Spring Quarter Program

A full quarter (15 units) of undergraduate course work in marine biology is available each spring quarter at the Bodega Marine Laboratory, located in Bodega Bay, California. Course offerings include lecture and laboratory instruction in the development of marine biology and physiological adaptation of marine organisms, and population biology and ecology; a weekly colloquium; and an intensive individual research experience under the direction of laboratory faculty. (Biological Sciences courses 122, 122P, 125; Neurobiology, Physiology, and Behavior 141, 141P). This is a 15 unit program and course offerings and instructors may vary from year to year. Applications are due April 15.

For more course detail, see full description under appropriate academic department listing or http://bml.ucdavis.edu/.

Summer Session Courses

This integrated program offers students a multidisciplinary understanding of coastal ecosystems through intensive, hands on lab and field courses taught at Bodega Marine Laboratory. Applications are due April 15.

For more course detail, see full description under appropriate academic department listing or http://bml.ucdavis.edu/.

Course offerings and instructors may vary from year to year.

Bodega Marine Laboratory spring and summer programs are residential, with students housed on the laboratory grounds. Participants are assessed a room and board fee in addition to standard campus registration fees. Applications and consent of instructors are required.

Additional information is available from the Biology Academic Success Center, in 1023 Sciences Laboratory Building, or directly from: Bodega Marine Laboratory P.O. Box 247 Bodega Bay, CA 94923 707-875-2211; http://bml.ucdavis.edu/.

Botany

See Plant Biology, on page 509; and Plant Biology (A Graduate Group), on page 511.

Business Management

See Managerial Economics, on page 415, for undergraduate study; and Management, Graduate School of, on page 410.

Cantonese

See Asian American Studies, on page 182.

Cell Biology

See Molecular and Cellular Biology, on page 463.

Cell and Developmental Biology (A Graduate Group)

The Cell and Developmental Biology program has merged with the Biochemistry and Molecular Biology program to form Biochemistry, Molecular, Cellular, and Developmental Biology (BMCDB); see Biochemistry, Molecular, Cellular and Developmental Biology, on page 189.

Group Office. 2278 Life Sciences 530-752-9091; http://bio3c.ucdavis.edu/GradGroups/BMCDB/

Cell Biology and Human Anatomy

See Medicine, School of, on page 427.

Chemistry

(Instruction of Letters and Science)

Department Administration. For a complete list of department administration, see http://chemistry.ucdavis.edu/homepage/department_administration.html

Department Office. 530-752-8900; Fax 530-752-8995; http://chemistry.ucdavis.edu

Faculty

James Ames, Ph.D., Professor
Shota Atsumi, Ph.D., Associate Professor
Matthew P. Augustine, Ph.D., Professor
Alan L. Baich, Ph.D., Professor
Enoch Baldwin, Ph.D., Associate Professor
Peter Beal, Ph.D., Professor
Louise A. Berben, Ph.D., Associate Professor
R. David Britt, Ph.D., Professor
William Casey, Ph.D., Professor
Julia Chamberlain, Ph.D., Lecturer PSEO Xi Chen, Ph.D., Professor
Kyle Crabtree, Ph.D., Assistant Professor
Stephen Cramer, Ph.D., Professor
Sheila David, Ph.D., Professor
David Donadio, Ph.D., Assistant Professor
Andrew J. Fisher, Ph.D., Professor
Anneliese K. Franz, Ph.D., Associate Professor
Jacquelyn Gervay Hague, Ph.D., Professor
David Goodin, Ph.D., Professor
Ozcan Gulacar, Ph.D., Lecturer PSEO Ting Guo, Ph.D., Professor
Susan M. Kauzlarich, Ph.D., Professor
Distinquished Graduate Mentoring Award
Peter B. Kelly, Ph.D., Professor
Kuril Kovarik, Ph.D., Assistant Professor
Mark J. Kurth, Ph.D., Professor
Donald P. Land, Ph.D., Professor
Delmar Larsen, Ph.D., Assistant Professor
Carlito B. Lebrilla, Ph.D., Professor
Gang-Yu Liu, Ph.D., Professor
C. William McCurdy, Ph.D., Professor
Mark Mascall, Ph.D., Professor
Alexandra Novotny, Ph.D., Professor
Cheuk-Yiu Ng, Ph.D., Professor
David Olson, Ph.D., Assistant Professor
Frank Osterloh, Ph.D., Professor
Phillip P. Power, FRS, Ph.D., Professor
Neil E. Shore, Ph.D., Professor
Academic Senate Distinguished Teaching Award
Jared T. Shaw, Ph.D., Professor
Justin Siegel, Ph.D., Assistant Professor
Alexei P. Stuchebrukhov, Ph.D., Professor
Dean Tambillo, Ph.D., Professor
Academic Senate Distinguished Teaching Award

