

# CHEMISTRY (CHEM)

## 100 Level Courses

**CHEM 101:** *Introduction to Modern Chemistry*. 3 credits.

Physical and chemical discoveries and properties of matter presented along with their application and impact on way of life. Topics include atomic and molecular structure, nuclear chemistry, and chemistry in Earth and atmosphere. Note: does not fulfill the requirement for a laboratory course in chemistry. Not for chemistry majors. No credit given for both CHEM 101 and CHEM 103 or for both CHEM 101 and CHEM 211-212. No previous knowledge of chemistry required. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 203, CHEM 204.

**Mason Core:** Natural Science Overview

**Schedule Type:** Lecture

**CHEM 102:** *Introduction to Organic, Biochemical, Pharmacological, and Fuel Chemistry*. 3 credits.

Modern and historical accounts of organic chemistry, biochemistry, pharmacology, and fuel chemistry. Topics include the chemistry of carbon compounds, synthesis of polymers and their utility and use in the modern world, biomolecules, DNA and animal cloning, embryonic stem cells, the chemical structure and biological activity of drugs and medicines, and fuel chemistry including petroleum through green chemistry and the future. Notes: Does not fulfill the requirement for a laboratory course in Chemistry. Not for Chemistry majors. No credit for both CHEM 102 and CHEM 104, or CHEM 212. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 203, CHEM 204.

**Mason Core:** Natural Science Overview

**Schedule Type:** Lecture

**CHEM 103:** *Chemical Science in a Modern Society*. 4 credits.

Terminal course in chemistry for nonscience and nursing majors. Principles and application of chemistry. Notes: CHEM 103 and CHEM 101 are taught simultaneously in the same room. CHEM 101 is for those students who are not required to complete the lab component of CHEM 103. Not open to students majoring in chemistry. Credit will not be given for both this course and CHEM 211, 212. Topics are those described for CHEM 101 and 102 but with lab to enhance scientific experience. Offered by Chemistry. May not be repeated for credit.

**Mason Core:** Natural Science with Lab

**Schedule Type:** Laboratory, Lecture

**CHEM 104:** *Introduction to Organic, Biochemical, Pharmacological, and Fuel Chemistry*. 4 credits.

Modern and historical accounts of organic chemistry, biochemistry, pharmacology, and fuel chemistry. Topics include the chemistry of carbon compounds, synthesis of polymers and their utility and use in the modern world, biomolecules, DNA and animal cloning, embryonic stem cells, the chemical structure and biological activity of drugs and medicines, and fuel chemistry including petroleum through green chemistry and the future. (CHEM 104 requires concomitant registration in a 104 laboratory section). Notes: Not open to students majoring in chemistry. Credit will not be given for both CHEM 104 and CHEM 212. Offered by Chemistry. May not be repeated for credit.

**Mason Core:** Natural Science with Lab

**Schedule Type:** Laboratory, Lecture

**CHEM 105:** *Introductory Chemistry Laboratory I*. 1 credit.

Introductory laboratory course to demonstrate principles and application of chemistry. Notes: Not open to students majoring in chemistry. Credit will not be given for both this course and CHEM 211, 212. Students will enroll in CHEM 105 by Individualized Section and attend one of the CHEM 103 lab sections. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 211, CHEM 212.

**Recommended Prerequisite:** CHEM 101.

**Schedule Type:** Laboratory

**CHEM 106:** *Introductory Chemistry Laboratory II*. 1 credit.

1-credit laboratory course for non-science majors. Laboratory experience to demonstrate principles and application of chemistry. Notes: Not open to students majoring in chemistry. Credit will not be given for both this course and CHEM 211, 212. Students will enroll in CHEM 106 by Individualized Section and attend one of the CHEM 104 lab sections. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 211, CHEM 212.

**Recommended Prerequisite:** CHEM 102.

**Schedule Type:** Laboratory

**CHEM 155:** *Introduction to Environmental Chemistry I*. 4 credits.

Basic chemical principles of Earth's water, air, and soil systems; presented in the context of understanding environmental issues. Includes Saturday morning field trips to sites of past and present environmental contamination, alternating with Saturday morning laboratory activities. Notes: Credit will not be given for this course and CHEM 103, 104. Offered by Chemistry. May not be repeated for credit.

**Mason Core:** Natural Science with Lab, Encore:Sustainability

**Specialized Designation:** Green Leaf Course

**Schedule Type:** Laboratory, Lecture

**CHEM 156:** *Introduction to Environmental Chemistry II*. 4 credits.

Basic chemical principles of Earth's water, air, and soil systems; presented in the context of understanding environmental issues. Includes Saturday morning field trips to sites of past and present environmental contamination, alternating with Saturday morning laboratory activities. Notes: Credit will not be given for this course and CHEM 103, 104. Offered by Chemistry. May not be repeated for credit.

**Mason Core:** Natural Science with Lab, Encore:Sustainability

**Specialized Designation:** Green Leaf Course

**Recommended Prerequisite:** CHEM 155 or permission of instructor.

**Schedule Type:** Laboratory, Lecture

## 200 Level Courses

**CHEM 201:** *Introductory Chemistry I*. 3 credits.

Fundamental principles of atomic and molecular structure; chemical bonding; basic concepts of chemical reactions and thermochemistry;

and properties of gases, liquids, and solids. Notes: Does not fulfill degree requirements for laboratory science course. Credit will not be given for this course and CHEM 211 or 103. General chemistry course for students interested in science, engineering, mathematics, or computer science who do not require a lab. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 211.

