

California State University, Long Beach 2025-2026 Undergraduate and Graduate Catalog

Courses

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Chemistry and Biochemistry

CHEM 90 - Introduction to General Chemistry

(4 units)

Prerequisite/Corequisite: [MATH 112A](#)
or higher.

Preparatory course for [CHEM 111A](#)

. Recommended for students who have not achieved a satisfactory score on the Chemistry Placement examination. Basic principles and concepts including atomic structure, nomenclature, and chemical calculations with emphasis on problem solving.

Credit/No Credit grading only. (Lecture 3 hrs., activity 2 hrs.) Cannot be taken for credit toward a university degree. Credit in CHEM 90 or CHEM 101 does not substitute for a passing score on the Chemistry Placement Test. Not open to students with credit in CHEM 101. May be offered in a hybrid format.

CHEM 95 - Foundations for General Chemistry

(1 unit)

Prerequisite: None.

Corequisite: [CHEM 111A](#)

Topics and skills that support student success in CHEM 111A.

Students required to enroll in this co-requisite course must remain enrolled in both courses for the semester. Students will not be permitted to withdraw from one of the courses (either CHEM 111A or CHEM 95) and not the other.

Credit/No Credit grading only. (Activity 2 hours). May be repeated to a maximum of 3 units in different semesters.

CHEM 95A - Foundations for General Chemistry

(1 unit)

Prerequisite(s): MATH 112A with a grade of "C" or better, or MATH 112B or higher (may be taken concurrently).

Recommended: Students in need of additional support for CHEM 111A will be required to enroll concurrently in CHEM 95A.

Corequisite(s): CHEM 111A, appropriate score on the chemistry placement test or other measures, or department consent.

Topics and skills that support student success in CHEM 111A.

Students required to enroll in this corequisite course must remain enrolled in both courses for the semester. Students will not be permitted to withdraw from one of the courses (either CHEM 111A or CHEM 95A) and not the other.

Credit / No Credit only. May be repeated to 3 units in different semesters.

CHEM 95B - Foundations for General Chemistry

(1 unit)

Corequisite: CHEM 111B.

Topics and skills that support student success in CHEM 111B.

Students required to enroll in this corequisite course must remain enrolled in both courses for the semester. Students will not be permitted to withdraw from one of the courses (either CHEM 111B or CHEM 95B) and not the other.

Credit / No Credit only. May be repeated to 3 units in different semesters.

CHEM 100 - Chemistry and Today's World

(4 units)

Prerequisite: One GE Foundation course (GE categories 1A, 1B, 1C or 2).

Introduction to basic principles of chemistry and a consideration of the benefits and problems arising from applications of chemistry. Discussions of foods and food additives, drugs, plastics, and other materials of everyday life, fuel sources, the atmosphere, and fresh water. Suitable for general education credit.

Both grading options. Course fee may be required. (Lecture 3 hrs., laboratory 3 hrs.) Not open for credit to chemistry or biochemistry majors or students with credit in CHEM 111A or CHEM 140.

CHEM 102 - Introduction to General Chemistry

(3 units)

Prerequisite(s): MATH 112A or higher (can be taken concurrently).

Preparatory course for CHEM 111A. Recommended for students who did not meet the requirements to place into CHEM 111A. Basic principles and concepts including atomic structure, nomenclature, and chemical calculations with emphasis on problem solving.

Both grading options. Not repeatable for credit.

CHEM 111A - General Chemistry

(5 units)

Prerequisite(s)/Corequisite(s): MATH 112B or higher (can be taken concurrently) and one of the following: CHEM 90 OR CHEM 102 OR CHEM 140 OR AP Chemistry with a score of 2 or 3 OR other department-approved measures for chemistry placement.

OR

MATH 119A or higher (can be taken concurrently). Strong background in high school chemistry: one year with a grade of A or B required. One year of high school physics strongly recommended.

Prerequisite(s)/Corequisite(s): Students in need of additional support will be required to enroll concurrently in [CHEM 95A](#).

First semester of a two-semester sequence (CHEM 111A and [CHEM 111B](#)). Introduction to principles of chemistry including chemical reactions, stoichiometry, thermochemistry, electronic structure, bonding, and properties of solids, liquids, gases, and solutions.

Letter grade only (A-F). Course fee may be required. (Lecture 3 hrs., lab and problem-solving session 6 hrs.)

CHEM 111B - General Chemistry

(5 units)

Prerequisites: [CHEM 111A](#)
or [CHEM 112A](#)
and [MATH 112B](#)
or higher both with a grade of "C" or better.

Prerequisite(s)/Corequisite(s): Students in need of additional support will be required to enroll concurrently in [CHEM 95B](#).

Second semester of a two-semester sequence ([CHEM 111A](#) and CHEM 111B). Continuation of chemical principles, chemical equilibrium, kinetics, thermodynamics, electrochemistry, elements of qualitative and quantitative inorganic analysis. Solving aqueous equilibrium problems are emphasized.

Letter grade only (A-F). Course fee may be required. (Lecture 3 hrs., lab and problem-solving sessions

6 hrs.)

CHEM 112A - Advanced General Chemistry

(5 units)

Prerequisite: Department consent.

