		52-54

Additional Major Requirements

Grade Rules

C- and D Grades

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

Pass/No Pass

No course taken Pass/No Pass will be counted toward the major with the exceptions of CHEM 101, Internship or Research (CHEM 398, CASC 95, CASC 98, CASC 395).

Requirements for Minor Offered by Department

Required Courses

Select one sequence from the following:		7-8
CHEM 109A & CHEM 109L	General Chemistry I and General Chemistry I Laboratory	
CHEM 110A & CHEM 110L	and General Chemistry II and General Chemistry II Laboratory	
or CHEM 113A & CHEM 113L	Fundamental Chemistry I and Fundamental Chemistry I Laboratory	
or CHEM 113B & CHEM 114	and Fundamental Chemistry II	
CHEM 221A & CHEM 221L	Elementary Quantitative Analysis and Elementary Quantitative Analysis Laboratory	5
Credit Hours Subtotal:		12-13
Additional Courses		
Select two additional sequences or courses from the following:		8-11

CHEM 251 & CHEM 253	Organic Chemistry I and Organic Chemistry I Laboratory	
CHEM 252 & CHEM 254	Organic Chemistry II and Organic Chemistry II Laboratory	
CHEM 261 & CHEM 263	Mechanistic Organic Chemistry I and Mechanistic Organic Chemistry I Laboratory	
CHEM 262 & CHEM 264	Mechanistic Organic Chemistry II and Mechanistic Organic Chemistry II Laboratory	
CHEM 421 & CHEM 423	Analytical Chemistry and Analytical Chemistry Laboratory	
CHEM 471	Physical Chemistry	
CHEM 481	Physical Chemistry I	
CHEM 482 & CHEM 484	Physical Chemistry II and Physical Chemical Measurements	
Credit Hours Subtotal:		8-11
Total Credit Hours		20-24

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

Grading Option: Pass No Pass

CHEM 105A Chemistry in Context I

Prerequisites: MATH 101, MATH 103, or Math Placement Exam score for MATH 102, MATH 104, or MATH 106.

Notes: Ideally, CHEM 105A and CHEM 105L should be taken together.

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 Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Prerequisite for: ASCI 240; CHEM 105L; CHEM 106A; FDST 369; NRES 319; PLAS 327

ACE: ACE 4 Science

CHEM 105L Chemistry in Context I Laboratory

Prerequisites: CHEM 105A or parallel.

Notes: Ideally, CHEM 105A and CHEM 105L should be taken together.

Credit may be earned in only one of CHEM 105 or CHEM 105L.

Description: Accompanying lab to CHEM 105A.

Credit Hours: 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded with Option

Prerequisite for: CHEM 106L; FDST 369; NRES 319; PLAS 327

Course and Laboratory Fee: \$50

CHEM 106A Chemistry in Context II

Prerequisites: C, P, or better in CHEM 105A or CHEM 109A. CHEM 106L recommended parallel. Credit toward the degree may be earned in only one of CHEM 106A, CHEM 110A, or CHEM 114

Notes: Ideally, CHEM 106A and CHEM 106L should be taken together.

Description: How organic chemistry and biochemistry complement one another. Chemical aspects of biological, social, or economic situations.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Offered: SPRING

Prerequisite for: ASCI 320; ASCI 321; CHEM 106L; FDST 367, AGST 367

CHEM 106L Chemistry in Context II Laboratory

Prerequisites: CHEM 105L or 109L; CHEM 106A or parallel.

Notes: Ideally, CHEM 106A and CHEM 106L should be taken together.

Credit may be earned in only one of CHEM 106 or CHEM 106L.

Description: Accompanying lab for CHEM 106A.

Credit Hours: 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded with Option

Prerequisite for: FDST 367, AGST 367

Course and Laboratory Fee: \$45

CHEM 109A General Chemistry I

Prerequisites: MATH 102, 103, or a Math Placement Exam score for MATH 106; CHEM 109L recommended parallel. Credit towards the degree may be earned in only one of CHEM 109A or 113A.

Notes: Ideally, CHEM 109A and CHEM 109L should be taken together.

