

CHEMISTRY (BS)

Chair: Phillip M. Sheridan, PhD

Introduction

Chemistry or Biochemistry graduates enter a variety of professions, including careers in research and industry, the health professions, teaching, technical writing, business, sales, patent law and civil service. A major in chemistry or biochemistry is an excellent preparation for entrance into medical, dental and pharmacy schools. It also prepares students to enter a range of graduate programs including chemistry, biochemistry, biotechnology, bioinformatics, medicinal chemistry, chemical engineering, environmental science, bioengineering, business and law.

The Department of Chemistry and Biochemistry offers three tracks that lead to a BS degree in Chemistry and one track that leads to a BS degree in Chemistry with Business. The three tracks in Chemistry include the Chemistry track that is certified by the American Chemical Society (CHM ACS certified track), Chemistry Health Professions track, and Chemistry track designed for students who intend to pursue technical employment in industry. Chemistry with Business is designed for students who want to pursue administrative or sales careers in the chemical industry. It is also an excellent degree for students who want to pursue careers in patent law.

Advisors in the Department will help you choose the track that best fits your interests and career plans. Students in all program tracks will gain hands-on experience with a wide variety of modern, sophisticated laboratory instrumentation; this helps provide the experience necessary to be competitive in today's job market and/or to gain entrance into highly ranked graduate programs.

All Chemistry tracks can be completed with a business minor. This option provides a very useful preparation for employment in sales, marketing, or other industrial professions, as well as preparing students for graduate studies in business or administration

Please go to the Chemistry and Biochemistry website (<https://www.canisius.edu/academics/programs/chemistry-and-biochemistry>) for a more detailed description of the program, faculty, facilities, and academic and co-curricular opportunities.

Qualifications

Students must attain the grade of C or greater in General Chemistry II (CHM 112) and C- or greater in Organic Chemistry II (CHM 228) in order to progress into the major. Several two-semester courses (CHM 111 and CHM 112, CHM 227 and CHM 228, BCH 301 and BCH 302) have a requirement for a minimum grade of C- in the first course to continue with the second course.

Advisement

All students have an advisor in the major and should contact the department directly to have an advisor assigned if they do not already have one. Students who are still deciding on a major should go to the Griff Center for Academic Engagement for advisement including course selection prior to registration. Meetings with academic advisors are required prior to students receiving their PIN for course registration each semester. All majors should work closely with their advisor in discussing career expectations, choosing their major electives, developing their entire academic program and planning their co-curricular or supplemental academic experiences.

Special Programs Offered by the Department

Early Assurance Program with University at Buffalo Medical School or Syracuse Medical School

Qualified students may apply to the University at Buffalo Medical School or Syracuse University Medical School during their sophomore year. Those accepted will be admitted into the Medical School freshman class after their graduation from Canisius.

Early Assurance Program with University at Buffalo Dental School

Qualified students may apply to the University at Buffalo Dental School during their sophomore year. Those accepted will be admitted into the Dental School freshman class after their graduation from Canisius.

Pre-Medical and Pre-Dental

The Chemistry and Biochemistry BS degrees are excellent preparations for entering into medical and dental schools, and a third of the graduates from this Department typically enter into these programs. Students applying to medical or dental schools must take the Medical College Admission Test (MCAT) or Dental Admission Test (DAT).

Pre-Pharmacy

For pre-pharmacy students we recommend the CHM Health Professions track, since students in this track can meet all pharmacy school entrance requirements. Students applying to most pharmacy schools must take the Pharmacy College Admission Test (PCAT).

Major Experiences

Following their freshman year, and sometimes earlier, chemistry and biochemistry majors are encouraged to become involved in research or other professional projects. Stipends for qualified students are often available so that work can be done on these projects during the summer and school year in the Department. Summer work in industrial laboratories and research institutions is also available. Our close relationship with local industries and institutions aids students in job placement before and after graduation. Students may also choose to undertake industrial internships for advanced elective course credit.

Double Majors

Students who wish to expand their educational opportunities may decide to declare a double major. The decision may be based on career goals or planned graduate studies. Before a student declares a double major, it is important to meet with the appropriate academic departments for advisement. Some double major combinations can be completed within the minimum 120 credit hour degree requirement, but in some cases additional course work may be required. In order to declare a double major, the student must complete the appropriate double major request form and get the signature of each department chairperson and the appropriate associate dean. Please note that students will receive only one degree, regardless of the number of majors they complete.

Minors in Other Disciplines

Minors provide students the opportunity to pursue additional interests but generally do not require as many courses as a major. Minors generally range from five to eight required courses. The minors page (<http://catalog.canisius.edu/undergraduate/minors>) provides a complete list of minors and provides links to each minor. Some majors and minors can be

completed within the minimum 120 credit hour degree requirement, but in some cases additional coursework may be required. Students must complete the appropriate minor request form.

