



Faculty

Kent Davis, chair; Richard Clark, **Pablo Hilario**,
Denise Lee-Haye, Marie Pak,

Departmental Office: 355 Chan Shun Hall; 965-7597

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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 Chemistry with a Biochemistry emphasis are suitable programs. Students who intend to enter a professional program in one of the medical sciences will find the B.S. in Chemistry with a Biochemistry emphasis 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. Those interested in a primary or secondary school teaching career may choose the B.S. in Natural Science.

Major in Chemistry, B.S.

A minimum of 88 hours (45 upper-division hours)

► Required Core Courses (53-54 hours):

CHEM 111-112-113	General Chemistry	5-5-5
CHEM 324	Analytical Chemistry I	3
CHEM 324L	Analytical Chemistry I Laboratory	2
CHEM 325	Analytical Chemistry II	3
CHEM 371-372-373	Organic Chemistry	4-4-4
CHEM 373L	Adv. Organic Chemistry Laboratory	1
CHEM 396	Seminar (4 quarters)	.5-.5-.5-.5
CHEM 414	Inorganic Chemistry	3
CHEM 451-452-453	Physical Chemistry	3-3-3
CHEM 499	Introduction to Research	1

At least two of the following courses: 2-3

CHEM 325L	Analytical Chemistry II Laboratory (1)
CHEM 450L	Physical Chemistry Laboratory (1)
CHEM 484L	Biochemistry Laboratory (2)

► Required Core Electives (6-7 hours):

At least 6-7 hours from the following: 6-7

(To be selected in consultation with the major advisor.)

Additional upper-division CHEM courses

► Required Cognate Courses (28 hours):

MATH 131-132-133	Calculus I-II-III	4-4-4
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One of the following sequences: 4-4-4

PHYS 111-112-113	General Physics (4-4-4)
PHYS 211-212-213	Physics with Calculus (4-4-4)

At least one of the following courses: 4

MATH 265	Elementary Linear Algebra (4)
MATH 267	Multivariable Calculus (4)
MATH 269	Elementary Differential Equations (4)
MATH 375	Numerical Analysis (4)

Recommended Cognate Courses:

CPTR 115	Intro. to Computer Programming (4)
PHYS 314	Elementary Modern Physics (4)

Chemistry

Major in Chemistry, B.A.

A minimum of 69 hours (34 upper-division hours)

► Required Core Courses (49-50 hours):

CHEM 111-112-113	General Chemistry	5-5-5
CHEM 324	Analytical Chemistry I	3
CHEM 324L	Analytical Chemistry I Laboratory	2
CHEM 325	Analytical Chemistry II	3
CHEM 371-372-373	Organic Chemistry	4-4-4
CHEM 373L	Adv. Organic Chemistry Laboratory	1
CHEM 396	Seminar (4 quarters)	.5-.5-.5-.5
CHEM 414	Inorganic Chemistry	3
CHEM 451-452	Physical Chemistry	3-3

At least two of the following courses: 2-3

CHEM 325L	Analytical Chemistry II Laboratory (1)
CHEM 450L	Physical Chemistry Laboratory (1)
CHEM 484L	Biochemistry Laboratory (2)

► Required Cognate Courses (20 hours):

MATH 131-132	Calculus I-II	4-4
PHYS 111-112-113	General Physics	4-4-4

Recommended Cognate Courses:

CPTR 115	Intro. to Computer Programming (4)
MATH 133	Calculus III (4)
PHYS 314	Elementary Modern Physics (4)

Major in Chemistry with an Emphasis in Biochemistry, B.S.