Description: Lecture 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: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Prerequisite for: ASCI 240; BIOC 205; BSEN 321, CIVE 321; BSEN 321H, CIVE 321H; CHEM 106A; CHEM 110A; CHME 114; ENVE 210; FDST 205; FDST 369; FORS 300; FORS 445; GEOL 200; MATL 260; MATL 360; NRES 319; PLAS 327; PLAS 455, AGRO 855, NRES 455, NRES 855, SOIL 455

ACE: ACE 4 Science

CHEM 109L General Chemistry I Laboratory

Notes: Ideally, CHEM 109A and CHEM 109L should be taken together.

Credit may be earned in only one of CHEM 109 or CHEM 109L.

Description: Use scientific methods, skills, and knowledge to examine matter in ways that address chemical questions relating to the mole concept, properties of the states of matter, atomic structure, periodic properties, chemical bonding, and molecular structure.

Credit Hours: 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded with Option

Offered: FALL/SPR

Prerequisite for: CHEM 106L; CHEM 110L; FDST 369; GEOL 200; NRES 319; PLAS 327; PLAS 455, AGRO 855, NRES 455, NRES 855, SOIL 455

Course and Laboratory Fee: \$50

CHEM 110A General Chemistry II

Prerequisites: A grade of C, P, or better in CHEM 109A; CHEM 110L recommended parallel. Credit toward the degree may be earned in only one of CHEM 106A, CHEM 110A, or CHEM 114

Notes: Ideally, CHEM 110A and CHEM 110L should be taken together.

Description: Lecture serving as an introduction to intermolecular forces, kinetics, chemical equilibrium, thermodynamics, and electrochemistry.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Prerequisite for: ASCI 320; ASCI 321; ASCI 340; BSEN 244; BSEN 321, CIVE 321; BSEN 321H, CIVE 321H; BSEN 355; CHEM 110L; CHEM 221A; CHEM 221L; CHEM 251; CHEM 261; CHME 202; FDST 205; FDST 367, AGST 367; FORS 300; FORS 411; FORS 445; PLAS 455, AGRO 855, NRES 455, NRES 855, SOIL 455

ACE: ACE 4 Science

CHEM 110L General Chemistry II Laboratory

Prerequisites: CHEM 109L; CHEM 110A or parallel.

Notes: Ideally, CHEM 110A and CHEM 110L should be taken together.

Credit may be earned in only one of CHEM 110 or CHEM 110L.

Description: Accompanying laboratory for CHEM 110A.

Credit Hours: 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded with Option

Prerequisite for: ASCI 340; CHEM 261; CHME 202; FDST 367, AGST 367; FORS 411; PLAS 455, AGRO 855, NRES 455, NRES 855, SOIL 455

Course and Laboratory Fee: \$50

CHEM 113A Fundamental Chemistry I

Prerequisites: MATH 102, MATH 103 or a Math Placement Exam score for MATH 106; CHEM 113L recommended parallel. Credit towards the degree may be earned in only one of CHEM 109A or CHEM 113A.

Notes: Ideally, CHEM 113A and CHEM 113L should be taken together.

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: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Prerequisite for: BIOC 205; BSEN 321, CIVE 321; BSEN 321H, CIVE 321H; CHEM 110A; CHEM 113L; CHEM 114; CHME 114; ENVE 210; FDST 369

ACE: ACE 4 Science

CHEM 113L Fundamental Chemistry I Laboratory

Prerequisites: CHEM 113A or parallel.

Notes: Ideally, CHEM 113A and CHEM 113L should be taken together.

Credit may be earned in only one of CHEM 113 or CHEM 113L.

Description: Accompanying lab for CHEM 113A.

Credit Hours: 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded with Option

Prerequisite for: FDST 369

Course and Laboratory Fee: \$50

CHEM 114 Fundamental Chemistry II

Prerequisites: A grade of C, P, or better in CHEM 113A. CHEM 113L recommended. Credit toward the degree may be earned in only one of CHEM 106A, CHEM 110A, or CHEM 114

Notes: CHEM 221L is the associated laboratory course and is recommended parallel.