Curriculum

An Ignatian Foundation

All undergraduate students must complete either the Canisius Core Curriculum (<http://catalog.canisius.edu/undergraduate/academics/curricular-information/core-curriculum>) or the All-College Honors Curriculum (<http://catalog.canisius.edu/undergraduate/academics/curricular-information/all-college-honors-program>). Many schools refer to their college-wide undergraduate requirements as "general education" requirements. We believe that the core curriculum and the honors curriculum are more than a series of required classes; they provide the basis for a Jesuit education both with content and with required knowledge and skills attributes that are central to our mission.

Free Electives

Students may graduate with more but not less than 120 credit hours. Free electives are courses in addition to the Core Curriculum or Honors Curriculum and major requirements sufficient to reach the minimum of 120 credit hours required for graduation.

Major Requirements

For ACS-certified Chemistry Track

The ACS-certified Chemistry track is recommended for students intending advanced study (pursuing a graduate degree) in Chemistry.

| Code | Title | Credits |
|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------|
| CHM 111 & 111L | General Chemistry I and General Chemistry I Laboratory | 4 |
| CHM 112 & 112L | General Chemistry II and General Chemistry II Laboratory | 4 |
| CHM 227 & 227L | Organic Chemistry I and Organic Chemistry I Laboratory | 4 |
| CHM 228 & 228L | Organic Chemistry II and Organic Chemistry II Laboratory | 4 |
| CHM 230 & 230L | Analytical Chemistry and Analytical Chemistry Laboratory | 4 |
| CHM 244 | Inorganic Chemistry | 3 |
| CHM 301 & 301L | Fundamental Physical Chemistry and Fundamental Physical Chemistry Laboratory | 4 |
| CHM 302 & 302L | Modern Physical Chemistry and Modern Physical Chemistry Laboratory | 4 |
| CHM 334 & 334L | Spectrometric Analysis and Spectrometric Analysis Lab | 4 |
| CHM 420 & 420L | Materials Chemistry and Materials Chemistry Laboratory | 4 |
| CHM 430 & 430L | Instrumental Analytical Chemistry and Instrumental Analytical Chemistry Laboratory | 4 |
| CHM 381 | Scientific Literature and Communication | 1 |
| CHM 480 | Communicating Concepts in Chemistry | 1 |
| CHM 481 | Communicating Research Literature | 1 |
| Choose 2 Chemistry or Biochemistry Electives (any 300- or 400- level CHM or BCH course) ¹ | | 6 |
| BCH 301 | Introduction to Biochemistry | 3 |

| | | |
|----------------|-------------------------------------------------------------------------------------------------------------|----|
| BIO 111 & 111L | Introductory Biology I and Introductory Biology Laboratory I | 4 |
| MAT 111 | Calculus I | 4 |
| MAT 112 | Calculus II | 4 |
| PHY 223 & 223L | General Physics for Physical Science Majors I and General Physics for Physical Science Majors I Laboratory | 4 |
| PHY 224 & 224L | General Physics for Physical Science Majors II and General Physics for Physical Science Majors I Laboratory | 4 |
| Total Credits | | 75 |

¹ Students may use PHY 332 or PHY 226 with lab as a Chemistry Elective.

For Chemistry Track

Chemistry track designed for students who intend to pursue technical employment in industry.

| Code | Title | Credits |
|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------|
| CHM 111 & 111L | General Chemistry I and General Chemistry I Laboratory | 4 |
| CHM 112 & 112L | General Chemistry II and General Chemistry II Laboratory | 4 |
| CHM 227 & 227L | Organic Chemistry I and Organic Chemistry I Laboratory | 4 |
| CHM 228 & 228L | Organic Chemistry II and Organic Chemistry II Laboratory | 4 |
| CHM 230 & 230L | Analytical Chemistry and Analytical Chemistry Laboratory | 4 |
| CHM 244 | Inorganic Chemistry | 3 |
| CHM 301 & 301L | Fundamental Physical Chemistry and Fundamental Physical Chemistry Laboratory | 4 |
| CHM 334 & 334L | Spectrometric Analysis and Spectrometric Analysis Lab | 4 |
| CHM 430 & 430L | Instrumental Analytical Chemistry and Instrumental Analytical Chemistry Laboratory | 4 |
| CHM 381 | Scientific Literature and Communication | 1 |
| CHM 480 | Communicating Concepts in Chemistry | 1 |
| CHM 481 | Communicating Research Literature | 1 |
| Choose 3 Chemistry or Biochemistry Electives (any 300- or 400- level CHM or BCH course) ¹ | | 9 |
| BCH 301 | Introduction to Biochemistry | 3 |
| BIO 111 & 111L | Introductory Biology I and Introductory Biology Laboratory I | 4 |
| MAT 111 | Calculus I | 4 |
| MAT 112 | Calculus II ² | 4 |
| or MAT 141 | Inferential Statistics and Computers for Science | |
| PHY 201 & 201L | College Physics I and College Physics I Laboratory | 4 |
| PHY 202 & 202L | College Physics II and College Physics II Laboratory | 4 |
| Total Credits | | 70 |

¹ Students may use PHY 332 or PHY 226 with lab as a Chemistry Elective.

² Students minoring in business may take ECO 255 in lieu of MAT 112 or MAT 141.

