

CHEMISTRY (CHEM)

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CHEM Courses

CHEM 1102 Introduction to the Chemical Sciences (1 unit)

Term Typically Offered: F

CR/NC

Prerequisite: Biochemistry or Chemistry major.

Introduction to the chemistry and biochemistry disciplines. Orientation, advising, career opportunities, and introduction to the faculty. Designed for first-year biochemistry and chemistry majors. Credit/No Credit grading only. 1 lecture. Formerly CHEM 101.

CHEM 1103 Research Methods I (1 unit)

Term Typically Offered: F, SP

CR/NC

Prerequisite: One of the following: CHEM 124, CHEM 125, CHEM 1120, or CHEM 1122.

Introduction to experimental and computational methods for laboratory research in the chemical sciences including experimental design, procedure optimization, data evaluation, and presentation of results. Designed for first-year biochemistry and chemistry majors. Credit/No Credit grading only. 1 laboratory.

CHEM 1110 World of Chemistry (4 units)

Term Typically Offered: F, SP, SU

2026-28 or later catalog: GE Area 5A

2026-28 or later catalog: GE Area 5C

2020-26 catalogs: GE Area B1

2020-26 catalogs: GE Area B3

Prerequisite: MATH 115, MATH 1000, or appropriate Math Placement Level.

The fundamentals of chemical cause/effect and structure/function relationships. The basic principles of chemistry and their applications to solving human problems in areas such as toxicology, environmental science, agriculture, nutrition, forensics, and medicine. Not open for major credit in Biochemistry or Chemistry. Not open to students with credit in CHEM 111, CHEM 124, CHEM 125, CHEM 127, CHEM 1120, or CHEM 1122. 3 lectures, 1 laboratory. Fulfills GE Areas 5A and 5C (GE Areas B1 and B3 for students on the 2020-26 catalogs. Formerly CHEM 110.

CHEM 1112 Chemistry in Context (3 units)

Term Typically Offered: F, SP

2026-28 or later catalog: GE Area 5A

2020-26 catalogs: GE Area B1

Exploration of fundamental chemical principles relevant to engineering applications. Atomic structure, bonding, stoichiometry, acid-base and redox reactions, kinetics, thermodynamics, chemical equilibrium, and electrochemistry. Role of chemistry in energy production, materials science, agriculture, and environmental technology. Not open for major credit in Biochemistry or Chemistry. Course may be offered in classroom-based or online format. 3 lectures. Fulfills GE Area 5A (GE Area B1 for students on the 2020-26 catalogs).

CHEM 1120 Fundamentals of Chemical Structure and Properties (4 units)

Term Typically Offered: F, SP, SU

2026-28 or later catalog: GE Area 5A

2026-28 or later catalog: GE Area 5C

2020-26 catalogs: GE Area B1

2020-26 catalogs: GE Area B3

Atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, molecular structure, and intermolecular forces. Theoretical concepts and experimental methods for distinguishing kinds of substances, determining the structure of substances, predicting properties of substances based on their underlying structure, and quantifying chemical processes. Not open to students with credit in CHEM 124 or CHEM 127. 3 lectures, 1 laboratory. Fulfills GE Areas 5A and 5C (GE Areas B1 and B3 for students on the 2020-26 catalogs). CHEM 1120 is equivalent to CHEM 124 and CHEM 127, students may not earn credit for CHEM 1120 if they have earned credit for CHEM 124 or CHEM 127.

CHEM 1122 Fundamentals of Chemical Reactivity (4 units)

Term Typically Offered: F, SP

2026-28 or later catalog: GE Area 5A

2026-28 or later catalog: GE Area 5C

2020-26 catalogs: GE Area B1

2020-26 catalogs: GE Area B3

Prerequisite: One of the following: MATH 118, MATH 330, MATH 1006, or MATH 3482.

Introduction to solution chemistry, thermodynamics, kinetics, equilibrium (including acids and bases), and electrochemistry. Not open to students with credit in CHEM 126 or CHEM 129. 3 lectures, 1 laboratory. Fulfills GE Areas 5A and 5C (GE Areas B1 and B3 for students on the 2020-26 catalogs). CHEM 1122 is equivalent to CHEM 125 or CHEM 128, students may not earn credit for CHEM 1122 if they have earned credit for CHEM 126 or CHEM 129.

CHEM 2200 Special Problems for Undergraduates (1-2 units)

Term Typically Offered: TBD

Prerequisite: One of the following: CHEM 124, CHEM 127, CHEM 1120, or CHEM 1122; and consent of department chair.

Individual investigation, research, studies, or surveys of selected problems. Repeatable up to 4 units. Formerly CHEM 200.

CHEM 2201 Undergraduate Research (1-2 units)

Term Typically Offered: F, SP, SU

CR/NC

Prerequisite: Consent of instructor.