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

Grading Option: Graded with Option

Prerequisite for: BSEN 244; BSEN 355; CHEM 221A; CHEM 221L; CHEM 251; CHEM 261; CHME 202

CHEM 131 The Science of Food

Crosslisted with: FDST 131, NUTR 131

Description: Covers general and food chemistry, nutrition, food microbiology, food safety and quality, standards that are enforced by regulatory agencies, and food processes applied to improve food quality, shelf life and safety.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Prerequisite for: FDST 205

ACE: ACE 4 Science

Course and Laboratory Fee: \$5

CHEM 131H The Science of Food

Crosslisted with: FDST 131H, NUTR 131H

Prerequisites: Credit toward the degree cannot be earned in both FDST/CHEM/NUTR 131 and FDST/CHEM/NUTR 131H.

Description: Covers general and food chemistry, nutrition, food microbiology, food safety and quality, standards that are enforced by regulatory agencies, and food processes applied to improve food quality, shelf life and safety.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

ACE: ACE 4 Science

Course and Laboratory Fee: \$5

CHEM 191 Special Topics in Chemistry

Description: Topics vary.

Credit Hours: 1-6

Min credits per semester: 1

Max credits per semester: 6

Max credits per degree: 6

Grading Option: Graded with Option

CHEM 221A Elementary Quantitative Analysis

Prerequisites: C, P, or better in CHEM 110A or CHEM 114; or CHEM 114 parallel.

Description: Methods of statistical data evaluation and rigorous treatment of chemical equilibria, including chemical activity and coupled equilibria, will provide a foundation for understanding classical chemical quantitation techniques.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Offered: FALL/SPR

Prerequisite for: PLAS 455, AGRO 855, NRES 455, NRES 855, SOIL 455

CHEM 221L Elementary Quantitative Analysis Laboratory

Prerequisites: CHEM 110A or CHEM 114; or CHEM 114 parallel.

Description: Methods of statistical data evaluation and rigorous treatment of chemical equilibria, including chemical activity and coupled equilibria, will provide a foundation for understanding classical chemical quantitation techniques. Emphasis on laboratory techniques, including gravimetric and volumetric methods.

Credit Hours: 2

Max credits per semester: 2

Max credits per degree: 2

Grading Option: Graded with Option

Offered: FALL/SPR

Course and Laboratory Fee: \$65

CHEM 251 Organic Chemistry I

Prerequisites: A grade of C, P, or better in CHEM 110A or CHEM 114.
Credit toward the degree may be earned in only one of CHEM 251 or 261.

Notes: It is suggested that CHEM 253 be taken parallel with CHEM 251.

Description: Chemistry of carbon compounds including basic principles of bonding and structure; properties and reactions of alkanes, alkenes, alkynes, alkyl halides; stereochemistry, and spectroscopy.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Offered: FALL/SPR

Prerequisite for: BIOS 302; BIOS 312; BIOS 314; BIOS 326; BIOS 443, BIOS 843, VBMS 843, MBIO 443, VBMS 443; CHEM 252; CHEM 253; CHEM 254; FORS 340; PLAS 455, AGRO 855, NRES 455, NRES 855, SOIL 455; VBMS 403

CHEM 252 Organic Chemistry II

Prerequisites: C, P, or better in CHEM 251 and 253.

Description: Properties, synthesis, and reactivity of alcohols, ethers, conjugated systems, aromatic systems, heterocycles, carbonyl 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

Grading Option: Graded with Option

Offered: FALL/SPR

Prerequisite for: CHEM 254; FORS 415

CHEM 253 Organic Chemistry I Laboratory

Prerequisites: CHEM 251 or parallel.

Notes: CHEM 221 or CHEM 221A & CHEM 221L 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

Grading Option: Graded with Option

Prerequisite for: CHEM 252; CHEM 254; FORS 340

Course and Laboratory Fee: \$65

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: 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded with Option

Prerequisite for: FORS 415

Course and Laboratory Fee: \$65

CHEM 261 Mechanistic Organic Chemistry I

Prerequisites: A grade of C, P, or better in CHEM 110A and CHEM 110L, or CHEM 114. Credit toward the degree may be earned in only one of CHEM 251 or 261.

Notes: CHEM 261 is recommended to be taken in parallel with CHEM 263. CHEM 261 and 262, with their corresponding labs of CHEM 263 and 264, form a continuous course in organic chemistry mechanisms.

