

Chemistry

IN THE DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY
IN THE COLLEGE OF SCIENCES

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Faculty

William G. Tong, Ph.D., Albert W. Johnson Distinguished Professor of Chemistry and Biochemistry, Chair of Department

Andrew L. Cooksy, Ph.D., Professor of Chemistry and Biochemistry

Douglas B. Grotjahn, Ph.D., Professor of Chemistry and Biochemistry (Graduate Admissions and Doctoral Adviser)

Tom Huxford, Ph.D., Professor of Chemistry and Biochemistry

William E. Stumph, Ph.D., Professor of Chemistry and Biochemistry, Emeritus

B. Mikael Bergdahl, Ph.D., Associate Professor of Chemistry and Biochemistry

Thomas E. Cole, Ph.D., Associate Professor of Chemistry and Biochemistry (Graduate Admissions Adviser and M.S./M.A. Graduate Adviser)

Jeffrey L. Gustafson, Ph.D., Associate Professor of Chemistry and Biochemistry

Christopher R. Harrison, Ph.D., Associate Professor of Chemistry and Biochemistry

Gregory P. Holland, Ph.D., Associate Professor of Chemistry and Biochemistry

John J. Love, Ph.D., Associate Professor of Chemistry and Biochemistry

David P. Pullman, Ph.D., Associate Professor of Chemistry and Biochemistry (Undergraduate Adviser)

Byron W. Purse, Ph.D., Associate Professor of Chemistry and Biochemistry

Diane K. Smith, Ph.D., Associate Professor of Chemistry and Biochemistry

Manal A. Swairjo, Ph.D., Associate Professor of Chemistry and Biochemistry

Peter van der Geer, Ph.D., Associate Professor of Chemistry and Biochemistry

Erica Forsberg, Ph.D., Assistant Professor of Chemistry and Biochemistry

Jing Gu, Ph.D., Assistant Professor of Chemistry and Biochemistry

Regis Komperda, Ph.D., Assistant Professor of Chemistry and Biochemistry

Young Lee, Ph.D., Assistant Professor of Chemistry and Biochemistry

Christal D. Sohl, Ph.D., Assistant Professor of Chemistry and Biochemistry

Yong Yan, Ph.D., Assistant Professor of Chemistry and Biochemistry

Associateships

Graduate teaching associateships and graduate nonteaching associateships in chemistry and biochemistry are available to a limited number of qualified students. Graduate teaching associateships can be valuable for applicable degree programs, preparing students for a teaching career. Application forms and additional information may be secured from the Department of Chemistry and Biochemistry websites at <http://www.chemistry.sdsu.edu/forms> and <http://www.chemistry.sdsu.edu/graduate/degrees.php#GradAdmission>.

General Information

The Department of Chemistry and Biochemistry offers graduate study leading to the Master of Arts, the Master of Science and the Doctor of Philosophy degrees in chemistry. The Ph.D. degree is offered jointly with the Department of Chemistry and Biochemistry at the University of California, San Diego. Thesis research in all graduate programs is offered in the following areas of chemistry: analytical chemistry, biochemistry, chemical education, inorganic chemistry, organic chemistry, and physical chemistry.

The Department of Chemistry and Biochemistry at SDSU provides a substantial inventory of modern chemical instrumentation in support of teaching and research. Included are systems for the performance of nearly all major types of chemical separations; several GC- and two HPLC-mass spectrometric systems; 400, 500, and 600 MHz nuclear magnetic resonance (NMR) spectrometers; three FT infrared spectrometers; ultraviolet-visible spectrometric instruments for both atomic and molecular emission and absorption studies; electrochemical instrumentation for potentiometric, voltammetric and coulometric measurements; radiochemical instrumentation; laser systems for spectroscopy, covering UV to mid-IR wavelengths, and x-ray diffractometers for both small and macromolecules. Several groups have inert-atmosphere gloveboxes for conducting research on air- and moisture-sensitive compounds. The departmental computer lab has 25 personal computers (Mac and PC) for general use, and numerous research-grade computers are housed in individual laboratories. Access is also available to accounts on the College of Sciences Molecular Sciences Cluster and at the San Diego Supercomputer Center. In-house support staff includes NMR, analytical instrument technicians, and a well-equipped shop is available for machining, plastic working, welding, and other fabrications needs.