**Mason Core:** Natural Science Overview

**Schedule Type:** Lecture

**CHEM 202:** *Introductory Chemistry II*. 3 credits.

Fundamentals of reaction rates and equilibrium. Topics include kinetics, properties of solutions, ionic equilibrium, chemical thermodynamics, electrochemistry, and nuclear chemistry. Notes: Does not fulfill degree requirements for laboratory science course. Credit will not be given for this course and CHEM 212 or 104. Second-semester general chemistry course for those interested in science, engineering, mathematics, or computer science who do not require a lab. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 212.

**Mason Core:** Natural Science Overview

**Recommended Prerequisite:** CHEM 201 or 211.

**Schedule Type:** Lecture

**CHEM 203:** *General Chemistry Laboratory I*. 1 credit.

General Chemistry laboratory course for students majoring in science, engineering, or mathematics. Laboratory experience to demonstrate general chemistry principles and applications. Students will enroll in CHEM 203 by Individualized Section and attend one of the CHEM 211 lab sections. Notes: Credit will not be given for this course and CHEM 101 or 102 to students majoring in science, engineering, or mathematics. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 101, CHEM 102, CHEM 213.

**Recommended Prerequisite:** CHEM 201.

**Schedule Type:** Laboratory

**CHEM 204:** *General Chemistry Laboratory II*. 1 credit.

Second semester general chemistry laboratory course for students majoring in science, engineering, or mathematics. Laboratory experience to demonstrate general chemistry principles and applications. Students will enroll in CHEM 204, by Individualized Section, and attend one of the CHEM 212 lab sections. Notes: Credit will not be given for this course and CHEM 101 or 102 to students majoring in science, engineering, or mathematics. Offered by Chemistry. May not be repeated for credit. Equivalent to CHEM 101, CHEM 102, CHEM 214.

**Recommended Prerequisite:** CHEM 202.

**Schedule Type:** Laboratory

**CHEM 211:** *General Chemistry I*. 3 credits.

Fundamental principles of atomic and molecular structure; chemical bonding; basic concepts of chemical reactions and thermochemistry; properties of gases, liquids, and solids. Notes: Credit will not be given for this course and CHEM 103, 104. Students majoring in science, engineering, or mathematics should choose this course sequence. CHEM 211 is a prerequisite to CHEM 212. Offered by Chemistry. Limited to two attempts. Equivalent to CHEM 105, CHEM 106, CHEM 201.

**Mason Core:** Natural Science with Lab

**Registration Restrictions:**

**Required Prerequisites:** CHEM 213<sup>\*C</sup>, U213<sup>\*</sup> or 213T<sup>\*</sup>.

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 212:** *General Chemistry II*. 3 credits.

Fundamentals of colligative properties, reaction rates and equilibrium. Topics Include kinetics, properties of solutions, ionic equilibrium, chemical thermodynamics, electrochemistry, and nuclear chemistry. Notes: Credit will not be given for this course and CHEM 103, 104. Students majoring in science, engineering, or mathematics should choose this course sequence. Offered by Chemistry. Limited to two attempts. Equivalent to CHEM 202.

**Mason Core:** Natural Science with Lab

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 211<sup>C</sup>, 211T or U211) and (CHEM 214<sup>\*C</sup>, 214T<sup>\*</sup> or U214<sup>\*</sup>).

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 213:** *General Chemistry Laboratory I*. 1 credit.

General Chemistry laboratory course for students majoring in science, engineering, or mathematics. Laboratory experience will demonstrate general chemistry principles and applications. Notes: Students majoring in science, engineering, or mathematics should choose this course sequence. Credit will not be given for this course and CHEM 103. Offered by Chemistry. Limited to two attempts. Equivalent to CHEM 203.

**Mason Core:** Natural Science with Lab

**Registration Restrictions:**

**Required Prerequisites:** CHEM 211<sup>\*C</sup>, U211<sup>\*</sup> or 211T<sup>\*</sup>.

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 214:** *General Chemistry Laboratory II*. 1 credit.

General Chemistry laboratory course for students majoring in science, engineering, or mathematics. Laboratory experience will demonstrate general chemistry principles and applications. Notes: Credit will not be given for this course and CHEM 103, CHEM 104. Students majoring in science, engineering, or mathematics should choose this course sequence. Offered by Chemistry. Limited to two attempts. Equivalent to CHEM 204.

**Mason Core:** Natural Science with Lab

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 212<sup>\*C</sup>, U212<sup>\*</sup> or 212T<sup>\*</sup>) and (CHEM 211<sup>C</sup>, 211T or U211).

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 251:** *General Chemistry for Engineers*. 4 credits.

Fundamental principles of chemical structure and reactivity including atomic and molecular structure; chemical bonding; structures of ionic, covalent, and metallic lattices; oxidation reduction; electrochemistry

and chemistry of metals; and introduction to organic chemistry and polymers. Notes: Enrollment restricted to students intending to major in engineering. Students who need two semesters of chemistry should enroll in CHEM 211. Credit will not be given for this course and CHEM 211. Offered by Chemistry. May not be repeated for credit.