Description: Mechanism-based approach to the properties, synthesis, and reactivity of important carbon-based functional groups. Topics include bonding and structure; stereochemistry; and the chemistry of alkenes, alkyl halides, alcohols, thiols, and ethers.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Offered: FALL

Prerequisite for: BIOS 302; BIOS 312; BIOS 314; BIOS 326; BIOS 443, BIOS 843, VBMS 843, MBIO 443, VBMS 443; CHEM 254; CHEM 262; CHEM 263; CHEM 263A

CHEM 262 Mechanistic Organic Chemistry II

Prerequisites: A grade of C, P, or better in CHEM 261.

Notes: It is suggested that CHEM 264 be taken parallel with CHEM 262. CHEM 261 and 262, with their corresponding labs of CHEM 263 and 264, form a continuous course in organic chemistry mechanisms.

Description: Mechanism-based approach to the properties, reactivity, synthesis, and applications of conjugated systems, carbonyl compounds, heterocycles, and nitrogen compounds.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded with Option

Offered: SPRING

Prerequisite for: CHEM 254; CHEM 264; CHEM 264A

CHEM 263 Mechanistic Organic Chemistry I Laboratory

Prerequisites: CHEM 261 or parallel.

Notes: It is suggested that CHEM 263 be taken parallel with CHEM 261. Not for Engineering students.

Description: Lab work in qualitative organic analysis from a mechanistic perspective.

Credit Hours: 2

Max credits per semester: 2

Max credits per degree: 2

Grading Option: Graded with Option

Offered: FALL

Prerequisite for: CHEM 254; CHEM 264; CHEM 264A

Course and Laboratory Fee: \$65

CHEM 263A Mechanistic Organic Chemistry I Laboratory

Prerequisites: CHEM 261 or parallel.

Notes: Lab accompanying CHEM 261 for Engineering students. It is ideal for CHEM 263A be taken parallel with CHEM 261.

Description: Lab work in qualitative organic analysis from a mechanistic perspective.

Credit Hours: 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded with Option

Offered: FALL

Prerequisite for: CHEM 254; CHEM 264A

Course and Laboratory Fee: \$65

CHEM 264 Mechanistic Organic Chemistry II Laboratory**Prerequisites:** CHEM 262 or parallel; CHEM 263.**Notes:** It is suggested that CHEM 264 be taken parallel with CHEM 262. Not for Engineering Students.**Description:** Continuation of CHEM 263. Lab work in qualitative organic analysis from a mechanistic perspective.**Credit Hours:** 2**Max credits per semester:** 2**Max credits per degree:** 2**Grading Option:** Graded with Option**Offered:** SPRING**Course and Laboratory Fee:** \$65**CHEM 264A Mechanistic Organic Chemistry II Laboratory****Prerequisites:** CHEM 262 or parallel; CHEM 263 or CHEM 263A.**Notes:** Lab accompanying CHEM 262 for Engineering students. It is ideal for CHEM 264A to be taken parallel with CHEM 262.**Description:** Continuation of CHEM 263A. Lab work in qualitative organic analysis from a mechanistic perspective.**Credit Hours:** 1**Max credits per semester:** 1**Max credits per degree:** 1**Grading Option:** Graded with Option**Offered:** SPRING**Course and Laboratory Fee:** \$65**CHEM 391 Special Topics in Chemistry****Description:** Topics vary.**Credit Hours:** 1-6**Min credits per semester:** 1**Max credits per semester:** 6**Max credits per degree:** 6**Grading Option:** Graded with Option**CHEM 396 Independent Study in Chemistry****Prerequisites:** Permission.**Description:** Independent reading or research under direction of a faculty member.**Credit Hours:** 1-3**Min credits per semester:** 1**Max credits per semester:** 3**Max credits per degree:** 6**Grading Option:** Graded with Option**CHEM 398 Undergraduate Research in Chemistry****Prerequisites:** Permission.**Description:** 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:** 1-6**Min credits per semester:** 1**Max credits per semester:** 6**Max credits per degree:** 12**Grading Option:** Graded with Option**Experiential Learning:** Research**CHEM 421 Analytical Chemistry****Crosslisted with:** CHEM 821**Prerequisites:** CHEM 221 or CHEM 221A & CHEM 221L and MATH 106; 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**Grading Option:** Graded with Option**Offered:** SPRING**Prerequisite for:** CHEM 423, CHEM 823; CHEM 824; CHEM 825A; CHEM 825B; CHEM 825D; CHEM 825G; CHEM 825J; CHEM 991A**ACE:** ACE 10 Integrated Product**CHEM 423 Analytical Chemistry Laboratory****Crosslisted with:** CHEM 823**Prerequisites:** CHEM 421/821 or parallel.**Notes:** It is suggested that CHEM 423 be taken parallel with CHEM 421.**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**Grading Option:** Graded with Option**Course and Laboratory Fee:** \$65**CHEM 431 Biochemistry I: Structure and Metabolism****Crosslisted with:** BIOC 431, BIOC 831, BIOS 431, BIOS 831, CHEM 831**Prerequisites:** LIFE 120 with a grade of C or better; CHEM 252 or CHEM 262 with a grade of C or better.**Notes:** BIOS 201 or PLAS 215 is recommended. First course of a two-semester, comprehensive biochemistry course sequence.**Description:** Structure and function of proteins, nucleic acids, carbohydrates and lipids; nature of enzymes; major metabolic pathways of catabolism; and biochemical energy production.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**Offered:** FALL/SPR**Prerequisite for:** ASCI 820; ASCI 917; ASCI 925, NUTR 925; ASCI 926, NUTR 926; ASCI 927, NUTR 927; BIOC 305; BIOC 390; BIOC 432, BIOC 832, BIOS 432, CHEM 432, CHEM 832, BIOS 832; BIOC 433, BIOC 833, BIOS 433, BIOS 833, CHEM 433, CHEM 833; BIOC 433H; BIOC 440; FDST 470, FDST 870; NUTR 450; NUTR 455; NUTR 820, NUTR 420; NUTR 821; PLAS 434, BIOC 434, BIOS 434, CHEM 434, AGRO 834, BIOC 834, BIOS 834, CHEM 834; VBMS 410; VBMS 805; VBMS 950

