

# Chemistry and Biochemistry

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The Department of Chemistry and Biochemistry provides high-quality training in chemistry and biochemistry while providing opportunities for meaningful spiritual and interpersonal experiences that will enable students to move successfully into the next phase of their professional training or the career of their choice. Chemistry is an excellent starting point for careers in research within the physical and life sciences, medicine, veterinary medicine, dentistry, pharmacy, environmental science, forensic science, education, industry, food science, and many others.

## Biochemistry (BS)

The Bachelor of Science degree with a major in Biochemistry requires 71-73 hours. This program prepares students for a career in biochemistry, medicine, molecular biology, and other related fields. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

### Major Requirements

|          |   |                              |
|----------|---|------------------------------|
| CHE 211  | 4 | College Chemistry I          |
| CHE 212  | 4 | College Chemistry II         |
| CHE 301  | 4 | Analytical Chemistry I       |
| CHE 302  | 4 | Analytical Chemistry II      |
| CHE 311  | 4 | Organic Chemistry I          |
| CHE 312  | 4 | Organic Chemistry II         |
| CHE 330  | 4 | Advanced Inorganic Chemistry |
| CHE 410L | 2 | Biochemistry Lab             |
| CHE 411  | 3 | Biochemistry I               |
| CHE 412  | 3 | Biochemistry II              |
| CHE 420  | 1 | Chemistry Thesis             |
| CHE 431  | 4 | Physical Chemistry I         |

Select 3 hours of advanced biochemistry or directed research

### Additional Major Requirements

|         |   |                                                     |
|---------|---|-----------------------------------------------------|
| BIO 201 | 4 | Biology I: Foundations of Cell Biology and Genetics |
| MAT 230 | 4 | Calculus II                                         |
| PHY 211 | 4 | University Physics I                                |
| PHY 212 | 5 | University Physics II                               |

Select one option from the following:

|                      |   |                                        |
|----------------------|---|----------------------------------------|
| MAT 151              | 4 | Calculus I                             |
| MAT 145 <sup>i</sup> | 3 | Introduction to Functions and Calculus |
| and                  |   |                                        |
| MAT 146 <sup>i</sup> | 3 | Functions and Calculus                 |

<sup>i</sup>MAT 145 and MAT 146 combination meets requirement.

### Electives

Select two additional upper-division biology courses totaling at least 6 hours. BIO 203 may also count as an elective.

### Recommended Biology Courses

|         |   |                                        |
|---------|---|----------------------------------------|
| BIO 203 | 4 | Principles of Genetics                 |
| BIO 462 | 4 | Molecular Genetics                     |
| BIO 471 | 4 | Microbiology and Immunology            |
| CHE 320 | 4 | Environmental Pollution and Toxicology |

## Chemistry (BA)

The Bachelor of Arts degree with a major in Chemistry requires two years of one foreign language and 59-61 hours in the major. This program is suitable for students wishing to enter either graduate school or the chemical industry. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

### Major Requirements

|          |   |                              |
|----------|---|------------------------------|
| CHE 211  | 4 | College Chemistry I          |
| CHE 212  | 4 | College Chemistry II         |
| CHE 301  | 4 | Analytical Chemistry I       |
| CHE 302  | 4 | Analytical Chemistry II      |
| CHE 311  | 4 | Organic Chemistry I          |
| CHE 312  | 4 | Organic Chemistry II         |
| CHE 330  | 4 | Advanced Inorganic Chemistry |
| CHE 410L | 2 | Biochemistry Lab             |
| CHE 411  | 3 | Biochemistry I               |
| CHE 420  | 1 | Chemistry Thesis             |
| CHE 431  | 4 | Physical Chemistry I         |
| CHE 432  | 4 | Physical Chemistry II        |

### Additional Major Requirements

|         |   |                       |
|---------|---|-----------------------|
| MAT 230 | 4 | Calculus II           |
| PHY 211 | 4 | University Physics I  |
| PHY 212 | 5 | University Physics II |

Select one option from the following:

|                      |   |                                        |
|----------------------|---|----------------------------------------|
| MAT 151              | 4 | Calculus I                             |
| MAT 145 <sup>i</sup> | 3 | Introduction to Functions and Calculus |
| and                  |   |                                        |
| MAT 146 <sup>i</sup> | 3 | Functions and Calculus                 |

<sup>i</sup>MAT 145 and MAT 146 combination meets requirement.