Michael Toney, Ph.D., Professor
Lee-Ping Wang, Ph.D., Assistant Professor

Emeriti Faculty

Thomas L. Allen, Ph.D., Professor Emeritus
W. Ronald Fawcett, Ph.D., Professor Emeritus
William H. Fink, Ph.D., Professor Emeritus
Edwin Friedrich, Ph.D., Professor Emeritus
Hokon Hope, Cand. ReaL., Professor Emeritus
William M. Jackson, Ph.D., Professor Emeritus
Gerd N. Lamar, Ph.D., Professor Emeritus
Claude F. Meares, Ph.D., Professor Emeritus
W. Kenneth Musker, Ph.D., Professor Emeritus
Marilyn Olimstead, Ph.D., Professor
Krishnan P. Nambiar, Ph.D., Professor Emeritus
Distinguished Graduate Mentoring Award
Carl W. Schmid, Ph.D., Professor, Emeritus
James H. Swinehart, Ph.D., Professor Emeritus
Dino S. Tinti, Ph.D., Professor, Emeritus
Nancy S. True, Ph.D., Professor Emeritus
George S. Zweifel, Sc.D., Professor Emeritus

Affiliated Faculty

Toby Allen, Ph.D., Associate Professor
Giulia Galli, Ph.D., Adjunct Professor

The Major Programs

Chemistry studies the composition of matter, its structure, and the means by which it is converted from one form to another.

The Program. The Department of Chemistry offers several degree programs leading to the Bachelor of Arts and the Bachelor of Science. The curriculum leading to the B.A. degree offers a substantive program in chemistry while allowing students the freedom to take more courses in other disciplines and pursue a broad liberal arts education. Students who have a deeper interest in chemistry normally elect one of the several programs leading to the B.S. degree. The standard B.S. program, the only chemistry program accredited by the American Chemical Society, is appropriate for students who are interested in chemistry as a profession. The B.S. in Chemical Physics, the B.S. in Pharmaceutical Chemistry, and the two B.S. Applied Chemistry emphases are slightly less intense in chemistry, and draw on significant course materials from areas relevant to their particular focus but outside of a classical chemistry degree. Students following the A.B. or one of the B.S. programs may consider taking advantage of the Education Abroad Program. Our major adviser can assist students in planning a curriculum while abroad that assures regular progress in the major. A minor program in chemistry is also available.

Career Alternatives. Chemistry graduates with bachelor’s degrees are employed extensively throughout the various industries in quality control research and development, production supervision, technical marketing, and other areas. The types of industries employing these graduates include chemical, energy, pharmaceutical, genetic engineering, biotechnology, food and beverage, petroleum and petrochemical, paper and textile, electronics and computer, and environmental and regulatory agencies. The bachelor’s programs also provide chemistry graduates with the rigorous preparation needed for an advanced degree in chemistry and various professional schools in the health sciences.

Chemistry

A.B. Major Requirements:............................ 41-42

Preparatory Subject Matter ....................... 36-42

Chemistry 2A-2B-2C or 2AH-2BH-2CH ...... 15

Physics 7A-7B-7C or 9A-9B-9C .......... 12-15

Mathematics 1A-1B-1C or 1A-1B-1C ..... 21-22

Depth Subject Matter................................. 43


At least 11 additional upper division units in chemistry (except Chemistry 107A or 107B) or related areas, including one course with

UNITs

Fall 2011 and on Revised General Education (GE) AE=Arts and Humanities; SE=Science and Engineering; SS=Social Sciences;
AGCh=American Cultures; DD=Dominant Diversity; OL=Other Skills; VL=Quantitative; SL=Scientific; VL=Visual; WC=World Cultures; WE=Writing Experience
Pre-Fall 2011 General Education (GE): Arthum=Arts and Humanities; Scileng=Science and Engineering; Socsci=Social Sciences; Div=Domestic Diversity; Wrt=Writing Experience Quarter Offered: F=Fall, W=Winter, S=Spring, Su=Summer; 2017-2018 offering in parentheses
American Chemical Society Accredited Program

B.S. Major Requirements:

Preparatory Subject Matter ........................................ 53
Chemistry 2A-2B-2C or 2AH-2BH-2CH ... 15
Physics 7A, 7B, 7C or 9A-9B-9C ....... 12-15
Mathematics 1A-1B-1C or 17A-17B-17C ... 9-12
Biological Sciences 2A ............................... 4
Statistics 13 or 32 or 100 .......... 3-4

Depth Subject Matter ........................................... 53-62
At least four additional upper-division units in chemistry [except Chemistry 107A, 107B] .......................... 4

Total Units for the Major ................. 107

Recommended

Physics 9D

Environmental Chemistry emphasis

B.S. Major Requirements:

Preparatory Subject Matter ........................................ 48-55
Chemistry 2A-2B-2C or 2AH-2BH-2CH ... 15
Physics 7A, 7B, 7C or 9A-9B-9C ....... 12-15
Mathematics 1A-1B-1C or 17A-17B-17C ... 9-12
Biological Sciences 2A ............................... 4
Statistics 13 or 32 or 100 .......... 3-4

Depth Subject Matter ........................................... 48-64
Chemistry 124A, 130A-130B-135, 150 .................................. 15
Chemistry 107A-107B or 110A-110B-110C .................................. 6-12
Environmental Science and Policy 104 ............................... 4
Chemistry 2A-2B-2C or 2AH-2BH-2CH .................................. 15
Mathematics 1A-1B-1C or 17A-17B-17C ... 9-12
Biological Sciences 2A ............................... 4
Statistics 13, 32, 100 or 102 .......... 3-4