First semester of a two-semester advanced general chemistry sequence (CHEM 112A and [CHEM 112B](#)). Introduction to principles of chemistry including chemical reactions, stoichiometry, thermochemistry, electronic structure, bonding, and properties of solids, liquids, gases, and solutions, kinetics, and equilibrium.

Letter grade only (A-F). (Lecture 3 hrs., lab and problem session 6 hrs.)

CHEM 112B - Advanced General Chemistry

(5 units)

Prerequisite: [CHEM 112A](#)

with a grade of "C" or better.

Second semester of a two-semester advanced general chemistry sequence ([CHEM 112A](#) and CHEM 112B). Continuation of chemical principles, electrochemistry, applications of bonding theories of inorganic molecules, trends and reactivities of elements and their compounds, elements of qualitative and quantitative inorganic analysis, introduction to coordination chemistry, solid-state chemistry, and reactions of transition metals. Solving aqueous equilibrium problems is emphasized.

Letter grade only (A-F). (Lecture 3 hrs., lab and problem session 6 hrs.)

CHEM 140 - General, Organic, and Biochemistry

(5 units)

Prerequisite(s): Restricted to pre-nursing majors. A grade of "C" or better in [STAT 108](#)

or [STAT 118](#)

, or [PSY 110](#)

or [SOC 170](#)

or [HDEV 190](#)

or [MATH 112A](#)

or [MATH 113](#)

or MATH 117 or [MATH 119A](#)

or [MATH 122](#)

.
This one-semester course encompasses general chemistry, organic chemistry, and biochemistry. Meets chemistry requirement for pre-nursing curriculum.

Letter grade only (A-F). Course fee may be required. (Lecture 3 hrs; problem-solving session 1 hr., and laboratory 3 hrs.)

CHEM 220A - Organic Chemistry I

(3 units)

Prerequisites: [CHEM 111B](#)

or [CHEM 112B](#)

with a grade of "C" or better.

Corequisites: [CHEM 224A](#)

is required for students repeating course. [CHEM 223A](#)

must be taken concurrently if required by a degree plan.

First semester of two-semester sequence (CHEM 220A, [CHEM 220B](#)

; and [CHEM 223A](#)

and [CHEM 223B](#)

or [CHEM 320L](#)

). Sequence meets requirements for medical and dental schools. Emphasis is upon application of modern principles of structure, reactivity, methods of synthesis, physical properties and spectroscopy.

Letter grade only (A-F). (Lecture 3 hrs.) Not open to students with credit in CHEM 320A or CHEM 322A.

CHEM 220B - Organic Chemistry II

(3 units)

Prerequisite: [CHEM 220A](#)

with a grade of "C" or better.

Corequisite(s): [CHEM 224B](#)

is required for students repeating course. [CHEM 223B](#)

or [CHEM 320L](#)

must be taken concurrently if required by a degree plan except for students who previously earned a "C" or better in [CHEM 223B](#)

or [CHEM 320L](#)

Second semester of two-semester sequence ([CHEM 220A](#)

, CHEM 220B; [CHEM 223A](#)

and [CHEM 223B](#)

or [CHEM 320L](#)

). Continuation of study of organic chemistry including chemistry of compounds containing more than one functional group, bioorganic molecules, and special topics.

Letter grade only (A-F). (Lecture 3 hrs.) Not open to students with credit in CHEM 320B or CHEM 322B.

CHEM 223A - Organic Chemistry Laboratory I

(1 unit)

Corequisite: [CHEM 220A](#)

, except for students who have previously earned a "C" or better in [CHEM 220A](#)

Introduction to organic laboratory techniques. First semester of a two-semester sequence (CHEM 223A, [CHEM 223B](#)

). Not applicable to a degree in chemistry or biochemistry.

Letter grade only (A-F). (Laboratory 3 hrs.) Not open to students with credit in [CHEM 320L](#) or CHEM 323A.

CHEM 223B - Organic Chemistry Laboratory II

(1 unit)

Prerequisites: [CHEM 220A](#)

and [CHEM 223A](#)

, both with a grade of "C" or better.

Corequisite: [CHEM 220B](#)

, except for students who have previously earned a "C" or better in [CHEM 220B](#)

.

Synthesis and characterization of organic and bioorganic compounds. Second semester of a two-semester sequence ([CHEM 223A](#)

, CHEM 223B). Not applicable to a degree in chemistry or biochemistry.

Letter grade only (A-F). (Laboratory 3 hrs.) Not open to students with credit in CHEM 320B, or [CHEM 320L](#)

, or CHEM 323B.

CHEM 224A - Organic Chemistry I Recitation

(1 unit)

Corequisite: [CHEM 220A](#)

Problem solving session emphasizing principles learned in first semester organic chemistry.

Credit/No Credit grading only. (Problem solving session 1 hr.) May be repeated to a maximum of 3 units in different semesters. Does not count for General Education credit.

CHEM 224B - Organic Chemistry II Recitation

(1 unit)

Corequisite: [CHEM 220B](#)

Problem solving session emphasizing principles learned in second semester organic chemistry.