**Mason Core:** Natural Science with Lab

**Schedule Type:** Laboratory, Lecture

### 300 Level Courses

**CHEM 300:** *Chemistry of Semiconductor Processing*. 3 credits. Chemical aspects of the manufacture of semiconductor devices. Topics include oxidation of silicon, photoresists, plasma etching, removal of metal contaminants by acid etching, and analysis of semiconductor thin films. Notes: Does not satisfy chemistry course requirements for BS in biology. Cannot be used as a chemistry elective toward BA, BS, or minor in chemistry, and does not fulfill premedical requirements. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** 30 credit hours or permission of instructor.

**Schedule Type:** Lecture

**CHEM 313:** *Organic Chemistry I*. 3 credits. Theoretical, synthetic, industrial, and biological aspects of the chemistry of carbon compounds. Offered by Chemistry. May not be repeated for credit.

**Recommended Corequisite:** CHEM 315.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 212<sup>C</sup> or U212) and (CHEM 211<sup>C</sup> or U211).  
<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 314:** *Organic Chemistry II*. 3 credits. Theoretical, synthetic, industrial, and biological aspects of the chemistry of carbon compounds. Offered by Chemistry. May not be repeated for credit.

**Recommended Corequisite:** CHEM 318.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 313<sup>C</sup> or L313) and CHEM 212<sup>C</sup> and 211<sup>C</sup>.  
<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 315:** *Organic Chemistry Lab I*. 2 credits. Lab techniques and reactions arranged to accompany CHEM 313. Notes: One-hour recitation. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 313<sup>\*C</sup> or L313<sup>\*</sup>) and CHEM 212<sup>C</sup> and 211<sup>C</sup>.  
<sup>\*</sup> May be taken concurrently.  
<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 318:** *Organic Chemistry Lab II*. 2 credits. Continuation of CHEM 315, arranged to accompany CHEM 314. Notes: One-hour recitation. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 315<sup>C</sup> or L315) and (CHEM 314<sup>\*C</sup> or L314<sup>\*</sup>) and (CHEM 313<sup>C</sup> or L313).

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 321:** *Quantitative Chemical Analysis*. 4 credits. Principles of chemical analysis emphasizing ionic equilibria. Lab consists of gravimetric, volumetric, and instrumental methods illustrating principal types of quantitative determinations. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 212<sup>C</sup>, MATH 113<sup>C</sup>, CHEM 211<sup>C</sup> and MATH 114<sup>\*C</sup>.

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory, Lecture

**CHEM 331:** *Physical Chemistry I*. 3 credits. Yearlong survey covering topics including thermodynamics, equilibria, kinetics, solution properties, elementary quantum theory, electrochemistry, atomic and molecular structure, and nuclear chemistry. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 212<sup>C</sup> and MATH 114<sup>C</sup>) and (PHYS 243<sup>\*C</sup> or 160<sup>\*C</sup>).

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 332:** *Physical Chemistry II*. 3 credits. Yearlong survey covering topics including thermodynamics, equilibria, kinetics, solution properties, elementary quantum theory, electrochemistry, atomic and molecular structure, and nuclear chemistry. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** (MATH 114<sup>C</sup> and CHEM 331<sup>C</sup>) and (PHYS 243<sup>C</sup> or 160<sup>C</sup>) and (PHYS 244<sup>\*C</sup> or 260<sup>\*C</sup>).

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 333:** *Physical Chemistry for the Life Sciences I*. 3 credits. Yearlong survey of principles of physical chemistry emphasizing application in biological sciences. Topics include first and second laws of thermodynamics, free energy and chemical equilibria, kinetics, transport properties, molecular interactions, molecular structure, spectroscopy, statistical thermodynamics, and x-ray diffraction. Notes: Credit will not be given for both this course sequence and CHEM 331, 332. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** MATH 113.

**Recommended Corequisite:** MATH 114.

**Schedule Type:** Lecture

**CHEM 334: *Physical Chemistry for the Life Sciences II*.** 3 credits.  
Yearlong survey of principles of physical chemistry emphasizing application in biological sciences. Topics include first and second laws of thermodynamics, free energy and chemical equilibria, kinetics, transport properties, molecular interactions, molecular structure, spectroscopy, statistical thermodynamics, and x-ray diffraction. Notes: Credit will not be given for both this course sequence and CHEM 331, 332. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 333, MATH 113, 114.

**Schedule Type:** Lecture

**CHEM 336: *Physical Chemistry Lab I*.** 2 credits.  
Quantitative experimental study of physicochemical principles. CHEM 336 and 337 constitute an introduction to the practice and theory of experimental physical chemistry. Notes: One-hour recitation. Offered by Chemistry. May not be repeated for credit.

**Specialized Designation:** Writing Intensive in the Major

**Registration Restrictions:**

**Required Prerequisites:** CHEM 212<sup>C</sup>, 321<sup>C</sup> and 331<sup>\*C</sup> and (PHYS 243<sup>\*C</sup> or 160<sup>\*C</sup>) and (MATH 114<sup>C</sup> or 116<sup>C</sup>).

\* May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 337: *Physical Chemistry Lab II*.** 2 credits.  
Continuation of CHEM 336. Notes: One-hour recitation. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 331<sup>C</sup> or L331) and (CHEM 332<sup>\*C</sup> or L332<sup>\*</sup>) and (CHEM 336<sup>C</sup> or L336).

