# CHEMISTRY-CHEM (CHEM)

## Courses

**CHEM 103 Chemistry in Context (GT-SC2) Credits: 3 (3-0-0)**
**Course Description:** Chemistry, chemical principles from more conceptual, less mathematical perspective; how chemical substances, chemical reactions affect our daily lives.
**Prerequisite:** None.
**Registration Information:** For students who do not plan to take additional courses in chemistry. Sections may be offered: Online.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**CHEM 104 Chemistry in Context Laboratory (GT-SC1) Credit: 1 (0-2-0)**
**Course Description:** Laboratory applications of principles covered in CHEM 103.
**Prerequisite:** CHEM 103, may be taken concurrently.
**Registration Information:** Sections may be offered: Online.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

**CHEM 105 Problem Solving in General Chemistry Credits: 2 (1-0-1)**
**Course Description:** Foundational problem-solving skills in general chemistry to support students for later success in general chemistry courses.
**Prerequisite:** MATH 118 or MATH 120 or MATH 127 or MATH 141 or MATH 155 or MATH 160 or MATH 161 or MATH 229 or MATH 261.
**Registration Information:** This is a partial semester course. Must register for lecture and recitation.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 107 Fundamentals of Chemistry (GT-SC2) Credits: 4 (4-0-0)**
**Course Description:** Atomic/molecular theory, gases, liquids, solids, solutions, acid/base and oxidation/reduction reactions, kinetics, selected topics. Quantitative reasoning but with less focus on mathematical calculations than CHEM 111/CHEM 113.
**Prerequisite:** MATH 117 or MATH 120 or MATH 127 or MATH 141, may be taken concurrently or MATH 155, may be taken concurrently or MATH 160, may be taken concurrently or MATH 161, may be taken concurrently or MATH 229, may be taken concurrently or MATH 261, may be taken concurrently.
**Registration Information:** For students in science-related programs requiring one semester of general chemistry. Sections may be offered: Online. Credit allowed for only one of the following: CHEM 107, CHEM 111, CHEM 117, or CHEM 120.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**CHEM 108 Fundamentals of Chemistry Laboratory (GT-SC1) Credit: 1 (0-2-0)**
**Course Description:** Laboratory applications of principles presented in CHEM 107.
**Prerequisite:** CHEM 107, may be taken concurrently.
**Registration Information:** Sections may be offered: Online. Credit allowed for only one of the following: CHEM 108, CHEM 112, or CHEM 121.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

**CHEM 111 General Chemistry I (GT-SC2) Credits: 4 (3-0-1)**
**Course Description:** Fundamental aspects of chemistry and chemical principles; emphasis on structure, bonding, and stoichiometry.
**Prerequisite:** MATH 118 or MATH 120 or MATH 127 or MATH 141 or MATH 155 or MATH 160 or MATH 161 or MATH 229 or MATH 261.
**Registration Information:** Must register for lecture and recitation. Intended for science majors. Students should complete the sequence CHEM 111, CHEM 112, CHEM 113, and CHEM 114. Credit allowed for only one of the following: CHEM 107, CHEM 111, CHEM 117, or CHEM 120.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**CHEM 112 General Chemistry Lab I (GT-SC1) Credit: 1 (0-3-0)**
**Course Description:** Laboratory applications of principles covered in CHEM 111.
**Prerequisite:** CHEM 111, may be taken concurrently or CHEM 117, may be taken concurrently.
**Registration Information:** Credit not allowed for both CHEM 112 and CHEM 108.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

**CHEM 113 General Chemistry II Credits: 3 (3-0-0)**
**Course Description:** Acid/base equilibria, kinetics, thermodynamics, solubility, oxidation-reduction reactions, electrochemistry, selected topics.
**Prerequisite:** (CHEM 107 or CHEM 111 or CHEM 117) and (MATH 120 or MATH 124 or MATH 127 or MATH 141, may be taken concurrently or MATH 155, may be taken concurrently or MATH 160, may be taken concurrently or MATH 161, may be taken concurrently or MATH 229, may be taken concurrently or MATH 261, may be taken concurrently).
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 114 General Chemistry Lab II Credit: 1 (0-3-0)**
**Course Description:** Laboratory applications of principles covered in CHEM 113.
**Prerequisite:** (CHEM 108 or CHEM 112) and (CHEM 113, may be taken concurrently).
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 115 General Chemistry II Recitation Credit: 1 (0-0-1)**
**Course Description:** Problem solving applied to topics in, e.g., acid/base equilibria, kinetics, thermodynamics, solubility, oxidation-reduction reactions, electrochemistry.
**Prerequisite:** None.
**Registration Information:** Must have concurrent registration in CHEM 113.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 117 General Chemistry I for Chemistry Majors Credits: 3 (3-0-0)**
**Course Description:** Fundamental aspects of chemistry and chemical principles, with an emphasis placed on atomic and molecular structure, bonding and stoichiometry.
**Prerequisite:** MATH 118 or MATH 120 or MATH 127 or MATH 141 or MATH 155 or MATH 160 or MATH 161 or MATH 229 or MATH 261.
