

CHEMISTRY (CHEM)

CHEM 110 General Chemistry I (3 semester hours)

Atomic theory; chemical nomenclature; chemical equations and reactions; stoichiometry; properties of gases, solids, and liquids; electronic structure of atoms and periodic properties of the elements; covalent bonding and molecular geometry. Prerequisite: MATH 120, MATH 122, or MATH 131 or concurrent enrollment or placement into MATH 120 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

CHEM 111 General Chemistry I Lab (1 semester hour)

Basic chemical lab technique, conservation of mass, definite composition, molar masses, gravimetric and titrimetric analyses, redox chemistry. Prerequisite: CHEM 110, CHEM 114, or concurrent enrollment.

CHEM 112 General Chemistry II (3 semester hours)

Solutions, chemical kinetics, thermodynamics, acids and bases, equilibria, electrochemistry, nuclear reactions, and selected additional topics. Prerequisite: CHEM 110.

CHEM 113 General Chemistry II Lab (1 semester hour)

Chemical kinetics, equilibrium, complex ions, solubility, visible spectrophotometry, inorganic synthesis, crystallization, inorganic qualitative analysis. Prerequisites: CHEM 111; 112 or concurrent enrollment.

CHEM 114 General Chemistry for Engineers (3 semester hours)

Atomic theory; stoichiometry; properties of gases, liquids, and solids; electronic structure and periodic table; covalent bonding; kinetics and equilibrium; acid-base, precipitation, and reduction-oxidation reactions; basic thermodynamics. Engineering majors only.

CHEM 190 World of Chemistry and Biochemistry (1 semester hour)

Introduction to the Chemistry and Biochemistry programs, faculty, staff, and the facilities. Students will have the opportunity to learn about the various research programs in the department. Students will also be introduced to various chemistry and biochemistry careers. Credit/No Credit only.

CHEM 198 Special Studies (0-3 semester hours)

CHEM 199 Independent Studies (0-3 semester hours)

CHEM 220 Organic Chemistry I (3 semester hours)

Introduction to the fundamentals of organic chemistry: chemical properties, synthesis and nomenclature of alkanes, alkenes, cycloalkanes, aromatic hydrocarbons, and alkyl halides. Prerequisites: CHEM 110 and CHEM 112. University Core fulfilled: Flag: Quantitative Literacy.

CHEM 221 Organic Chemistry I Lab (1 semester hour)

Introduction to the fundamental lab techniques used in organic chemistry. Prerequisites: CHEM 111, CHEM 113; CHEM 220 or concurrent enrollment.

CHEM 222 Organic Chemistry II (3 semester hours)

Introduction to the chemistry of alcohols, ethers, carbonyl compounds, amines, and carbohydrates. Prerequisite: CHEM 220.

CHEM 223 Organic Chemistry II Lab (1 semester hour)

Laboratory experience in synthesis and analysis of organic compounds. Prerequisites: CHEM 221; 222 or concurrent enrollment.

CHEM 225 Organic Chemistry II Lab for Molecular Sciences (1 semester hour)

Organic Chemistry Laboratory for students interested in the molecular sciences, including biochemistry, chemistry, molecular biology, chemical physics, and chemical engineering. Laboratory experience in multistep synthesis of compounds as well as opportunity for participation in course-based original research projects. Additional emphasis on techniques for determining molecular structure and quantitative sample purity: nuclear magnetic resonance, mass spectrometry, gas and liquid chromatography, as well as uses of standard compounds. Skills in experimental design and troubleshooting as well as laboratory independence will be cultivated. Prerequisites: CHEM 221; CHEM 222 or concurrent enrollment.

CHEM 250 Earth System Science (3 semester hours)

An introductory exploration of how the Earth works. Focus is placed on connecting the Earth systems - the solid Earth, atmosphere, oceans, and biosphere - through the cycling of chemical elements and energy. The course will also discuss significant anthropogenic impacts to the natural Earth system. Prerequisites: CHEM 110 and 112.

CHEM 262 The Chemical Environment (3 semester hours)

The important chemical processes of the world in which we live; air, water, agriculture, food additives, household chemicals, cosmetics, chemotherapy, sports, toxic waste management. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher.

