CHEMISTRY

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Our mission is to enhance the intellectual and personal development of our students within an undergraduate liberal arts setting. We specifically develop the understanding of both chemistry majors and non-majors of the theoretical and experimental background in chemistry necessary for their pursuit of careers in research, industry, education, the health professions and other fields. Our curriculum is designed to foster critical thinking, creativity, communication skills, discipline and the ability to work closely with others so solve complex problems.

By the end of their studies, graduating majors will:

• understand the relationships between atomic and molecular structure and macroscopic properties seen in the natural world
• have a working knowledge of the basic areas of chemistry (inorganic, organic, biochemical, physical and analytical chemistry) and be able to apply this knowledge to analyze data and scientific arguments and to formulate and carry out strategies for solving scientific problems
• synthesize and apply concepts from multiple sub-areas of chemistry
• be proficient in basic laboratory skills (e.g., preparing solutions, synthesizing organic and inorganic materials, performing chemical and instrumental analyses and measurements)
• have developed good laboratory practice such as properly documenting laboratory work, using proper safety procedures and identifying and appropriately dealing with hazardous waste
• have an understanding of principles and applications of modern instrumentation, computation, experimental design and data analysis
• have developed good scientific communication, including writing, oral communication and presentation skills
• have developed the ability to locate, read, understand and critically evaluate the scientific literature
• have developed experience working with others as part of a team
• have conducted an individual research project within the University or in another appropriate setting

Chemistry: Requirements for the Major

CHEM 220-230 General Chemistry I-II 8 credits
CHEM 300 Fundamentals of Organic Chemistry 4 credits
CHEM 330 Fundamentals of Inorganic Chemistry 4 credits
CHEM 340-341 Quantitative Analysis 4 credits
CHEM 370 Fundamentals of Physical Chemistry 4 credits
CHEM 380 Fundamentals of Biochemistry 4 credits
CHEM 396 Chemical Literacy 1 credit
CHEM 392 Integrated Lab 1 credit
CHEM 486 Capstone Research 1-2 credits
CHEM 489 or 499 Capstone Project or Capstone Thesis 1-2 credits

Chemistry electives* 8 credits
CHEM 400, 437, 439, 444, 450, 460, 472, 474, 480 or 481

CHEM/ENV 361* 8 credits

Ancillary Requirements

MATH 226-227 Calculus I-II 8 credits
Physics - one year with laboratory (PHY 232-242 recommended) 8 credits

TOTAL: 56-58 Credits

*Up to 2 credits of CHEM 495 Research or 4 credits of appropriate upper-division electives from chemistry or another department may be substituted by petition to the chemistry department in advance.

At least six credits of upper-division chemistry, including at least one course with a laboratory, must be taken at Pacific University.

Chemistry: Requirements for the Minor

CHEM 220-230 General Chemistry I-II 8 credits
CHEM 300 Fundamentals of Organic Chemistry 4 credits
CHEM 340 Quantitative Analysis 2 credits
CHEM 341 Quantitative Analysis Lab 2 credits
CHEM 385 Seminar 1 credit

Upper-division elective courses 8 credits
(at least 4 credits must be CHEM 330, 370 or 380)

TOTAL: 25 credits

COURSES

CHEM-110 Chemistry & Your Environment
An introductory chemistry course for students who do not plan to take additional chemistry. Basic principles of chemistry are developed and used to explain phenomena of significance to our lives. Topics include environmental issues such as atmospheric and water chemistry, nuclear power, and fuels. 2 credits.

CHEM-155 Special Topics
See department for course description.

CHEM-195 Independent Study
See department for details. Independent study contract required.

CHEM-220 General Chemistry I
The first of a two semester sequence which introduces the basic concepts of chemistry by addressing: atomic and molecular structure, chemical and physical properties of materials, nomenclature, chemical reactions, stoichiometry, gas laws, and thermochemistry. These topics are studied in the context of inorganic and organic chemistry. Includes laboratory. Prerequisite: MATH 122 or placement. Corequisite: CHEM 220L. 4 credits.