**Registration Information:** Must have concurrent registration in CHEM 192. Credit allowed for only one of the following: CHEM 107, CHEM 111, CHEM 117, or CHEM 120.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 120 Foundations of Modern Chemistry (GT-SC2) Credits: 4 (3-0-1)**
**Course Description:** Fundamental aspects of chemistry and chemical principles, with an emphasis placed on modern atomic and molecular structure theory, structure and reactivity.
**Prerequisite:** MATH 118 or MATH 120 or MATH 127 or MATH 141 or MATH 155 or MATH 160 or MATH 161 or MATH 229 or MATH 261.
**Registration Information:** Intended for Chemistry majors. Must register for lecture and recitation. Credit allowed for only one of the following: CHEM 107, CHEM 111, CHEM 117, or CHEM 120.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**CHEM 121 Foundations of Modern Chemistry Laboratory (GT-SC1) Credit: 1 (0-3-0)**
**Course Description:** Laboratory applications of principles covered in CHEM 120.
**Prerequisite:** CHEM 120, may be taken concurrently.
**Registration Information:** Intended for Chemistry majors. Credit allowed for only one of the following: CHEM 108, CHEM 112, or CHEM 121.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.
**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

**CHEM 192 Introductory Seminar in Chemistry Credits: 2 (0-0-2)**
**Course Description:** Small-group discussions of aspects of chemistry.
**Prerequisite:** None.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 231 Foundations of Analytical Chemistry Credits: 3 (3-0-0)**
**Course Description:** Fundamental chemical measurement science. Measuring chemical composition, either qualitative or quantitative, is essential to interact with the world and understand chemistry. Importance of equilibrium in making measurements.
**Prerequisite:** CHEM 111 and CHEM 112 or CHEM 120 and CHEM 121.
**Registration Information:** Chemistry majors only.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 232 Foundations of Analytical Chemistry Lab Credits: 2 (0-6-0)**
**Course Description:** Laboratory applications of principles of analytical chemistry.
**Prerequisite:** CHEM 114 or CHEM 231, may be taken concurrently.
**Registration Information:** Chemistry majors only.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 241 Foundations of Organic Chemistry Credits: 4 (3-0-1)**
**Course Description:** Nomenclature, structure, bonding, reactions, mechanisms, synthesis, and the stereochemistry of organic compounds.
**Prerequisite:** CHEM 111 and CHEM 113 or CHEM 120.
**Registration Information:** Must register for lecture and recitation. Credit allowed for only one of the following: CHEM 241, CHEM 245, CHEM 341, or CHEM 345.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 242 Foundations of Organic Chemistry Laboratory Credit: 1 (0-3-0)**
**Course Description:** Laboratory applications of organic chemistry principles.
**Prerequisite:** (CHEM 114 or CHEM 121) and (CHEM 241, may be taken concurrently).
**Registration Information:** Chemistry majors only.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 245 Fundamentals of Organic Chemistry Credits: 4 (4-0-0)**
**Course Description:** Nomenclature, structure, bonding, reactions, mechanisms, synthesis, stereochemistry of organic compounds.
**Prerequisite:** CHEM 107 or CHEM 113.
**Registration Information:** Intended for students in science-related programs requiring one semester of organic chemistry. Credit allowed for only one of the following: CHEM 245, CHEM 341, and CHEM 345. Sections may be offered: Online.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 246 Fundamentals of Organic Chemistry Laboratory Credit: 1 (0-2-0)**
**Course Description:** Laboratory applications of principles presented in CHEM 245.
**Prerequisite:** (CHEM 108 or CHEM 112 or CHEM 114) and (CHEM 245, may be taken concurrently).
**Registration Information:** Credit not allowed for students who have already taken CHEM 344.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 261 Fundamentals of Inorganic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Preparation, structures, properties, and reactions of chemical elements and inorganic compounds; periodic trends, organizing principles; applications.
**Prerequisite:** CHEM 113, may be taken concurrently.
**Registration Information:** Credit not allowed for both CHEM 261 and CHEM 263.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 263 Foundations of Inorganic Chemistry Credits: 4 (3-0-1)**
**Course Description:** Preparation, structures, properties, and reactions of chemical elements and inorganic compounds; periodic trends, organizing principles; applications.
**Prerequisite:** CHEM 111 and CHEM 112 or CHEM 120 and CHEM 121.
**Registration Information:** Must have concurrent registration in CHEM 264. Must register for lecture and recitation. Chemistry majors only. Credit not allowed for both CHEM 261 and CHEM 263.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 264 Foundations of Inorganic Chemistry Laboratory Credit: 1 (0-3-0)**
**Course Description:** Synthetic techniques and instrumental methods in inorganic chemistry.
**Prerequisite:** CHEM 111 and CHEM 112 or CHEM 120 and CHEM 121.
**Registration Information:** Must have concurrent registration in CHEM 263. Chemistry majors only.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 301 Advanced Scientific Writing--Chemistry (GT-CO3) Credits: 3 (3-0-0)**
**Course Description:** Advanced scientific writing using the read-analyze-write approach to writing scientific journal articles.
**Prerequisite:** (CO 150) and (CHEM 232 or CHEM 242 or CHEM 264 or CHEM 322 or CHEM 334 or CHEM 344 or CHEM 345 or CHEM 498).
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.