### Recommended Courses

|          |   |                                        |
|----------|---|----------------------------------------|
| CHE 320  | 4 | Environmental Pollution and Toxicology |
| CHE 412  | 3 | Biochemistry II                        |
| MAT 240  | 4 | Calculus III                           |
| MAT 251  | 4 | Differential Equations                 |
| MAT 352  | 4 | Mathematical Statistics                |
| COS ____ |   | Any Computer Science course            |

NAS 480 is recommended in the junior or senior year.

## Chemistry (BS)

The Bachelor of Science degree with a major in Chemistry consists of 68 hours in the major. This program is especially attractive to students planning to enter either graduate school or the chemical industry. All major courses must be completed with a grade of C- or better and are included in the major GPA.

### Major Requirements

|          |   |                              |
|----------|---|------------------------------|
| CHE 211  | 4 | College Chemistry I          |
| CHE 212  | 4 | College Chemistry II         |
| CHE 301  | 4 | Analytical Chemistry I       |
| CHE 302  | 4 | Analytical Chemistry II      |
| CHE 311  | 4 | Organic Chemistry I          |
| CHE 312  | 4 | Organic Chemistry II         |
| CHE 330  | 4 | Advanced Inorganic Chemistry |
| CHE 410L | 2 | Biochemistry Lab             |
| CHE 411  | 3 | Biochemistry I               |
| CHE 412  | 3 | Biochemistry II              |
| CHE 420  | 1 | Chemistry Thesis             |
| CHE 431  | 4 | Physical Chemistry I         |
| CHE 432  | 4 | Physical Chemistry II        |
| CHE 450* | 6 | Directed Research            |

### Additional Requirements

|         |   |                       |
|---------|---|-----------------------|
| MAT 151 | 4 | Calculus I            |
| MAT 230 | 4 | Calculus II           |
| PHY 211 | 4 | University Physics I  |
| PHY 212 | 5 | University Physics II |

### Recommended Courses

|         |   |                                                     |
|---------|---|-----------------------------------------------------|
| BIO 201 | 4 | Biology I: Foundations of Cell Biology and Genetics |
| CHE 320 | 4 | Environmental Pollution and Toxicology              |
| MAT 240 | 4 | Calculus III                                        |
| MAT 251 | 4 | Differential Equations                              |
| MAT 352 | 4 | Mathematical Statistics                             |

\*A minimum of 3 credits must be completed on campus

## Chemistry Education (BS)

The Bachelor of Science degree with a major in Chemistry Education requires 45-48 hours in addition to education courses. All major courses, including education curriculum courses, must be completed with a grade of C- or better and are included in the major GPA.

### Chemistry Courses

|         |   |                         |
|---------|---|-------------------------|
| CHE 211 | 4 | College Chemistry I     |
| CHE 212 | 4 | College Chemistry II    |
| CHE 301 | 4 | Analytical Chemistry I  |
| CHE 302 | 4 | Analytical Chemistry II |
| CHE 311 | 4 | Organic Chemistry I     |
| CHE 420 | 1 | Chemistry Thesis        |
| CHE 431 | 4 | Physical Chemistry I    |

Select at least one course from:

|         |   |                                        |
|---------|---|----------------------------------------|
| CHE 312 | 4 | Organic Chemistry II                   |
| CHE 320 | 4 | Environmental Pollution and Toxicology |
| CHE 330 | 4 | Advanced Inorganic Chemistry           |
| CHE 411 | 3 | Biochemistry I                         |

### Additional Major Requirements

|         |   |                       |
|---------|---|-----------------------|
| MAT 230 | 4 | Calculus II           |
| PHY 211 | 4 | University Physics I  |
| PHY 212 | 5 | University Physics II |

Select one option from the following:

|                      |   |                                        |
|----------------------|---|----------------------------------------|
| MAT 151              | 4 | Calculus I                             |
| MAT 145 <sup>†</sup> | 3 | Introduction to Functions and Calculus |
| and                  |   |                                        |
| MAT 146 <sup>†</sup> | 3 | Functions and Calculus                 |

<sup>†</sup>MAT 145 & 146 count as one option.