Credit/No Credit grading only. (Problem solving session 1 hr.) May be repeated to a maximum of 3 units in different semesters. Does not count for General Education credit.

CHEM 227 - Fundamentals of Organic Chemistry

(3 units)

Prerequisite: [CHEM 111A](#)

or [CHEM 112A](#)

with a grade of "C" or better; [CHEM 111B](#)

or [CHEM 112B](#)

is recommended.

Lecture course in chemistry of carbon compounds.

Letter grade only (A-F). (Lecture 3 hrs.) Not applicable to a degree in chemistry. Not open for credit to students with credit in CHEM 327.

CHEM 241 - Explorations in Biochemistry

(1 unit)

Prerequisite: [BIOL 212](#)

with a grade of "C" or better

Prerequisite/Corequisite: [CHEM 220A](#)

An introduction to the core principles, key topics, and seminal discoveries in the field of biochemistry.

Letter grade only (A-F). (Lecture 1 hr.)

CHEM 251 - Quantitative Analysis

(4 units)

Prerequisite: [CHEM 111B](#)

or [CHEM 112B](#)

with a grade of "C" or better. Strongly recommended for pre-pharmacy students and students planning careers in clinical or analytical laboratory sciences. It is strongly recommended that CHEM 251 be taken within one calendar year of [CHEM 111B](#).

Introduction to techniques and theory of volumetric analysis, spectrophotometry, potentiometry, and chromatography.

Letter grade only (A-F). Course fee may be required. (Lecture 2 hrs., laboratory 6 hrs.)

CHEM 301 - Naturally Dangerous

(3 units)

Prerequisite(s): Grade of "C" or better in [CHEM 100](#)

, or [CHEM 111A](#)

, or [CHEM 140](#)

or consent of instructor. Completion of GE Foundation requirements. Completion of at least 60 units. Is anything safe? How do we know? A course in scientific literacy and critical thinking. Case study discussions of naturally occurring compounds and facets of science whose safety is unclear or has been the subject of misleading claims. Not applicable to a degree in chemistry or biochemistry.

Letter Grade Only (A-F) Lecture 3 hrs. Not Repeatable for credit

CHEM 304 - Chemistry in the Kitchen

(3 units)

Prerequisites: Completion of at least 60 units, completion of the entire Foundation, and completion of at least one Explorations course in category B.

From the first discovery of the positive impacts of cooking on food safety, taste, and digestibility, to molecular gastronomy, where chefs use scientific techniques to play with their food, chemistry is at the core. This course explores the chemical and biochemical processes that make food edible and delicious. In addition to gaining an understanding of the science of cooking, students will be encouraged to develop their own skills as science-driven cooks.

Letter grade only (A-F). Not repeatable for credit.

CHEM 320L - Organic Chemistry Laboratory

(2 units)

Prerequisite: [CHEM 220A](#)

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Corequisite: [CHEM 220B](#)

, except for students who have previously earned a "C" or better in [CHEM 220B](#)

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Introduction to organic laboratory techniques, synthesis and characterization of organic and bioorganic compounds.

Letter grade only (A-F). Course fee may be required. (Laboratory 6 hrs.) Not open for credit to students with credit in CHEM 320B.

CHEM 330 - Bio-inorganic Chemistry

(3 units)

Prerequisite(s): [CHEM 220B](#)

and [CHEM 241](#)

with a grade of "C" or better

Introduction to coordination chemistry including bonding, structure, geometry, and reactions of metal complexes. Introduction to metals and metal complexes in biological systems focusing on structures and functions. Introduction to therapeutic use of coordination compounds.

Letter grade only (A-F) Lecture 3 hrs. Not open for credit to students who have credit for CHEM 331.

CHEM 331 - Inorganic Chemistry

(3 units)

Prerequisites: [CHEM 111B](#)

or [CHEM 112B](#)

with a grade of "C" or better.

Introduction to coordination chemistry, solid-state chemistry, and reactions of transition metals.

Letter grade only (A-F). (Lecture 3 hrs.) Not open for credit to students who have credit for CHEM 330.

CHEM 332 - Inorganic Chemistry Laboratory

(2 units)

Prerequisite(s): CHEM330 or [CHEM 331](#)

with a grade of "C" or better.

Synthesis, characterization, and manipulation of inorganic compounds and materials.

Letter grade only (A-F). (Laboratory 3 hrs.)

CHEM 361 - Chemical Communications

(3 units)

Prerequisites: GE Foundation requirement.

Prerequisites: Students must have scored 11 or higher on the GEAR Placement Examination or completed the necessary portfolio course that is a prerequisite for a GEAR Writing Intensive Capstone. (**Note: The preceding prerequisite statement related to GEAR is temporarily suspended effective Summer 2025.**)

Prerequisite/Corequisite: [CHEM 220A](#)

Using the chemical literature. Writing technical reports for various purposes. Oral presentation of chemical information. Includes extensive writing. Fulfills the GE Writing Intensive Capstone requirement.

Letter grade only (A-F). (Seminar 3 hrs.) Not open for credit to students with credit in NSCI 361.