Total Units for the Major ................... 98-115

Chemical Physics

B.S. Major Requirements:

Preparatory Subject Matter ........................................ 57
Chemistry 2A-2B-2C or 2AH-2BH-2CH ... 15
Physics 9A, 9B, 9C, 9D .................. 19

Depth Subject Matter ........................................... 53
Physics 104A, 105A, 110A .................................. 12
At least one course from: Physics 105B, 110B, 112, 115A, 140A  .......... 4
At least two additional upper-division units in chemistry [except Chemistry 107A, 107B] .......................... 2

Total Units for the Major ................... 110

Pharmaceutical Chemistry

B.S. Major Requirements:

Preparatory Subject Matter ........................................ 48-55
Chemistry 2A-2B-2C or 2AH-2BH-2CH ... 15
Physics 7A, 7B, 7C or 9A-9B-9C ....... 12-15
Mathematics 1A-1B-1C or 17A-17B-17C ... 9-12
Biological Sciences 2A ............................... 4
Statistics 13 or 32 or 100 .......... 3-4

Depth Subject Matter ........................................... 62-85
Statistics 13, 32, 100 or 102 .......... 3-4

Total Units for the Major ................. 79-85

Chemistry

Forensic Chemistry Emphasis

B.S. Major Requirements:

Preparatory Subject Matter ........................................ 47-54
Chemistry 2A-2B-2C or 2AH-2BH-2CH ... 15
Physics 7A-7B-7C or 9A-9B-9C ..... 12-15
Mathematics 1A-1B-1C or 17A-17B-17C ... 9-12
Biological Sciences 2A ............................... 4

Depth Subject Matter ........................................... 51-61
Chemistry 2A-2B-2C or 2AH-2BH-2CH ... 15
Physics 7A-7B-7C or 9A-9B-9C ..... 12-15
Mathematics 1A-1B-1C or 17A-17B-17C ... 9-12
Biological Sciences 2A ............................... 4
Statistics 13, 32, 100 or 102 .......... 3-4

Graduate Study. The Department of Chemistry offers programs of study and research leading to the M.S. and Ph.D. degrees in Chemistry. Detailed information regarding graduate study may be obtained by contacting the Graduate Adviser, Department of Chemistry. See also Graduate Studies, on page 120.

Courses in Chemistry (CHE)

Chemistry Placement Requirement. Students who enroll in Chemistry 2A, 2AH or Workload Chemistry 41C must satisfy the Chemistry Placement Requirement. See the Department of Chemistry website at http://chemistry.ucdavis.edu/undergraduate/chemistry_placement_exam.html

The Student Academic Success Center (SASC) provides review materials, workshops, drop-in and group tutoring, and additional resources.

Chemistry Graduate Students Tutors are also listed on the Department of Chemistry website at http://chemistry.ucdavis.edu/undergraduate/ta_tutors_in_chemistry.html

Lower Division

2A. General Chemistry (5)

Lecture—3 hours; laboratory/discussion—4 hours. Prerequisite: high school chemistry and physics strongly recommended; any one of the following: (A) SAT Mathematics score = 600+; (B) ACT Mathematics score = 27+; (C) AP Chemistry exam score of = 3+; (D) SAT Chemistry subject test score = 700+; (E) UC Davis Chemistry Placement Examination score = 24+ on first attempt; in lieu of A-E, either completion of ALEKS online Preparatory Chemistry course with 100% Mastery or completion of WAPOL Chemistry 1A with a grade of C or better (offered only in fall quar- ter to students who do not meet A-E). Periodic table, stoichiometry, chemical equations, physical proper- ties and kinetic theory of gases, atomic and molecu- lar structure and chemical bonding. Laboratory experiments in stoichiometric relations, properties and collection of gases, atomic spectroscopy, and introductory quantitative analysis. Not open for credit to students who have taken course 2AH. GE credit: SciEng | QL, SE, SL — F, W, F, W

2AH. Honors General Chemistry (5)

Lecture—3 hours; laboratory/discussion—4 hours. Prerequisite: high school chemistry and physics. Any ONE of the following: (A) SAT Mathematics score = 670+; (B) ACT Mathematics score = 30+; (C) AP Chemistry exam score of = 4+; (D) SAT Chemistry subject test score = 700+; (E) UC Davis Chemistry Placement Examination score = 33+ on first attempt; (F) UC Davis Chemistry Placement Examination score = 30+ AND UC Davis Mathematics Placement Examination score = 45+, both on first attempts, consent of instructor. Limited enrollment course with a more rigorous treatment of material covered in course 2A. Students completing course 2AH can continue with course 2BH or 2B. Not open for credit to students who have taken course 2A. GE credit: SciEng | QL, SE, SL — F, F

2B. General Chemistry (5)