Research under faculty supervision. Credit/No Credit grading only. Repeatable up to 7 units. Formerly CHEM 201.

CHEM 2202 Undergraduate Seminar I (1 unit)

Term Typically Offered: TBD

CR/NC

Prerequisite: CHEM 124 or CHEM 1120; and CHEM 125 or CHEM 1122.

Introduction to basic scientific literature and scientific presentation skills. Targeted advising and preparation for research and career opportunities. Designed for second-year students majoring in biochemistry or chemistry. Credit/No Credit grading only. 1 seminar. Formerly CHEM 203.

CHEM 2203 Research Methods II (1 unit)

Term Typically Offered: F, SP

CR/NC

Prerequisite: CHEM 1103.

An intermediate exploration of core principles of research in chemistry and biochemistry in a laboratory setting. A deeper dive into scientific practices, primary literature, laboratory safety and protocols, scientific communication, and scientific ethics. Credit/No Credit grading only. 1 laboratory.

CHEM 2220 Inorganic Chemistry I: D-Block Chemistry (3 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 124 or CHEM 1120; and CHEM 125 or CHEM 1122.

Introduction to the structural and electronic features of transition metals that control the reactivity and physical properties of transition metal complexes. Coordination chemistry, electrochemistry, Lewis acid/base relationships, solid-state structures, ligand field theory, and simple applications of group theory. 3 lectures.

CHEM 2221 Inorganic Chemistry I Laboratory (1 unit)

Term Typically Offered: F, SP

Prerequisite: CHEM 124 or CHEM 1120; and CHEM 125 or CHEM 1122. Corequisite: CHEM 2220.

Introductory application of methods and theory to study the structural and electronic features of transition metal compounds, and to control the reactivity and physical properties of transition metal complexes. Coordination chemistry, electrochemistry, Lewis acid/base relationships, solid state structures, ligand field theory, and simple applications of group theory. 1 laboratory.

CHEM 2240 Organic Chemistry: Fundamentals and Applications (4 units)

Term Typically Offered: F, SP, SU

Prerequisite: CHEM 124, CHEM 128, or CHEM 1120.

Structure, isomerism, nomenclature, fundamental reactions of major functional groups and applications of organic chemicals in agriculture, medicine, industry, and the home. Not open to students with credit in CHEM 216 or CHEM 2242. 3 lectures, 1 laboratory. Replaced CHEM 312.

CHEM 2242 Organic Chemistry I (5 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 124 or CHEM 1120 with a grade of C- or better and CHEM 125 or CHEM 1122 with a grade C- or better; or CHEM 126 or CHEM 129 with a grade of C- or better; or consent of instructor.

Foundational concepts and laboratory skills in organic chemistry. Structure, bonding, nomenclature, isomerism, stereochemistry and physical properties of organic compounds. Spectroscopic methods. Reactivity and reaction mechanisms of essential functional group transformations. Fundamental laboratory techniques in organic chemistry. 4 lectures, 1 laboratory. Formerly CHEM 216.

CHEM 2244 Organic Chemistry II (4 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 216 or CHEM 2242 with a grade of C- or better or consent of instructor.

Intermediate concepts and laboratory skills in organic chemistry. Reactions and properties of alcohols, epoxides, aromatic compounds, amines, and enolates/enols. In-depth treatment of reaction mechanisms, multi-step organic synthesis, molecular orbital theory, pericyclic reactions. 3 lectures, 1 laboratory. Formerly CHEM 217.

CHEM 2252 Orientation to Biotechnology (2 units)

Term Typically Offered: TBD

Prerequisite: Completion of one course with a BIO, BOT, or MCRO prefix; and completion of one course with a CHEM prefix.

Introduction to the diversity of fields in biotechnology. Applications of biotechnology methods to agricultural, pharmaceutical, nutritional, medicinal, and environmental problems and systems. Course may be offered in classroom-based or hybrid format. 2 lectures. Crosslisted as BIO/CHEM 2252. Formerly BIO/CHEM 202.

CHEM 2270 Special Topics (1-3 units)

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of special topics. The Class Schedule will list topic selected. Repeatable up to 6 units. Course may be offered in classroom-based, online, or hybrid format. 1 to 3 lectures. Formerly CHEM 270.

CHEM 3302 Undergraduate Seminar II (1 unit)

Term Typically Offered: F, SP

CR/NC

Prerequisite: Junior standing; and CHEM 203 or CHEM 2202.

Advanced exploration of more sophisticated scientific literature and scientific presentation skills. Targeted advising and preparation for research and career opportunities. Designed for third-year biochemistry and chemistry majors. Credit/No Credit grading only. 1 seminar. Formerly CHEM 303.