For Chemistry for Health Professions Track

The Health Professions Track is recommended for students preparing for a health-related profession (e.g. Medicine, Dentistry, Physician Assistant, etc.).

| Code | Title | Credits |
|----------------|-------------------------------------------------------------------------------------------------|---------|
| CHM 111 & 111L | General Chemistry I and General Chemistry I Laboratory | 4 |
| CHM 112 & 112L | General Chemistry II and General Chemistry II Laboratory | 4 |
| CHM 227 & 227L | Organic Chemistry I and Organic Chemistry I Laboratory | 4 |
| CHM 228 & 228L | Organic Chemistry II and Organic Chemistry II Laboratory | 4 |
| CHM 230 & 230L | Analytical Chemistry and Analytical Chemistry Laboratory | 4 |
| CHM 244 | Inorganic Chemistry | 3 |
| CHM 301 | Fundamental Physical Chemistry | 3 |
| CHM 381 | Scientific Literature and Communication | 1 |
| CHM 480 | Communicating Concepts in Chemistry | 1 |
| CHM 481 | Communicating Research Literature | 1 |
| | Choose a Chemistry or Biochemistry Elective (any 300- or 400- level CHM or BCH course) with lab | 4 |
| | Science Elective (choose from CSC 111 or any 300- or 400-level course in CHM, BCH, BIO, or PHY) | 3 |
| | Science Elective with Lab (choose any 300- or 400-level course in CHM, BCH, BIO, or PHY) | 4 |
| BCH 301 | Introduction to Biochemistry | 3 |
| BCH 302 | Cellular Biochemistry | 3 |
| BIO 111 & 111L | Introductory Biology I and Introductory Biology Laboratory I | 4 |
| BIO 112 & 112L | Introductory Biology II and Introductory Biology Laboratory II | 4 |
| MAT 111 | Calculus I | 4 |
| MAT 112 | Calculus II ¹ | 4 |
| or MAT 141 | Inferential Statistics and Computers for Science | |
| PHY 201 & 201L | College Physics I and College Physics I Laboratory ² | 4 |
| PHY 202 & 202L | College Physics II and College Physics II Laboratory ² | 4 |
| Total Credits | | 70 |

¹ Students minoring in business may take ECO 255 in lieu of MAT 112 or MAT 141.

² Students may take the PHY 223, PHY 223L and PHY 224, PHY 224L in lieu of this sequence.

For Chemistry with Business Track

Chemistry with Business is designed for students who want to pursue administrative or sales careers in the chemical industry. It is also an excellent degree for students who want to pursue careers in patent law.

| Code | Title | Credits |
|---------------------------------|--------------------------------------------------------|---------|
| Required Science Courses | | |
| CHM 111 & 111L | General Chemistry I and General Chemistry I Laboratory | 4 |

| | | |
|----------------|----------------------------------------------------------|---|
| CHM 112 & 112L | General Chemistry II and General Chemistry II Laboratory | 4 |
| CHM 227 & 227L | Organic Chemistry I and Organic Chemistry I Laboratory | 4 |
| CHM 228 & 228L | Organic Chemistry II and Organic Chemistry II Laboratory | 4 |
| CHM 301 | Fundamental Physical Chemistry | 3 |

| | | |
|------------------------------|--------------------------------------------------------------------------------------|--|
| Choose one of the following: | | |
| CHM 230 & 230L | Analytical Chemistry and Analytical Chemistry Laboratory | |
| CHM 232 & 232L | Environmental Analytical Chemistry and Environmental Analytical Chemistry Laboratory | |
| CHM 334 & 334L | Spectrometric Analysis and Spectrometric Analysis Lab | |
| CHM 430 & 430L | Instrumental Analytical Chemistry and Instrumental Analytical Chemistry Laboratory | |

Choose a Chemistry or Biochemistry Elective (any 300- or 400- level CHM or BCH course)

| | | |
|----------------|--------------------------------------------------------------------------|---|
| CHM 381 | Scientific Literature and Communication | 1 |
| CHM 480 | Communicating Concepts in Chemistry | 1 |
| BCH 301 & 301L | Introduction to Biochemistry and Introduction to Biochemistry Laboratory | 4 |
| BIO 111 & 111L | Introductory Biology I and Introductory Biology Laboratory I | 4 |
| BIO 112 & 112L | Introductory Biology II and Introductory Biology Laboratory II | 4 |
| MAT 111 | Calculus I | 4 |
| MAT 112 | Calculus II ¹ | 4 |
| or MAT 141 | Inferential Statistics and Computers for Science | |
| PHY 201 & 201L | College Physics I and College Physics I Laboratory | 4 |
| PHY 202 & 202L | College Physics II and College Physics II Laboratory | 4 |

Required Business Courses

| | | |
|---------|-----------------------------------|---|
| ECO 101 | Principles of Macroeconomics | 3 |
| MGT 101 | Introduction to Management | 3 |
| MKT 201 | Principles of Marketing | 3 |
| ACC 201 | Financial Accounting | 3 |
| FIN 201 | Introduction to Corporate Finance | 3 |

Major Electives

| | | |
|--------------------------------------------------------------|--|----|
| Select two courses in business, law, or science ² | | 6 |
| Total Credits | | 77 |

¹ Students in this track may take ECO 255 in lieu of MAT 112 or MAT 141.