Admission to Graduate Study

Students applying for admission should electronically submit the university application available at <http://www.calstate.edu/apply> along with the application fee.

In addition, admissions materials must be submitted electronically. Three letters of reference are required from people who can comment on the applicant's academic and research abilities. Refer to <http://www.chemistry.sdsu.edu/graduate/degrees.php#GradAdmission> for requirements for direct and indirect admission to the doctoral program and admission to Master of Science and Master of Arts programs.

The following materials should be submitted as a complete package directly to:

Graduate Admissions
Enrollment Services
San Diego State University
San Diego, CA 92182-7416

1. Official transcripts (in sealed envelopes) from all postsecondary institutions attended;
 - Students who attended SDSU need only submit transcripts for work completed since last attendance.
 - Students with international coursework must submit both the official transcript and proof of degree. If documents are in a language other than English, they must be accompanied by a certified English translation.
2. GRE scores (<http://www.ets.org> SDSU institution code 4682);
3. English language score, if medium of instruction was in a language other than English (<http://www.ets.org> SDSU institution code 4682).

For information about the admissions process, visit the school website at <http://www.sci.sdsu.edu/chemistry>.

Section I. Master's Degree Programs

Advancement to Candidacy

All students must satisfy the general requirements for advancement to candidacy as stated in Requirements for Master's Degrees. In addition, the student must pass orientation examinations in chemistry. These examinations should be taken during the first year in residence.

Specific Requirements for the Master of Arts Degree

(Major Code: 19051) (SIMS Code: 772602)

In addition to meeting the requirements for classified graduate standing and the basic requirements for the master's degree as described in Requirements for Master's Degrees, the student must complete a graduate program of 30 units which includes a major consisting of at least 24 units in chemistry from courses listed below as acceptable for master's degree programs. At least 15 of these units must be in 600- and 700-numbered courses. Chemistry 790 is required. At least 21 units of graded graduate courses (500-level or above) must be taken in at least three of the five disciplines within chemistry. These 21 units must be numbered below 790. A maximum of three units of Chemistry 797 or 798 may be used provided a written report is approved by course instructor. This degree is offered under the non-thesis, Plan B option, as described in Requirements for Master's Degrees. A written comprehensive examination is required.

Specific Requirements for the Master of Science Degree

(Major Code: 19051) (SIMS Code: 772601)

In addition to meeting the requirements for classified graduate standing, the student must satisfy the basic requirements for the master's degree as described in Requirements for Master's Degrees. The student must also complete a graduate program of 30 units which includes a major consisting of at least 24 units in chemistry from courses listed below as acceptable for master's degree programs. At least 15 of these units must be in 600- and 700-numbered courses. Chemistry 790, 791, 792, and 799A are required. A student must pass a final oral examination on the thesis.

Section II. Doctoral Program

<http://www.chemistry.sdsu.edu/chemistry/>

General Information

(Major Code: 19051) (SIMS Code: 772603)

The cooperating faculties of the Department of Chemistry and Biochemistry at San Diego State University and the Department of Chemistry and Biochemistry at the University of California, San Diego, possess complementary specialties that enable the doctoral student to gain familiarity with most areas in chemistry and to find research activity and direction in a great variety of specific problems.

The entering student will be required to have a mastery of the subjects usually presented in the undergraduate curriculum: physical, organic, analytical, and inorganic chemistry. All applicants will be expected to have taken the equivalent of one year of physics and of mathematics at least through integral calculus. Students should be prepared to take placement examinations which will be administered by a joint committee and will cover the fields of inorganic, organic and physical chemistry.

On admission to the program, the student is guided by Requirements for the Doctoral Degree Program given in Requirements for Master's Degrees. Students will normally spend their first year in the program completing their year of residency at the University of California, San Diego. It is desirable for the student to complete the qualifying examination by the end of the fifth semester and to be advanced to candidacy.

Faculty

The following faculty members of the cooperating institutions participate in the joint doctoral program, being available for direction of research and as departmental members of joint doctoral committees.