A minimum of 95 hours (45 upper-division hours)

► Required Core Courses (55 hours):

CHEM 111-112-113	General Chemistry	5-5-5
CHEM 324	Analytical Chemistry I	3
CHEM 324L	Analytical Chemistry I Laboratory	2
CHEM 371-372-373	Organic Chemistry	4-4-4
CHEM 373L	Adv. Organic Chemistry Laboratory	1
CHEM 396	Seminar (4 quarters)	.5-.5-.5-.5
CHEM 451-452	Physical Chemistry	3-3
CHEM 481-482-483	Biochemistry I-II-III	4-4-3
CHEM 484L	Biochemistry Laboratory	2

At least one of the following courses: 1

CHEM 325L	Analytical Chemistry II Laboratory (1)
CHEM 450L	Physical Chemistry Laboratory (1)

► Required Core Electives (5 hours):

At least 5 hours from the following: 5

(To be selected in consultation with the major advisor.)

BIOL 320 Cellular and Molecular Biology (4)

Additional upper-division CHEM courses

► Required Cognate Courses (35 hours):

BIOL 111-112-113	Biological Foundations	5-5-5
MATH 131-132	Calculus I-II	4-4
PHYS 111-112-113	General Physics	4-4-4

Pre-medical and pre-dental students:

See advisor for recommended cognates.

Major in Natural Science, B.S. Chemistry Emphasis

A minimum of 100 hours (40 upper-division hours)

This major provides appropriate preparation for teaching science at the secondary level. The core requirement of 65 quarter hours of course work corresponds to science subjects commonly taught in California public schools, and the emphasis treats the subject matter at a depth more than adequate for teaching the higher secondary science courses in chemistry. Emphases may also be obtained in biology or physics. For further information, see the sections entitled "Biology" and "Physics" in this catalog.

► Required Core Courses (65 hours):

ASTR 115	Astronomy	5
ASTR 173	Meteorology	1
BIOL 111-112-113	Biological Foundations	5-5-5
BIOL 331	Marine Science	4
BIOL 355	Issues on Origins	3
CHEM 111-112-113	General Chemistry	5-5-5
GEOL 233	Geology	4
PHYS 390	History and Philosophy of Science	3

At least one of the following courses: 3

ENVR 360	Conservation Biology (3)
ENVR 361	Energy and Climate Change (3)
ENVR 362	Pollution and Environmental Quality (3)

One of the following sequences: 4-4-4

PHYS 111-112-113	General Physics (4-4-4)
PHYS 211-212-213	Physics with Calculus (4-4-4)

Chemistry Emphasis (35 hours)

► Required Core Courses (27 hours):

CHEM 324-324L	Analytical Chemistry I, Laboratory	3-2
CHEM 371-372-373	Organic Chemistry	4-4-4
CHEM 373L	Adv. Organic Chemistry Laboratory	1
CHEM 396	Seminar (4 quarters)	.5-.5-.5-.5
CHEM 451	Physical Chemistry	3
CHEM 481	Biochemistry I	4

► Required Cognate Courses (8 hours):

MATH 131-132	Calculus I-II	4-4
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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 the B.S. degree in Natural Science, Chemistry Emphasis. 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 Edu-

cation Program as outlined in the section entitled "Education" in this catalog.

Minor in Chemistry

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

► Required Courses (20 hours):

CHEM 111-112-113	General Chemistry	5-5-5
CHEM 324	Analytical Chemistry I	3
CHEM 324L	Analytical Chemistry I Laboratory	2

► Required Electives (10 hours):

<i>At least 10 hours from the following:</i>	10
Additional upper-division 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: Secondary-school Algebra I or MATH 019.

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: Secondary-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 **5-5-5 F-W-S** **General Chemistry**

A complete introduction to the fundamental principles of chemistry. Includes the following topics: atomic and molecular orbital theory, stoichiometry, gas laws, thermodynamics, kinetics, chemical equilibrium, acid-base theory, pH and introductions 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. Four lectures and one laboratory per week. Prerequisites: Algebra II or MATH 106. A score of 19 on the mathematics section of the ACT (or 500 on the SAT) is expected. Secondary school chemistry (or CHEM 101) and physics are highly recommended.

UPPER-DIVISION COURSES:

CHEM 324 **3 F** **Analytical Chemistry I**

The quantitative study of chemical reactions occurring in the aqueous phase, including solubility, acid base equilibria and complex formation. Methods of data recording and manipulation, error analysis and statistical treatment of data are also included. Prerequisite: CHEM 113.