CHEM 371A - Physical Chemistry: Thermodynamics and Kinetics

(3 units)

Prerequisites: [CHEM 111B](#)
or [CHEM 112B](#)
, [MATH 123](#)
, [PHYS 152](#)
(all with a grade of "C" or better).
Prerequisite/Corequisite: [MATH 224](#)
.

Half of the two semester physical chemistry package. The two courses, CHEM 371A, [CHEM 371B](#), may be taken in either order. Principles and applications of classical thermodynamics; introduction to chemical kinetics.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 371B - Physical Chemistry: Quantum Mechanics and Spectroscopy

(3 units)

Prerequisites: [CHEM 111B](#)
or [CHEM 112B](#)
, [MATH 123](#)
, [PHYS 152](#)
(all with a grade of "C" or better).
Prerequisite/Corequisite: [MATH 224](#)
.

Half of the two semester physical chemistry package. The two courses [CHEM 371A](#), B may be taken in either order. Principles and applications of quantum chemistry, spectroscopy, and statistical thermodynamics.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 373 - Physical Chemistry Laboratory

(3 units)

Prerequisites: [CHEM 361](#)

, [CHEM 371A](#)

or [CHEM 377A](#)

, and [CHEM 371B](#)

or [CHEM 377B](#)

, all with a grade of "C" or better.

Introduction to basic physico-chemical experimental techniques with applications to principles

discussed in [CHEM 371A](#)

, [CHEM 371B](#)

and [CHEM 377A](#)

, [CHEM 377B](#)

.

Letter grade only (A-F). (Lecture 1 hr., laboratory 6 hrs.)

CHEM 375 - Physical Chemistry for Engineers

(3 units)

Prerequisites: [MATH 123](#)

; [PHYS 151](#)

and either [PHYS 152](#)

or [E E 210](#)

/[E E 210L](#)

; [CHE 220](#)

; [CHEM 111A](#)

or [CHEM 112A](#)

/[CHEM 111B](#)

or [CHEM 112B](#)

; and [CHEM 220A](#)

or [CHEM 227](#)

, all grades of "C" or better. [CHE 310](#)

is strongly recommended.

Principles and applications of real gases, liquids, and solutions; intra- and intermolecular interactions; kinetic theory and chemical kinetics; quantum chemistry, chemical bonding, and spectroscopy.

Letter grade only (A-F). (Lecture 3 hrs)

CHEM 377A - Fundamentals of Physical Chemistry

(3 units)

Prerequisites: [CHEM 111B](#)

or [CHEM 112B](#)

, [MATH 123](#)

, and [PHYS 152](#)

(all with a grade of "C" or better).

Half of the two semester physical chemistry package with a biochemical emphasis. The two courses CHEM 377A, [CHEM 377B](#)

may be taken in either order. Principles of physical chemistry emphasizing thermodynamics and chemical kinetics. Biological and environmental science examples used to illustrate principles.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 377B - Fundamentals of Physical Chemistry

(3 units)

Prerequisites: [CHEM 111B](#)

or [CHEM 112B](#)

, [MATH 123](#)

, and [PHYS 152](#)

(all with a grade of "C" or better).

Half of the two semester physical chemistry package with a biochemical emphasis. The two courses [CHEM 377A](#)

,B may be taken in either order. Principles of physical chemistry with emphasis on molecular structure and spectroscopy.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 379 - Physical Chemistry for the Biosciences

(4 units)

Prerequisites: [CHEM 111B](#)

or [CHEM 112B](#)

, [CHEM 220A](#)

, [MATH 123](#)

, and [PHYS 100B](#)

or [PHYS 152](#)

, all with grades of C or better.

Principles of chemical thermodynamics and kinetics, quantum chemistry, chemical bonding, and spectroscopy, with applications in the biological sciences.

Letter grade only (A-F). (Lecture 4 hrs.)

CHEM 381 - Special Topics in Spectroscopy

(1 unit)

Prerequisite(s): [CHEM 220B](#)

Prerequisite(s)/Corequisite(s): [CHEM 371B](#)

or [CHEM 377B](#)

or [CHEM 379](#)

Fundamentals, modern aspects, and applications of spectroscopic methods in chemical and biological systems.

A. Vibrational spectroscopy

B. Electron spectroscopy

C. Luminescence

D. Magnetic resonance spectroscopy

Letter grade only (A-F) Lecture 1 hr. May be repeated to a maximum of 4 units with different topics. Topics announced in the Schedule of Classes.

CHEM 385 - Materials Science

(3 units)

Prerequisite: [CHEM 111A](#)

or [CHEM 112A](#)

and [PHYS 152](#)

and ([CHEM 111B](#)

or [CHEM 112B](#)

or [PHYS 320](#)

), completion of [CHEM 111B](#) or [CHEM 112B](#)

is strongly recommended.

Introduction to general principles of energy materials including catalytic, photovoltaic, and thermoelectric materials based on nanostructural and/or nanoporous systems. Students will be required to complete preparatory modules on Kinetics (reaction dynamics), Electrochemistry, Fermi statistics, and Diodes.

Letter grade only (A-F). Same course as [PHYS 385](#)

. Not open for credit to students with credit in [PHYS 385](#)

.