**Additional Information:** Advanced Writing 2, Advanced Writing (GT-CO3).

**CHEM 311 Introduction to Nanoscale Science Credits: 3 (3-0-0)**
**Prerequisite:** (CHEM 113) and (CHEM 346 or CHEM 343).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 315 Foundations of Polymer Chemistry Credits: 3 (3-0-0)**
**Course Description:** Synthesis, characterization, and applications of polymeric materials.
**Prerequisite:** CHEM 241 or CHEM 245 or CHEM 341 or CHEM 345.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 320 Chemistry of Addictions Credits: 3 (3-0-0)**
**Course Description:** Chemical processes of addiction; receptor binding, molecular deactivation, and feedback in the context of protein-substrate molecular interactions.
**Prerequisite:** CHEM 241 or CHEM 245 or CHEM 341 or CHEM 345.
**Registration Information:** Junior standing.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 321 Foundations of Chemical Biology Credits: 4 (3-0-1)**
**Course Description:** Principles of chemical biology. Chemical methods for understanding and controlling the structure and function of biopolymers.
**Prerequisite:** CHEM 241 or CHEM 341.
**Registration Information:** Must register for lecture and recitation.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 322 Foundations of Chemical Biology Laboratory Credit: 1 (0-3-0)**
**Course Description:** Chemical biology approaches used to illustrate how chemistry can be applied to manipulate and study biological problems using a combination of experimental techniques ranging from organic chemistry, analytical chemistry, biochemistry, molecular biology, biophysical chemistry, and cell biology.
**Prerequisite:** BC 351, may be taken concurrently or CHEM 321, may be taken concurrently.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 333 Forensic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Basic knowledge related to the application of chemical principles in forensic sciences. Techniques discussed are hair, soil, dye, glass, ammunition, drugs, and biological materials analysis. These techniques are used to support evidence on and off the crime scene.
**Prerequisite:** (LIFE 102) and (CHEM 108 or CHEM 114 or CHEM 232) and (CHEM 241 or CHEM 245 or CHEM 341).
**Restriction:** Must not be a: Freshman.
**Registration Information:** Sections may be offered: Online.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 334 Quantitative Analysis Laboratory Credit: 1 (0-3-0)**
**Course Description:** Laboratory applications of principles presented in CHEM 335.
**Prerequisite:** CHEM 114 and CHEM 335, may be taken concurrently.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 335 Introduction to Analytical Chemistry Credits: 3 (3-0-0)**
**Course Description:** Modern and classical applications and methods in analytical chemistry including statistical, kinetic, spectroscopic, and chromatographic analysis.
**Prerequisite:** CHEM 113 with a minimum grade of C and CHEM 334, may be taken concurrently.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 338 Environmental Chemistry Credits: 3 (3-0-0)**
**Course Description:** Processes that control the fate of chemicals in the environment. Focus on the chemistry of the atmosphere, hydrosphere, and soils, especially as it pertains to pollution of these environmental compartments. Topics covered in the course may include smog and air pollution, ocean acidification, acid mine drainage, pesticide chemistry, and heavy metal contamination.
**Prerequisite:** (CHEM 107 or CHEM 113 or CHEM 120 or CHEM 231 or CHEM 263) and (CHEM 241 or CHEM 245 or CHEM 341 or CHEM 345).
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 341 Modern Organic Chemistry I Credits: 3 (3-0-0)**
**Course Description:** Structures, nomenclature, dynamics, spectroscopy, and reactions of organic molecules.
**Prerequisite:** CHEM 113.
**Registration Information:** Credit allowed for only one of the following: CHEM 341, CHEM 245, and CHEM 345.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 343 Modern Organic Chemistry II Credits: 3 (3-0-0)**
**Course Description:** Continued studies of reactions and mechanisms of organic molecules and biological chemistry.
**Prerequisite:** CHEM 241 with a minimum grade of C- or CHEM 245 with a minimum grade of C- or CHEM 341 with a minimum grade of C- or CHEM 345 with a minimum grade of C-.
**Registration Information:** Credit not allowed for both CHEM 343 and CHEM 346.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 344 Modern Organic Chemistry Laboratory Credits: 2 (0-6-0)**
**Course Description:** Laboratory applications of modern organic chemistry.
**Prerequisite:** CHEM 114 and CHEM 343, may be taken concurrently.
**Registration Information:** Intended for science majors. Credit not allowed for both CHEM 344 and CHEM 246.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 345 Organic Chemistry I Credits: 4 (3-3-0)**
**Course Description:** Structure, nomenclature, dynamics, spectroscopy, reactions of organic molecules. Laboratory applications of principles presented in lecture.
**Prerequisite:** CHEM 113 and CHEM 114.
**Registration Information:** Chemistry majors only. Must register for lecture and laboratory. Students should plan to complete the sequence CHEM 345, CHEM 346. Credit allowed for only one of the following: CHEM 245, CHEM 341, and CHEM 345.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 346 Organic Chemistry II Credits: 4 (3-3-0)**
**Course Description:** Continue studies of reactions and mechanisms of organic molecules. Laboratory applications of principles presented in lecture.