San Diego State University:

Graduate Advisers: Thomas E. Cole (master's degree programs), Douglas B. Grotjahn (doctoral program)

Graduate Admissions: Thomas E. Cole, Douglas B. Grotjahn

Committee Members: Bergdahl, Cole, Cooksy, Grotjahn, Gustafson, Harrison, Holland, Huxford, Love, Pullman, Purse, Smith, Sohl, Stumph, Tong, van der Geer

University of California, San Diego:

Vice Chair of Graduate Education: Judy Kim

Committee Members: Amaro, Baker, Bertram, Burkart, Cohen, Continetti, Crowell, Dennis, Devaraj, Dixon, Donoghue, Dorrestein, Figueroa, Fox, Galperin, G. Ghosh, P. Ghosh, Gianneschi, Guerrero, Hermann, Hoffmann, Jennings, Joseph, Kim, Komives, Kubiak, Kummel, Lindenberg, Magde, McCammon, Molina, Molinski, Muller, Nakagawa, Nicolaou, O'Connor, Opella, Paesani, Perrin, Prather, Rheingold, Sailor, Sawrey, Sinha, Tauber, Taylor, Tezcan, Theodorakis, Thiemens, Toor, Tor, Trogler, Tsien, Tukey, Viadiu, Wang, Weare, Whitesell, Yang

Courses Acceptable for Master's and Doctoral Degree Programs in Chemistry

(CHEM)

Refer to Courses and Curricula and Regulations of the Division of Graduate Affairs sections of this bulletin for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

UPPER DIVISION COURSES

CHEM 510. Advanced Physical Chemistry (3)

Prerequisite: Chemistry 410B.

Problems in chemical thermodynamics, statistical mechanics, chemical kinetics, quantum chemistry and molecular structure and spectroscopy, with applications.

CHEM 520A-520B. Inorganic Chemistry (3-3)

Prerequisite: Chemistry 410A. Chemistry 520A is prerequisite to 520B.

Nature of chemical bond and an advanced systematic study of representative and transition elements and their compounds.

CHEM 530. Physical Organic Chemistry (3)

Prerequisites: Chemistry 410B, 432.

Attractive and repulsive interactions between molecules, experimental methods and applications. Kinetic and thermodynamic analysis of reaction mechanisms and noncovalent binding. Qualitative molecular orbital theory, strain and stability, structure and bonding of organic molecules. Not open for post-baccalaureate credit or to students with credit in Chemistry 730.

CHEM 531. Synthetic Organic Chemistry (3)

Prerequisites: Chemistry 432, 432L.

Modern methods, strategies, and mechanisms in advanced organic synthesis. Retrosynthetic analysis of and synthetic routes towards biologically important compounds. Not open for post-baccalaureate credit or to students with credit in Chemistry 731.

CHEM 532. Mechanism of Pharmaceutical Synthesis (3)

Prerequisites: Chemistry 410B, 432.

Organic reactions and mechanisms frequently used in the pharmaceutical industry. Not open for post-baccalaureate credit or to students with credit in Chemistry 732.

CHEM 534. Organometallics (1-3)

Prerequisites: Chemistry 410A or 432; 457, 550.

Advanced or special topics in organometallic chemistry and applications to organic chemistry. Not open for post-baccalaureate credit or to students with credit in Chemistry 734.

Chemistry

CHEM 536. Spectroscopic Characterization of Organic Compounds (3)

Prerequisite: Chemistry 432 with a grade of C (2.0) or better.

Organic compounds using physical and spectroscopic methods. Establishment of purity and yields. Not open for post-baccalaureate credit or to students with credit in Chemistry 736.

CHEM 538. Polymer Science (3) (Same course as Physics 538)

Prerequisites: Chemistry 200 or 202; and credit or concurrent registration in Chemistry 410B or Physics 360 or Mechanical Engineering 350.

Structure, synthesis, physical properties, and utilities of polymers and biopolymers.