CHEM 3318 Genetic Engineering Technology (3 units)

Term Typically Offered: F

2026-28 or later: Upper-Div GE Area 2/5

2020-26 catalogs: Upper-Div GE Area B

Prerequisite: Junior standing; completion of GE Area 1 with grades of C- or better (GE Area A for the 2020-26 catalogs); completion of GE Area 2 with a grade of C- or better (GE Area B4 for the 2020-26 catalogs); completion of GE Area 5 (GE Areas B1 to B3 for the 2020-26 catalogs); and one of the following courses: CHEM 110, CHEM 124, CHEM 127, CHEM 1110, CHEM 1112, CHEM 1120, or CHEM 1122.

Introduction to the biology, methodology, and techniques used in genetic engineering. Potential benefits and problems in application within agriculture, nutrition, medicine and environmental context, including the underlying ethical questions. Not open to students with credit in CHEM 373 or CHEM 3356, or to Biological Sciences major or Microbiology major. 3 lectures. Crosslisted as BIO/CHEM 3318. Fulfills GE Areas Upper-Division 2 or Upper-Division 5 (GE Area Upper-Division B for students on the 2020-26 catalogs). Formerly BIO/CHEM 308.

CHEM 3320 Inorganic Chemistry II: Group Theory and Spectroscopy (3 units)

Term Typically Offered: SP

Prerequisite: CHEM 2220.

Exploration of advanced topics in the field of Inorganic Chemistry, focusing on the implications of d-orbitals on spectroscopy and bonding. The application of Group Theory to spectroscopic problems and molecular orbitals, electrochemistry as a means to probe reactivity, an introduction to organometallic mechanisms, and solid state structures. 3 lectures.

CHEM 3321 Inorganic Chemistry II Laboratory (2 units)

Term Typically Offered: SP

Prerequisite: CHEM 2221. Corequisite: CHEM 3320.

Laboratory course covering advanced topics in the field of Inorganic Chemistry, focusing on the implications of d-orbitals on spectroscopy and bonding. Experiments will cover coordination chemistry, principles of absorption spectroscopy, inorganic synthesis of transition metal complexes, and electrochemistry of transition metal complexes. 2 laboratories.

CHEM 3330 Foundations of Chemical Analysis (4 units)

Term Typically Offered: F, SP, SU

Prerequisite: CHEM 125, CHEM 129, or CHEM 1120 and CHEM 1122.

Theory and application of chemical equilibrium to analytical problems. Survey of important analytical methods with stress placed on the theory and application associated with titrimetric and spectrophotometric analysis. Course may be offered in class-room based or hybrid format. 2 lectures, 2 laboratories. Formerly CHEM 331.

CHEM 3350 Biochemistry: Fundamentals and Applications (4 units)

Term Typically Offered: F, SP

2026-28 or later: Upper-Div GE Area 2/5

2020-26 catalogs: Upper-Div GE Area B

Prerequisite: Junior standing; completion of GE Area 1 with grades of C- or better (GE Area A for the 2020-26 catalogs); completion of GE Area 5A (GE Area B1 for the 2020-26 catalogs); completion of GE Area 5B (GE Area B2 for the 2020-26 catalogs); completion of GE Area 2 with a grade of C- or better (GE Area B4 for the 2020-26 catalogs); and one of the following courses: CHEM 212, CHEM 216, CHEM 312, CHEM 2240, or CHEM 2242.

Chemistry of biomolecules including carbohydrates, proteins, lipids, vitamins, enzymes and hormones. Basic molecular biology with applications to biotechnology and genetic engineering. Practical intermediary metabolism of prokaryotic and eukaryotic systems. 3 lectures, 1 laboratory. Fulfills GE Areas Upper-Division 2 or Upper-Division 5 (GE Area Upper-Division B for students on the 2020-26 catalogs). Formerly CHEM 314.

CHEM 3352 Biochemistry (4 units)

Term Typically Offered: F, SP

2026-28 or later: Upper-Div GE Area 2/5

2020-26 catalogs: Upper-Div GE Area B

Prerequisite: Junior standing; completion of GE Area 1 with grades of C- or better (GE Area A for the 2020-26 catalogs); completion of GE Area 5A (GE Area B1 for the 2020-26 catalogs); completion of GE Area 2 with a grade of C- or better (GE Area B4 for the 2020-26 catalogs); BIO 161 or BIO 1151; and CHEM 216 or CHEM 2242.

Chemistry and function of major cellular constituents: proteins, lipids, carbohydrates, nucleic acids, and membranes. Mechanisms of protein and enzyme function and regulation. Mechanisms and analysis of biomolecular binding interactions. Introduction to gene regulation and bioenergetics. 3 lectures, 1 laboratory. Fulfills GE Areas Upper-Division 2 or Upper-Division 5 (GE Area Upper-Division B for students on the 2020-26 catalogs). Formerly CHEM 369.

CHEM 3354 Metabolism (3 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 369 or CHEM 3352.