CHEM 270 Frontiers of Science (3 semester hours)

Study of the methods of inquiry used across the disciplines in science. Development of scientific literacy through discussion of important public issues such as energy, medicine, the environment, and climate change. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

CHEM 272 Biotechnology in the News (3 semester hours)

Study of the methods of inquiry used across the disciplines of chemistry and biochemistry in science. Development of scientific literacy through discussion of important public issues within biotechnology. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

CHEM 290 Chemistry Seminar (1 semester hour)

Regular attendance by second-year students at the Departmental Seminar Program. May be taken twice. Credit/No Credit only.

CHEM 298 Special Studies (1-3 semester hours)

CHEM 299 Independent Studies (1-3 semester hours)

CHEM 330 Inorganic Chemistry (3 semester hours)

Introduction to the chemistry of the transition elements. Structure, stereochemistry, and bonding in transition metal complexes. Applied thermodynamics, oxidation-reduction, and descriptive chemistry of the main group elements. Nuclear reactions and the actinide elements. Prerequisite: CHEM 222.

CHEM 331 Inorganic Chemistry Lab (1 semester hour)

The synthesis of transition metal complexes and characterization by infra-red, UV-Visible, and NMR spectroscopy. Optical activity and the resolution of a racemic mixture. Organometallic compounds and clusters of the p-block elements. Reactions in non-aqueous solvents and under an inert atmosphere. Prerequisites: CHEM 222 and CHEM 223.

CHEM 340 Physical Chemistry (3 semester hours)

The objective of this course is to introduce the student to the principles of physical chemistry, both to satisfy a requirement of the major and to serve as preparation to enrollment in subsequent in-depth courses in selective topics in physical chemistry. Topics include: properties of gases, chemical thermodynamics, chemical equilibria, colligative properties, electrochemistry, chemical kinetics and reaction mechanisms. Prerequisites: CHEM 222 and CHEM 223 or CHEM 225; MATH 123 or MATH 132; PHYS 201 or PHYS 254. University Core fulfilled: Flag: Quantitative Literacy.

CHEM 341 Physical Chemistry Lab (1 semester hour)

Physical measurements, calorimetry, physical equilibria, phase behavior, chemical equilibria, kinetics, colligative properties and electrochemistry. Prerequisite: CHEM 340 or concurrent enrollment. University Core fulfilled: Flags: Quantitative Literacy, Writing.

CHEM 342 Advanced Physical Chemistry (3 semester hours)

Chemical kinetics, quantum mechanics, atomic and molecular spectroscopy, statistical mechanics. Prerequisites: CHEM 340 and 341.

CHEM 343 Advanced Physical Chemistry Lab (1 semester hour)

Kinetics, colligative properties, atomic and molecular spectroscopy. Prerequisites: CHEM 340 and 341.

CHEM 346 Physical Biochemistry (3 semester hours)

Chemical and enzyme kinetics, solutions of macromolecules, chemical equilibria, transport processes, sedimentation, transport in electric fields, physical methods in biochemistry, scattering, molecular modeling. Prerequisites: CHEM 340 and 341. Corequisite: CHEM 347.

CHEM 347 Physical Biochemistry Lab (1 semester hour)

Kinetics, colligative properties, macromolecular solution properties, atomic and molecular spectroscopy as applied to biochemical systems. Prerequisites: CHEM 340 and 341. Corequisite: CHEM 346.

CHEM 350 Earth System Science (3 semester hours)

An in-depth exploration of how the Earth works. Focus is placed on the complex interactions between the Earth systems – the solid Earth, atmosphere, oceans, and biosphere – through the cycling of chemical elements and energy. The course will also discuss significant anthropogenic impacts to the natural Earth system. Prerequisites: CHEM 110 and CHEM 112

CHEM 356 Sustainable Practices (3 semester hours)

Discussion of the history of water and energy use in society; analysis of pollution resulting from use of non-renewable energy sources and recent advances in production of renewable and sustainable energy practices; and pollution of water with sustainable practices to provide clean freshwater and appropriate wastewater management. Prerequisite: CHEM 112 or ENVS 101 or permission of instructor.

CHEM 357 Environmental Chemistry: Atmosphere and Climate (3 semester hours)

A study of chemical processes in the environmental. Topics include stratospheric ozone depletion, the greenhouse effect, climate change, air pollution, and non-renewable sources of energy. Prerequisites: CHEM 110 and CHEM 112.