Lecture—3 hours; laboratory/discussion—4 hours. Prerequisite: C or better in course 2A or 2AH. Continu- ination of course 2A. Condensed phases and inter- molecular forces, chemical thermodynamics, chemical equilibria, acids and bases, solubility. Lab- oratory experiments in thermodynamics, chemical equilibria, and quantitative analysis using volumetric methods. Not open for credit to students who have taken course 2B. GE credit: SciEng | QL, SE, SL — W, W, S

2BH. Honors General Chemistry (5)

Lecture—3 hours; laboratory/discussion—4 hours. Prerequisite: course 2A with consent of instructor or course 2AH with a grade of C or better; and Mathem-atics 218 (may be taken concurrently) or consent of instructor. Limited enrollment course with a more rigorous treatment of material covered in course 2B.
Students completing course 2BH may take course 2CH with a C- or better. GE credit: SciEng|QL, SE.—Fall, Winter, Spring, Summer; 2017-2018 offering in parentheses

2C. General Chemistry (5)
Lecture—3 hours; laboratory/discussion—4 hours.
Prerequisite: C- or better in course 2B or 2BH. Kinetics, electrochemistry, spectroscopy, structure and bonding in transition metal compounds, application of principles to chemical reactions. Laboratory experiments in selected analytical methods and syntheses. Not open for credit to students who have taken course 2CH. GE credit: SciEng|QL, SE.—F, S (F, S)

8B. Organic Chemistry: Brief Course (4)
Lecture—3 hours; laboratory—3 hours.
Prerequisite: course 8A, 118A, or 128A. Laboratory primarily with monodisperse polymers and the chemistry of the common classes of organic compounds. Lecture portion a continuation of course 8A. Varying credit hours according to courses taken previously and corresponding expected workload for this course; full credit to students who complete course 118A or 128A; 3 units credit to students who have completed courses 128A and 129A (students who have completed course 128A are exempt from the laboratory portion of course 8B); 2 units credit to students who have completed course 128B; 1 unit credit to students who have completed course 118B or courses 128B and 129A (students who have completed course 118B are exempt from the laboratory portion of course 8B). GE credit: SciEng|SE.—F, W, F, W

10. Concepts of Chemistry (4)
Lecture—4 hours. Survey of basic concepts and contemporary applications of chemistry. Designed for non-science majors and not as preparation for Chemistry 2A. Not open for credit to students who have had Chemistry 2A with credit for course 10 may take Chemistry 2A for full credit. GE credit: SciEng, Writ|SE, SL.—F (F, F)

98. Directed Group Study (1-5)
Prerequisite: consent of instructor. Primarily for lower division students who have completed 2A, 2B or 2CH with a C- or better. GE credit: SciEng|QL, SE.—F, W, F, W

99. Special Study for Undergraduates (1-5)
Prerequisite: consent of instructor. (F/P grading only)

Upper Division

100. Environmental Water Chemistry (3)
Lecture—3 hours. Prerequisite: course 2C or 2CH. Practical aspects of water chemistry in the environment, including thermodynamic relations, coordination chemistry, and stability calculations, redox reactions and rate laws. Computer modeling of the evolution in water chemistry from contact with minerals and gases. W (W) Casey

104. Forensic Applications of Analytical Chemistry (3)
Lecture—2 hours; laboratory—3 hours.
Prerequisite: course 2C or 2CH. Theory and application of standard methods of chemical analysis to evidentiary samples. Use and interpretation of results from screening tests, FTIR, GC and GCMS to various sample types encountered in forensics. F (F) Land

105. Analytical and Physical Chemical Methods (4)
Lecture—2 hours; laboratory—6 hours.
Prerequisite: course 110A (may be taken concurrently) or course 107B (may be taken concurrently). Fundamental theory and laboratory techniques in analytical and physical chemistry. Errors and data analysis methods. Basic electrical circuits in instruments. Advanced solution equilibria. Potentiometric analysis. Chromatographic separations. UV/visible spectroscopy. Lasers. GE credit: SciEng|QL, SE.—F, S (F, S)

107A. Physical Chemistry for the Life Sciences (3)
Lecture—3 hours. Prerequisite: course 2C. Mathematics 16A, 16C, 21C, one year of college level physics. Physical chemistry intended for majors in the life sciences. Introductory development of classical and statistical thermodynamics including equilibrium processes and solutions of both non-electrolytes and electrolytes. The thermodynamic basis of electrochemistry and membrane potentials. F (F)

107B. Physical Chemistry for the Life Sciences (3)
Lecture—3 hours. Prerequisite: course 107A. Continuation of course 107A. Continuation of course 107A. Kinetic theory of gases and transport processes in liquids. Chemical kinetics, enzyme kinetics and theories of reaction rates. Introduction to quantum theory, atomic and molecular structure, and spectroscopy. Application of these principles to the biological sciences. GE credit: SciEng|SE.—W, S, W, S

108. Molecular Biochemistry (3)
Lecture—3 hours. Prerequisite: course 118C or 128C. Pass One open to Chemistry majors. Chemical and experimental methods applied to the biological sciences to understand the molecular structure and function of proteins, nucleic acids, carbohydrates, and membrane lipids. S (S) Ames, Fisher