**Prerequisite:** CHEM 345.
**Registration Information:** Chemistry majors only. Must register for lecture and laboratory. Students should plan to complete the sequence CHEM 345 and CHEM 346. Credit not allowed for both CHEM 343 and CHEM 346.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 371 Fundamentals of Physical Chemistry Credits: 4 (4-0-0)**
**Course Description:** Quantum mechanics; molecular structure and spectroscopy; statistical and equilibrium thermodynamics; kinetics.
**Prerequisite:** (CHEM 232) and (MATH 161 or MATH 271) and (PH 141).
**Registration Information:** Chemistry majors only. Credit allowed for only one of the following CHEM 371, CHEM 473, or CHEM 474.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 372 Fundamentals of Physical Chemistry Lab Credit: 1 (0-3-0)**
**Course Description:** Laboratory experiments illustrate the Fundamentals of Physical Chemistry, including atomic and molecular spectroscopy, thermochemistry, chemical equilibrium, and kinetics.
**Prerequisite:** CHEM 371, may be taken concurrently.
**Registration Information:** Chemistry majors only. Credit not allowed for both CHEM 372 and CHEM 475.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 384 Supervised College Teaching Credits: Var[1-3] (0-0-0)**
**Course Description:**
**Prerequisite:** CHEM 100 to 499 - at least 20 credits.
**Registration Information:** Written consent of department chair. Maximum of 12 credits for any combination of CHEM 384, CHEM 487, CHEM 495, CHEM 498. A maximum of 10 combined credits for all 384 and 484 courses are counted towards graduation requirements.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 431 Instrumental Analysis Credits: 4 (3-3-0)**
**Course Description:** Instrumental methods of chemical analysis.
**Prerequisite:** CHEM 371 and CHEM 372 or CBE 310, may be taken concurrently or CHEM 473, may be taken concurrently or CHEM 474, may be taken concurrently.
**Registration Information:** Must register for lecture and laboratory.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 433 Clinical Chemistry Credits: 3 (2-3-0)**
**Course Description:** Principles and methodology of clinical chemistry. Laboratory experience in methodology and method development.
**Prerequisite:** (CHEM 232 or CHEM 334) and (BC 404 or CHEM 322).
**Registration Information:** Must register for lecture and laboratory.
**Term Offered:** Spring (odd years).
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 440 Advanced Organic Chemistry Laboratory Credits: 2 (0-6-0)**
**Course Description:** Advanced techniques in organic synthesis, mechanisms of reactions, structure determination.
**Prerequisite:** CHEM 242 or CHEM 344 or CHEM 346.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 442 Chemistry of Hemp and Cannabis Credits: 3 (2-3-0)**
**Course Description:** Examine characteristics of cannabis chemical families and the pharmacological properties. Study the methods for isolation, separation, processing and the transformation into commercial products within the context of chemical principles. Examine analytic techniques for quantitation.
**Prerequisite:** (CHEM 241 or CHEM 245 or CHEM 341 and CHEM 343) and (CHEM 113 or CHEM 231 or CHEM 335) and (CHEM 232 or CHEM 334) and (CHEM 242 or CHEM 246 or CHEM 344).
**Registration Information:** Must register for lecture and laboratory. Credit not allowed for both CHEM 442 and CHEM 480A3.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 445 Synthetic Organic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Functional group interconversions, carbonyl chemistry, alkene synthesis, pericyclic reactions, metal-mediated reactions, synthetic planning and retrosynthesis, stereocontrolled reactions.
**Prerequisite:** CHEM 241 or CHEM 343 or CHEM 346.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 448 Medicinal Chemistry Credits: 3 (3-0-0)**
**Course Description:** Foundational understanding of how drugs function and affect biological systems, overview of the pharmaceutical industry, synthetic chemistry relevant to therapeutic compounds, introduction to process (scale up) chemistry, case studies of drug development.
**Prerequisite:** CHEM 241 or CHEM 343 or CHEM 346.
**Registration Information:** Sections may be offered: Online. Credit not allowed for both CHEM 448 and CHEM 480A2.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 451 Foundations of Catalytic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Foundational aspects of catalytic chemistry applied to homogeneous and heterogeneous systems utilizing molecular and biological catalysts as well as nano and supported catalytic materials.
**Prerequisite:** (CHEM 241 or CHEM 343 or CHEM 346) and (CHEM 261 or CHEM 263) and (BC 351 or CHEM 321) and (CHEM 371 or CHEM 473 or CHEM 474).
**Term Offered:** Spring (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 461 Inorganic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Concepts, models to explain structural, spectroscopic, magnetic, thermodynamic, and kinetic properties of inorganic compounds; symmetry, group theory.
**Prerequisite:** (CHEM 261 or CHEM 263) and (CBE 310 or CHEM 371 or CHEM 474).
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 462 Inorganic Chemistry Laboratory Credits: 2 (0-6-0)**
**Course Description:** Synthetic techniques and instrumental methods in inorganic chemistry.
**Prerequisite:** CHEM 461, may be taken concurrently.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 465 Chemistry of Sustainable E-Waste Management Credit: 1 (1-0-0)**
**Course Description:** A chemistry complement to a trans-disciplinary overview of the electronics industry. Focus on the chemistry of the extraction, use, and toxicity of electronics materials.
**Prerequisite:** (CHEM 263) and (BC 351 or CHEM 321) and (CHEM 371) and (GES 465, may be taken concurrently or MSE 465, may be taken concurrently).