CHEM 358 Environmental Chemistry: Water, Soil, and Sediment (3 semester hours)

A study of chemical processes in the environment. Topics include renewable sources of energy, water chemistry, water purification, sewage treatment, pesticides, solid waste, soils and sediments. Prerequisites: CHEM 110 and CHEM 112.

CHEM 359 Environmental Chemistry Laboratory (1 semester hour)

Analysis to determine pollutants found in air, water, soil systems; emphasis on the use of instrumental methods and techniques. Prerequisite: CHEM 357 or CHEM 358 or concurrent enrollment.

CHEM 360 Analytical Chemistry and Lab (4 semester hours)

Theory of chemical analyses, statistical analyses in chemistry, and an introduction to spectroscopy. Lab includes quantitative analyses by gravimetric, titrimetric, and spectroscopic methods. Prerequisites: CHEM 112 and CHEM 113. University Core fulfilled: Flag: Quantitative Literacy.

CHEM 370 Biochemistry (3 semester hours)

Macromolecular structure and function, enzymology, bioenergetics and kinetics, biotechnology, major metabolic pathways. Prerequisites: CHEM 222 and CHEM 223. University Core fulfilled: Integrations: Interdisciplinary Connections.

CHEM 371 Biochemistry Lab (1 semester hour)

Techniques of protein purification, enzyme assay, and kinetics. Prerequisite: CHEM 370 or concurrent enrollment. University Core fulfilled: Flags: Engaged Learning, Writing.

CHEM 372 Advanced Biochemistry (3 semester hours)

Metabolic regulation; macromolecular structure, function and synthesis membrane transport; DNA and RNA metabolism and control; biochemistry of vitamins and other nutrients; protein biosynthesis. Prerequisite: CHEM 370.

CHEM 373 Advanced Biochemistry Lab (1 semester hour)

Techniques in lipid and carbohydrate analysis; enzyme regulation; enzymes as diagnostic tools, restriction enzymes. Prerequisites: CHEM 370, 371; and 372 or concurrent enrollment.

CHEM 380 Forensic Chemistry (3 semester hours)

An introduction to the forensic sciences with an emphasis on chemistry. This course gives students an appreciation for the activities of a real forensic laboratory. Topics covered include basic analytical techniques, arson investigation, and fingerprint, drug, blood, and DNA analyses. Prerequisites: CHEM 222, CHEM 223, and CHEM 360 or permission of instructor.

CHEM 382 Wine Chemistry (3 semester hours)

Addresses the major chemical topics associated with wine production, chemical analysis of wine and wine faults. Provides an overview of wine-making and the wine industry through a combination of lecture, lab and field trips. Prerequisite: CHEM 222. Minimum age of 21 required for full participation.

CHEM 390 Chemistry Seminar (1 semester hour)

Regular attendance at Departmental Seminar Program. Credit/No Credit only.

CHEM 391 Chemistry Seminar (1 semester hour)

Regular attendance at Departmental Seminar Program and presentation of a seminar.

CHEM 393 Chemistry/Biochemistry Internship (1-3 semester hours)

Research/Development work conducted in a professional chemical setting in a local government or industrial laboratory. Work includes both theory and laboratory practice on a project designed cooperatively by the laboratory's supervisory staff and LMU faculty. The project is jointly supervised by on-site staff and LMU faculty. May be repeated for credit up to 6 semester hours. Credit/No Credit grading only.

CHEM 397 Directed Research (0-3 semester hours)

May be repeated for credit up to 6 semester hours. Permission of instructor required.

CHEM 398 Special Studies (0-3 semester hours)**CHEM 399 Independent Studies (0-3 semester hours)****CHEM 420 Advanced Organic Chemistry (3 semester hours)**

Modern synthetic reactions, mechanisms and study of organic synthesis. Prerequisites: CHEM 220 and 222.

CHEM 421 Advanced Organic Chemistry Lab (1 semester hour)

Laboratory techniques for multi-step synthesis and spectroscopic analysis of organic compounds. Prerequisites: CHEM 222; CHEM 223 or CHEM 225. University Core fulfilled: Flag: Writing.

CHEM 422 Physical Organic Chemistry (3 semester hours)

In-depth study of organic, organometallic, and biochemical reaction mechanisms and how these mechanisms are investigated experimentally. Emphasis on application of structural, thermodynamic, and kinetic concepts to understand and predict chemical phenomena. Prerequisite: CHEM 222.