110A. Physical Chemistry: Introduction to Quantum Mechanics (4)
Lecture—3 hours; discussion—1 hour.
Prerequisite: course 110A. Group theory. Application of quantum mechanics to polyatomic molecules and molecular spectroscopy. Intermolecular forces, crystals, liq- uid and solid states. Distributions, ensembles and partition functions. Transport properties. F, W, W

110C. Physical Chemistry: Thermodynamics, Equilibria and Kinetics (4)
Lecture—3 hours; discussion—1 hour.
Prerequisite: course 110B. Development and application of the general principles of thermodynamics and statistical thermodynamics. Chemical kinetics, rate laws for chemical reactions and reaction mechanisms. F, S (F, S)

115. Instrumental Analysis (4)
Lecture—2 hours; laboratory—6 hours. Prerequisite: courses 105 and 110B (may be taken concurrently) or 107A-107B. Intermediate theory and laboratory techniques in analytical and physical chemistry. Advanced data analysis methods and goodness-of-fit criteria. Fourier transform spectroscopic methods and instrumentation. Mass spectrometry. Electrochemistry. Liquid chromatography. GE credit: SciEng, Writ|QL, SE, WC.—F, W, F, W

118A. Organic Chemistry for Health and Life Sciences (4)
Lecture—3 hours; laboratory—3 hours.
Prerequisite: courses 118A or 128A. Continuation of course 118A, with emphasis on spectroscopy and the preparation and reactions of aromatic hydrocarbons, organometallic compounds, aldehydes and ketones. F, W, S (F, W, S)

118B. Organic Chemistry for Health and Life Sciences (4)
Lecture—3 hours; laboratory—3 hours.
Prerequisite: course 118B or courses 128B and 129A. Open to students changing from the Chemistry 128 course sequence only if they have completed prior organic laboratory work (at least course Chemistry 129A). Continuation of course 118B, with emphasis on the preparation, reactions and identification of carboxylic acids and their derivatives, alcohols and aldehydes and ketones. W, S, W, S

118C. Organic Chemistry for Health and Life Sciences (4)
Lecture—3 hours; laboratory—3 hours.
Prerequisite: course 118C or courses 129A and 129B. Open to students changing from the Chemistry 129 course sequence only if they have completed prior organic laboratory work (at least course Chemistry 129A). Continuation of course 118C, with emphasis on the preparation, reactions and identification of carboxylic acids and their derivatives, alcohols and aldehydes and ketones. W, S, W, S

3A. Chemistry for Life Sciences: Determining Structure and Predicting Properties (5)
Lecture—2 hours; discussion—1 hour; laboratory—3 hours.
Prerequisite: high school chemistry and physics strongly recommended; satisfactory score on the Chemistry and Mathematics Placement Examinations or satisfactory score on the ALEKS Summer Math Prep Course, a satisfactory grade in Workload 41C (P or C or better) will suffice in lieu of a satisfactory Chemistry Placement Examination score. Concurrent enrollment with course 2A, 2B, 2C, 2AH, 2BH, 2CH prohibited; not open for enrollment to students who have completed CHE 2C or 2CH with a C- or better. Integrated General and Organic Chemistry intended for majors in the life sciences. Core concepts of chemical composition, structure and properties. Includes phase changes, separation methods, composition, spectroscopy, atomic and molecular structure, periodicity, bonding, change distribution, intermolecular forces, and physical properties. Only 3 units credit for students who have completed course 2A or 2AH with a C- or better. GE credit: SciEng|QL, SE, SL.—F, W, F, W

3B. Chemistry for Life Sciences: Predicting and Characterizing Chemical Change (5)
Lecture—3 hours; discussion—1 hour; laboratory—3 hours.
Prerequisite: C- or better in course 3A; note: C- or better in course 2A or 2AH does not satisfy the prerequisite requirement. Concurrent enrollment with course 2B, 2C, 2AH, 2BH, 2CH prohibited. Continuation of course 3A covering core concepts of characterization of chemical processes and predicting chemical changes. Includes modeling chemical reactions, understanding the proportions/stoichiometry, tracking energy, activation energy, reaction kinetics, thermodynamics, and equilibrium. Only 3 units credit for students who have completed course 2B or 2BH with a C- or better. GE credit: SciEng|QL, SE, SL.—W (W)

3C. Chemistry for Life Sciences: Controlling Processes and Synthetic Pathways (5)
Lecture—3 hours; discussion—1 hour; laboratory—3 hours.
Prerequisite: C- or better in course 3B; note: C- or better in course 2B or 2BH does not satisfy the prerequisite requirement. Concurrent enrollment with course 2A, 2B, 2C, 2AH, 2BH, 2CH prohibited. Continuation of course 3B covering core concepts of harnessing energy, controlling reaction extent, and organic chemistry synthetic pathways. Includes acids and bases, thermodynamics, chemical equilibria, organic acid and base reactions, and stereochemistry. Only 3 units credit for students who have completed course 2C or 2CH with a C- or better. GE credit: SciEng|QL, SE, SL.—S (S)

8A. Organic Chemistry: Brief Course (2)
Lecture—2 hours. Prerequisite: C- or better in course 2B or 2BH. With course 8B, an introduction to the nomenclature, structure, chemistry, and reaction mechanisms of organic compounds. Intended for stu-
210A. Quantum Chemistry: Introduction and Stationary-State Properties (3)
Lecture—3 hours. Prerequisite: course 110B and 110C or equivalent. Stationary-state quantum chemistry: postulates of quantum mechanics, simple solutions, central field problems and angular momentum, perturbation theory, variational theory, atoms and molecules. —W. (W.)