CHEM 385C - Materials Science Colloquium

(1 unit)

Prerequisite: [CHEM 111A](#)

or [CHEM 112A](#)

and [PHYS 152](#)

and ([CHEM 111B](#)

or [CHEM 112B](#)

or [PHYS 320](#)

), completion of [CHEM 111B](#)

or [CHEM 112B](#)

is strongly recommended

Discussion of advances as reported in recent literature related to energy materials. Provides

experience in library use, organization, presentation, and critical evaluation of the literature.

Letter grade only (A-F). Same course as [PHYS 385C](#)
. Not open for credit to students with credit in [PHYS 385C](#)
.

CHEM 385L - Materials Science Laboratory

(2 units)

Prerequisite: [CHEM 111A](#)
or [CHEM 112A](#)
and [PHYS 152](#)
and ([CHEM 111B](#)
or [CHEM 112B](#)
or [PHYS 320](#)
) , completion of [CHEM 111B](#)
or [CHEM 112B](#)

is strongly recommended

Introduction to synthesis, characterization methods, and property measurement of advanced materials.

Letter grade only (A-F). Course fee may be required. (Laboratory 6 hrs.) Same course as [PHYS 385L](#)
. Not open for credit to students with credit in [PHYS 385L](#)
.

CHEM 420 - Advanced Organic Chemistry Laboratory

(3 units)

Prerequisites: [CHEM 220B](#)
and [CHEM 320L](#)
. CHEM 331 is recommended.
Prerequisite/Corequisite: CHEM 361.

Modern methods in synthesis and characterization of organic compounds. Multistep synthesis, synthetically useful transformations and transition metal catalysis. Small molecule structure elucidation with an emphasis on NMR and mass spectrometry. Separations of complex reaction mixtures and utilization of inert atmosphere. In addition to regularly scheduled lectures, students are expected to attend three hours of lecture on use of chemical literature.

Letter grade only (A-F). Course fee may be required. (Lecture 1 hr., laboratory 6 hrs.)

CHEM 421 - Physical Organic Chemistry

(3 units)

Prerequisites: [CHEM 220B](#)
with a grade of "C" or better.

Prerequisite/Corequisite: [CHEM 371B](#)

or [CHEM 377B](#)

. Undergraduates enroll in CHEM 421; graduates in [CHEM 521](#)

.

Theoretical interpretation of chemical and physical properties of organic compounds: mathematical derivations of rate equations from experimental results, quantitative comparison of organic compounds reactivities, mathematical correlations of structure and properties. Solving problems relating to reaction mechanisms to described factors.

Letter grade only (A-F). (Lecture 3 hrs.) [CHEM 521](#)

CHEM 431 - Advanced Inorganic Chemistry

(3 units)

Prerequisite(s): [CHEM 331](#)

, with a grade of "C" or better.

Prerequisite(s)/Corequisite(s): [CHEM 371B](#)

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Quantitative study of chemical bonding in inorganic molecules emphasizing on molecular orbital theory. Transition metal chemistry including coordination chemistry, ligand field theory, spectroscopy applications to structural analysis of inorganic molecules, and review of properties and reactivities of elements and their compounds.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 441A - Biological Chemistry

(3 units)

Prerequisites: [BIOL 212](#)

, [CHEM 220B](#)

and either [CHEM 320L](#)

or [CHEM 223B](#)

all with a grade of "C" or better.

First semester of a two-semester sequence (CHEM 441A and [CHEM 441B](#)

) in biochemistry. Chemical and mathematical treatment of energetics and kinetics of reactions in living systems, including chemistry and metabolism of carbohydrates and chemistry of proteins.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 441B - Biological Chemistry

(3 units)

Prerequisite: [CHEM 441A](#)

with a grade of "C" or better.

Second semester of two-semester sequence ([CHEM 441A](#)

and CHEM 441B) in biochemistry. Metabolism of lipids, proteins, and nucleic acids, and other advanced topics in metabolism.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 442 - Methods in Biochemistry

(2 units)

Prerequisites: [CHEM 361](#)

and [CHEM 441A](#)

both with grades of C or better.

Modern laboratory methods used in biochemistry and molecular biology.

Letter grading only (A-F). (1 hr. lecture and 3 hrs. laboratory). Course open only to BA biochemistry students. Not open to students with credit in [CHEM 443](#)

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CHEM 443 - Biochemistry Laboratory

(4 units)

Prerequisites: [CHEM 441A](#)

and [CHEM 361](#)

; all with a grade of "C" or better.

Theory of biochemical and molecular biology methods. Modern laboratory techniques used in biochemical research.

Letter grading only (A-F). Course fee may be required. (Lecture 1 hr., laboratory 9 hrs.)

CHEM 448 - Fundamentals of Biological Chemistry

(3 units)

Prerequisites: [CHEM 220B](#)

or [CHEM 227](#)

either with a grade of "C" or better.

Major principles of biochemistry including metabolic processes, biological control and regulatory processes, nutrition and chemical energetics and kinetics of animals, plants and microorganisms. Emphasis on major concepts and problem solving.