CHEM 430 Advanced Inorganic Chemistry (3 semester hours)

Ligand field theory and spectral properties of transition metal complexes. Acid-base concepts and non-aqueous ionizing solvents. Molecular orbital theory applied to p-block clusters. Metallic bonding and chemistry of the solid state. Prerequisites: CHEM 330 and 331 or concurrent enrollment.

CHEM 434 Bioinorganic Chemistry (3 semester hours)

The study of the function and structure of metal ions in biology: the properties and spectroscopy of metal ions; metalloproteins; the interaction between metal ions and DNA or RNA; introduction of metal ions into biological systems as probes and as drugs. Prerequisite: CHEM 370 or permission of instructor.

CHEM 460 Instrumental Analysis and Lab (4 semester hours)

Theory and practice of analytical methods including infrared spectroscopy, atomic spectroscopy, nuclear magnetic resonance spectroscopy, mass spectrometry, and gas and liquid chromatography. Prerequisite: CHEM 360. University Core fulfilled: Flag: Writing.

CHEM 474 Food Chemistry (3 semester hours)

The chemistry involved in food preparation and development. Examples include flavorings, food additives, what happens when it is cooked, then eaten; nutritional aspects of foods, food supplements, preservation, food fads. Prerequisite: CHEM 370.

CHEM 476 Advanced Topics in Biochemistry and Biotechnology (3 semester hours)

Recent advances in biochemistry and biotechnology are discussed and analyzed. Typical topics discussed include protein phage display, genome sequencing technologies, gene synthesis and mutagenesis, protein design and engineering. Students will also read and discuss recent publications from leaders in the fields of biochemistry and biotechnology. Prerequisite: CHEM 370.

CHEM 478 Introduction to Virology (3 semester hours)

The foundational principles of biochemistry will be used to explore the structures and functions of viruses. Topics discussed will include recent scientific discoveries in virology. In addition to gaining content knowledge in virology, students will develop their scientific communication and information literacy skills. Prerequisite: CHEM 370.

CHEM 480 Medicinal Chemistry (3 semester hours)

Chemical principles involved in design and formulation of drugs; their absorption, distribution, and elimination; and their interaction at possible active sites. Mechanism of action of specific groups of drugs are discussed. Prerequisites: CHEM 370 or permission of director.

CHEM 482 Toxicology (3 semester hours)

An introduction to the principles of toxicology, emphasizing cellular mechanisms, e.g., cell signaling, mutagenesis, and/or carcinogenesis. Topics will also include dose-response, toxicokinetics, risk assessment, effects of toxicants on the environment, and approaches that can decrease the amounts of toxicants in the environment. Prerequisite: CHEM 370 or permission of instructor.

CHEM 490 Chemistry Seminar (1 semester hour)

Regular attendance at Departmental Seminar Program. Credit/No Credit only.

CHEM 491 Chemistry Seminar (1 semester hour)

Regular attendance at Departmental Seminar Program and presentation of a seminar.

CHEM 493 Chemistry/Biochemistry Internship (1-3 semester hours)

Research/Development work conducted in a professional chemical setting in a local government or industrial laboratory. Work includes both theory and laboratory practice on a project designed cooperatively by the laboratory's supervisory staff and LMU faculty. The project is jointly supervised by on-site staff and LMU faculty. A written report is required. May be repeated for credit up to 6 semester hours.

CHEM 495 Chemistry Teaching (0-1 semester hours)

Guided teaching of the undergraduate laboratories. May be repeated for credit up to 8 semester hours. Credit/No Credit only. Permission of Department Chairperson required.

CHEM 497 Directed Research (1-3 semester hours)

A written report is required. May be repeated for credit up to 6 semester hours. Permission of instructor required.

CHEM 498 Special Studies (1-3 semester hours)**CHEM 499 Independent Studies (0-4 semester hours)**

May be repeated for credit up to 6 Semester Hours.

CHEM 560 Introduction to Modern Spectroscopy (3 semester hours)

Theory, instrumentation principles, methods for data collection, results interpretation, and contemporary applications of modern spectroscopic methods including Gas Chromatography-Mass Spectrometry (GC-MS), Liquid Chromatography-Mass Spectrometry (LC-MS), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), and Nuclear Magnetic Resonance Spectroscopy (NMR). The course will include hands-on use of instrumentation in the laboratory setting. Prerequisite: CHEM 360 or permission of instructor.

CHEM 598 Special Studies (1-3 semester hours)