### Professional Education

|         |    |                                                                   |
|---------|----|-------------------------------------------------------------------|
| EDU 150 | 3  | Education in America                                              |
| EDU 222 | 2  | Reading in the Content Area for Secondary Teachers                |
| EDU 260 | 3  | Educational Psychology                                            |
| EDU 307 | 2  | Discipline and Classroom Management for Secondary Teachers        |
| EDU 309 | 1  | Teaching in Secondary, Junior High/Middle Schools—Special Methods |
| EDU 328 | 2  | Assessment for Student Learning                                   |
| EDU 332 | 2  | The Junior High/Middle School                                     |
| EDU 344 | 1  | Educational Technology in Secondary Education                     |
| EDU 384 | 1  | Perspectives on Diversity                                         |
| EDU 431 | 15 | Supervised Internship in Secondary Schools                        |
| NAS 309 | 2  | Science Education Methods                                         |
| SED 220 | 3  | Exceptional Children                                              |

### Additional Education Requirements

|         |   |                       |
|---------|---|-----------------------|
| CAS 110 | 3 | Public Speaking       |
| PSY 340 | 3 | Adolescent Psychology |

## Chemistry–Environmental Science (BS)

This integrated major has a strong emphasis on the physical aspects of environmental studies. It is appropriate for students planning careers in environmental research or industrial or municipal environmental monitoring and control. The Bachelor of Science degree with a major in Chemistry–Environmental Science requires 91 major hours. All major courses must be completed with a grade of C- or better and are included in the major GPA.

### Chemistry Requirements

|          |   |                              |
|----------|---|------------------------------|
| CHE 211  | 4 | College Chemistry I          |
| CHE 212  | 4 | College Chemistry II         |
| CHE 301  | 4 | Analytical Chemistry I       |
| CHE 302  | 4 | Analytical Chemistry II      |
| CHE 311  | 4 | Organic Chemistry I          |
| CHE 312  | 4 | Organic Chemistry II         |
| CHE 330  | 4 | Advanced Inorganic Chemistry |
| CHE 410L | 2 | Biochemistry Lab             |
| CHE 411  | 3 | Biochemistry I               |
| CHE 420  | 1 | Chemistry Thesis             |
| CHE 431  | 4 | Physical Chemistry I         |
| CHE 432  | 4 | Physical Chemistry II        |

### Physics Requirements

|         |   |                       |
|---------|---|-----------------------|
| PHY 211 | 4 | University Physics I  |
| PHY 212 | 5 | University Physics II |

### Environmental Science Requirements

|         |   |                                                    |
|---------|---|----------------------------------------------------|
| CHE 320 | 4 | Environmental Pollution and Toxicology             |
| ENS 204 | 4 | Principles of Ecology                              |
| ENS 302 | 4 | Environmental Law and Policy                       |
| ENS 383 | 4 | Environmental Ethics                               |
| SUS 231 | 4 | Environmental Science, Society, and Sustainability |

Select one course from the following:

|         |     |           |
|---------|-----|-----------|
| CHE 393 | 2-4 | Practicum |
| ENS 393 | 2-4 | Practicum |

### Mathematics Requirements

|                                              |   |                                        |
|----------------------------------------------|---|----------------------------------------|
| MAT 230                                      | 4 | Calculus II                            |
| Select <u>one</u> option from the following: |   |                                        |
| MAT 151                                      | 4 | Calculus I                             |
| MAT 145 <sup>†</sup>                         | 3 | Introduction to Functions and Calculus |
| and                                          |   |                                        |
| MAT 146 <sup>†</sup>                         | 3 | Functions and Calculus                 |

<sup>†</sup>MAT 145 & 146 count as one option.

**Electives** (to complete a minimum of 91 major hours)

|         |   |                         |
|---------|---|-------------------------|
| CHE 412 | 3 | Biochemistry II         |
| ENS 241 | 4 | Physical Geology        |
| MAT 210 | 4 | Introductory Statistics |

## Chemistry/Pre-Medicine Concentration (BA)

The Bachelor of Arts degree with a major in Chemistry and a pre-professional concentration in Pre-Medicine requires two years, sequential study of one foreign language and 67-69 major hours.

Students interested in the pre-medicine curriculum should check out during their sophomore year the medical school admissions requirements for the school(s) to which they plan to apply. The Medical School Admission Requirements guide published annually by AAMC is the best resource for this information. It is important to meet the specific entrance requirements of the medical school(s) chosen.