Both grading options. Not open for credit to students with credit in [CHEM 441A](#), [CHEM 441B](#)

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CHEM 449 - Nutritional Biochemistry Laboratory

(1 unit)

Prerequisite: [CHEM 448](#)

with a grade of "C" or better.

May be taken concurrently with [CHEM 448](#)

Analytical and biochemical analyses of foodstuffs and other compounds of biochemical interest.

Letter grade only (A-F). Course fee may be required. (Laboratory 3 hrs.)

CHEM 451 - Instrumental Methods of Analysis

(5 units)

Prerequisite(s): [PHYS 152](#)

, and either [CHEM 361](#)

or NSCI 361, and either [CHEM 371B](#)

or [CHEM 377B](#)

or CHEM 379 all with a grade of "C" or better; [CHEM 251](#)

is recommended.

Theory and application of instrumental methods to chemical problems. Includes measurement basics, atomic and molecular spectroscopy, electroanalytical chemistry, separation methods, surface analysis, and statistical evaluation of analytical data.

Letter grade only (A-F). Course fee may be required (Lecture 3 hrs., laboratory 6 hrs.)

CHEM 460 - Seminar in Chemistry

(1 unit)

Corequisite(s): [CHEM 496](#)

or consent of instructor. Students must have filed for graduation and be in their last semester.

Weekly meetings for presentation and discussion of advanced work in special fields including original research by faculty and students. Requires participation in organization and critical evaluation of these presentations.

Credit/No Credit grading only. (Seminar 1 hr.)

CHEM 461 - Chemistry Capstone

(1 unit)

Prerequisite/Corequisite: Department consent. Students must have filed for graduation and be in their last semester.

The capstone course for chemistry and biochemistry graduating seniors in their final semester

integrating knowledge and skills from different disciplines of chemistry and biochemistry. Includes discussion of regulatory affairs, ethics in research, and seminars on research topics in chemistry and biochemistry.

Letter grade only (A-F). (Seminar 1 hr.)

CHEM 480 - Biomolecular Modeling and Simulation

(3 units)

Prerequisites: [CHEM 220B](#)

or [CHEM 227](#)

, MATH 119B or [MATH 123](#)

, and [PHYS 100B](#)

or [PHYS 152](#)

, all with a grade of "C" or better. Strongly recommended: one semester of Physical Chemistry and

[BIOL 200](#)

or [BIOL 212](#)

The study of biomolecular phenomena using computer-based modeling and simulation techniques with varying degrees of resolution, including development and validity of molecular models.

Letter grade only (A-F). (Lecture 3 hrs.) Double Numbered with: CHEM 580

CHEM 485 - Special Topics in Materials Chemistry

(3 units)

Prerequisite: [CHEM 220B](#)

and [CHEM 331](#)

and [CHEM 385](#)

or consent of instructor

Areas of current interest in materials chemistry with introduction to principles of materials synthesis, characterization, and application.

Letter grade only (A-F)

CHEM 496 - Undergraduate Directed Research

(1-3 units)

Prerequisite: Consent of instructor.

Research in a specific topic in chemistry or biochemistry approved and directed by faculty.

Both grading options. Written report required. (Independent Study). May be repeated to a maximum of 6 units.

CHEM 498 - Senior Thesis

(3 units)

Prerequisites: Major GPA 3.0 or higher, 3 units of [CHEM 496](#) with a grade of "A", consent of instructor.

Continuation of research in chemistry and biochemistry, planning, preparation, and completion of thesis based on original research project. Submission of acceptable thesis meeting the guidelines for research reports issued by the Committee on Professional Training American Chemical Society is required.

Letter grade only (A-F). Not available for graduate students.

CHEM 498H - Senior Thesis - Honors

(1-3 units)

Prerequisites: At least one unit of [CHEM 496](#) with a grade of "A"; admission into the Honors in Chemistry program, and consent of instructor. Planning, preparation, and completion of thesis based on a research project in chemistry or biochemistry.

Letter grade only (A-F). Not available to graduate students.

CHEM 499 - Directed Reading

(1 unit)

Survey of chemical literature on some topic of current interest under supervision of a faculty member. Preparation of a written report based on readings.

Letter grade only (A-F). Not open for credit to graduate students.

CHEM 521 - Physical Organic Chemistry

(3 units)

Undergraduates enroll in CHEM 421; graduates in CHEM 521. Recommended: One year of undergraduate organic chemistry and one year of undergraduate physical chemistry.

Theoretical interpretation of chemical and physical properties of organic compounds: mathematical derivations of rate equations from experimental results, quantitative comparison of organics compounds reactivities, mathematical correlations of structure and properties. Solving problems relating to reaction mechanisms to described factors.

Letter grade only (A-F). (Lecture 3 hrs.) Double Numbered with: [CHEM 421](#)

CHEM 522 - Selected Topics in Organic Chemistry

(3 units)

Recommended: One year of undergraduate organic chemistry and [CHEM 421](#) or [CHEM 521](#)

Areas of current interest in organic chemistry.

Letter grade only (A-F). (Lecture 3 hrs.) May be repeated to a maximum of 6 units with different topics. Topics announced in the *Schedule of Classes*.