\* May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 341: *Fundamental Inorganic Chemistry*.** 3 credits.  
Descriptive chemistry including chemical properties, reactions, and reaction mechanisms of inorganic elements and compounds. Topics include main group and transition elements, organometallic compounds, and bioinorganic chemistry. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 212<sup>C</sup>, 313<sup>C</sup> and 315<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 355: *Undergraduate Research*.** 1-3 credits.  
Original research project. May involve lab study, computer modeling and analysis, or other original research as appropriate. Research formulated and completed under instructor's guidance. Culminates in a written and oral final report. May be repeated for a total of 6 credits. Offered by Chemistry. May be repeated within the degree for a maximum 6 credits.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 313<sup>C</sup>, 315<sup>C</sup>, MATH 113<sup>C</sup>, PHYS 243<sup>C</sup> and 244<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

Enrollment limited to students with a class of Junior, Sophomore, Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Chemistry.

**Schedule Type:** Research

## 400 Level Courses

**CHEM 413: *Synthetic and Mechanistic Organic Chemistry*.** 3 credits.  
General review of synthetic pathways and applications to new topics, emphasizing fused ring aromatics, heterocyclics, natural products, and biologically active compounds. Includes relationship of applied organic chemistry to consumer products, including drugs and agricultural chemicals. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 314<sup>C</sup> or 314L) and (CHEM 318<sup>C</sup> or 318L) and CHEM 331<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 422: *Instrumental Methods of Chemical Analysis*.** 3 credits.  
Introduces theories of analysis by instrumental methods. Basic electronics applied to chemical measurements. Topics include introduction to theory of spectroscopy including ultraviolet, visible, and infrared, and electrochemical methods of analysis; theory of Fourier transform techniques such as FT-IR and FT-NMR; and theory of advanced pulse techniques. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 321<sup>C</sup>, 332<sup>C</sup> and 337<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 423: *Instrumental Methods of Chemical Analysis Laboratory*.** 2 credits.  
Laboratory-based introduction to quantitative analysis of organic and inorganic substances by using modern analytical instrumentation. Laboratory highlights practice of atomic and molecular spectroscopy, spectrophotometry, chromatography, voltammetry, and potentiometry in relation to chemical experimentation. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisite:** CHEM 422<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 427: *Aquatic Environmental Chemistry*.** 3 credits.  
Thermodynamic and kinetic processes regulating the chemistry of surface and groundwater in natural and polluted environments with particular emphasis in explaining the aqueous concentrations of chemical species and controlling geochemical factors in the hydrosphere. Structure, sources and transformations of organic matter in the aquatic environment and interactions with aqueous solutes will be covered as related to contemporary issues in water quality. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisite:** CHEM 321<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 438:** *Atmospheric Chemistry*. 3 credits.

The fundamental chemical processes of the Earth's atmosphere including chemical cycles, thermodynamics, reaction kinetics, photochemistry, radiative balance, ozone chemistry and environmental issues, including air pollution, acid rain and global change. Offered by Chemistry. May not be repeated for credit. Equivalent to CLIM 438.

**Registration Restrictions:**

**Required Prerequisite:** CHEM 332<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 439:** *RS: Atmospheric Chemistry II: Air Analysis Techniques*. 3 credits.

The theory, design and implementation of air sampling and analysis techniques for investigating GMU and regional air quality. Offered by Chemistry. May not be repeated for credit.

**Specialized Designation:** Research/Scholarship Intensive

**Recommended Prerequisite:** CHEM 438 or permission of instructor.

**Schedule Type:** Lecture

**CHEM 441:** *Properties and Bonding of Inorganic Compounds*. 3 credits.

Interpretation of physical and chemical properties of inorganic compounds in terms of currently used bonding concepts. Topics include molecular symmetry and applications of symmetry, structure and bonding in ionic solids; reactions and characterizations of solids; electronic and magnetic properties and applications of solids. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 332<sup>C</sup> and 337<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 445:** *Inorganic Preparations and Techniques*. 2 credits.

Application of techniques of inorganic chemistry to preparation, purification, and spectroscopic characterization of selected substances. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisite:** CHEM 441<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 446:** *Bioinorganic Chemistry*. 3 credits.

Application of inorganic coordination chemistry and physical methods in study of structure and function of metal ion sites in biomolecules. Properties of transition metal ions, ligand field theory. Topics include iron cytochromes, zinc and copper enzymes, cobalamins, iron sulfur proteins, oxygen transport, iron storage, electron transfer, inorganic model compounds, metals in medicine, and toxicity of inorganic species. Notes: Students may take this course concurrently with CHEM 463 or after taking CHEM 463. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 463<sup>C</sup> or BIOL 483<sup>C</sup>) and CHEM 331<sup>C</sup> and 336<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 451:** *Special Projects in Chemistry*. 1-3 credits.

Introduction to chemical research or development. Includes literature search, conferences, and lab. Notes: Written and oral technical reports required. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 314<sup>C</sup>, 318<sup>C</sup>, 321<sup>C</sup>, 331<sup>C</sup> and 336<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Chemistry.

**Schedule Type:** Research

**CHEM 452:** *Special Projects in Chemistry*. 1-3 credits.

Introduction to chemical research or development. Includes literature search, conferences, and lab. Notes: Written and oral technical reports required. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisite:** CHEM 451<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Chemistry.