Maintaining at least an A- average and scoring well on the MCAT test (usually taken in the spring of the junior year) are common prerequisites for acceptance to a medical school. Assistance is available in preparing for the MCAT examinations. *All major courses, including those in the concentration, must be completed with a grade of C- or better and are included in the major GPA.*

### Major Requirements

|          |   |                              |
|----------|---|------------------------------|
| CHE 211  | 4 | College Chemistry I          |
| CHE 212  | 4 | College Chemistry II         |
| CHE 301  | 4 | Analytical Chemistry I       |
| CHE 302  | 4 | Analytical Chemistry II      |
| CHE 311  | 4 | Organic Chemistry I          |
| CHE 312  | 4 | Organic Chemistry II         |
| CHE 330  | 4 | Advanced Inorganic Chemistry |
| CHE 410L | 2 | Biochemistry Lab             |
| CHE 411  | 3 | Biochemistry I               |
| CHE 420  | 1 | Chemistry Thesis             |
| CHE 431  | 4 | Physical Chemistry I         |

### Additional Major Requirements

|                                              |   |                                        |
|----------------------------------------------|---|----------------------------------------|
| MAT 230                                      | 4 | Calculus II                            |
| PHY 211                                      | 4 | University Physics I                   |
| PHY 212                                      | 5 | University Physics II                  |
| Select <u>one</u> option from the following: |   |                                        |
| MAT 151                                      | 4 | Calculus I                             |
| MAT 145†                                     | 3 | Introduction to Functions and Calculus |
| and                                          |   |                                        |
| MAT 146†                                     | 3 | Functions and Calculus                 |
| †MAT 145 & 146 count as one option.          |   |                                        |

Select three biology courses from the following:

|          |   |                                                     |
|----------|---|-----------------------------------------------------|
| BIO 201* | 4 | Biology I: Foundations of Cell Biology and Genetics |
| BIO 202  | 4 | Biology II: Organisms and Diversity                 |
| BIO 203* | 4 | Principles of Genetics                              |
| BIO 312  | 4 | Cellular and Molecular Biology                      |
| BIO 331* | 4 | Comparative Anatomy                                 |
| BIO 432  | 4 | Developmental Biology                               |
| BIO 452* | 4 | Animal Physiology                                   |
| BIO 471  | 4 | Microbiology and Immunology                         |

\*BIO 201; 203; and 331 or 452 are highly recommended.

### Recommended Courses

|         |   |                                        |
|---------|---|----------------------------------------|
| CHE 320 | 4 | Environmental Pollution and Toxicology |
| CHE 412 | 3 | Biochemistry II                        |

## Chemistry Minor

The Chemistry minor requires a minimum of 22-24 hours and includes at least four semesters of core chemistry lab courses. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

### Minor Requirements

|         |   |                      |
|---------|---|----------------------|
| CHE 211 | 4 | College Chemistry I  |
| CHE 212 | 4 | College Chemistry II |
| CHE 311 | 4 | Organic Chemistry I  |

### Electives

Select one of the following chemistry options:

|         |   |                                        |
|---------|---|----------------------------------------|
| CHE 301 | 4 | Analytical Chemistry I                 |
| CHE 302 | 4 | Analytical Chemistry II                |
| CHE 320 | 4 | Environmental Pollution and Toxicology |
| CHE 330 | 4 | Advanced Inorganic Chemistry           |

Select at least two additional, 3-4 credit hour upper-division (300/400-level) chemistry courses.

## Chemistry Courses

### CHE 100 4 hours

#### Chemistry for Living

A course designed for students who have little or no background in chemistry. Basic principles of chemistry are applied in a social context. Three hours of lecture and one two-hour lab per week. *Meets foundational core physical science requirement. No prerequisite, although high school algebra is recommended.*

### CHE 120 4 hours

#### Forensic Science

This course is a one semester introduction to forensic science which will focus on the application of physical and life sciences to criminal investigation. Topics include the crime scene, physical evidence, fingerprints, forensic toxicology, forensic serology, as well as many others. *There are no prerequisites. Based upon the course section selected, will meet either a life or physical science foundational core requirement.*

### CHE 170 1-4 hours

#### Selected Topics

A course offered on a subject of interest but not listed as a regular course offering.