CHEM 523 - Synthetic Methods

(3 units)

Recommended: One year of undergraduate organic chemistry and [CHEM 521](#)

Introduction to current methods of synthetic transformations; topics may include, but not limited to the following: Retrosynthetic analysis, protecting groups, functional group transformations, enolate chemistry, organometallics, stereochemistry and conformational analysis, pericyclic reactions, alkene functionalization and reactions of carbon nucleophiles.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 524 - Catalysis in Organic Chemistry

(3 units)

Recommended: One year of undergraduate organic chemistry.

A study of catalysis beginning with a general theory of catalysis. The course also covers catalysis in synthetic organic chemistry centered on metals and ligated metals and catalysis centered on organic molecules as the catalytic species.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 531 - Advances in Inorganic Chemistry

(3 units)

Recommended: One year of undergraduate in organic chemistry.

Current topics and advances in inorganic chemistry.

Letter grade only (A-F). (Lecture 3 hrs.) May be repeated to a maximum of 6 units with different topics.

CHEM 532 - Inorganic Materials Chemistry

(3 units)

Recommended: One year of undergraduate in organic chemistry.

Advanced studies in bonding in solids, crystal structure variations, band theory and electronic structure, crystal structure-electronic structure-physical properties relationship, electron transport properties, magnetic materials, materials by design for technological applications.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 533 - Physical Techniques in Inorganic Chemistry

(3 units)

Recommended: One year of undergraduate in organic chemistry.

An introduction to physical techniques commonly used in inorganic chemistry with focus on the magnetic resonance spectroscopic techniques: EPR and multinuclear NMR.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 534 - Crystal Structure Analysis

(3 units)

Recommended: One year of undergraduate in organic chemistry.

An introduction to structural methods commonly used in inorganic chemistry with focus on single crystal and powder X-ray diffraction.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 541 - Biochemistry Core for Graduate Study

(3 units)

Recommended: One year of undergraduate biochemistry.

The course is divided into three topics: (i) structure and evolution of proteins and their complexes with nucleic acids, lipids and carbohydrates, including structure determination methods; (ii) metabolic regulation from mechanistic and physiological viewpoints; (iii) applications of biochemical methodologies.

Letter grade only (A-F), (Lecture 3 hrs.)

CHEM 542 - Selected Topics in Biochemistry

(3 units)

Recommended: One year of undergraduate biochemistry and [CHEM 541](#).

Intensive discussion of a limited aspect of biochemistry with reference to current literature. Course content will vary from year to year.

Letter grade only (A-F). (Lecture 3 hrs.) May be repeated to a maximum of 6 units with different topics in different semesters. Topics announced in the *Schedule of Classes*.

CHEM 543 - Cytoskeleton in Health and Disease

(3 units)

Prerequisite(s): CHEM 541 with a grade of "C" or better.

This course focuses on the components of cell cytoskeleton and molecular-level insights on its regulation. Topics such as cytoskeletal architecture, regulatory factors, and role of cytoskeleton in key cellular processes will be covered. This course also covers experimental methods to study actin cytoskeleton including fluorescence microscopy. The course includes lectures, group discussions, and a microscopy data analysis module.

Letter grade only (A-F). Not repeatable for credit.

CHEM 545 - Biochemistry of Cellular Stress Responses

(3 units)

Recommended: One year of undergraduate biochemistry and [CHEM 541](#).

This course will focus on the biochemical pathways and mechanisms activated by cells in response to stress with a special emphasis on proteostatic stress. Topics such as cellular architecture, biochemical signal transduction, types of cellular stress and the sensing mechanisms, and the unfolded protein response (UPR, a homeostatic signaling program that cells mount in response to proteostatic stress)

will be covered. Role and regulation of UPR in the context of pathophysiological conditions such as cancer, type II diabetes, neurodegeneration, cardiovascular diseases, and viral infections will be discussed.

Letter grade only (A-F). Not repeatable for credit.

CHEM 546 - Protein Structure and Function

(3 units)

Recommended: One year of undergraduate biochemistry and [CHEM 541](#)

Principles of protein structure, folding, and function. Includes techniques used for the production, isolation and characterization of proteins.

Letter grade only (A-F). (Lecture 3 hrs)

CHEM 548 - Cell Membranes

(3 units)

Recommended: One year of undergraduate biochemistry and [CHEM 541](#)

Examination of modern membrane biochemistry. May include membrane structure and transport, phospholipids sorting, vesicular transport, membrane coat protein structure and function, and membrane-dependent signal transduction.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 549 - Biochemistry of Lipids and Lipoproteins

(3 units)

Recommended: One year of undergraduate biochemistry and [CHEM 541](#)

Current topics on the biochemistry of lipids and lipoproteins in health and disease. Lipid absorption, synthesis and transport; Cellular uptake of lipoproteins, lipid storage and mobilization; lipid signaling; cellular lipid efflux.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 552 - Selected Topics in Analytical Chemistry

(3 units)

Recommended: One year of undergraduate analytical chemistry.

Including electrochemical measurements, chromatographic techniques, spectroscopic techniques,

radiochemical analysis and basic electronic components of instrumentation. Emphasizing the chemical principles involved, utility and limitations of each method. Includes trace analysis of water and air.