CHEM-220L General Chemistry I Lab
Laboratory to accompany General Chemistry I lecture. Corequisite: CHEM 220. 0 credits.

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CHEM-230 General Chemistry II
The second of a two semester sequence continuing from CHEM 220. Topics include: kinetics, equilibrium, thermodynamics, electrochemistry and special topics such as nuclear chemistry. General Chemistry II Laboratory is a corequisite. Prerequisite: CHEM 220 with a minimum grade of C- and MATH 125 or MATH 226 with a minimum grade of C-. Corequisite: CHEM 230L. 4 credits.

CHEM-230L General Chemistry II Laboratory
Laboratory to accompany General Chemistry II lecture. Corequisite: CHEM 230. 0 credits.

CHEM-255 Special Topics
See department for course description.

CHEM-275 Internship
See department for details. Internship contract required.

CHEM-295 Independent Project
Work in chemistry and introduction to chemistry research on a topic of mutual interest to the student and a faculty member. Instructor's consent required. May be repeated for credit or continued as CHEM 495.

CHEM-300 Fundamentals of Organic Chemistry
This course is an introduction to the primary topics of organic chemistry, largely organized around the study of the major functional groups. Topics include: structural analysis of simple carbon compounds, organic chemical nomenclature, survey of functional group chemistry (including carbonyl groups), elementary polar reaction mechanisms, and stereochemistry. Requires concurrent enrollment in a corresponding laboratory section. Prerequisite: CHEM 230 with a minimum grade of C-. Corequisite: CHEM 300L. 4 credits.

CHEM-300L Fundamentals of Organic Chemistry Lab
Laboratory to accompany Fundamentals of Organic Chemistry lecture. Corequisite: CHEM 300. 0 credits.

CHEM-330 Fundamentals of Inorganic Chemistry
An introduction to the primary topics of inorganic chemistry: atomic and molecular structure including molecular orbital theory and molecular symmetry, solid state chemistry, coordination compounds, organometallics, catalysis and bioinorganic chemistry. Physical methods appropriate to the study of inorganic chemistry will also be discussed. Prerequisite: CHEM 230 with a minimum grade of C-. Concurrent enrollment in CHEM 300 is highly recommended. 4 credits.

CHEM-340 Quantitative Analysis
An introduction to the theories and principles of volumetric, gravimetric, and colorimetric methods of analysis. Prerequisite: Sophomore standing or above (30 or more completed credits) and CHEM 230 with a minimum grade of C-. 2 credits.

CHEM-341 Quantitative Analysis Lab
A laboratory course to accompany and give practical illustration to the principles covered in CHEM 340, which is a corequisite. Prerequisite: Sophomore standing or above (30 or more completed credits). Corequisite: CHEM 340. CHEM 300 is highly recommended. 2 credits.

CHEM-355 Special Topics
See department for course description. Prerequisite: Sophomore standing or above (30 or more completed credits).

CHEM-361 Lab Techniques Env Toxicology & Chem
Changes in the environment are ultimately the result of chemical processes. This laboratory course examines our understanding of chemical change in various environmental compartments from a practical perspective. Methodology for monitoring and modeling these systems will be utilized, including standard toxicity testing, use of biomarkers, tissue, air, water and soil analyses, and molecular techniques. Prerequisite: CHEM 300. 1 credit.

CHEM-370 Fundamentals of Physical Chemistry
An introduction to the primary topics of physical chemistry: chemical thermodynamics and equilibrium, chemical kinetics, molecular structure, and molecular spectroscopy. Includes laboratory applications of the principles of physical chemistry. Prerequisite: CHEM 230; PHY 202 or PHY 232; and MATH 227, each with a minimum grade of C-. 4 credits.