### CHE 201 4 hours

#### General, Organic, and Biochemistry I

This is the first semester of a two-semester sequence designed for students with minimal backgrounds in chemistry yet need a solid foundation in chemistry for their major. These students do not typically take other chemistry courses beyond this sequence. The two semesters are a comprehensive overview of general chemistry, organic chemistry, and biochemistry. The first semester focuses on general chemistry with an introduction to organic chemistry. *Three hours of lecture and three hours of lab per week. Meets foundational core physical science requirement. No college level prerequisites, but high school algebra and chemistry are strongly recommended.*

### CHE 202 4 hours

#### General, Organic, and Biochemistry II

This is the continuation of CHE 201 (see CHE 201 description). The second semester continues with the introduction to organic chemistry and includes an overview of biochemistry. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 201.*

### CHE 211 4 hours

#### College Chemistry I

This is a general chemistry course for those intending to take later coursework in chemistry, such as organic, inorganic, analytical, or environmental chemistries. The course thoroughly explores the basic concepts and theories of chemistry, using quantitative skills to predict and characterize chemical properties and changes. The nature of atomic structure and chemical bonding and the properties of solids, liquids, and gases are all presented and studied using lectures, demonstrations, and computer-assisted teaching and testing methods. Chemical change is studied in terms of reaction classes, energy flows, and kinetic theories. *Three hours of lecture and three hours of lab per week. Meets the foundational core physical science requirement. High school algebra and chemistry are strongly recommended.*

### CHE 212 4 hours

#### College Chemistry II

The second general chemistry course for those intending to take later coursework in chemistry, such as organic, inorganic, analytical, or environmental chemistries. This course thoroughly explores the basic concepts and theories of chemistry using quantitative skills to predict and characterize chemical properties and changes. The nature of organic chemistry, complexes, equilibria, electrochemistry, and advanced acid-base properties are all presented and studied using lectures, demonstrations, and computer-assisted teaching and testing methods. Chemical change is studied in terms of entropy, free energy, and kinetic theories. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 211.*