Intermediary metabolism of carbohydrates, lipids, amino acids and nucleotides, regulation and integration of metabolic pathways, bioenergetics, photosynthesis, electron transport, nitrogen fixation, and biochemical function of vitamins and minerals. 3 lectures. Formerly CHEM 372.

CHEM 3356 Genetic Information Processing (4 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 369 or CHEM 3352.

Structure of nucleic acids and chromosomes. Genome transmission. Mechanisms and regulation of nucleic acid and protein synthesis in prokaryotes and eukaryotes. Molecular biology techniques. Not open to students with credit in MCRO 3351. 3 lectures, 1 laboratory. Formerly CHEM 373.

CHEM 3370 Marine Chemistry (3 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 124 or CHEM 1120; CHEM 125 or CHEM 1122; and one of the following: CHEM 216, CHEM 312, CHEM 2240, or CHEM 2242.

Introduction to chemical processes in the ocean including distributions and reactivity of elements in seawater, the oceanic carbon and nutrient cycles, coastal and estuarine chemistry, and anthropogenic impacts on seawater. 3 lectures. Formerly CHEM 302.

CHEM 3372 Environmental Chemistry (3 units)

Term Typically Offered: TBD

Prerequisite: CHEM 124 or CHEM 1120; and one of the following: CHEM 216, CHEM 312, CHEM 2240, or CHEM 2242.

Chemical aspects of air, water, and soil pollution; remediation and green chemistry. Alkalinity, acid deposition, climate change, drinking and wastewater treatment, energy sources, eutrophication, pesticides, ozone depletion, smog and air particulates, toxic inorganic and organic compounds, and hazardous wastes. Field trip may be required. 3 lectures. Formerly CHEM 341.

CHEM 3374 Chemical and Biological Warfare (3 units)

Term Typically Offered: F, SP

2026-28 or later: Upper-Div GE Area 2/5

2020-26 catalogs: Upper-Div GE Area B

Prerequisite: Junior standing; completion of GE Area 1 with grades of C- or better (GE Area A for the 2020-26 catalogs); completion of GE Area 2 with a grade of C- or better (GE Area B4 for the 2020-26 catalogs); completion of one CHEM course in GE Area 5A (GE Area B1 for the 2020-26 catalogs); and completion of GE Area 5B (GE Area B2 for the 2020-26 catalogs).

History, development, and use of chemical and biological warfare (CBW). Chemical and biological disarmament. Production and destruction of CBW agents. CBW terrorism. Ethics of CBW. 1 lecture, 2 seminars. Fulfills GE Areas Upper-Division 2 or Upper-Division 5 (GE Area Upper-Division B for students on the 2020-26 catalogs). Formerly CHEM 349.

CHEM 3380 Foundations of Macromolecular Chemistry (4 units)

Term Typically Offered: SP

Prerequisite: CHEM 124 or CHEM 1120; and one of the following: CHEM 125, CHEM 1122, MATE 280, or MATE 2280.

Overview of macromolecular chemistry encompassing synthesis and properties of synthetic polymer materials and biomacromolecules. Molecular weight averages, synthetic methods, physical properties, solution state properties, and special applications. Sustainability, polymer recycling, and the twelve principles of green chemistry. 3 lectures, 1 laboratory.

CHEM 3390 Physical Chemistry for Life Sciences (3 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 1103; CHEM 124 or CHEM 1120; CHEM 125 or CHEM 1122; and one of the following: MATH 121, MATH 143, MATH 1262, or MATH 1264.

Basic physical chemistry for the study of chemical and biochemical systems. Principles of thermodynamics, chemical kinetics in aqueous systems, energy levels in quantum systems. Application of these principles to living systems. 3 lectures. Formerly CHEM 351.

CHEM 3391 Physical Chemistry for Life Sciences Laboratory (1 unit)

Term Typically Offered: F, SP

Corequisite: CHEM 351 or CHEM 3390.

Basic physical chemistry laboratory for the study of chemical and biochemical systems. Experimental studies of solutions, thermochemistry, chemical and phase equilibria, diffusion, viscosity, chemical kinetics, computational methods, and applications to chemistry and biochemistry. Written communication of scientific results using applicable literature and databases. 1 laboratory.

CHEM 3392 Physical Chemistry I (3 units)

Term Typically Offered: F

Prerequisite: CHEM 1103; CHEM 124 or CHEM 1120; CHEM 125 or CHEM 1122; and one of the following: MATH 123, MATH 143, MATH 1262, MATH 1263, or MATH 1265.

Foundations of physical chemistry, including quantum mechanics, quantum mechanical model systems, molecular orbital theory, and statistical thermodynamics. 3 lectures. Formerly CHEM 353.

CHEM 3393 Physical Chemistry Laboratory I (1 unit)

Term Typically Offered: F

Corequisite: CHEM 353 or CHEM 3392.

Foundations of physical chemistry laboratory to cover topics in quantum mechanics, statistical mechanics, and statistical thermodynamics. Activities includes computation, programming, and spectroscopy. 1 laboratory. Formerly CHEM 357.