CHEM-380 Fundamentals of Biochemistry
An introduction to the chemistry of biological molecules with investigation of the structure and function of biological molecules in enzyme action, metabolism, energetics, and the flow of genetic information. Prerequisite: CHEM 300 with a minimum grade of C-. BIOL 204 is highly recommended. 4 credits.

CHEM-385 Seminar
Participation in discussions about recent advances in the field of chemistry. Prerequisite: Sophomore standing or above (30 or more completed credits) and CHEM 230 with a minimum grade of C-. May be repeated once for credit. Pass/No Pass. 1 credit.

CHEM-392 Advanced Integrated Laboratory
An advanced laboratory experience for upper division chemistry majors. The course will focus on one area of chemistry but will incorporate ideas and techniques from several of the sub-disciplines. A course, for example, might be focused on synthetic inorganic chemistry but also incorporate organic synthesis, catalysis, kinetic measurements and spectroscopic analysis. Prerequisite: Three foundational courses from CHEM 300, CHEM 330, CHEM 341, CHEM 370, and CHEM 380 each with a minimum grade of C-. 1 credit.

CHEM-395 Independent Study
See department for details. Independent study contract required.

CHEM-396 Chemical Literacy
This course is a formal introduction to the primary and secondary chemical literature and serves to prepare students with the literature skills necessary to complete their senior capstone project. As such, it is normally taken by students in the spring of their junior year and is a prerequisite of the capstone courses. Students wishing to travel abroad that semester will need to consult with the department to arrange an alternative. In the course, students will practice searching, reading and evaluating the chemical literature. They will also learn writing skills relevant to scientific papers. In this context, students will be instructed in ethics and pathways beyond Pacific. Prerequisite: Declared chemistry major. 1 credit.

CHEM-400 Advanced Organic Chemistry
This course is an exploration of advanced topics in organic chemistry. Topics include spectroscopy and structural determination; reaction mechanisms associated with aromatic, pericyclic, and radical reactions; organic synthetic methods; polymer chemistry, and a survey of biomolecules. Requires concurrent enrollment in a corresponding laboratory section. Prerequisite: CHEM 300 with a minimum grade of C. Corequisite: CHEM 400L. 4 credits.
CHEM-400L Advanced Organic Chemistry Laboratory
Laboratory to accompany Advanced Organic Chemistry lecture. Corequisite: CHEM 400. 0 credits.

CHEM-437 Solid State & Surface Chemistry
This course explores the chemistry of solid-state materials and surfaces. The focus will be on the molecular and electronic structure of solids and surfaces and how their properties are used in the creation of complex devices. The physical methods used to study these topics will also be explored. Analysis of papers from the primary literature will be included. Prerequisite: CHEM 330 and CHEM 370, both with a minimum grade of C. 2 credits.

CHEM-438 Bioinorganic Chemistry
This course explores the role of metals in biological systems. Topics include a review of basic coordination chemistry and biochemistry, metal uptake and transport, metallo-protein structure and function, metal complexes as therapeutics and imaging agents, and the physical methods used to study these topics. Analysis of papers from the primary literature will be included. Prerequisite: CHEM 330 and CHEM 380, both with a minimum grade of C. 2 credits.

CHEM-444 Instrumental Methods of Analysis
A three hour lecture and three hour laboratory for the introduction to the principles of instrumental methods of chemical analysis. Topics include data handling, spectrometric, chromatographic and electrochemical methods of analysis. Prerequisite: CHEM 340 and CHEM 341 both with a minimum grade of C; and PHY 202 or PHY 242 with a minimum grade of C-. 4 credits.

CHEM-450 Advanced Topics
A lecture or laboratory course concentrating on a specific topic in chemistry at the advanced level. For example mass spectrometry, high field nuclear magnetic resonance, or pharmacology. Prerequisite: Sophomore standing or above; additional prerequisites may apply depending on the topic. May be repeated for credit. 1-2 credits.

CHEM-455 Special Topics
See department for course description. Prerequisite: Sophomore standing or above (30 or more completed credits).