CHEM 324L **2 F** **Analytical Chemistry I Laboratory**

A series of laboratory experiments to determine unknown quantities of selected chemical substances. The chemical principles in CHEM 324 are reiterated; emphasis, however, is on laboratory technique. Six hours laboratory per week. Prerequisite or corequisite: CHEM 324.

CHEM 325 **3 W** **Analytical Chemistry II**

The theoretical basis of chemical analysis using electrochemical, spectrophotometric and chromatographic methods. Introduction to principles of operation of current analytical instrumentation. Prerequisites: CHEM 324L, 373, MATH 132. Strongly recommended corequisite: CHEM 325L.

Chemistry

CHEM 325L **1 W**

Analytical Chemistry II Laboratory

Laboratory coordinated with CHEM 325. Prerequisite or corequisite: CHEM 325.

CHEM 344 **3 S**

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, and PHYS 113.

CHEM 371-372 **4-4 F-W**

Organic Chemistry

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. Three lectures and one laboratory per week. Prerequisite: CHEM 113.

CHEM 373 **4 S**

Organic Chemistry

A continuation of CHEM 372 and an introduction to biochemistry (carbohydrates, proteins, and lipids). Prerequisite: CHEM 372. Corequisite: 373L required of all chemistry majors.

CHEM 373L **1 S**

Advanced Organic Chemistry Laboratory

Laboratory coordinated with CHEM 373. Required of all chemistry majors.

CHEM 396 **.5 F, W, S** **Seminar**

(See also BIOL 396, CPTR 396, ENVR 396, PHYS 396)

Single topics of current interest in the natural sciences are presented by guest lecturers. Student must be on time and attend all five course sessions. Prerequisite: CHEM 373. Enrollment limited to

upper-division students. Repeatable to a maximum of 2 credits. Graded S/F.

CHEM 414 **3 S**

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 372, MATH 132. Even years.

CHEM 450L **1 W, S**

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**

Physical Chemistry: Thermodynamics

The laws of thermodynamics and their application to chemistry. Prerequisites: CHEM 113, MATH 131, and PHYS 113.

CHEM 452 **3 W**

Physical Chemistry: Dynamics

Kinetic theory, chemical kinetics, including enzyme kinetics, transport properties. Introduction to the basic ideas of quantum mechanics. Prerequisites: CHEM 113, MATH 132, and PHYS 113.

CHEM 453 **3 S**

Physical Chemistry: Structure

An introduction to the Schrödinger wave equation with applications to chemical systems and spectroscopy. Prerequisite: CHEM 452.

CHEM 474 **3 W**

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 relation-

ships, and photochemistry. Prerequisite: CHEM 373. Even years.

CHEM 481 **4 F**

Biochemistry I

An introduction to the chemistry of biologically-relevant molecules. Includes attention to biological oxidations, energy relationships, and enzyme kinetics. Prerequisite: CHEM 373.

CHEM 482 **4 W**

Biochemistry II

The intermediary metabolism of carbohydrates, lipids and proteins, and an introduction to the replication and transmission of genetic information. Prerequisite: CHEM 481.

CHEM 483 **3 S**

Biochemistry III

The signaling processes of cells, including the structure and function of signaling molecules. Includes the mechanism of signal processing, coordination by information transducing pathways, and consequences of signaling pathway defects. Prerequisite: CHEM 482.

CHEM 484L **2 S**

Biochemistry Laboratory

Laboratory discussions and activities introducing the basic experimental techniques of biochemistry. One lecture and one laboratory per week. Prerequisite: CHEM 482.

CHEM 499 **1-2 F, W, S**

Introduction to Research

A directed research project intended to acquaint students with research problems of current interest. A suitable problem is undertaken with the direction of the faculty. Open to upper-division majors in chemistry and, by permission, to other upper-division students. Repeatable to a maximum of 4 credits in Bachelor of Science curricula.