CHEM 3394 Physical Chemistry II (3 units)

Term Typically Offered: SP

Prerequisite: CHEM 353 or CHEM 3392.

Physical chemistry for the study of chemical and biochemical systems. Principles of thermodynamics, kinetic molecular theory, and chemical kinetics. 3 lectures. Formerly CHEM 352.

CHEM 3395 Physical Chemistry Laboratory II (2 units)

Term Typically Offered: SP

Corequisite: CHEM 352 or CHEM 3394.

Foundations of physical chemistry laboratory to cover topics in thermodynamics, chemical and phase equilibria, solutions, chemical kinetics, computational methods and applications to chemistry and biochemistry. Written communication of scientific results using applicable literature and databases. 2 laboratories.

CHEM 4400 Special Problems for Advanced Undergraduates (1-2 units)

Term Typically Offered: TBD

Prerequisite: Junior standing and consent of department chair.

Individual investigation, research, studies, or surveys of selected problems. Repeatable up to 4 units. Formerly CHEM 400.

CHEM 4401 Advanced Undergraduate Research (1-2 units)

Term Typically Offered: F, SP, SU

Prerequisite: Consent of instructor.

Research under faculty supervision. Repeatable up to 7 units. Formerly CHEM 401.

CHEM 4404 Learning Assistant Seminar (2 units)

Term Typically Offered: F, SP

CR/NC

Prerequisite: Consent of instructor.

Pedagogical instruction and introduction to education research for Chemistry Learning Assistants. Effective questioning, the effect of explanatory knowledge on student learning, student misconceptions in chemistry, collaborative problem solving techniques in chemistry, studio curriculum development, content in the general chemistry curriculum. Repeatable up to 4 units. Credit/No Credit grading only. 2 seminars. Formerly CHEM 466.

CHEM 4415 College Teaching Practicum (1-2 units)

Term Typically Offered: F, SP

CR/NC

Prerequisite: Consent of instructor and department chair approval.

Teaching assignment in an undergraduate college classroom. Includes teaching and related activities under the direction of a permanent faculty member in the Department of Chemistry and Biochemistry. Credit/No Credit grading only. Repeatable up to 4 units. Formerly CHEM 465.

CHEM 4420 Inorganic Chemistry III: Transition Metals in Context (2 units)

Term Typically Offered: F

Prerequisite: CHEM 3320.

Study of the applications of transition metal complexes in the context of bioinorganic chemistry, organometallic chemistry, materials chemistry, and computational chemistry. 2 lectures.

CHEM 4430 Instrumental Analysis (5 units)

Term Typically Offered: SP

Prerequisite: CHEM 331 or CHEM 3330; and one of the following: CHEM 356, CHEM 357, CHEM 3391, or CHEM 3393.

Theory, practice, method selection, and method development of quantitative and qualitative modern instrumental analytical techniques, including spectrophotometric methods, mass spectrometry, chromatographic methods, and electrochemical methods. 3 lectures, 2 laboratories. Formerly CHEM 439.

CHEM 4432 Advanced Techniques in Chemical Analysis (2 units)

Term Typically Offered: TBD

Prerequisite: CHEM 331 or CHEM 3330; and CHEM 356, CHEM 3391, or CHEM 3393.

Advanced techniques in chemical analysis, including modern instrumental methods, instrument design and construction, applications of modern methods to analysis of complex chemical samples, and current trends and challenges in the field of analytical chemistry. 2 lectures.

CHEM 4440 Advanced Organic Chemistry - Mechanisms (2 units)

Term Typically Offered: TBD

Prerequisite: CHEM 218 or CHEM 2244.

A mechanistic study of organic reactions. Correlation of structure with reactivity, reaction intermediates and species involved in reactions, and methods of probing reaction mechanisms. 2 lectures. Formerly CHEM 414.

CHEM 4442 Advanced Organic Chemistry - Synthesis (2 units)

Term Typically Offered: SP

Prerequisite: CHEM 218 or CHEM 2244.

Modern methods of organic synthesis. Carbon-carbon bond forming reactions, functional group transformations, protecting groups, strategies to synthesize complex molecules such as pharmaceuticals and natural products. Course may be offered in classroom-based or online format. 2 lectures. Formerly CHEM 420.

CHEM 4444 Advanced Organic Chemistry Laboratory (2 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 218 or CHEM 2244.

Advanced organic laboratory experimentation and characterization techniques. Inert-atmosphere chemical reactions, chromatography, 2-dimensional NMR spectroscopy, heteronuclear NMR spectroscopy, mass spectrometry, and multi-step synthesis. 2 laboratories. Formerly CHEM 458.

CHEM 4450 Nutritional Biochemistry (2 units)

Term Typically Offered: SP

Prerequisite: One of the following: CHEM 314, CHEM 369, CHEM 3350, or CHEM 3352.

