Faculty
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Degrees and Programs
Chemistry, B.S. .................................................................77
Chemistry, B.A. ............................................................... 78
Biochemistry, B.S. ............................................................78
Teaching Credential ..........................................................78
Chemistry, Minor ............................................................. 78

The Chemistry Department serves students with a primary interest in chemical science as well as students in other fields for which chemistry is an important foundation. The department has the following objectives:
• To give a thorough grounding in the principles of chemistry, both in theory and in practical experience with instrumentation currently in use.
• To help the student develop problem-solving abilities through a careful analysis of problems and the application of chemical principles.
• To provide an atmosphere where Christian values are integrated into the learning experience.

The department offers several degree options. For students intending to enter a graduate chemistry program or directly enter the profession, both the B.S. in Chemistry and the B.S. in Biochemistry are suitable programs. Students who intend to enter a professional program in one of the medical sciences will find the B.S. in Biochemistry provides a very good preparation. Students are encouraged to work closely with their major advisor to select suitable electives regardless of their career choice. Students whose interests include the liberal arts and languages as well as chemistry may choose the B.A. in Chemistry.

Major in Chemistry, B.S.
A minimum of 93 hours (48 upper-division hours)

► Required Core Courses (59 hours):
CHEM 111+111L General Chemistry I + Lab 4+1
CHEM 112+112L General Chemistry II + Lab 4+1
CHEM 113+113L General Chemistry III + Lab 4+1
CHEM 225 Chemical Modeling 2
CHEM 324+324L Analytical Chemistry I + Lab 2+1
CHEM 325+325L Analytical Chemistry II + Lab 2+1
CHEM 326+326L Analytical Chemistry III+ Lab 2+1
CHEM 371+371L Organic Chemistry I + Lab 3+1
CHEM 372+372L Organic Chemistry II + Lab 3+1
CHEM 373+373L Organic Chemistry III + Lab 3+1
CHEM 396+397 Science + Chemistry Seminars .5+.5
CHEM 414 Inorganic Chemistry 3
CHEM 450L Physical Chemistry Lab 1
CHEM 451+452 Thermodynamics + Kinetics 3+3
CHEM 453 Quantum Chemistry 3
CHEM 481 Biochemistry I 4
CHEM 490+490L Senior Capstone + Lab 1+1
CHEM 499 Independent Research (2 qtrs.) 1+1

► Required Core Electives (5 hours):
At least 5 hours from the following:
Additional upper-division CHEM courses

► Required Cognate Courses (28 hours):
MATH 131+132 Calculus I, II 4+4
One of the following sequences: 4+4+4
PHYS 111+112+113 General Physics I, II, III (4+4+4)
PHYS 211+212+213 Physics with Calculus I, II, III (4+4+4)
At least two of the following courses: 8-9
INFS 115 Intro to Computer Programming (4)
MATH 265 Elementary Linear Algebra (4)
MATH 267 Multivariable Calculus (5)
MATH 269 Elementary Differential Equations (4)
## Chemistry

### Major in Chemistry, B.A.

A minimum of 68 hours (33 upper-division hours)

- **Required Core Courses (48-49 hours):**
  - CHEM 111+111L General Chemistry I + Lab 4+1
  - CHEM 112+112L General Chemistry II + Lab 4+1
  - CHEM 113+113L General Chemistry III + Lab 4+1
  - CHEM 324+324L Analytical Chemistry I + Lab 2+1
  - CHEM 325 Analytical Chemistry II 2
  - CHEM 326 Analytical Chemistry III 2
  - CHEM 371+371L Organic Chemistry I + Lab 3+1
  - CHEM 372+372L Organic Chemistry II + Lab 3+1
  - CHEM 373+373L Organic Chemistry III + Lab 3+1
  - CHEM 396 Science Seminar .5
  - CHEM 397 Chemistry Seminar .5
  - CHEM 414 Inorganic Chemistry 3
  - CHEM 451 Kinetics 3
  - CHEM 490+490L Senior Capstone + Lab 1+1

  At least two of the following courses: 2-3
  - CHEM 325L Analytical Chemistry II Lab (1)
  - CHEM 372L Analytical Chemistry III Lab (1)
  - CHEM 450L Physical Chemistry Lab 1
  - CHEM 481 Biochemistry I 4
  - CHEM 482+482L Biochemistry II + Lab 4+1
  - CHEM 483+483L Biochemistry III + Lab 3+2
  - CHEM 490L Senior Capstone + Lab 1+1

- **Required Cognate Courses (20 hours):**
  - MATH 131+132 Calculus I, II 4+4
  - PHYS 111+112+113 General Physics I, II, III 4+4+4

  At least one of the following courses: 4
  - BIOL 320 Cell & Molecular Biology (4)
  - BIOL 354 Genetics (4)
  - BIOL 469 Immunology (4)

- **Required Core Electives (6 hours):**
  - At least 6 hours from the following: 6
    - Additional upper-division CHEM courses

- **Required Cognate Courses (39 hours):**
  - BIOL 112+111+113 Biological Foundations II, I, III 5+5+5
  - MATH 131+132 Calculus I, II 4+4
  - PHYS 111+112+113 General Physics I, II, III 4+4+4

  At least one of the following courses: 4
  - BIOL 320 Cell & Molecular Biology (4)
  - BIOL 354 Genetics (4)
  - BIOL 469 Immunology (4)

### Pre-medical and pre-dental students:

See advisor for recommended cognates.