CHEM 432 Biochemistry II: Metabolism and Biological Information

Crosslisted with: BIOC 432, BIOC 832, BIOS 432, CHEM 832, BIOS 832

Prerequisites: BIOC 431/831 with a grade of C or better; BIOS 201 or PLAS 215 with a grade of C or better.

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

Grading Option: Graded with Option

Offered: FALL/SPR

Prerequisite for: ASCI 949, BIOC 949, NUTR 949; BIOC 435; BIOC 932, BIOS 932, CHEM 932; BIOC 933, BIOS 933, CHEM 933; BIOC 934, BIOS 934, CHEM 934; BIOC 935, BIOS 935, CHEM 935; BIOC 998; VBMS 919; VBMS 950; VBMS 951

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

Grading Option: Graded with Option

Offered: FALL/SPR

Prerequisite for: BIOC 437, BIOC 837, BIOS 437, BIOS 837; BIOC 898

Course and Laboratory Fee: \$50

CHEM 434 Plant Biochemistry

Crosslisted with: PLAS 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

Grading Option: Graded with Option

CHEM 435 Chemical Biology

Crosslisted with: CHEM 835

Prerequisites: CHEM 252 or 262, and CHEM 221A/CHEM 221L

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

Grading Option: Graded with Option

Offered: FALL

Prerequisite for: BIOC 433, BIOC 833, BIOS 433, BIOS 833, CHEM 433, CHEM 833; CHEM 437, CHEM 837

CHEM 437 Chemical Biology Laboratory

Crosslisted with: CHEM 837

Prerequisites: BIOC/BIOS/CHEM 431/831 or CHEM 435/835 or parallel

Description: Introduction to techniques of chemical biology including the study of biological macromolecules and their interaction with small molecule ligands and effectors. Explore modern methods for macromolecular isolation, characterization, and for kinetic analysis and modeling.

Credit Hours: 2

Max credits per semester: 2

Max credits per degree: 2

Grading Option: Graded

Offered: SPRING

Course and Laboratory Fee: \$65

CHEM 438 Computational Chemical Biology

Crosslisted with: CHEM 838

Description: Introduction to computational chemistry applications including molecular dynamics simulations, density functional theory optimizations, and computational docking of small molecules to protein targets.