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>CHE 270</b><br><b>Selected Topics</b><br>A course offered on a subject of interest but not listed as a regular course offering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>1-4 hours</b> | <b>CHE 393</b><br><b>Practicum</b><br>Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. Offered primarily during summer.                                                                                                                                                                                                                                                                                                                 | <b>1-4 hours</b> |
| <b>CHE 301</b><br><b>Analytical Chemistry I</b><br>Introduction to modern theories and methods used in separations and quantitative determinations. Topics include basic statistics and treatment of data, gravimetry, titrations, and spectroscopy. Topics correlate with the lab. Lab includes gravimetric, titrations, and spectroscopy. Some instrumentation is used including AA and GCMS. Three hours of lecture and three hours of lab per week. Prerequisite: CHE 212 or permission of instructor.                                                                                                                                                                             | <b>4 hours</b>   | <b>CHE 410L</b><br><b>Biochemistry Lab</b><br>The lab uses a case study approach in which an enzyme is isolated and characterized in detail. The molecular genetics, structure, regulation, and kinetics of the enzyme are studied using a wide range of techniques. This course is designed for chemistry and biology majors with a background in organic chemistry. There will be some lecture, but the primary experience will be in the lab. Prerequisite: CHE 411 or consent of instructor. BIO 201 is strongly recommended. Offered January interterm. | <b>2 hours</b>   |
| <b>CHE 302</b><br><b>Analytical Chemistry II</b><br>A continuation of CHE 301 in which instrumental methods of analysis are emphasized. A survey of instrumental methods used in modern analytical chemistry. Topics include the general principles of basic instrument components and their integration into the wide variety of modern instrumentation. Students will gain hands-on experience with a variety of spectroscopic (UV, VIS, AA), spectrometric (MS), electrochemical, chromatographic (HPLC, GC, IC), and hybrid (GC/MS, LC/MS) analytical instrumentations. Three hours of lecture and three hours of lab per week. Prerequisite: CHE 301 or permission of instructor. | <b>4 hours</b>   | <b>CHE 411</b><br><b>Biochemistry I</b><br>An introduction to the principles of biochemistry in which conformation and biosynthesis of macromolecules, bioenergetics, molecular genetics, and techniques of separation and analysis are studied. This course is designed for chemistry and biology majors with a background in organic chemistry. Three hours of lecture per week. Prerequisite: CHE 311 or permission of instructor. BIO 201 and CHE 312 are strongly recommended.                                                                          | <b>3 hours</b>   |
| <b>CHE 311</b><br><b>Organic Chemistry I</b><br>The study of covalent carbon compounds. Nomenclature, properties, and reactions (including reaction mechanisms) of all classes of hydrocarbons, alcohols, ethers, halides, and organometallic substances are studied. NMR, IR, and MS spectroscopic methods are learned and applied. The lab includes development of advanced lab skills and study of the kinetics and properties of organic substances in reactions. Three hours of lecture and three hours of lab per week. Prerequisite: CHE 212.                                                                                                                                   | <b>4 hours</b>   | <b>CHE 412</b><br><b>Biochemistry II</b><br>This course is a continuation of CHE 411. The emphasis is on metabolism, molecular genetics, and molecular physiology. This course is designed for chemistry and biology majors with a background in organic chemistry. Three hours of lecture per week. Prerequisite: CHE 411 or consent of instructor. BIO 201 is strongly recommended.                                                                                                                                                                        | <b>3 hours</b>   |
| <b>CHE 312</b><br><b>Organic Chemistry II</b><br>Continuation of CHE 311. Focuses on carbonyl and carboxylate compounds and their derivatives, amines, and polyfunctional compounds, including biomolecules. Lab work includes study of the properties of aromatic compounds, qualitative organic analysis, and small group original research projects. Three hours of lecture and three hours of lab per week. Prerequisite: CHE 311.                                                                                                                                                                                                                                                 | <b>4 hours</b>   | <b>CHE 420</b><br><b>Chemistry Thesis</b><br>Students write a major paper, receive coaching and feedback, modify their paper if necessary, and give an oral presentation. Prerequisite: Successful completion of fall term paper writing workshop. Required of all chemistry seniors.                                                                                                                                                                                                                                                                        | <b>1 hour</b>    |
| <b>CHE 320</b><br><b>Environmental Pollution and Toxicology</b><br>A course that emphasizes principles and analysis of pollution sources, movement, distribution, and toxic effects in natural and biological environment. The principles of toxicology related to industry and the environment, including dose response, mechanisms of toxicity, hazard evaluation will be explored. The laboratory work will provide experience in sampling and analysis of water, as well as common toxicology techniques. Three hours of lecture and three hours of lab per week. One year of general chemistry is recommended.                                                                    | <b>4 hours</b>   | <b>CHE 431</b><br><b>Physical Chemistry I</b><br>An introduction to the principles of thermodynamics, kinetic-molecular theory of gases, and chemical kinetics. The lab includes vacuum techniques, thermometry, thermoregulation, calorimetry, physical characterization of solutions, and optical techniques. Three hours of lecture and three hours of lab per week. Prerequisites: CHE 211; CHE 212; PHY 211; PHY 212; MAT 146 or 151; and MAT 230.                                                                                                      | <b>4 hours</b>   |
| <b>CHE 330</b><br><b>Advanced Inorganic Chemistry</b><br>Coverage of the bonding and properties of the main group and especially transition metal elements with a focus on their coordination and solid-state chemistry. Molecular symmetry principles, spectroscopy, materials science and catalytic applications of these substances are discussed in lecture and studied in lab. Three hours of lecture and three hours of lab per week. Prerequisite: CHE 311.                                                                                                                                                                                                                     | <b>4 hours</b>   | <b>CHE 432</b><br><b>Physical Chemistry II</b><br>Emphasis on elementary principles of quantum mechanics, molecular structure, spectroscopy, and photochemistry. The lab focuses on computational chemistry and spectroscopy. Three hours of lecture and three hours of lab per week. Prerequisites: CHE 211, CHE 212, PHY 211, PHY 212, MAT 146 or 151, and MAT 230.                                                                                                                                                                                        | <b>4 hours</b>   |
| <b>CHE 360</b><br><b>Independent Study</b><br>An individualized, directed study involving a specified topic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>1-4 hours</b> | <b>CHE 450</b><br><b>Directed Research</b><br>Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.                                                                                                                                                                                                                                                                                                                                                                                        | <b>1-4 hours</b> |
| <b>CHE 370</b><br><b>Selected Topics</b><br>A course offered on a subject of interest but not listed as a regular course offering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>1-4 hours</b> | <b>CHE 480</b><br><b>Seminar</b><br>A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.                                                                                                                                                                                                                                                                                                                                                                                                | <b>1-4 hours</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  | <b>CHE 490</b><br><b>Honors</b><br>Individualized study or research of an advanced topic within a student's major. Open to students with at least a 3.00 GPA in the major field.                                                                                                                                                                                                                                                                                                                                                                             | <b>1-2 hours</b> |

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## Notes