### Teaching Credential

Students desiring to enter a program of studies leading to a California teaching credential in science with a concentration in chemistry may take any of the Chemistry baccalaureate degrees. Students will need to pass the science (chemistry concentration) portion of the CSET exam one quarter prior to doing full-time student teaching. Students are invited to discuss the program with their major advisor in the Chemistry Department.

Those who plan to teach on the secondary level should consult with the credential analyst in the Education Department and should become acquainted with the specific requirements for admission to and successful completion of the Teacher Education Program as outlined in the section entitled “Education” in this catalog.

## Minor in Chemistry

A minimum of 30 hours (15 upper-division hours)

Take at least 30 hours (15 upper-division) chosen from any non-service CHEM courses.
Chemistry

Service Courses:
(Not applicable to a major or minor in this department)

CHEM 101  4 F
Introductory Chemistry
An elementary introduction to fundamental principles of chemistry. Primarily for students preparing to enter an allied health or related field or to enroll in CHEM 102 and 111. Three lectures and one laboratory per week. Prerequisite: High school Algebra I or MATH 095.

CHEM 102  4 W
Survey of Organic Chemistry
The important classes of organic compounds. Emphasis is given to topics related to the health sciences and biochemistry. Three lectures and one laboratory per week. Prerequisite: High school chemistry or CHEM 101.

CHEM 103  4 S
Survey of Biochemistry
The chemistry of living organisms emphasizing the normal processes occurring in the human body. Three lectures and one laboratory per week. Prerequisite: CHEM 102.

Lower-Division Courses:

CHEM 111+112+113  4+4+4 F+W+S
General Chemistry I, II, III
A complete introduction to the fundamental principles of chemistry including atomic and molecular structure, bonding theories, intermolecular forces, phases of matter, stoichiometry, kinetics, thermodynamics, acid/base equilibria, and electrochemistry. Includes the following topics: Atomic and molecular orbital theory, stoichiometry, gas laws, thermodynamics, kinetics, chemical equilibrium, acid-base theory, pH and introduc-

tions to nuclear, inorganic, and organic chemistry. Intended for chemistry majors and preprofessional students in medicine, dentistry, and other technical fields. Must be taken in sequence. Prerequisites: Algebra II, Integrated Math III, or MATH 096. An ACT Math score of 19 (or SAT Math score of 500) is expected. Secondary school chemistry and physics are highly recommended. Corequisite: CHEM 111L, 112L, 113L.

CHEM 111L+112L+113L  1+1+1 F+W+S
General Chemistry Lab I, II, III
Laboratory activities exploring aspects of the fundamental principles of chemistry. Corequisite: CHEM 111, 112, 113.

CHEM 210  1 S
Laboratory Glassblowing
Introduction to laboratory glassblowing. Includes basic seals, annealing and glass repair. One laboratory per week.

CHEM 225  2 S
Chemical Modeling
Introduction to computers in chemistry. Software solutions to mathematically model chemical processes and for modeling chemical structures and reactions will be explored. Prerequisite: CHEM 111.

Upper-Division Courses:

CHEM 324  2 F
Analytical Chemistry I
An introduction to analytical chemistry. Emphasis is on gravimetric analysis, ions in solution, acid-base equilibria, complex formation, and titrations. Data recording and processing methods, including error analysis and statistics. Prerequisite: CHEM 113, STAT 222.

CHEM 324L  1 F
Analytical Chemistry I Laboratory
A series of laboratory experiments to determine unknown quantities of selected chemical substances. Prerequisite or corequisite: CHEM 324.

CHEM 325  2 W
Analytical Chemistry II
The theoretical basis of chemical analysis using electrochemical and spectroscopic analysis with an introduction to principles of operation of current analytical instrumentation. Prerequisite: CHEM 324L. Strongly recommended corequisite: CHEM 325L.

CHEM 325L  1 W
Analytical Chemistry II Laboratory
A series of laboratory experiments in electrochemistry. Prerequisite or corequisite: CHEM 325.

CHEM 326  2 S
Analytical Chemistry III
The theoretical basis of chemical analysis using electrochemical, mass spectrometry, and chromatographic methods with an introduction to principles of operation of current analytical instrumentation. Prerequisite: CHEM 324L. Strongly recommended corequisite: CHEM 326L.

CHEM 326L  1 S
Analytical Chemistry III Laboratory
A series of laboratory experiments in chemical separations. Prerequisite or corequisite: CHEM 326.