² Choose two courses from the following: CSC 111, IBUS 301, PSC 320, PSC 321, ACC 202, ECO 102, any 200-level or higher ECO course, or any 300- or 400-level course in CHM, BCH, BIO, PHY, MGT, or MKT.

Additional Course Considerations

MAT 211 is highly recommended for students interested in pursuing a PhD degree. In addition, MAT 219 and MAT 222 are highly recommended for students interested in pursuing a PhD degree in physical, inorganic, or analytical chemistry.

Roadmap

Recommended Semester Schedule for Major Course Requirements

CHM ACS Certified Track

Freshman

| Fall | Spring |
|----------------|----------------|
| CHM 111 & 111L | CHM 112 & 112L |
| BIO 111 & 111L | PHY 223 & 223L |
| MAT 111 | MAT 112 |

Sophomore

| Fall | Spring |
|----------------|----------------|
| CHM 227 & 227L | CHM 228 & 228L |
| PHY 224 & 224L | CHM 230 & 230L |
| CHM 244 | |

Junior

| Fall | Spring |
|----------------|----------------|
| CHM 301 & 301L | CHM 302 & 302L |
| CHM 381 | CHM 430 & 430L |
| CHM 420 & 420L | CHM 480 |

Senior

| Fall | Spring |
|----------------|--------------|
| CHM 334 & 334L | CHM Elective |
| BCH 301 | CHM Elective |
| CHM 481 | |

CHM ACS Certified Track with Business Minor

Freshman

| Fall | Spring |
|----------------|----------------|
| CHM 111 & 111L | CHM 112 & 112L |
| BIO 111 & 111L | PHY 223 & 223L |
| MAT 111 | MAT 112 |

Sophomore

| Fall | Spring |
|----------------|--------------------|
| CHM 227 & 227L | CHM 228 & 228L |
| PHY 224 & 224L | CHM 230 & 230L |
| ECO 101 | ECO 102 |
| CHM 244 | MAT 141 or ECO 255 |

Junior

| Fall | Spring |
|----------------|----------------|
| CHM 301 & 301L | CHM 302 & 302L |

| | |
|----------------|----------------|
| CHM 381 | CHM 430 & 430L |
| CHM 420 & 420L | CHM 480 |
| MKT 201 | MGT 101 |

Senior

| Fall | Spring |
|----------------|--------------|
| CHM 334 & 334L | CHM Elective |
| BCH 301 | CHM Elective |
| CHM 481 | FIN 201 |
| ACC 201 | |

CHM Track

Freshman

| Fall | Spring |
|----------------|----------------|
| CHM 111 & 111L | CHM 112 & 112L |
| BIO 111 & 111L | MAT 112 or 141 |
| MAT 111 | |

Sophomore

| Fall | Spring |
|----------------|----------------|
| CHM 227 & 227L | CHM 228 & 228L |
| PHY 201 & 201L | PHY 202 & 202L |

Junior

| Fall | Spring |
|---------|----------------|
| BCH 301 | CHM 230 & 230L |
| CHM 244 | CHM Elective |
| CHM 381 | CHM 480 |

Senior

| Fall | Spring |
|----------------|----------------|
| CHM 301 & 301L | CHM 430 & 430L |
| CHM 334 & 334L | CHM Elective |
| CHM 481 | CHM Elective |

CHM Track with Business Minor

Freshman

| Fall | Spring |
|----------------|--------------------|
| CHM 111 & 111L | CHM 112 & 112L |
| BIO 111 & 111L | MAT 141 or ECO 255 |
| MAT 111 | |

Sophomore

| Fall | Spring |
|----------------|----------------|
| CHM 227 & 227L | CHM 228 & 228L |
| PHY 201 & 201L | PHY 202 & 202L |

| | |
|-------------------|-------------------|
| | ECO 102 |
| Junior | |
| Fall | Spring |
| BCH 301 | CHM 230 & 230L |
| CHM 244 | CHM Elective |
| CHM 381 | CHM 480 |
| ECO 101 | MGT 101 |
| Senior | |
| Fall | Spring |
| CHM 301 & 301L | CHM 430 & 430L |
| CHM 334 & 334L | CHM Elective |
| CHM 481 | CHM Elective |
| ACC 201 | FIN 201 |
| MKT 201 | |

CHM Health Professions Track

| | |
|--------------------|--------------------|
| Freshman | |
| Fall | Spring |
| CHM 111 & 111L | CHM 112 & 112L |
| BIO 111 & 111L | BIO 112 & 112L |
| MAT 111 | MAT 112 or 141 |
| Sophomore | |
| Fall | Spring |
| CHM 227 & 227L | CHM 228 & 228L |
| PHY 201 & 201L | PHY 202 & 202L |
| Junior | |
| Fall | Spring |
| BCH 301 | CHM 230 & 230L |
| CHM 244 | BCH 302 |
| CHM 381 | CHM 480 |
| Senior | |
| Fall | Spring |
| CHM 301 | CHM Elective + Lab |
| CHM 481 | SCI elective |
| SCI Elective + Lab | |