210B. Quantum Chemistry: Time-Dependent Systems (3)
Lecture—3 hours. Prerequisite: course 210A. Matrix mechanics and time-dependent quantum chemistry: matrix formulation of quantum mechanics, Heisenberg representation, time-dependent perturbation theory, selection rules, density matrices, and miscellaneous molecular properties. —S. (S.)

210C. Quantum Chemistry: Molecular Spectroscopy (3)
Lecture—3 hours. Prerequisite: course 210B. Molecular spectroscopy: Born-Oppenheimer approximations, rotational, vibrational and electronic spectroscopy, nuclear and molecular physics. —F. (F.)

211A. Advanced Physical Chemistry: Statistical Thermodynamics (3)
Lecture—3 hours. Prerequisite: consent of instructor. Principles of statistical mechanics, ensemble theory, statistical thermodynamics of gases, solids, liquids, electrolyte solutions and polymers; chemical equilibrium. —F. (F.)

211B. Statistical Mechanics (3)
Lecture—3 hours. Prerequisite: course 211A. Statistical mechanics of nonequilibrium systems, including the rigorous kinetic theory of gases, continuum mechanics transport in dense fluids, stochastic processes, mechanical modes and linear response theory. Offered in alternate years. —W.

212. Chemical Dynamics (3)
Lecture—3 hours. Prerequisite: consent of instructor. Introduction to modern concepts in chemical reaction dynamics for graduate students in chemistry. Emphasis will be placed on experimental techniques as well as emerging physical models for characterizing chemical reactivity at a microscopic level. Offered in alternate years. —S. (S.)

215. Theoretical and Computational Chemistry (3)
Lecture—3 hours. Prerequisite: courses 211A and 210B or consent of instructor. Mathematics of wide utility in chemistry, computational methods for guidance or alternative to experiment, and modern formulations of chemical theory. Emphasis will vary in successive years. May be repeated for credit when topic differs and with consent of instructor. —S. (S.)

216. Magnetic Resonance Spectroscopy (3)
Lecture—3 hours. Prerequisite: courses 210A, 210B (may be taken concurrently). Quantum mechanics of spin and orbital angular momentum, nuclear magnetic resonance, theory of chemical shift and multiple structures, electron spin resonance, theory of g-tensor in organic and transition ions, spin Hamiltonians, nuclear quadrupolar resonance, spin relaxation processes. Offered in alternate years. —S. (S.)

217. X-Ray Structure Determination (3)
Lecture—3 hours. Prerequisite: consent of instructor. Introduction to x-ray structure determination; crystal symmetry, diffraction geometry, sample preparation and handling, x-ray diffraction apparatus and data collection, methods of structure solution and refinement, presentation of results, text, tables and graphs, crystallographic literature. —S. (S.)

218. Macromolecules: Physical Principles (3)
Lecture—3 hours. Prerequisite: courses 110A, 110B, 110C or the equivalent. Relationship of higher order macromolecular structure to subunit composition; equilibrium properties and macromolecular properties; physical chemical determination of macromolecular structure. Offered in alternate years. —F.

219. Spectroscopy of Organic Compounds (4)
Lecture—2 hours; laboratory—2.5 hours. Prerequisite: course 128C or the equivalent. Identification of organic compounds and investigation of stereochemical and reaction mechanism phenomena using spectroscopic methods—primarily NMR, IR and MS. —W. (W.)

219L. Laboratory in Spectroscopy of Organic Compounds (1)
Laboratory—2.5 hours. Prerequisite: course 219 (may be taken concurrently). Restricted to Chemistry graduate students only (for consent of instructor). Practical application of NMR, IR and MS techniques for organic molecules. —S. (S.)

221A. Special Topics in Organic Chemistry (3)
Lecture—3 hours. Selected topics of current interest in organic chemistry. Topics will vary each time the course is offered, and in general will emphasize the research interests of the staff member giving the course. —F. (F.)

221B. Special Topics in Organic Chemistry (3)
Lecture—3 hours. Selected topics of current interest in organic chemistry. Topics will vary each time the course is offered, and in general will emphasize the research interests of the staff member giving the course. —F. (F.)

221C. Special Topics in Organic Chemistry (3)
Lecture—3 hours. Selected topics of current interest in organic chemistry. Topics will vary each time the course is offered, and in general will emphasize the research interests of the staff member giving the course. —F. (F.)

221D. Special Topics in Organic Chemistry (3)
Lecture—3 hours. Selected topics of current interest in organic chemistry. Topics will vary each time the course is offered, and in general will emphasize the research interests of the staff member giving the course. —F. (F.)