Nutritional aspects of biochemistry. Essential and energy providing nutrients, vitamins and minerals, deficiencies, degenerative and genetic diseases of metabolism, hormones and brain chemistry, and other current topics. Nutritional claims made by popular media and nonscientific courses will be evaluated critically and contrasted with principles of evidence-based nutrition science. 2 lectures. Formerly CHEM 428.

CHEM 4451 Bioinformatics Applications (4 units)

Term Typically Offered: F

Prerequisite: One of the following: BIO 302, BIO 351, BIO 3312, BIO 3351, CHEM 373, CHEM 3356, or MCRO 3351; or graduate standing in Biological Sciences.

Introduction to new problems in molecular biology and current computer applications for genetic database analyses. Use of software for nucleic acid, genome and protein sequence analysis, genetic databases, database tools, industrial applications in bioinformatics, and ethical and societal concerns. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. Crosslisted as BIO/CHEM 4451. Formerly BIO/CHEM 441.

CHEM 4452 Physical Biochemistry Methods and Applications (2 units)

Term Typically Offered: SP

Prerequisite: CHEM 369 or CHEM 3352; and CHEM 351 or CHEM 3390.

Principles of biochemistry and physical chemistry applied to structure and function of biomacromolecules. Emphasis on the techniques used in the study of protein/ligand binding, macromolecular structure and dynamics, and on understanding current literature. 2 lectures. Formerly CHEM 432.

CHEM 4453 Molecular Biology Techniques (2 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 373 or CHEM 3356.

Experiments in molecular biology and biotechnology. Nucleic acid purification and characterization, oligonucleotide design, polymerase chain reaction, molecular cloning, gene editing, and sequencing analysis. Not open to students with credit in BIO 475, BIO 4457, or CHEM 475. 2 laboratories.

CHEM 4454 Protein Techniques (2 units)

Term Typically Offered: F, SP

Prerequisite: CHEM 369 or CHEM 3352.

Experiments in protein purification and analysis from recombinant sources. Ion-exchange and affinity chromatography, and electrophoresis and blotting. UV, chemical, immune, and fluorescent detection. Enzyme kinetic analysis. 2 laboratories. Formerly CHEM 474.

CHEM 4456 Chemical Biology (2 units)

Term Typically Offered: TBD

Prerequisite: CHEM 217 or CHEM 2244; and one of the following: CHEM 314, CHEM 369, CHEM 3350 or 3352.

Introduction to key topics and experimental techniques in bioorganic chemistry and chemical biology. Synthesis and organic transformations of biomacromolecules, library generation and screening, unnatural amino acids and bioorthogonal chemistry, photochemistry, and imaging techniques. Literature analysis of example systems. 2 lectures.

CHEM 4457 Chemistry of Drugs and Poisons (2 units)

Term Typically Offered: SP

Prerequisite: CHEM 216 or CHEM 2242; and CHEM 369 or CHEM 3352.

Introduction to pharmacology and toxicology. History, sources, development and testing, physical and chemical properties, biochemical and physiological effects, mechanisms of action, computational design, and the therapeutic uses and toxicology of common drugs and poisons. 2 lectures. Formerly CHEM 377.

CHEM 4458 Neurochemistry (3 units)

Term Typically Offered: F

Prerequisite: One of the following: CHEM 314, CHEM 369, CHEM 3350, or CHEM 3352.

Chemistry of neurotransmission. Channels, receptors, and enzymes involved in signal transduction. Biosynthesis, storage, release, reuptake, and breakdown of major neurotransmitters. Mechanism of action of medicinal and recreational drugs and their effects on cells, individuals, and society. Course may be offered in classroom-based or online format. 3 lectures. Formerly CHEM 418.

CHEM 4461 Senior Project I (1-2 units)

Term Typically Offered: F, SP

Prerequisite: Senior standing; one of the following: CHEM 201, CHEM 2201, or CHEM 2203; CHEM 303 or CHEM 3302; and consent of instructor.

Selection and completion of a project under faculty supervision. Projects typical of the type that a graduate may encounter in a field of employment or graduate study related to chemistry or biochemistry. Project results culminate in appropriate deliverables.

CHEM 4462 Senior Project II (1 unit)

Term Typically Offered: F, SP

Prerequisite: Senior standing; CHEM 4461; and consent of instructor.

Completion of a project under faculty supervision. Projects typical of the type that a graduate may encounter in a field of employment or graduate study related to chemistry or biochemistry. The project culminates in appropriate deliverables. 1 seminar. Formerly CHEM 403.

CHEM 4470 Special Advanced Topics (1-3 units)

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of special topics for advanced students. The Class Schedule will list topic selected. Course may be offered in classroom-based, online, or hybrid format. Repeatable up to 6 units. 1 to 3 lectures. Formerly CHEM 470.