Credit Hours: 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded

Offered: SPRING

CHEM 441 Inorganic Chemistry

Crosslisted with: CHEM 841

Prerequisites: CHEM 221 or CHEM 221A & CHEM 221L 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

Grading Option: Graded with Option

Prerequisite for: 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

Grading Option: Graded with Option

Prerequisite for: CHEM 845

Course and Laboratory Fee: \$65

CHEM 453 Biosynthetic Pathways**Crosslisted with:** CHEM 853**Prerequisites:** CHEM 251 or CHEM 261**Description:** Biosynthetic pathways for bioactive natural products and pathway engineering with an emphasis on those that are medicinally significant, including the biosynthesis of fatty acids, polyketides, phenylpropanoids, terpenoids, steroids, alkaloids, non-ribosomal peptides, and carbohydrates.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**Offered:** SPRING**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**Grading Option:** Graded with Option**CHEM 471 Physical Chemistry****Crosslisted with:** CHEM 871**Prerequisites:** CHEM 221 or CHEM 221A & CHEM 221L; MATH 107; and PHYS 142 or 212. Credit toward the degree may be earned in only one of CHEM 471 or 481.**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**Grading Option:** Graded with Option**Prerequisite for:** BIOC 486, BIOC 886, CHEM 486, CHEM 886**CHEM 481 Physical Chemistry I****Crosslisted with:** CHEM 881**Prerequisites:** CHEM 221 or CHEM 221A & CHEM 221L with grade of at least C; MATH 208; PHYS 212. Credit toward the degree may be earned in only one of CHEM 471 or 481.**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**Grading Option:** Graded with Option**Prerequisite for:** BIOC 486, BIOC 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**Grading Option:** Graded with Option**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**Grading Option:** Graded with Option**Course and Laboratory Fee:** \$65**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**Grading Option:** Graded with Option**Course and Laboratory Fee:** \$65**CHEM 486 Advanced Topics in Biophysical Chemistry****Crosslisted with:** BIOC 486, BIOC 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**Grading Option:** Graded with Option**CHEM 499 Undergraduate Thesis****Prerequisites:** Permission**Description:** Independent research leading to a thesis.**Credit Hours:** 1-3**Min credits per semester:** 1**Max credits per semester:** 3**Max credits per degree:** 6**Grading Option:** Graded with Option

CHEM 499H Honors Undergraduate Thesis

Prerequisites: Permission. Credit toward the degree cannot be earned in CHEM 499 and CHEM 499H.

Description: Independent research leading to a thesis.

Credit Hours: 1-3

Min credits per semester: 1

Max credits per semester: 3

Max credits per degree: 6

Grading Option: Graded with Option

- Doctoral Degree, Analytical Chemistry, Ohio State University – Columbus, OH
- Doctoral Degree, Chemistry, Massachusetts Institute of Technology – Cambridge, MA
- Doctor of Medicine, University of Nebraska Medical Center – Omaha, NE
- Doctor of Pharmacy, University of Nebraska Medical Center – Omaha, NE

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

- Scientist, Streck – Omaha, NE
- Bio-Analytical Analyst, Celerion – Lincoln, NE
- Military Pay Technician, United States Coast Guard – Topeka, KS
- Chemical Contractor, Zoetis – Lincoln, NE
- Laboratory Technician, Enthone – Bridgeview, IL
- Principle Scientist, Novartis – Lincoln, NE
- Pharmacy Technician, CVS – Lincoln, NE
- Quality Management Chemist, Cargil – Blair, NE
- Chemical Analyst, Purac America – Lincolnshire, IL
- Civilian Scientist, United States Navy – China Lake, CA

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

- Master's Degree, Recreational Management, Oklahoma State University – Stillwater, OK
- Master's Degree, Science Teaching, University of Nebraska-Lincoln – Lincoln, NE
- Master's Degree, Synthetic Chemistry, University College Dublin – Dublin, Ireland
- Master's Degree, Biostatistics, University of Nebraska Medical Center – Omaha, NE
- Master's Degree, Geology, University of Nebraska-Lincoln – Lincoln, NE
- Master's Degree, Public Health Administration and Epidemiology, University of Pittsburg – Pittsburg, PA