**Registration Information:** Sections may be offered: Online.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 473 Foundations of Physical Chemistry Credits: 4 (4-0-0)**
**Course Description:** Quantum chemistry; molecular structure and spectroscopy; equilibrium thermodynamics; kinetics.
**Prerequisite:** (CHEM 113) and (MATH 161 or MATH 255 or MATH 271) and (PH 122 or PH 142).
**Registration Information:** Credit allowed for only one of the following CHEM 371, CHEM 473, or CHEM 474.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 474 Physical Chemistry I Credits: 3 (3-0-0)**
**Course Description:** Quantum chemistry; applications to bonding, molecular structure, and spectroscopy.
**Prerequisite:** (CHEM 113) and (MATH 261 or MATH 272) and (PH 142).
**Registration Information:** Credit allowed for only one of the following CHEM 371, CHEM 473, or CHEM 474.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 475 Physical Chemistry Laboratory I Credit: 1 (0-3-0)**
**Course Description:** Physiochemical experiments; emphasis on quantum mechanics/spectroscopy; interpretation/presentation of data; formal lab reports.
**Prerequisite:** (CBE 310, may be taken concurrently or CHEM 473, may be taken concurrently or CHEM 474, may be taken concurrently) and (CHEM 334).
**Registration Information:** Credit not allowed for both CHEM 372 and CHEM 475.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 476 Physical Chemistry II Credits: 3 (3-0-0)**
**Course Description:** Statistical thermodynamics; applications to phase and chemical equilibria; kinetics.
**Prerequisite:** CHEM 371 or CHEM 474.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 477 Physical Chemistry Laboratory II Credit: 1 (0-3-0)**
**Course Description:** Physiochemical experiments; emphasis on thermodynamics/statistical mechanics/kinetics; interpretation/presentation of data; formal lab reports.
**Prerequisite:** CHEM 475.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** Yes.

**CHEM 487 Internship Credits: Var[1-12] (0-0-0)**
**Course Description:** Supervised work experience in approved off-campus chemical laboratory setting. Consultation with faculty adviser/instructor.
**Prerequisite:** CHEM 476.
**Registration Information:** Maximum of 12 credits allowed for any combination of CHEM 384, CHEM 487, CHEM 495, and CHEM 498.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 493 Senior Seminar Credits: 2 (0-0-2)**
**Course Description:** Critical analysis of selected literature; develop presentation of technical topic; required oral presentation.
**Prerequisite:** CHEM 371 or CHEM 473 or CHEM 474.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 495 Independent Study Credits: Var[1-3] (0-0-0)**
**Prerequisite:** CHEM 100 to 499 - at least 9 credits.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 498 Research Credits: Var[1-3] (0-0-0)**
**Prerequisite:** CHEM 100 to 499 - at least 20 credits.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 499 Senior Thesis Credits: 2 (0-0-2)**
**Course Description:** Preparation of a written thesis and an oral defense, based upon undergraduate research performed or an internship experience, under the guidance of a thesis advisor and thesis committee.
**Prerequisite:** CHEM 487 or CHEM 498.
**Registration Information:** Senior standing. Written consent of department chair.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 511 Solid State Chemistry Credits: 3 (3-0-0)**
**Course Description:** Physical and descriptive chemistry of solids including characterization and synthetic methods.
**Prerequisite:** CHEM 461 and CHEM 476.
**Term Offered:** Fall (odd years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 515 Polymer Chemistry Credits: 3 (3-0-0)**
**Course Description:** Fundamentals of polymer chemistry: synthesis, characterization, physical properties.
**Prerequisite:** CHEM 346 and CHEM 476.
**Term Offered:** Fall (odd years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 517 Chemistry of Electronic Materials Credits: 3 (3-0-0)**
**Course Description:** Chemical aspects of preparation and processing of materials in electronic devices, "molecular electronics," and nanostructured materials.
**Prerequisite:** CHEM 571A, may be taken concurrently or CHEM 571B, may be taken concurrently.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 521 Principles of Chemical Biology Credits: 3 (3-0-0)**
**Also Offered As:** BC 521.
**Prerequisite:** CHEM 245 or CHEM 343 or CHEM 346.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 522 Methods of Chemical Biology Credits: 2 (2-0-0)**
**Course Description:** Approaches to quantitative chemical biology, visualization, study and characterization of macromolecules and macromolecular-dependent processes.
**Prerequisite:** BC 351 with a minimum grade of B or BC 401 with a minimum grade of B.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 530A Advanced Topics in Chemical Analysis: Environmental Chemical Analysis Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 431, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 530B Advanced Topics in Chemical Analysis: Absorption and Emission Spectroscopy Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 431, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 530C Advanced Topics in Chemical Analysis: Bioanalytical Chemistry Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 431, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 530D Advanced Topics in Chemical Analysis: Statistical Analysis in Analytical Chemistry Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 431, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 530E Advanced Topics in Chemical Analysis: Mass Spectrometry Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 431, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 530F Advanced Topics in Chemical Analysis: Analysis of Materials Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 431, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 532 Advanced Chemical Analysis II Credits: 3 (3-0-0)**
**Course Description:** Advanced optics; instrumentation and methodology for analytical spectroscopy; computer applications.