CHEM 4471 Special Advanced Laboratory (1-3 units)

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group laboratory study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 6 units. 1 to 3 laboratories. Formerly CHEM 471.

CHEM 4480 Polymer Synthesis and Characterization (3 units)

Term Typically Offered: F

Prerequisite: One of the following: CHEM 216, CHEM 312, CHEM 2240, or CHEM 2242; and CHEM 3380. Recommended: One of the following: CHEM 351, CHEM 353, CHEM 3390, or CHEM 3392.

Polymerization methods and mechanisms. Chemistry of initiators, catalysts, and inhibitors. Polymerization kinetics. Use of representative types. Physical properties and their measurements. Molecular weight, glass transition, solution thermodynamics, viscoelasticity, and rheology. Thermal analysis, spectroscopic analysis, and mechanical testing. Polymer coatings. 3 lectures. Formerly CHEM 444.

CHEM 4481 Polymer Synthesis and Characterization Laboratory (2 units)

Term Typically Offered: F

Corequisite: CHEM 444 or CHEM 4480.

Polymer synthesis using solution, suspension, bulk, and emulsion techniques. Chain-growth, step-growth, and controlled radical polymerization. Polymerization kinetics. Synthesis of resins used in modern coatings. Polymer characterization and analysis including molecular weight, phase transitions, mechanical properties, and rheology. Infrared, Raman, and NMR spectroscopy. 2 laboratories. Formerly CHEM 447.

CHEM 4482 Coatings and Formulations (3 units)

Term Typically Offered: SP

Prerequisite: CHEM 444 or CHEM 4480.

Formulation, optimization, and testing of modern coatings. Raw materials including resins, solvents, pigments, and additives. Formulation principles and strategies for solvent-borne, waterborne, radiation cure, industrial, powder, architectural coatings, and cosmetics. Sustainability, regulatory issues, and VOC reduction. 3 lectures. Formerly CHEM 445.

CHEM 4483 Coatings and Formulations Laboratory (2 units)

Term Typically Offered: SP

Prerequisite: CHEM 447 or CHEM 4481. Corequisite: CHEM 445 or CHEM 4482.

Formulation of modern coatings, pigment dispersions, solvent-borne and high solids coatings, water-borne coatings, powder coatings, radiation cure coatings, and architectural coatings. Coating properties, film formation, film defects, VOCs, color, hiding, gloss, and durability. 2 laboratories. Formerly CHEM 448.

CHEM 4484 Functional Polymeric Materials (3 units)

Term Typically Offered: SP

Prerequisite: One of the following: CHEM 216, CHEM 312, CHEM 2240, or CHEM 2242; and CHEM 3380; or graduate standing. Recommended: One of the following: CHEM 351, CHEM 352, CHEM 3390, or CHEM 3394; and CHEM 444 or CHEM 4480.

Structure-property-processing correlations of functional polymeric materials. Additive group contribution methodologies for predicting and determining physical properties. Semi-empirical approaches for estimating and evaluating the values of physical properties from chemical structures. 3 lectures. Formerly CHEM 454.

CHEM 4485 Cooperative Education Experience (1-6 units)

Term Typically Offered: F, SP, SU

CR/NC

Prerequisite: Sophomore standing and consent of department chair.

Work experience in business, industry, government, and other areas of student career interest. Positions are usually paid and require relocation. Formal report and evaluation by work supervisor required. Repeatable up to 12 units. Credit/No Credit grading only. Formerly CHEM 485.

CHEM 4486 Surface Chemistry of Materials (3 units)

Term Typically Offered: SP

Prerequisite: One of the following: CHEM 351, CHEM 353, CHEM 3390, CHEM 3392, MATE 280, MATE 380, MATE 2280, or ME 302.

Surface energy. Capillarity, solid and liquid interface, and adsorption. Surface areas of solids. Contact angles and wetting. Friction, lubrication, and adhesion. Surface properties of materials. Applications. 3 lectures. Crosslisted as CHEM/MATE 4486. Formerly CHEM/MATE 446.

CHEM 4487 Polymers and Coatings Internship (2 units)

Term Typically Offered: F, SP, SU

Prerequisite: CHEM 444 or CHEM 4480; or CHEM 5580.

Selected students will spend a semester with an approved polymers and coatings firm or industry partner, engaged in research and development, production, or related business. Time will be spent applying and developing production and technical skills and abilities in the polymers and coatings industry. Formerly CHEM 449.

CHEM 4490 Computational Chemistry (2 units)

Term Typically Offered: SP

Theory and applications of computational chemistry to chemistry and biochemistry, including molecular simulation, electronic structure, and cheminformatics. 2 lectures. Prerequisites One of the following: CHEM 351, CHEM 353, CHEM 3390, or CHEM 3392.