CHEM 344  3 Arranged
Nuclear Physics and Chemistry
Radioactivity, properties of radioactive nuclei, nuclear structure, nuclear reactions, and nuclear fission with applications to the cosmos. Prerequisites: CHEM 113, MATH 132, PHYS 113.
Chemistry

CHEM 371+372+373  3+3+3 F+W+S
Organic Chemistry I, II, III
The physical and chemical properties of compounds of carbon. A mechanistic approach to the study of organic reactions with an emphasis on spectroscopic methods of analysis. Must be taken in sequence. Prerequisite: CHEM 113. Corequisite: CHEM 371L, 372L, 373L.

CHEM 371L+372L+373L 1+1+1 F+W+S
Organic Chemistry Lab I, II, III
Laboratory activities exploring the physical and chemical properties of compounds of carbon. Corequisite: CHEM 371, 372, 373.

CHEM 396  .5 W
Science Seminar
(See also BIOL 396, ENVR 396)
Discussions of career options for scientists and skills needed for obtaining a job or success at the next level of education. Topics of scientific interest presented by guest lecturers. Graded S/F.

CHEM 397  .5 S
Chemistry Seminar
Introduction to chemical literature searching, the anatomy of a scientific paper, and critiques of scientific communication. Also includes talks on current topics in science. Prerequisite: CHEM 373. Graded S/F.

CHEM 414  3 F
Inorganic Chemistry
A systematic study of inorganic chemistry with emphasis on chemical theory and bonding, the descriptive chemistry of the elements, and transition-metal chemistry. Prerequisite: CHEM 113. Odd years.

CHEM 450L  1 W
Physical Chemistry Laboratory
Laboratory activities exploring aspects of thermodynamics, kinetics, quantum chemistry, and spectroscopy. Prerequisite or corequisite: CHEM 451, 452 or 453.

CHEM 451  3 F
Thermodynamics
The laws of thermodynamics and their application to chemistry. Prerequisites: CHEM 113, MATH 132, and PHYS 111 or 211.

CHEM 452  3 W
Kinetics
Kinetic theory, chemical kinetics, including enzyme kinetics, transport properties. Introduction to the basic ideas of quantum mechanics. Prerequisites: CHEM 113, MATH 132, and PHYS 111 or 211.

CHEM 453  3 S
Quantum Chemistry
An introduction to the Schrödinger wave equation with applications to chemical systems and spectroscopy. Prerequisites: CHEM 113, MATH 132, and PHYS 111 or 211.

CHEM 474  3 Arranged
Organic Theory and Reaction Mechanisms
A mechanistic approach to the study of selected topics in organic chemistry, such as orbital symmetry, molecular rearrangements, linear free energy relationships, and photochemistry. Prerequisite: CHEM 373. Even years.

CHEM 481  4 F
Biochemistry I
Structure-function studies of biomolecules, enzyme kinetics, and bioenergetics. Prerequisite: CHEM 373.

CHEM 482  4 W
Biochemistry II
Cellular metabolism of carbohydrates, lipids, and proteins. Signal transduction and hormonal integration of metabolism. Prerequisite: CHEM 481.

CHEM 482L  1 W
Biochemistry II Lab
Introduction to experimental methods in nucleic acids; techniques and methodologies in nucleic acid biochemistry. One laboratory per week. Prerequisite: CHEM 481.

CHEM 483  3 S
Biochemistry III
Information pathways of DNA, RNA, protein metabolism, & regulation of gene expression. Prerequisite: CHEM 482.

CHEM 483L  2 S
Biochemistry III Laboratory
Laboratory discussions and activities introducing the basic experimental techniques of protein biochemistry. One lecture and one laboratory per week. Prerequisite: CHEM 482. Previously CHEM 484L.

CHEM 485  3 S
Topics in Biochemistry
Study of an advanced topic in biochemistry. Topics may include biophysical chemistry, pharmaceutical chemistry, nucleic acid enzymology, signal transduction, or macromolecular structure and function. Repeatable for credit under different subtitles. Prerequisite: CHEM 482 or BIOL 320.
CHEM 486  3 Arranged
Topics in Chemistry
   Study of an advanced topic in chemistry. Topics may include advanced organic synthesis or mechanisms, organometallic chemistry, materials chemistry, or statistical thermodynamics. Repeatable for credit under different subtitles. Prerequisite: CHEM 373.

CHEM 490  1 W
Senior Capstone
   Topics of current interest in chemistry. Under supervision of department faculty, each student prepares and presents a paper on a topic of interest in chemistry. Prerequisite: CHEM 396, 397.

CHEM 490L  1 W
Capstone Lab
   An integrated laboratory with experiments touching on all the major areas of chemistry. One laboratory per week. Taken concurrently with CHEM 490.

CHEM 495  1-3 Arranged
Independent Study
   Offers the advanced student opportunity to pursue investigation in a field of special interest under the direction of department faculty.

CHEM 499  1-2 F, W, S
Independent Research
   An independent research project undertaken with direction from a faculty member. Arrangements should be made before the beginning of the quarter. Repeatable to a maximum of 4 credits in Bachelor of Science curricula.