221E. Special Topics in Organic Chemistry (3)
Lecture—3 hours. Selected topics of current interest in organic chemistry. Topics will vary each time the course is offered, and in general will emphasize the research interests of the staff member giving the course. —F. (F.)

221F. Special Topics in Organic Chemistry (3)
Lecture—3 hours. Selected topics of current interest in organic chemistry. Topics will vary each time the course is offered, and in general will emphasize the research interests of the staff member giving the course. —F. (F.)

221G. Special Topics in Organic Chemistry (3)
Lecture—3 hours. Selected topics of current interest in organic chemistry. Topics will vary each time the course is offered, and in general will emphasize the research interests of the staff member giving the course. —F. (F.)

222. Principles of Transition Metal Chemistry (3)
Lecture—3 hours. Prerequisite: course 124A or the equivalent. Electronic structures, bonding, and reactivity of transition metal compounds. —F. (F.)

228A. Bio-inorganic Chemistry (3)
Lecture—3 hours. Prerequisite: course 226 or consent of instructor. Defines role of inorganic chemistry in the functioning of biological systems by identifying the functions of metal ions and main group compounds in biological systems and discussing the chemistry of model and isolated biological compounds. Offered every other year. —W.

228B. Main Group Chemistry (3)
Lecture—3 hours. Prerequisite: course 226 or consent of instructor. Synthesis, physical properties, reactions and bonding of main group compounds. Discussions of concepts of electron deficiency, hyper-valency, and non-classical bonding. Chemistry of the main group elements will be treated systematically. Offered every third year. —W.

228C. Solid-State Chemistry (3)
Lecture—3 hours. Prerequisite: courses 124A, 110B, 226, or the equivalent. Design and synthesis, structure and bonding of solid-state compounds; physical properties and characterization of solids; topics of current interest such as liquid crystals, inorganic polymers, materials for catalysis. Offered every third year. —W.

228D. Homogeneous Catalysis (3)
Lecture—2 hours; discussion—1 hour. Prerequisite: course 124A or 201 or an equivalent class from either Physics or Chemical Engineering and Materials Science. Covers the basic principles and concepts of catalysis, methods used for characterization of catalytic properties, as well as specific state-of-the-art catalytic materials and topics from the recent chemistry literature. Offered in alternate years. —F. (F.) Kovnir

231A. Organic Synthesis: Methods and Strategies (4)
Lecture—3 hours; lecture/discussion—3 hours. Prerequisite: course 128C or equivalent. Current strategies and methods in synthetic organic chemistry. Focus on construction of carbon frameworks, control of configuration and absolute stereochemistry and synthetic strategies. Use of databases and molecular modeling software in multistep strategies. —W. (W.)

231B. Advanced Organic Synthesis (3)

233. Physical-Organic Chemistry (3)
Lecture—3 hours. Prerequisite: courses 128A-128B-128C and 110A-110B-110C or the equivalent. Introduction to elementary concepts in physical-organic chemistry including the application of simple numerical techniques in characterizing and modeling organic reactions. —F. (F.)

235. Organometallic Chemistry in Organic Synthesis (3)
Lecture—3 hours. Prerequisite: course 128C. Current trends in use of organometallics for organic synthesis; preparations, properties, applications, and limitations of organometallic reagents derived from transition and/or main group metals. Offered in alternate years. —S. (S.)
236. Chemistry of Natural Products (3)
Lecture—3 hours. Prerequisite: course 128C or the equivalent. Advanced treatment of chemistry of naturally occurring compounds isolated from a variety of sources. Topics will include isolation, structure determination, chemical transformations, total synthesis, biologically active and biosynthetic. Biosynthetic origin will be used as a unifying theme. — W (W)

237. Bio-organic Chemistry (3)
Lecture—3 hours. Prerequisite: course 128C or the equivalent. Structure and function of biomolecules; molecular recognition, enzyme reaction mechanisms; designates for enzymes; enzyme engineering; design of artificial enzymes and application of enzymes in organic synthesis. Offered in alternate years. — F

238. Introduction to Chemical Biology (3)
Lecture—3 hours. Prerequisite: course 118C or 128C, or the equivalent; course 130A & B & Biological Sciences 102, 103, & 104, or the equivalents recommended. Synthesis of complex molecules in nature. Use of biosynthetic pathways in synthesis of new chemical entities. Applications of small molecules in chemical genetics and structural biology. Solving biological problems using synthetic biomolecules. — F

240. Advanced Analytical Chemistry (3)
Lecture—3 hours. Prerequisite: courses 110A and 115 or the equivalent. Numerical treatment of experimental data; thermodynamics of electrolyte and non-electrolyte complex equilibria in aqueous and non-aqueous solutions; potentiometry and specific ion electrodes; mass transfer in liquid solutions; fundamentals of separation science, including column, gas and liquid chromatography. — F

241A. Surface Analytical Chemistry (3)
Lecture—3 hours. Prerequisite: course 110C or the equivalent. Concepts of surfaces and interfaces: physical properties, unique chemistry and electronic effects. Focus on gas-solid interfaces, with some discussion of liquid-solid interfaces. Offered in alternate years. — F