CHM Health Professions Track with Business Minor

| | |
|-------------------|--------------------|
| Freshman | |
| Fall | Spring |
| CHM 111 & 111L | CHM 112 & 112L |
| BIO 111 & 111L | BIO 112 & 112L |
| MAT 111 | MAT 141 or ECO 255 |

| | |
|--------------------|--------------------|
| Sophomore | |
| Fall | Spring |
| CHM 227 & 227L | CHM 228 & 228L |
| PHY 201 & 201L | PHY 202 & 202L |
| ECO 101 | ECO 102 |
| Junior | |
| Fall | Spring |
| BCH 301 | CHM 230 & 230L |
| CHM 381 | BCH 302 |
| CHM 244 | CHM 480 |
| MKT 201 | MGT 101 |
| Senior | |
| Fall | Spring |
| CHM 301 | CHM Elective + Lab |
| CHM 481 | SCI Elective |
| ACC 201 | FIN 201 |
| SCI Elective + Lab | |

CHM with Business Track

| | |
|-------------------|------------------------------------------------------------|
| Freshman | |
| Fall | Spring |
| CHM 111 & 111L | CHM 112 & 112L |
| BIO 111 & 111L | BIO 112 & 112L |
| MAT 111 | MAT 141 or 112 |
| Sophomore | |
| Fall | Spring |
| CHM 227 & 227L | CHM 228 & 228L |
| PHY 201 & 201L | PHY 202 & 202L |
| ECO 101 | MGT 101 |
| Junior | |
| Fall | Spring |
| BCH 301 & 301L | CHM 480 |
| CHM 381 | Major Elective ² |
| ACC 201 | Analytical/Instrumental Chemistry with lab ¹ |
| MKT 201 | |
| Senior | |
| Fall | Spring |
| CHM 301 | BCH or CHM Elective |
| FIN 201 | Major Elective |

¹ Choose one of the following analytical/instrumental courses with its associated laboratory: CHM 230, CHM 232, CHM 334, or CHM 430.

- ² Choose two courses in business, law, or science: a 300 level course or higher in MGT, ACC 202, ECO 102 or a 200 level course or higher in ECO, IBUS 301, PSC 320, PSC 321, a 300 or 400 level course in CHM, BCH, BIO, or PHY, or CSC 111.

Learning Goals & Objectives

Student Learning Goal 1:

Knowledge; Department majors will demonstrate an understanding of fundamental chemical concepts.

Students will:

- Objective A (Concepts): Demonstrate broad knowledge of chemical concepts;
- Objective B (Reactions): Predict and analyze the effects of chemical changes;
- Objective C (Derivations): Manipulate expressions of chemical quantities to derive higher-order relationships;
- Objective D (Safety): Demonstrate knowledge of chemical, instrumental and workplace safety.

Student Learning Goal 2:

Professional Skills; Department majors will be able to work effectively in a professional or laboratory setting.

Students will:

- Objective A (Scientific Literacy): Identify, access and use chemical literature sources;
- Objective B (Scientific Method): Define chemical problems, then formulate hypotheses and design experiments to address them;
- Objective C (Laboratory Skills): Carry out experiments (follow directions, manipulate materials and lab apparatus, record data);
- Objective D (Laboratory Instrumentation): Use modern instrumentation (prepare samples, operate systems, troubleshoot common problems, organize and label data).

Student Learning Goal 3:

Communication; Department majors will be proficient in the communication of chemical information.

Students will:

- Objective A (Oral Communication): Construct and deliver an effective oral presentation;
- Objective B (Written Communication): Write an effective, properly formatted scientific report.

Minor

Students majoring in various disciplines such as biology, mathematics, physics, bioinformatics, computer science, psychology and business can benefit from pursuing a minor in chemistry. The chemistry minor requires a student to complete the following sequence of courses:

| Code | Title | Credits |
|------------------------------|----------------------------------------------------------|---------|
| CHM 111 & 111L | General Chemistry I and General Chemistry I Laboratory | 4 |
| CHM 112 & 112L | General Chemistry II and General Chemistry II Laboratory | 4 |
| CHM 227 & 227L | Organic Chemistry I and Organic Chemistry I Laboratory | 4 |
| CHM 228 & 228L | Organic Chemistry II and Organic Chemistry II Laboratory | 4 |
| Select one of the following: | | 4 |

| | | |
|-------------------------------------|------------------------------------------------------------------------------------|-------|
| CHM 230 & 230L | Analytical Chemistry and Analytical Chemistry Laboratory | |
| CHM 334 & 334L | Spectrometric Analysis and Spectrometric Analysis Lab | |
| CHM 430 & 430L | Instrumental Analytical Chemistry and Instrumental Analytical Chemistry Laboratory | |
| Select one of the following: | | 3 |
| CHM 244 | Inorganic Chemistry | |
| CHM 301 | Fundamental Physical Chemistry | |
| Select one of the following: | | 3-4 |
| CHM or BCH 300- or 400-level course | | |
| Total Credits | | 26-27 |

Courses

CHM 104 Energy, Environment, and Society 3 Credits

Designed to provide a better understanding of energy and our environment, including man's interaction with his environment and the consequences facing society today. This course satisfies the goals and objectives of Field 6, Natural Sciences.