**Schedule Type:** Research

**CHEM 455:** *Honors Research in Chemistry*. 3 credits.

Introduction to research on current problem in chemical sciences under supervision of faculty advisor. Includes literature search, laboratory or theoretical work, conferences with faculty advisor, attendance at regularly scheduled seminars, and oral and written presentations. Notes: Credit will not be given for both these courses and CHEM 451, 452. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 313<sup>C</sup>, 314<sup>C</sup>, 315<sup>C</sup>, 318<sup>C</sup>, 331<sup>C</sup> and 336<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major in Chemistry.

Enrollment limited to students with the Honors Coll Schlrshp Confirmd, Honors College. or Honors in the Major. attributes.

**Schedule Type:** Research

**CHEM 456:** *Honors Research in Chemistry*. 3 credits.

Introduction to research on current problem in chemical sciences under supervision of faculty advisor. Includes literature search, laboratory or theoretical work, conferences with faculty advisor, attendance at regularly scheduled seminars, and oral and written presentations. Notes: Credit will not be given for both these courses and CHEM 451, 452. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** B+ or higher in CHEM 455.

**Registration Restrictions:**

**Required Prerequisite:** CHEM 455<sup>B+</sup>.

<sup>B+</sup> Requires minimum grade of B+.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major in Chemistry.

Enrollment limited to students with the Honors Coll Schlrshp Confirmed, Honors College. or Honors in the Major. attributes.

**Schedule Type:** Research

**CHEM 458: *Chemical Oceanography*.** 3 credits.

The world's oceans, including a variety of closed basins and estuaries, comprise a complex and dynamic system of chemical processes that interact with biological, geological, physical, and atmospheric processes to play a significant role in defining the earth's fragile environment. This course will present an overview of the origin, occurrence, and distribution of the chemical components in sea water and an introduction to the basic principles of the chemical processes taking place in the marine environment. Designated a Green Leaf Course. Offered by Chemistry. May not be repeated for credit. Equivalent to GEOL 458.

**Specialized Designation:** Green Leaf Course

**Registration Restrictions:**

**Required Prerequisites:** CHEM 211<sup>C</sup> and 212<sup>C</sup> and (CHEM 321<sup>C</sup> or GEOL 309<sup>C</sup>).

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 463: *General Biochemistry I*.** 4 credits.

Brief introduction to biochemistry, followed by in-depth look at amino acids and proteins, 3-D structure, folding and dynamics, their specialized function, and primary metabolism. Emphasizes enzymes and their chemical mechanisms, and metabolism. Offered by Chemistry. May not be repeated for credit. Equivalent to BIOL 483.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 313<sup>C</sup> or L313) and BIOL 213<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 464: *General Biochemistry II*.** 3 credits.

Continuation of general biochemistry, focusing on secondary metabolism, cell signaling, and processes of replication, transcription, and translation. Emphasizes important biochemistry research topics; much material drawn from current biochemical literature. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 463<sup>C</sup> and (CHEM 314<sup>C</sup> or 314L).

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 465: *Biochemistry Lab*.** 2 credits.

Introduction to modern biochemical experimental methods of studying chemical and physical properties of biological molecules. Includes

separation, identification, and characterization of biomolecules. Offered by Chemistry. May not be repeated for credit.

**Specialized Designation:** Writing Intensive in the Major

**Recommended Prerequisite:** Grade of C or better in CHEM 315 and CHEM 463.

**Recommended Corequisite:** CHEM 463.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 463<sup>\*C</sup> and (CHEM 315<sup>C</sup> or 315L).

<sup>\*</sup> May be taken concurrently.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Laboratory

**CHEM 467: *The Chemistry of Enzyme-Catalyzed Reactions*.** 3 credits.

Examples of enzyme mechanisms demonstrate how chemical principles are employed by living organisms. Specific enzyme mechanisms used to illustrate principles from organic, inorganic, and physical chemistry. Discusses techniques to monitor enzyme reactions. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 463<sup>C</sup>, 464<sup>C</sup>, 314<sup>C</sup> and 331<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 468: *Bioorganic Chemistry*.** 3 credits.

Basic understanding of chemical nature of biomolecules and biomacromolecules. Introduces biomolecules such as amino acids, proteins, carbohydrates, and lipids. Lectures focus on biophysical properties and synthesis, using practical examples and visual aids. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

**Required Prerequisites:** CHEM 463<sup>C</sup>, 464<sup>C</sup> and 314<sup>C</sup>.

<sup>C</sup> Requires minimum grade of C.

**Schedule Type:** Lecture

**CHEM 470: *Laboratory Instructional Methods for Chemistry*.** 3 credits.

Lecture and laboratory experience teaching chemistry in laboratory. Students work closely with faculty members and are responsible for all aspects of teaching undergraduate laboratory techniques. Students also learn techniques for acquisition and storage of chemicals and laboratory apparatus, safety, disposal of chemical waste, and literature of chemical education. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 314.

**Schedule Type:** Laboratory

**CHEM 490: *Undergraduate Seminar*.** 1 credit.

Selected topics from recent chemical theory and applications, generally consisting of research presentations by invited faculty from other institutions. Attendance is required at 80% of the seminars and students must write up a one-page summary of each talk attended. This course will also be used to teach students how to give effective presentations. May be repeated for a total of 2 credits. Offered by Chemistry. May be repeated within the degree for a maximum 2 credits.