CHEM-460 Environmental Chemistry
This course explores chemical processes in the environment. Students will examine our understanding of chemical change in the atmosphere, groundwater, and various aquatic environments from both a theoretical and practical perspective. Prerequisite: CHEM 300 with a minimum grade of C; CHEM 340 is recommended. 2 credits.

CHEM-472 Chemical Thermodynamics & Kinetics
An advanced physical chemistry course focusing on chemical thermodynamics and kinetics. The study of thermodynamics will apply mathematical models of energy relationships to the understanding of chemical equilibrium. The subject of statistical thermodynamics will be introduced. The study of kinetics will include a survey of experimental techniques used to quantify the rates of chemical reactions, as well as a study of the molecular models of chemical reactions, including reaction mechanisms and reaction theories. The course includes a laboratory component to complement the in-class work. Prerequisite: CHEM 370 with a minimum grade of C. 2 credits.

CHEM-474 Chem Quantum Mechanics & Spectroscopy
An advanced physical chemistry course focusing on quantum mechanics and its applications toward chemical spectroscopy. The study of quantum mechanics will apply quantum principles and mathematical methods to fundamental chemical systems: the atom, diatomic and polyatomic molecules. Molecular electronic structure and its applications to predict molecular properties will be emphasized. Electronic structure computational methods will be introduced. An understanding of quantum effects in molecules will inform the study molecular spectroscopy techniques. Spectroscopic techniques covered include rotational, vibrational, electronic, and magnetic methods. The course includes a laboratory component to complement the in-class work. Prerequisite: CHEM 370 with a minimum grade of C. 2 credits.

CHEM-475 Internship
See department for details. Internship contract required. Pass/No Pass.

CHEM-480 Advanced Biochemistry
This course will further explore the metabolism and structure and function of biological molecules and will continue to emphasize major biochemical concepts developed in CHEM 380. Prerequisite: CHEM 380 with a minimum grade of C. 2 credits.

CHEM-481 Biochemistry Laboratory
A laboratory course to introduce standard biochemical techniques including protein purification, execution of enzyme assays, SDS-PAGE, and western blots. Emphasis will be placed on experimental design, data acquisition, and data interpretation. Prerequisite: Sophomore standing or above (30 or more completed credits) and CHEM 380 with a minimum grade of C-. Offered Winter. 1 credit.

CHEM-486 Capstone Research
Students begin their senior capstone research with a faculty mentor. Topics should be selected in consultation with the mentor and should be consistent with the goals of the final capstone course, either Capstone: Project or Capstone: Thesis. Students wishing to continue on to CHEM 499, Capstone: Thesis, should enroll in 2 credits. Regular attendance at department colloquia required. Prerequisite: CHEM 396. Instructor's consent required. 1-2 credits.

CHEM-489 Capstone: Project
This course is a culmination of the work started in CHEM 486 Capstone Research. Examples of acceptable projects include: a focused review of the literature that results in an original interpretation or novel application, a pedagogical project for students interested in pursuing a career in teaching, an internship at an industrial or government laboratory, and a community service project which uses innovative application of chemical principles and technology. Students will complete a project paper and make an oral presentation based on work completed the previous semester. Regular attendance and presentation at department colloquia is required. Prerequisite: CHEM 486 with a minimum grade of C. Instructor consent required. Offered Spring semester. 1 credit.

CHEM-495 Research
Independent laboratory studies or theoretical studies on projects of mutual interest to the student and faculty. Instructor's consent required. May be repeated for credit for continuing or new projects.

CHEM-499 Capstone: Thesis
This course is a culmination of the work started in CHEM 486 Capstone Research. Students electing to do a thesis will engage in a substantial research project that will involve an investigation of the scientific literature and original research on a current topic in chemistry. Presentation of the thesis work at a department colloquium and for senior presentation day is required. Regular attendance and participation at department colloquia is required. Prerequisite: 2 credits of CHEM 486 with a minimum grade of C. Instructor's consent required. Offered Spring semester. 2 credits.