Letter grade only (A-F). (Lecture 3 hrs.) May be repeated to a maximum of 6 units with different topics. Topics announced in the *Schedule of Classes*.

CHEM 553 - Fundamentals of Electroanalytical Chemistry

(3 units)

Recommended: One year of undergraduate analytical chemistry.

In-depth description of electrochemical processes and research techniques. Voltammetric, potentiometric, and impedance methods. Scanning probe techniques. Analysis of current research literature related to electroanalytical chemistry and surface science.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 554 - Surface and Interface Chemistry

(3 units)

Recommended: One year of undergraduate analytical chemistry and one semester of physical chemistry.

An introduction to the theories and applications of surface and interface chemical/physical phenomena. Literature-based discussions on analytical methods used in vacuum, solid and liquid surface chemistry.

Letter grade only (A-F). Not repeatable for credit.

CHEM 572 - Advanced Physical Chemistry

(3 units)

Recommended: One year of undergraduate physical chemistry.

Special topics in physical chemistry.

Letter grade only (A-F). (Lecture 3 hrs.) May be repeated to a maximum of 6 units with different topics.

CHEM 574 - Kinetics and Dynamics

(3 units)

Recommended: One year of undergraduate physical chemistry

Reaction rates for chemical systems; dependence on concentration and temperature. Derivation of the mechanisms of chemical reactions. Kinetic theory and analysis of experimental results for different

systems. Dynamics of chemical reactions; transition state theory, potential-energy surfaces, and reaction pathways.

Letter grade only (A-F). (Lecture 3 hrs.)

CHEM 580 - Biomolecular Modeling and Simulation

(3 units)

Recommended: One semester of undergraduate organic chemistry, one year of undergraduate physics, and one semester of undergraduate calculus.

The study of biomolecular phenomena using computer-based modeling and simulation techniques with varying degrees of resolution, including development and validity of molecular models.

Letter grade only (A-F). (Lecture 3 hrs.) Double Numbered with: [CHEM 480](#)

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CHEM 582 - Organic Chemistry of Biological Processes

(3 units)

Recommended: One year of undergraduate biochemistry and [CHEM 541](#)

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Examination of the mechanisms and energetics of biochemical reactions.

Letter grade only (A-F). (3 hours lecture).

CHEM 583 - Electrochemical Methods and Materials

(3 units)

Recommended: One year of undergraduate analytical and/or physical chemistry.

Fundamentals, modern aspects, and applications of electrochemical methods and materials. The course focuses on energy devices and bioelectrochemical systems.

Letter grade only (A-F). (3 hrs. lecture).

CHEM 595A - Colloquium in Biochemistry

(1 unit)

Prerequisite: Graduate standing or consent of instructor.

Discussion of advances as reported in recent literature. Provides experience in library use, organization, presentation, and critical evaluation of the chemical literature.

Letter grade only (A-F). (Seminar 1 hr.) May be repeated to a maximum of 3 units (not more than a

total of 3 units may be earned in any combination of CHEM 595 courses).

CHEM 595B - Colloquium in Organic Chemistry

(1 unit)

Prerequisite: Graduate standing or consent of instructor.

Discussion of advances as reported in recent literature. Provides experience in library use, organization, presentation, and critical evaluation of the chemical literature.

Letter grade only (A-F). (Seminar 1 hr.) May be repeated to a maximum of 3 units (not more than a total of 3 units may be earned in any combination of CHEM 595 courses).

CHEM 595C - Colloquium in Analytical, Physical and Inorganic Chemistry

(1 unit)

Prerequisite: Graduate standing or consent of instructor.

Discussion of advances as reported in recent literature. Provides experience in library use, organization, presentation, and critical evaluation of the chemical literature.

Letter grade only (A-F). (Seminar 1 hr.) May be repeated to a maximum of 3 units (not more than a total of 3 units may be earned in any combination of CHEM 595 courses).

CHEM 660 - Seminar in Chemistry

(1 unit)

Weekly meetings for presentation and discussion of advanced work in special fields including original research by faculty and graduate students.

Credit/No Credit grading only. (Seminar 1 hr.) May be repeated to a maximum of 3 units.

CHEM 695 - Directed Reading

(1 unit)

Survey of information in chemical literature on a current research topic, under direction of a faculty member. Written report prepared from these readings.

Letter grade only (A-F).

CHEM 697 - Directed Research

(1-3 units)

Prerequisite: Arrangement with instructor.

Laboratory work supervised on an individual basis. A written report will be required.

Letter grade only (A-F). May be repeated to a maximum of 3 units.

CHEM 697C - Directed Research

(1-3 units)

Prerequisite: Arrangement with Instructor

Continuation of laboratory work supervised on an individual basis. A written report will be required.

Credit/No Credit grading only. May be repeated to a maximum of 3 units.

CHEM 698 - Thesis

(1-6 units)

Prerequisites: Advancement to candidacy for M.S. in Chemistry or M.S. in Biochemistry and arrangement with instructor.

Planning, preparation and completion of a thesis in chemistry or biochemistry.

Letter grade only (A-F).