**Prerequisite:** CHEM 431.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 533 Chemical Separations Credits: 3 (3-0-0)**
**Course Description:** Fundamentals and applications of chemical separations.
**Prerequisite:** CHEM 335 and CHEM 431.
**Terms Offered:** Fall, Spring (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 537 Electrochemical Methods Credits: 3 (3-0-0)**
**Course Description:** Theory and methods of electrochemistry; applications of modern electrochemical techniques.
**Prerequisite:** CHEM 431.
**Term Offered:** Spring (odd years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 539A Principles of NMR and MRI: Basic NMR Principles Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 474.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 539B Principles of NMR and MRI: NMR Diffusion Measurements-2D NMR and MRI Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 474.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 539C Principles of NMR and MRI: Advanced NMR and MRI Techniques Credit: 1 (1-0-0)**
**Course Description:**
**Prerequisite:** CHEM 474.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 541 Organic Molecular Structure Determination Credits: 2 (2-0-0)**
**Course Description:** Determination of organic molecular structure by spectroscopic methods.
**Prerequisite:** CHEM 440.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 543 Structure/Mechanisms in Organic Chemistry Credits: 2 (2-0-0)**
**Course Description:** Structure including stereochemistry and conformational isomerism; reactivity and mechanisms in organic chemistry.
**Prerequisite:** CHEM 343 or CHEM 346.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 545 Synthetic Organic Chemistry I Credits: 3 (3-0-0)**
**Course Description:** Reactions and synthesis in organic chemistry.
**Prerequisite:** CHEM 543.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 547 Physical Organic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Mechanisms, theory, kinetics, and thermodynamics.
**Prerequisite:** CHEM 543.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 548 Organometallics in Synthesis Credits: 2 (2-0-0)**
**Course Description:** Fundamental aspects of organometallic chemistry applied to organic synthesis.
**Prerequisite:** CHEM 545.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 549 Synthetic Organic Chemistry II Credits: 2 (2-0-0)**
**Course Description:** Strategies for the total synthesis of natural products.
**Prerequisite:** CHEM 545.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 550A Materials Chemistry: Hard Materials Credit: 1 (1-0-0)**
**Course Description:** Structure and bonding; crystallography; properties; synthesis; characterization of metals, semiconductors, and network solids.
**Prerequisite:** (CHEM 343 or CHEM 346) and (CHEM 461 and CHEM 476).
**Term Offered:** Fall (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 550B Materials Chemistry: Soft Materials Credit: 1 (1-0-0)**
**Course Description:** Structure and bonding, mechanisms, properties, applications, synthesis, characterization of polymers, complex fluids, and biomaterials.
**Prerequisite:** (CHEM 343 or CHEM 346) and (CHEM 461 and CHEM 476).
**Term Offered:** Fall (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 550C Materials Chemistry: Nanomaterials Credit: 1 (1-0-0)**
**Course Description:** Structure and bonding, synthesis, properties, characterization of carbon nanotubes, metal and semiconductor nanocrystals, and nanocomposites.
**Prerequisite:** (CHEM 343 or CHEM 346) and (CHEM 461 and CHEM 476).
**Term Offered:** Fall (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 551 Catalytic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Fundamental aspects of catalytic chemistry applied to homogeneous and heterogeneous systems utilizing molecular catalysts as well as nano and supported catalytic materials.
**Prerequisite:** (CHEM 343 or CHEM 346) and (CHEM 461 and CHEM 476).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 555 Chemistry of Sustainability Credits: 3 (3-0-0)**
**Course Description:** The central role of chemistry for achieving sustainability in key areas including chemicals and materials, energy, and environment.
**Prerequisite:** (BC 411 or CBE 310 or CHEM 476) and (CHEM 343 or CHEM 346).
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 560 Foundations of Inorganic Synthesis Credit: 1 (1-0-0)**
**Prerequisite:** CHEM 461.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 561 Inorganic Synthesis Credits: 2 (2-0-0)**
**Course Description:** Chemistry of compounds of representative elements and transition metals.
**Prerequisite:** CHEM 560, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 563A Physical Methods in Inorganic Chemistry: Group Theory Credit: 1 (1-0-0)**
**Course Description:** Modern experimental methods in inorganic chemistry.
**Prerequisite:** CHEM 461.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 563B Physical Methods in Inorganic Chemistry: Vibrational Spectroscopy Credit: 1 (1-0-0)**
**Course Description:** Modern experimental methods in inorganic chemistry.
**Prerequisite:** CHEM 461.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 563C Physical Methods in Inorganic Chemistry: Electronic Structure and Magnetism Credit: 1 (1-0-0)**
**Course Description:** Modern experimental methods in inorganic chemistry.
**Prerequisite:** CHEM 461.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 563D Physical Methods in Inorganic Chemistry: Magnetic Spectroscopies Credit: 1 (1-0-0)**
**Course Description:** Modern experimental methods in inorganic chemistry.
**Prerequisite:** CHEM 461.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 563E Physical Methods in Inorganic Chemistry: Advanced Nuclear Magnetic Resonance Spectroscopy Credit: 1 (1-0-0)**
**Course Description:** Modern experimental methods in inorganic chemistry.
**Prerequisite:** CHEM 461.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 563F Physical Methods in Inorganic Chemistry: Other Structural Methods Credit: 1 (1-0-0)**
**Course Description:** Modern experimental methods in inorganic chemistry.
**Prerequisite:** CHEM 461.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 565 Inorganic Mechanisms Credits: 3 (3-0-0)**
**Course Description:** Fundamental tools, key principles, selected classic case histories of inorganic and organometallic mechanistic chemistry, emphasizing kinetic methods.