Fulfills College Core: (part of the Sustainability Core Pathway), Field 6 (Natural Sciences), Global Awareness

Offered: every fall.

CHM 109 General Chemistry I with Review - Part I 3 Credits

General Chemistry I for science majors, Part I, three lectures and one recitation per week. This course reviews some mathematical concepts, emphasizes dimensional analysis, nomenclature, stoichiometry, solutions, basic chemical reactions, and thermochemistry. This course satisfies the goals and objectives of Field 6, Natural Sciences.

Fulfills College Core: Field 6 (Natural Sciences)

Offered: every fall.

CHM 110 General Chemistry I with Review - Part II 3 Credits

General Chemistry I for science majors, Part II, three lectures, one laboratory, and one recitation per week. This course emphasizes atomic and molecular structure, periodic properties, gas laws, and states of matter. The CHM 109 and CHM 110 sequence is equivalent to CHM 111 and a free elective. Students completing the CHM 109 and CHM 110 sequence are eligible to take CHM 112 in the fall of their sophomore year or during the summer. A minimum grade of C- in CHM 110 is required for both CHM 112 (General Chemistry II) and CHM 227 (Organic Chemistry I).

Prerequisite: minimum grade of C- in CHM 109. **Corequisite:** CHM 111L.

Offered: every spring.

CHM 111 General Chemistry I 3 Credits

General Chemistry I for science majors, three lectures, one laboratory, and one recitation per week. This course is recommended for students with a very good background in mathematics and significant exposure to high school chemistry. The course emphasizes dimensional analysis, nomenclature, stoichiometry, solutions, basic chemical reactions, thermochemistry, atomic and molecular structure, periodic properties, gas laws, and states of matter. A minimum grade of C- in CHM 111 is a prerequisite for both CHM 112 (General Chemistry II) and CHM 227 (Organic Chemistry I). This course satisfies the goals and objectives of Field 6, Natural Sciences.

Prerequisite: minimum score of 580 in MSAT or permission of instructor.

Corequisite: CHM 111L.

Fulfills College Core: Field 6 (Natural Sciences)

Offered: every fall.

| | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| CHM 111L General Chemistry I Laboratory | 1 Credit | CHM 232 Environmental Analytical Chemistry | 3 Credits |
| One three-hour lab per week. | | Environmental applications of analytical chemistry. Sampling techniques and statistical analysis of data. Soil chemistry, aquatic chemistry and atmospheric chemistry. Trace analysis with electroanalytical, liquid and gas chromatography, atomic absorption spectroscopy and ion selective electrodes. Three lectures, one laboratory and one recitation per week. | |
| Corequisite: CHM 110 or CHM 111. | | Prerequisite: CHM 112. Corequisite: CHM 232L. | |
| Offered: every fall. | | Offered: spring 2018. | |
| CHM 112 General Chemistry II | 3 Credits | CHM 232L Environmental Analytical Chemistry Laboratory | 1 Credit |
| General Chemistry II for science majors, three lectures, one laboratory, and one recitation per week. The course emphasizes properties of solutions, kinetics, chemical equilibrium concepts, calculations involving acid/base and precipitation equilibria, thermodynamics, electrochemistry, nuclear chemistry, and chemistry of the environment. A minimum grade of C in CHM 112 is required for all chemistry and biochemistry majors. This course satisfies the goals and objectives of Field 6, Natural Sciences. | | One four-hour lab per week. | |
| Prerequisite: minimum grade of C- in either CHM 110 or CHM 111. | | Prerequisite: CHM 112L. Corequisite: CHM 232. | |
| Corequisite: CHM 112L. | | Offered: spring 2018. | |
| Fulfills College Core: Field 6 (Natural Sciences) | | CHM 244 Inorganic Chemistry | 3 Credits |
| Offered: every fall & spring. | | Electronic configuration of atoms, periodic classification of the elements, nature of chemical bonding, symmetry and application of group theory to molecular orbitals, structures and thermodynamics of solids, bonding in metals and semiconductors, acid/base concepts, electrochemistry, isomerism, bonding, reactions and spectroscopy of coordination compounds, and other aspects of modern inorganic chemistry. Three lectures and one recitation per week. | |
| CHM 112L General Chemistry II Laboratory | 1 Credit | Prerequisite: minimum grade of C in CHM 112. | |
| One three-hour lab per week. | | Offered: every fall. | |
| Prerequisite: minimum grade of C- in CHM 111L. Corequisite: CHM 112. | | CHM 301 Fundamental Physical Chemistry | 3 Credits |
| Offered: every fall & spring. | | Fundamental topics in thermodynamics, kinetics, quantum mechanics, and spectroscopy. Three lectures and one recitation per week. Prerequisite: minimum grade of C in CHM 112, successful completion of MAT 111 or MAT 110, and a year of physics (PHY 201 & PHY 202 or PHY 223 & PHY 224). Offered: every fall. Three lectures and one recitation per week. | |
| CHM 227 Organic Chemistry I | 3 Credits | Prerequisite: minimum grade of C in CHM 112, successful completion of MAT 111 or MAT 110, and a year of physics (PHY 201 & PHY 202 or PHY 223 & PHY 224). | |
| Fundamental treatment of organic chemistry. Includes bonding, structure, nomenclature and stereochemistry of organic functional groups. Introduces mechanisms and reactivity in substitution and elimination reactions. Laboratory covers techniques of separation, purification and analysis of organic compounds. Three lectures, one laboratory, and one recitation per week. | | Offered: every fall. | |
| Prerequisite: minimum grade of C- in either CHM 110 or CHM 111. | | CHM 301L Fundamental Physical Chemistry Laboratory | 1 Credit |
| Corequisite: CHM 227L. | | Selected experiments demonstrating principles of thermodynamics and chemical kinetics. One four-hour lab per week. | |
| Offered: every fall. | | Prerequisite: minimum grade of C in CHM 230L & C in CHM 301 (or concurrent registration in CHM 301). | |
| CHM 227L Organic Chemistry I Laboratory | 1 Credit | Fulfills College Core: Advanced Writing-Intensive | |
| One four-hour lab per week. | | Offered: every fall. | |
| Prerequisite: minimum grade of C- in CHM 111L. Corequisite: CHM 227. | | CHM 302 Modern Physical Chemistry | 3 Credits |
| Offered: every fall. | | Introduction to quantum chemistry with applications to the structure of atoms and molecules. Molecular spectroscopy. Three lectures and one recitation per week. | |
| CHM 228 Organic Chemistry II | 3 Credits | Prerequisite: minimum grade of C in CHM 112, successful completion of MAT 111 or MAT 110; MAT 112; and a year of physics (PHY 201 & PHY 202 or PHY 223 & PHY 224). | |
| Continuation of organic chemistry. Includes chemistry and reaction mechanisms of unsaturated compounds, and oxygen and nitrogen-containing functional groups. Introduces the organic chemistry of carbohydrates, lipids and peptides. Laboratory expands on techniques for the synthesis, purification and investigation of the chemical properties of organic compounds. Three lectures, one laboratory, and one recitation per week. | | Offered: every spring. | |
| Prerequisite: minimum grade of C- in CHM 227. Corequisite: CHM 228L. | | CHM 302L Modern Physical Chemistry Laboratory | 1 Credit |
| Offered: every spring. | | Selected spectroscopy experiments with applications to molecular structure. One four-hour lab per week. | |
| CHM 228L Organic Chemistry II Laboratory | 1 Credit | Prerequisite: CHM 302 (or concurrent registration in CHM 302) & minimum grade of C in CHM 230L, CHM 301L, CHM 334L or CHM 430L. | |
| One four hour lab per week. | | Offered: every spring. | |
| Prerequisite: minimum grade of C- in CHM 227L. Corequisite: CHM 228. | | CHM 230 Analytical Chemistry | 3 Credits |
| Offered: every spring. | | Principles and methodology of modern analytical chemistry presented with particular emphasis on statistical error analysis, solution equilibrium, and potentiometry. Three lectures, one laboratory, and one recitation per week. | |
| CHM 230 Analytical Chemistry | 3 Credits | Prerequisite: minimum grade of C in CHM 112. Corequisite: CHM 230L. | |
| Principles and methodology of modern analytical chemistry presented with particular emphasis on statistical error analysis, solution equilibrium, and potentiometry. Three lectures, one laboratory, and one recitation per week. | | Offered: every spring. | |
| Prerequisite: minimum grade of C in CHM 112. Corequisite: CHM 230L. | | CHM 230L Analytical Chemistry Laboratory | 1 Credit |
| Offered: every spring. | | One four-hour lab per week. | |
| CHM 230L Analytical Chemistry Laboratory | 1 Credit | Prerequisite: minimum grade of C- in CHM 112L. Corequisite: CHM 230. | |
| One four-hour lab per week. | | Offered: every spring. | |