241B. Laser and X-ray Spectroscopy (3)
Lecture—3 hours. Prerequisite: course 110B or the equivalent. Concepts and mechanisms of light-matter interactions. Chemical applications of modern spectroscopic methods, including multiphoton spectroscopy, time-resolved laser and x-ray photolysis, and phase-sensitive x-ray imaging. Offered in alternate years. — F

241C. Mass Spectrometry (3)
Lecture—3 hours. Prerequisite: course 110C and 115 or the equivalent. Mass spectrometry and related methods in ionization methods, mass analyzers, and detectors. Related methods may include ion-molecule reactions, unimolecular dissociation of organic and bioorganic compounds, and applications in biological and environmental analysis. Offered in alternate years. — W

241D. Electroanalytical Chemistry (3)
Lecture—3 hours. Prerequisite: course 110C and 115 or the equivalent. Electroanalytical chemistry with consideration of mass transfer and electrode kinetics for polarizable electrodes. Current-potential curves for a variety of conditions, including both kinetic for polarizable electrodes. Current-potential with consideration of mass transfer and electrode activities in the Department and research topic selection. (S/U grading only) — F, W, S (F, W, S)

245. Mechanistic Enzymology (3)
Lecture—3 hours. Advanced topics in chemical kinetics relevant to enzymes, enzyme kinetics, theory of enzymatic catalysis, and the design of a selection of organic enzyme reaction mechanisms by the tools introduced in the first part of the course. — F

261. Current Topics in Chemical Research (2)
Lecture—2 hours. Prerequisite: graduate standing in Chemistry or consent of instructor. Designed to help chemistry graduate students develop and maintain familiarity with the current and past literature in their immediate field of research and related areas. May be repeated for credit when topics differ. — F, W, S (F, W, S)

263. Introduction to Chemical Research Methodology (3)
Lecture—9 hours. Prerequisite: course 293 and graduate student standing in Chemistry; consent of instructor. Introduction to identification, formulation, and solution of meaningful scientific problems including experimental design and/or theoretical analyses of new and prevailing techniques, theories and hypotheses. May be repeated for credit when topics differ. (S/U grading only) — F, W, S (F, W, S)

290. Seminar (2)
Seminar—2 hours. Prerequisite: consent of instructor. (S/U grading only) — F, W, S (F, W, S)

295. Careers in Chemistry (1)
Seminar—2 hours. Restrictions to graduate students who have not yet given their departmental presentation. Introduces first and second-year Chemistry graduate students to the process of giving an effective research presentation. Advanced Ph.D. students give formal seminars describing the design and execution of their research projects. May be repeated three times for credit. (S/U grading only) — F, S, F, S

296. Research in Pharmaceutical Chemistry (6)
Laboratory—18 hours. Prerequisite: courses 130A and 130B, 135, and 233 (may be taken concurrently); consent of instructor. Open to qualified graduate students in the Integrated B.S./M.S. Program in Chemistry (Pharmaceutical Chemistry Emphasis). May be repeated three times for credit when topics differ. — F, W, S, S, Su (F, W, S, Su)

298. Group Study (1-5)
Lecture—1 hour. — W (W)

299. Research (1-12)
The laboratory is open to qualified graduate students who wish to pursue original investigation. Students wishing to enroll should communicate with the department well in advance of the quarter in which the work is to be undertaken. (S/U grading only)

Professional

390. Methods of Teaching Chemistry (2)
Lecture—1 hour; discussion—1 hour. Prerequisite: graduate student standing in Chemistry and consent of instructor. Practical experience in methods and problems of teaching chemistry. Includes analyses of texts and supplying material, discussion of teaching techniques, preparing for and conducting of discussion sections and student laboratories. Participation in the teaching program required for Ph.D. in Chemistry. May be repeated for credit. (S/U grading only) — F, W, S (F, W, S)

392. Advanced Methods of Teaching Chemistry (2)
Lecture—2 hours. Prerequisite: course 390. Advanced topics in teaching chemistry. Analysis and discussion of curricular design, curricular materials, teaching methods and evaluation. For students who are planning a career in teaching chemistry. (P/NP grading only) — S

Chicana/Chicano Studies

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Beatriz Pesquera, Ph.D., Associate Professor Emerita
Regina Rochin, Ph.D., Professor Emeritus
Adaljiza Sosa-Riddell, Ph.D., Senior Lecturer Emerita

The Major Program
The Department of Chicana/Chicano Studies offers an interdisciplinary curriculum focusing on the Chicana/Chicano experience through an analysis of class, race, ethnicity, gender and sexuality, and cultural expression. The department offers a major leading to the Bachelor of Arts degree and a minor that can satisfy breadth requirements for the College of Letters and Science. Both the major and minor frame an analysis within the historical, contemporary experiences of Chicana/os in the Americas. The major gives students an opportunity to specialize in one of two emphases: Cultural Studies or Social/Political Studies. Students in the major are expected to read, write, and speak Spanish at a level suitable for