**Registration Restrictions:**

**Required Prerequisites:** (CHEM 331<sup>C</sup> or 336<sup>C</sup>).

<sup>C</sup> Requires minimum grade of C.

Enrollment limited to students with a class of Senior Plus or Senior.

Enrollment is limited to students with a major, minor, or concentration in Chemistry.

**Schedule Type:** Seminar

## 500 Level Courses

**CHEM 500:** *Selected Topics in Modern Chemistry*. 3 credits.

Topics of interest in analytical, biological, environmental, geological, geochemical, inorganic, organic, and physical chemistry. Notes: Credit not allowed toward major in chemistry. Credit not allowed toward minor in chemistry. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 513:** *Synthetic and Mechanistic Organic Chemistry*. 3 credits.

General review of synthetic pathways and applications to new topics, emphasizing fused ring aromatics, heterocyclics, natural products, and biologically active compounds. Includes relationship of applied organic chemistry to consumer products, including drugs and agricultural chemicals. Organic core course. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** Grade of C or better in CHEM 314, CHEM 318 and CHEM 331.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 529:** *Instrumental Techniques of Analysis*. 2 credits.

Principles and operation of modern instrumentation, emphasizing applications to analysis of chemical, biological, and environmental samples. Methods include combined capillary column gas chromatography and mass spectrometry, high-performance liquid chromatography, optical methods, surface analysis methods, magnetic resonance spectroscopy, atomic emission and absorption spectrometry, and electroanalytical methods. With approval of research committee, students choose methods studied. Offered by Chemistry. May be repeated within the term.

**Recommended Prerequisite:** CHEM 321 and 422 or 521 or permission of department.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Independent Study

**CHEM 563:** *General Biochemistry I*. 4 credits.

Brief introduction to biochemistry, followed by an in-depth look at amino acids and proteins, 3-D structure, folding and dynamics, their specialized function and primary metabolism. Emphasizes enzymes and their chemical mechanisms and metabolism. Students will be assigned papers from the primary literature and be required to answer questions from these papers on exams. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 313, BIOL 213.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 564:** *General Biochemistry II*. 3 credits.

Previous course in biology recommended but not required. Important biological compounds, including proteins, carbohydrates, lipids, and nucleic acids, and their interrelations. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 563 or equivalent.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 567:** *The Chemistry of Enzyme-Catalyzed Reactions*. 3 credits.

Examples of enzyme mechanisms demonstrate how chemical principles are employed by living organisms. Specific enzyme mechanisms used to illustrate principles from organic, inorganic, and physical chemistry. Discusses techniques to monitor enzyme reactions. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 313 and 463 or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 568:** *Bioorganic Chemistry*. 3 credits.

Basic understanding of chemical nature of biomolecules and biomacromolecules. Introduces biomolecules such as amino acids, proteins, carbohydrates, and lipids. Lectures focus on biophysical properties and synthesis, using practical examples and visual aids. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 314 and 463, or equivalent, or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 579:** *Special Topics*. 1-6 credits.

Current topics in chemistry, depending on instructor's specialty. Notes: May be repeated with different topics, with department approval. Offered by Chemistry. May be repeated within the term.

**Recommended Prerequisite:** CHEM 313 and 314, or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

## 600 Level Courses

**CHEM 613:** *Modern Polymer Chemistry*. 3 credits.

Synthetic and analytical chemistry of synthetic macromolecules. Topics include polymer solutions, molecular weight determination, spectroscopy, thermal analysis, x-ray crystallinity, polymerization types, and commercial and electroactive polymers. Organic core course. Offered by Chemistry. May not be repeated for credit.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 614:** *Physical Organic Chemistry*. 3 credits.

Principles underlying molecular structure, reactivity, and reaction mechanisms. Topics include valence-bond and molecular-orbital theory, electronic interpretation of organic reactions, stereochemistry, conformational analysis, kinetics and thermodynamics of organic reactions, and photochemistry. Organic core course. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 314 or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 620:** *Modern Instrumentation*. 3 credits.

Methods of sensing and measurement of radiation, particles, pressure, concentrations of specific elements and compounds. Topics include basic operational amplifier circuits for analog signals, digitizing devices and computerized data collection, noise and noise-reduction methods, and specialized instrumentation systems for various areas of chemistry and physics. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 422 or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 624:** *Principles of Chemical Separation*. 3 credits.

Theories and models of separation with applications to analyses of a wide range of chemical, biological, and environmental samples. Topics include high-resolution gas and high-performance liquid chromatography. Emphasizes theory of reverse phase, normal phase, ion exchange, size exclusion, and affinity based separations. Also presents instrumentation such as detectors, pumps, and columns, and data acquisition. Analytical core course. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 422 or 521 or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 625: *Electroanalytical Chemistry*. 3 credits.**

Review of basic electrochemistry. Emphasizes analysis and research for applications of modern electrochemical techniques such as chronoamperometry; cyclic, stripping, and AC voltammetry; pulse polarography; coulometry; electrochemical sensors; and instrumentation. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 321 and CHEM 331.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 627: *Aquatic Environmental Chemistry*. 3 credits.**

Thermodynamic and kinetic processes regulating the chemistry of surface and groundwater in natural and polluted environments with particular emphasis in explaining the aqueous concentrations of chemical species and controlling geochemical factors in the hydrosphere. Structure, sources and transformations of organic matter in the aquatic environment and interactions with aqueous solutes will be covered as related to contemporary issues in water quality. Students will be assigned papers from the primary literature and be required to answer questions from these papers on exams. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 321 or GEOL 302 or equivalent courses or permission of the instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 633: *Chemical Thermodynamics and Kinetics*. 3 credits.**

Advanced study covering application of kinetics to the elucidation of reaction mechanisms and application of statistical thermodynamics to theory of elementary reaction rates. Physical core course. Offered by Chemistry. May not be repeated for credit. Equivalent to CSI 711.