CHEM 4495 Cooperative Education Experience (6-12 units)

Term Typically Offered: F, SP, SU

CR/NC

Prerequisite: Sophomore standing and consent of department chair.

Work experience in business, industry, government, and other areas of student career interest. Positions are usually paid and require relocation. Formal report and evaluation by work supervisor required. Repeatable up to 12 units. Credit/No Credit grading only. Formerly CHEM 495.

CHEM 5500 Special Problems for Graduate Students (1-2 units)

Term Typically Offered: F, SP, SU

Prerequisite: Graduate standing and consent of department chair.

Individual investigation, research, studies, or surveys of selected problems. Repeatable up to 4 units. Formerly CHEM 500.

CHEM 5502 Graduate Seminar in Polymers and Coatings (1 unit)

Term Typically Offered: F, SP

Prerequisite: Graduate standing in the Polymers and Coatings program or consent of instructor.

Problems and topics in polymers and coatings selected according to the interest and needs of the students enrolled. Repeatable up to 2 units. Course may be offered in classroom-based or hybrid format. 1 seminar. Formerly CHEM 590.

CHEM 5570 Special Advanced Topics (1-3 units)

Term Typically Offered: TBD

Prerequisite: Graduate standing and consent of instructor.

Directed group study of special topics for graduate students. The Class Schedule will list topic selected. Repeatable up to 6 units. Course may be offered in classroom-based, online, or hybrid format. 1 to 3 lectures. Formerly CHEM 570.

CHEM 5571 Special Advanced Laboratory (1-2 units)

Term Typically Offered: TBD

Prerequisite: Graduate standing and consent of instructor.

Directed group laboratory study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 2 units. 1 to 2 laboratories. Formerly CHEM 571.

CHEM 5580 Advanced Polymer Synthesis and Characterization (3 units)

Term Typically Offered: F

Prerequisite: One of the following: CHEM 216, CHEM 312, CHEM 2240, or CHEM 2242; or graduate standing. Recommended: One of the following: CHEM 351, CHEM 353, CHEM 3390, or CHEM 3392.

Advanced polymerization methods and mechanisms. Advanced chemistry of initiators, catalysts, and inhibitors. Synthesis of polymers used in coatings. Physical properties and their measurement. Molecular weight, phase transition, solution thermodynamics, and rheology. Thermal analysis, spectroscopic analysis, mechanical testing, and polymer coatings. Special individual project. 3 lectures. Formerly CHEM 544.

CHEM 5581 Advanced Polymer Synthesis and Characterization Laboratory (2 units)

Term Typically Offered: F

Prerequisite: Graduate standing. Corequisite: CHEM 544 or CHEM 5580.

Advanced polymer synthesis using solution, suspension, bulk, and emulsion techniques. Chain-growth, step-growth, and controlled radical polymerization. Polymerization kinetics. Synthesis of resins used in modern coatings. Polymer characterization and analysis, including molecular weight, phase transitions, mechanical properties, and rheology. Polymer spectroscopy. Special individual project. 2 laboratories. Formerly CHEM 547.

CHEM 5582 Advanced Coatings and Formulations (3 units)

Term Typically Offered: SP

Prerequisite: CHEM 544 or CHEM 5580.

Formulation, optimization, and testing of modern coatings. Raw materials, including resins, solvents, pigments, and additives. Formulation principles and strategies for solvent-borne, waterborne, radiation cure, industrial, powder, architectural coatings, and cosmetics. Sustainability, regulatory issues, and VOC reduction. Individual project. 3 lectures. Formerly CHEM 550.

CHEM 5583 Advanced Coatings and Formulations Laboratory (2 units)

Term Typically Offered: SP

Prerequisite: CHEM 547 or CHEM 5581. Corequisite: CHEM 550 or CHEM 5582.

Formulation of modern coatings, pigment dispersions, solvent-borne and high solids coatings, water-borne coatings, powder coatings, radiation cure coatings, and architectural coatings. Coating properties, film formation, defects, VOCs, color, gloss, and durability. Special individual project. 2 laboratories. Formerly CHEM 551.

CHEM 5598 Project (3 units)

Term Typically Offered: F, SP, SU

Prerequisite: CHEM 551 or CHEM 5583.

Supervised industrial graduate internship in polymers and coatings science. Provides students with industrial research experience. Requires approval of graduate advisor. Students engage in industrial research and development at an approved industry site, make regular reports back to graduate advisor, and present formal report and seminar on work each semester. Total credit limited to 6 units. Formerly CHEM 598.

CHEM 5599 Thesis (3 units)

Term Typically Offered: F, SP, SU

Prerequisite: CHEM 551 or CHEM 5583.

Directed graduate research in specialized advanced topics related to polymers and coatings science, leading to a graduate thesis of suitable quality. Requires approval of graduate advisor. Students are expected to work independently and report weekly to faculty advisor. Repeatable up to 6 units. Formerly CHEM 599.