**Prerequisite:** CHEM 476.
**Term Offered:** Fall (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 566 Bioinorganic Chemistry Credits: 3 (3-0-0)**
**Course Description:** Biological-inorganic chemistry, including key principles, prototype systems, classic papers, and problems.
**Prerequisite:** CHEM 461.
**Term Offered:** Spring (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 567 Crystallographic Computation Credit: 1 (1-0-0)**
**Course Description:** Theory and practice of structural computations using single crystal X-ray diffraction data.
**Prerequisite:** CHEM 474 with a minimum grade of C-.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 569 Chemical Crystallography Credits: 3 (3-0-0)**
**Course Description:** Theory and practice of determination of crystal and molecular structure by single crystal X-ray and neutron diffraction.
**Prerequisite:** CHEM 474.
**Term Offered:** Spring (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 570 Chemical Bonding Credits: 3 (3-0-0)**
**Course Description:** Electronic structure methods; chemical bonding models; intermolecular interactions.
**Prerequisite:** CBE 310 or CHEM 474.
**Term Offered:** Fall (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 571A Quantum Chemistry: Foundations Credits: 2 (2-0-0)**
**Course Description:** Simple systems; symmetry; approximate methods; time dependent methods; molecular structures.
**Prerequisite:** CBE 310 or CHEM 474.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 571B Quantum Chemistry: Electronic Structure Credit: 1 (1-0-0)**
**Course Description:** Simple systems; symmetry; approximate methods; time dependent methods; molecular structures.
**Prerequisite:** CHEM 571A, may be taken concurrently.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 573A Chemical Spectroscopy: Interactions of Light and Matter Credit: 1 (1-0-0)**
**Course Description:** Introduction to the fundamentals of spectroscopies used in chemical analysis from the perspective of time dependent quantum mechanics. Time-dependent perturbation theory, absorption and emission of radiation, two-level systems, and electronic, vibrational and rotational transitions.
**Prerequisite:** CHEM 571A.
**Registration Information:** This is a partial semester course.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 573B Chemical Spectroscopy: Electromagnetic Fields in Practice Credit: 1 (1-0-0)**
**Course Description:** Foundation in electromagnetic fields used in chemical spectroscopy. Dispersion and phase, the measurement of electromagnetic fields, properties of short optical pulses, and modulating electromagnetic fields.
**Prerequisite:** CHEM 431.
**Registration Information:** This is a partial semester course.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 573C Chemical Spectroscopy: Condensed Phase Spectroscopy Credits: 2 (2-0-0)**
**Course Description:** Foundations of spectroscopic measurements conducted on condensed phase chemical systems. Use of quantum mechanics and statistical mechanics to describe Response Theory, density matrix formalism, correlation functions, line shapes and spectral fluctuations, response functions, and the use of polarization in spectroscopy.
**Prerequisite:** CHEM 571A and CHEM 576.
**Registration Information:** This is a partial semester course.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 573D Chemical Spectroscopy: Nonlinear Spectroscopy Credit: 1 (1-0-0)**
**Course Description:** Foundations of multidimensional spectroscopic measurements conducted on chemical systems.
**Prerequisite:** CHEM 573A and CHEM 573C.
**Registration Information:** This is a partial semester course.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 573E Chemical Spectroscopy: Spectroscopic Instrumentation Credit: 1 (1-0-0)**
**Course Description:** Instrumentation used to carry out spectroscopic measurements in chemistry research. Lasers and other light sources, optics, and detectors, spectroscopic techniques, and electronic and digital interfacing specific to spectroscopic instrumentation.
**Prerequisite:** CHEM 431.
**Registration Information:** This is a partial semester course.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 573F Chemical Spectroscopy: Computational Spectroscopy Credit: 1 (1-0-0)**
**Course Description:** Theory and computational techniques to compute and analyze molecular spectra, including aspects of quantum mechanics and statistical mechanics. Emphasis on implementation and computation of molecular spectra.
**Prerequisite:** CHEM 571A and CHEM 571B and CHEM 575 and CHEM 576.
**Registration Information:** This is a partial semester course.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 575 Fundamentals of Chemical Thermodynamics Credit: 1 (1-0-0)**
**Course Description:** Fundamental thermodynamic concepts and some applications to chemical problems.
**Prerequisite:** CBE 310 or CHEM 476 or PH 361.
**Registration Information:** This is a partial-semester course.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 576 Statistical Mechanics Credits: 2 (2-0-0)**
**Course Description:** Principles of statistical mechanics with applications to chemical systems.
**Prerequisite:** CHEM 575, may be taken concurrently.
**Registration Information:** This is a partial-semester course.
**Term Offered:** Fall.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 577 Surface Chemistry Credits: 3 (3-0-0)**
**Course Description:** Capillarity; interfacial thermodynamics, electrical aspects of surface chemistry, absorbed layers.