**Recommended Prerequisite:** CHEM 331 and 332.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 641: *Solid State Chemistry*. 3 credits.**

Focuses on the design and synthesis, structure and bonding of solid state compounds; physical properties and characterization of solids. Topics of current interest will also be included. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 441 or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 646: *Bioinorganic Chemistry*. 3 credits.**

Applies inorganic coordination chemistry and physical methods to understand structure and function of metal ion sites in biomolecules. Biochemical roles of metal centers in oxygen transport, metalloenzymes, and electron transfer. Topics include iron cytochromes, zinc and copper enzymes, cobalamins, iron sulfur proteins, inorganic model compounds, and metals in medicine. Inorganic core course. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 441, or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 651: *Environmental Chemistry of Organic Substances*. 3 credits.**

Study of principles governing multimedia distribution and fate of organic chemicals in environment. Overview of origin and occurrence of major classes of natural and anthropogenic organic chemicals in environment. Environmental core course. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** One semester of Physical Chemistry, or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 660: *Protein Biochemistry*. 3 credits.**

Proteins play critical roles in most biological processes. Therefore, to understand these processes, it is necessary to understand proteins. This course will introduce students to proteins, their biosynthesis/ biodegradation and their biophysical and biochemical properties.

Biochemistry core course. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 463 or equivalent or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 661: Antibiotic Chemistry and Resistance.** 3 credits.

Introduces the various classes of antibiotics. Focus on the chemistry of antibiotics and how they inhibit bacterial growth and/or cause death and the response of bacteria to these compounds. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 463 or equivalent or permission of instructor

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 662: Modern Methods of Drug Discovery.** 3 credits.

Introduction to the process of drug discovery. Covers modern methods and strategies of target identification, lead identification, and lead optimization. Biochemistry core course. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 463 (or equivalent) or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 665: Protein-Protein Interactions: Methods and Applications.** 3 credits.

Introduction to the fundamental principles of protein-protein interactions, including experimental design considerations and methods for quantification of these interactions. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 463 (or equivalent), or permission of instructor.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 670: Teaching Practicum.** 2 credits.

Prelaboratory lecture and laboratory teaching in chemistry. Students work closely with faculty and are responsible for all aspects of teaching undergraduate laboratory techniques. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** Enrollment in the graduate program and permission of Chair.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Internship

## 700 Level Courses

**CHEM 728: Introduction to Solid Surfaces.** 3 credits.

Introduces properties of solid surfaces. Topics include gas absorption isotherms, surface area measurement techniques, real and clean surfaces, physisorption and chemisorption, methods of gas adsorption and desorption, measurement of heats of adsorption, desorption kinetics, electron spectroscopies and surface sensitivities, instrumentation; and principles of vacuum technology. Offered by Chemistry. May not be repeated for credit. Equivalent to CSI 712.

**Recommended Prerequisite:** CHEM 422 or equivalent.

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 735: Astrophysical Chemistry of Planetary Bodies.** 3 credits.

In depth review of the chemistry of planets, comets and other bodies in the Solar System. Emphasis will be placed on the laboratory techniques and measurements made in order to understand and predict astronomical observations. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 331, or ASTR 403, or permission of instructor.

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 736: Computational Quantum Mechanics.** 3 credits.

Study of fundamental concepts of quantum mechanics from computational point of view, review of systems with spherically symmetric potentials, electron-atom solutions to Schrodinger's equation, electron spin in many electron systems, atomic structure calculations, algebra of many electron calculations, Hartree-Fock, self-consistent field method, molecular structure calculations, scattering theory computations, and solid-state computations. Offered by Chemistry. May not be repeated for credit. Equivalent to CSI 783, PHYS 736.

**Recommended Prerequisite:** PHYS 502, 510, or permission of instructor.

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 767: Industrial Biochemistry.** 3 credits.

An introduction to industrial biochemistry. Includes a mechanistic examination of the biosynthesis of several industrially important secondary metabolites, the industrial scale process of obtaining commercially valuable biochemical products, and the regulations that oversee the industrial biochemical process. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 463 or permission of instructor.

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Lecture

**CHEM 790: Graduate Seminar.** 1 credit.

Selected topics from recent chemical theory and applications, generally consisting of research presentations by invited faculty from other institutions. Attendance is required at 80% of the seminars and students must write up a 1 page summary of each talk attended. Course also used to teach students effective presentation methods. Notes: Requires, in last semester, seminar presentation on student's research or another topic acceptable to department. Three credits of CHEM 790 required for MS degree; an additional 3 credits required after admission to PhD program. Offered by Chemistry. May be repeated within the degree for a maximum 3 credits.

**Recommended Prerequisite:** Admission to a graduate program in Chemistry and Biochemistry, or permission of instructor.

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Seminar

**CHEM 796: Directed Reading and Research.** 1-6 credits.

Reading and research on a specific topic in chemistry or biochemistry under direction of a faculty member. Offered by Chemistry. May be repeated within the degree for a maximum 12 credits.