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| CHM 334 Spectrometric Analysis | 3 Credits | CHM 420 Materials Chemistry | 3 Credits |
| Spectrometric methods for the elucidation of chemical structures. Includes nuclear magnetic resonance, infrared, ultraviolet and mass spectrometry. Emphasis on organic compounds. Three lectures and one laboratory per week. | | A survey of topics and applications in modern materials chemistry including solid state materials, semiconductors, polymers, nanomaterials, and introductions to mechanical properties, device fabrication, and structure-activity relationships. | |
| Prerequisite: CHM 228. | | Prerequisite: CHM 228 & CHM 244 (or concurrent registration in CHM 244). Corequisite: CHM 420L. | |
| Offered: every fall. | | Offered: either spring or fall 2018 (please consult with department). | |
| CHM 334L Spectrometric Analysis Lab | 1 Credit | CHM 420L Materials Chemistry Laboratory | 1 Credit |
| One four-hour lab per week. | | This laboratory develops concepts introduced in the lecture component of Materials Chemistry, CHM420, including solid-state structure, mechanical properties, semiconductors, polymers, and nanomaterials. The lab meets for four hours per week. | |
| Prerequisite: CHM 228L. | | Prerequisite: CHM 228L (may be taken concurrently). Corequisite: CHM 420. | |
| Offered: every fall. | | Offered: either spring or fall 2018 (please consult with department). | |
| CHM 338 Intermediate Organic Chemistry | 3 Credits | CHM 430 Instrumental Analytical Chemistry | 3 Credits |
| Important basic concepts in organic chemistry are reviewed at a higher level than is possible in the introductory courses. New concepts are presented in the areas of reaction mechanisms, frontier molecular orbitals, physical organic chemistry, and in stereoelectronic effects. | | Advanced instrumental methods of analysis including spectroscopy, chromatography and various electrochemical techniques. Three lectures and one laboratory per week. | |
| Prerequisite: CHM 228. | | Prerequisite: CHM 112 & CHM 228 (or concurrent registration in CHM 228). | |
| Offered: fall 2019. | | Offered: every spring. | |
| CHM 344 Metal Ions in Biological Systems | 3 Credits | CHM 430L Instrumental Analytical Chemistry Laboratory | 1 Credit |
| Chemical processes in biological systems, which include participation of metal ions, are covered. The course begins with the principles of coordination chemistry and structural biochemistry. The rest of the course is organized according to the functions performed by the metal centers: gene expression and signal transduction, digestion, bioenergetics and electron transfer, oxygen transport, liver functions and anticancer drugs. | | One four-hour lab per week. | |
| Prerequisite: CHM 228. | | Prerequisite: CHM 112L & CHM 228L (or concurrent registration in CHM 228L). Corequisite: CHM 430. | |
| Offered: occasionally in spring. | | Offered: every spring. | |
| CHM 381 Scientific Literature and Communication | 1 Credit | CHM 450 Research in Chemistry | 3 Credits |
| First of three student-faculty seminars for majors. Introduces scientific literature, technical writing and oral communication in chemistry and allied fields. | | Independent research under the direction of the chemistry faculty. Students are required to spend 9 hours per week conducting research. CHM 450 may be taken in place of a chemistry elective without lab. Research and consultation times to be arranged after approval of department chair. | |
| Prerequisite: CHM 228 & junior standing. | | Prerequisite: permission of department chair. | |
| Offered: every fall. | | Offered: fall & spring. | |
| CHM 401 Modern Synthetic Methods | 3 Credits | CHM 451 Research in Chemistry | 4 Credits |
| Structure-reactivity relationships in organometallic chemistry and the application of organometallic compounds in organic synthesis, including industrial catalysis. | | Independent research under the direction of the chemistry faculty. Students are required to spend 12 hours per week conducting research. CHM 451 may be taken in place of a chemistry elective with lab. Research and consultation times to be arranged after approval of department chair. | |
| Prerequisite: CHM 228 & CHM 244. | | Prerequisite: permission of department chair. | |
| Offered: occasionally in spring. | | Offered: fall & spring. | |
| CHM 401L Modern Synthetic Methods Laboratory | 1 Credit | CHM 455 Medicinal Chemistry | 3 Credits |
| Designed to illustrate some of the most important synthetic and physical techniques used by modern synthetic chemists. | | Chemical principles are used to explain the interaction of drugs with biological targets. Strategies used in the design and development of medicines are discussed. | |
| Prerequisite: CHM 401 (or concurrent registration). | | Prerequisite: minimum grade of C- in both CHM 228 & BCH 301. | |
| Offered: occasionally in spring. | | Offered: spring 2019. | |
| CHM 402 Advanced Physical Chemistry | 3 Credits | CHM 480 Communicating Concepts in Chemistry | 1 Credit |
| Introduction to statistical thermodynamics. Applications of group theory to chemical bonding and molecular spectroscopy. Angular momentum coupling in atomic and molecular spectroscopy. Three lectures per week. | | Second of three student-faculty seminars for majors. Students give a 25-minute presentation on an advanced coursework topic. Emphasis is placed on the process and the mechanics of constructing a scientific talk. | |
| Prerequisites: MAT 111 & MAT 112; CHM 244; CHM 302 (may be taken concurrently); and either PHY 201 & PHY 202 or PHY 223 & PHY 224. | | Prerequisite: CHM 228 & junior standing. | |
| Offered: Occasionally in spring. | | Offered: every spring. | |

CHM 481 Communicating Research Literature 1 Credit

Third of three student-faculty seminars for majors. Students give a 45-minute presentation on a scientific work from the chemical literature. Emphasis is placed on constructing a narrative and gaining a working understanding of the scientific issues in the presented paper.

Prerequisite: CHM 228 & junior standing.

Fulfills College Core: Oral Communication

Offered: every fall.

CHM 490 Chemistry Internship 3 Credits

Internships in chemical or biochemical industry under the direction of company and faculty supervisors.

Prerequisite: permission of department chair & associate dean.

Offered: fall & spring.

CHM 499 Independent Study 3-4 Credits

Independent study under the direction of the chemistry faculty.

Independent studies require an application and approval by the associate dean.

Prerequisite: permission of the instructor, department chair, & associate dean.

Offered: fall & spring.