**Prerequisite:** CBE 310 or CHEM 476.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 578A Computational Chemistry: Electronic Structure Credit: 1 (1-0-0)**
**Course Description:** Electronic structure calculations of energetic and structural properties of molecules and chemical reactions.
**Prerequisite:** CHEM 571A and CHEM 571B.
**Registration Information:** This is a partial semester course.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 578B Computational Chemistry: Molecular Dynamics Credit: 1 (1-0-0)**
**Course Description:** Molecular Dynamics simulations of liquids to compute static and time dependent properties. Applications include biological and materials chemistry.
**Prerequisite:** CHEM 576.
**Registration Information:** This is a partial semester course.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 579 Chemical Kinetics Credits: 3 (3-0-0)**
**Course Description:** Elementary reactions, unimolecular reactions, reactions in solution, gas phase ion chemistry, photochemistry, and kinetic modeling.
**Prerequisite:** CBE 310 or CHEM 476.
**Term Offered:** Fall (odd years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 601 Responsible Conduct in Chemistry Research Credit: 1 (1-0-0)**
**Course Description:** Appropriate conduct in research, publishing, intellectual property decisions, job hunting, and negotiating; social responsibilities of scientists.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Term Offered:** Spring (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 641 Organic Reaction Mechanisms Credits: 2 (2-0-0)**
**Course Description:** Organic reaction mechanisms, including using arrows to show electron movement; heterolytic, radical, and pericyclic reactions.
**Prerequisite:** CHEM 545.
**Restriction:** Must be a: Graduate, Professional.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 651A Special Topics in Chemistry: Analytical Chemistry Credits: Var[1-4] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Written consent of instructor.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 651B Special Topics in Chemistry: Inorganic Chemistry Credits: Var[1-4] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Written consent of instructor.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 651C Special Topics in Chemistry: Organic Chemistry Credits: Var[1-4] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Written consent of instructor.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 651D Special Topics in Chemistry: Physical Chemistry Credits: Var[1-4] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Written consent of instructor.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 651E Special Topics in Chemistry: Materials Chemistry Credits: Var[1-4] (0-0-0)**
**Course Description:** Discussion of current topics in materials chemistry.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Written consent of instructor.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 651F Special Topics in Chemistry: Chemical Biology Credits: Var[1-4] (0-0-0)**
**Course Description:** Discussion of current topics in chemical biology.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Written consent of instructor.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 651G Special Topics in Chemistry: Chemistry Education Credits: Var[1-4] (0-0-0)**
**Course Description:** Discussion of current topics in chemistry education.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Written consent of instructor.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 695 Independent Study Credits: Var[1-3] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 698 Research Credits: Var[1-9] (0-0-0)**
**Course Description:** Graduate research in chemistry for students who do not plan to write an M.S. thesis.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Graduate standing in chemistry.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 699 Thesis Credits: Var[1-15] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 702 Independent Research Proposal Credit: 1 (0-0-1)**
**Course Description:** Preparation, submission, and defense of an independent research proposal; creative and original thinking about research problems in modern chemistry.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Registration Information:** Admission to Ph.D. candidacy.
**Terms Offered:** Fall, Spring.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 751 Methods of Chemistry Laboratory Instruction Credit: 1 (1-0-0)**
**Course Description:** Basic materials, methods, and skill development related to teaching undergraduate chemistry laboratory courses.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Term Offered:** Fall.
**Grade Mode:** S/U Sat/Unsat Only.
**Special Course Fee:** No.

**CHEM 752 Advanced Chemical Instruction Credit: 1 (0-0-1)**
**Course Description:** Advanced materials, methods, and presentation skills development related to teaching undergraduate chemistry courses.
**Prerequisite:** CHEM 751.
**Restriction:** Must be a: Graduate, Professional.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 773 Atomic and Molecular Spectroscopy Credits: 3 (3-0-0)**
**Course Description:** Time-dependent methods; multiphoton and nonlinear spectroscopy; fundamentals of rotational, vibrational, electronic and magnetic resonance spectroscopy.
**Prerequisite:** CHEM 571A or CHEM 571B.
**Restriction:** Must be a: Graduate, Professional.
**Term Offered:** Spring (even years).
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 775 Pillars of Physical Chemistry Credit: 1 (1-0-0)**
**Course Description:** Fundamental concepts in physical chemistry through reading and discussing primary literature.
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Term Offered:** Spring.
**Grade Mode:** Traditional.
**Special Course Fee:** No.

**CHEM 784 Supervised College Teaching Credits: Var[1-2] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 793 Seminar Credit: 1 (0-0-1)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 795A Independent Study: Inorganic Chemistry Credits: Var[1-5] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 795B Independent Study: Analytical Chemistry Credits: Var[1-5] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 795C Independent Study: Biological Chemistry Credits: Var[1-5] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 795D Independent Study: Physical Chemistry Credits: Var[1-5] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.

**CHEM 799 Dissertation Credits: Var[1-15] (0-0-0)**
**Course Description:**
**Prerequisite:** None.
**Restriction:** Must be a: Graduate, Professional.
**Terms Offered:** Fall, Spring, Summer.
**Grade Mode:** Instructor Option.
**Special Course Fee:** No.