**Recommended Prerequisite:** Admission to a graduate program in Chemistry and Biochemistry or affiliated programs.

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Research

**CHEM 798: Research Project.** 3-6 credits.

Experimental or theoretical research project chosen and completed under guidance of graduate faculty member. Notes: Requires comprehensive report acceptable to advisory committee, and final oral exam on report. Offered by Chemistry. May be repeated within the degree for a maximum 6 credits.

**Recommended Corequisite:** Permission of department; 6 credits of CHEM 798 or 799 (credit will not be given for both).

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Thesis

**CHEM 799: Master's Thesis.** 1-6 credits.

Laboratory thesis research and writing under direction of supervisor. Notes: Minimum of 3 credits for first two enrollment periods. Offered by Chemistry. May be repeated within the degree.

**Recommended Corequisite:** Permission of the department.

**Registration Restrictions:**

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

**Schedule Type:** Thesis

**800 Level Courses****CHEM 814: Advanced Bioorganic Chemistry.** 3 credits.

Introduces the chemical nature of biomolecules, with a focus on their organic properties. Focuses on the chemical principals that underlie the diverse structures, properties and reactions of biomolecules. Core course in the Chemistry and Biochemistry doctoral program. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 313, 314, and 463 or equivalent; or permission of instructor.

**Registration Restrictions:**

Enrollment is limited to Graduate level students.

**Schedule Type:** Lecture

**CHEM 817: Organic Structural Spectroscopy.** 3 credits.

Spectroscopic determination of organic molecular structure using <sup>1</sup>H, <sup>13</sup>C, <sup>19</sup>F, and <sup>31</sup>P nuclear magnetic resonance, infrared, ultraviolet, visible, and Raman spectroscopy, and mass spectrometry. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 314 or equivalent.

**Registration Restrictions:**

Enrollment is limited to Graduate level students.

**Schedule Type:** Lecture

**CHEM 821:** *Theory of Analytical Processes*. 3 credits.

Theory and application of contemporary analytical processes and methods used in chemistry research. Emphasis on analytical signals and accompanying noise, sample preparation techniques, and quality assurance in measurements. Core course in the Chemistry and Biochemistry doctoral program. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** Admission to Chemistry and Biochemistry doctoral program.

**Registration Restrictions:**

Enrollment is limited to Graduate level students.

**Schedule Type:** Lecture

**CHEM 833:** *Physical Chemistry and Biochemistry*. 3 credits.

The theory and practical use of thermodynamics, kinetics, spectroscopy and quantum chemistry in chemical and biochemical research. Core course in the Chemistry and Biochemistry doctoral program. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** CHEM 331 or permission of instructor.

**Registration Restrictions:**

Enrollment is limited to Graduate level students.

**Schedule Type:** Lecture

**CHEM 891:** *Doctoral Scientific Critique, Writing and Presentation*. 3 credits.

Development of skills associated with scientific communication and research such as oral presentation of scientific material, analysis of scientific research and preparation of scientific proposals. In preparing scientific proposals, students will learn how to identify scientific questions of interest and how to plan a course of experiments to address these questions. Core course in the Chemistry and Biochemistry doctoral program. Offered by Chemistry. May not be repeated for credit.

**Recommended Prerequisite:** Permission of academic advisor, research advisor and/or research committee

**Registration Restrictions:**

Enrollment is limited to Graduate level students.

**Schedule Type:** Lecture

**CHEM 896:** *Doctoral Directed Reading and Research*. 1-6 credits.

Reading and research on a specific topic in Chemistry or Biochemistry under direction of a faculty member. Offered by Chemistry. May be repeated within the degree for a maximum 15 credits.

**Recommended Prerequisite:** Admission to the PhD in Chemistry and Biochemistry or affiliated programs.

**Registration Restrictions:**

Enrollment is limited to Graduate level students.

**Schedule Type:** Research

## 900 Level Courses

**CHEM 998:** *Doctoral Dissertation Proposal*. 1-12 credits.

Development of a research proposal under the guidance of the research advisor and graduate committee. The resulting proposal, once approved by the student's research advisor and committee, forms the basis of the student's doctoral dissertation. May be repeated for credit, but no more than 24 combined credits from CHEM 998 and CHEM 999 may be applied

toward satisfying doctoral degree requirements, with no more than 12 credits of CHEM 998. Offered by Chemistry. May be repeated within the degree.

**Recommended Prerequisite:** Permission of research advisor and/or graduate committee.

**Registration Restrictions:**

Enrollment is limited to Graduate level students.

**Schedule Type:** Dissertation

**CHEM 999:** *Doctoral Dissertation Research*. 1-12 credits.

Research in the concentration pertinent to student's program of study under the direction of their research advisor and committee. Students may enroll for credits in this course once their research proposal has been approved. May be repeated for credit, but no more than 24 combined credits from CHEM 998 and CHEM 999 may be applied toward satisfying doctoral degree requirements, with no more than 12 credits of CHEM 998. Offered by Chemistry. May be repeated within the degree.

**Recommended Prerequisite:** Admission to candidacy in Chemistry and Biochemistry Doctoral Program.

**Registration Restrictions:**

Enrollment limited to students with a class of Advanced to Candidacy.

Enrollment is limited to Graduate level students.

**Schedule Type:** Dissertation