CHEM 550. Instrumental Methods of Chemical Analysis (2)

Prerequisites: Chemistry 232, 232L, and credit or concurrent registration in Chemistry 410A; credit or concurrent registration in Chemistry 457 for undergraduate students only. Chemistry majors in the teaching credential program (BA in Applied Arts and Sciences) can replace Chemistry 457 with credit or concurrent registration in Chemistry 417. Chemical Physics majors can replace Chemistry 457 with credit or concurrent registration in Physics 311.

Theory and application of instrumental methods of chemical separation and analysis most frequently used in all disciplines of chemistry.

CHEM 560. General Biochemistry (3)

Prerequisites: Chemistry 232, 232L, and credit or concurrent registration in Chemistry 410A, 432, 432L.

The structure, function, metabolism, and thermodynamic relationships of chemical entities in living systems. Not open to students with credit in Chemistry 365.

CHEM 562. Intermediary Metabolism (2)

Prerequisite: Chemistry 365 or 560.

Catabolic and biosynthetic pathways of carbohydrate, lipid, amino acid, and nucleotide metabolism; TCA cycle, mitochondrial and chloroplast electron transport chains, ATP generation and their interactions and control. Not open to students with credit in Chemistry 361.

CHEM 563. Nucleic Acid Function and Protein Synthesis (2)

Prerequisite: Chemistry 365 or 560.

DNA replication, RNA transcription, RNA processing, and protein translation, including chemical mechanisms of synthesis and cellular mechanisms of regulating gene expression; genomics, recombinant DNA, and DNA topology. Not open to students with credit in Chemistry 361.

CHEM 564. Receptor Biochemistry and Protein Modification (2)

Prerequisite: Chemistry 365 or 560.

Biochemical study of receptors, second messengers, and cellular proteins that participate in extracellular and intracellular communication, with focus on protein structures, post-translational modifications, and biochemical mechanisms that regulate receptors and effector enzymes.

CHEM 567. Biochemistry Laboratory (3)

One lecture and six hours of laboratory.

Prerequisite: Chemistry 560.

Theory and practice of procedures used in study of life at molecular level. Includes purification and characterization of enzymes, isolation of cell components, and use of radioactive tracer techniques.

CHEM 571. Topics in Environmental Chemistry (1-3)

Prerequisites: Chemistry 232, 232L, 251; consent of instructor for all other majors.

Fundamentals of chemistry applied to environmental problems. Chemistry of ecosystems; analysis of natural constituents and pollutants; sampling methods; transport of contaminants; regulations and public policy. Maximum credit three units.

CHEM 596. Advanced Special Topics in Chemistry (1-3)

Prerequisite: Consent of instructor.

Advanced selected topics in modern chemistry. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit of six units of 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

GRADUATE COURSES

CHEM 695. Graduate Education in Chemistry (1-3)

Prerequisite: Concurrent registration in chemistry course at 500-level or higher.

Skills and knowledge needed for success in chemistry graduate program to include techniques for successful teaching, key safety protocols, ethical issues in teaching and research, department research programs, effective means of finding and communicating chemical information.

CHEM 696. Selected Topics in Chemistry (1-3)

Prerequisite: Graduate standing.

Intensive study in specific areas of chemistry. May be repeated with new content. Maximum credit six units. See *Class Schedule* for specific content. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

CHEM 711. Chemical Thermodynamics (3)

Prerequisite: Chemistry 410B.

Chemical thermodynamics and introduction to statistical thermodynamics.

CHEM 712. Chemical Kinetics (3)

Prerequisite: Chemistry 410B.

Theory of rate processes; applications of kinetics to the study of reaction mechanisms.

CHEM 713. Quantum Chemistry (3)

Prerequisite: Chemistry 410B.

Quantum mechanics of atomic and molecular systems; applications to chemical bonding theory.

CHEM 714. Topics in Statistical Mechanics (3)

Prerequisites: Chemistry 410A, 410B, Mathematics 252.

Selected topics from the field of physical chemistry. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

CHEM 730. Physical Organic Chemistry (3)

Prerequisites: Chemistry 410B, 432.

Attractive and repulsive interactions between molecules, experimental methods and applications. Kinetic and thermodynamic analysis of reaction mechanisms and noncovalent binding. Qualitative molecular orbital theory, strain and stability, structure and bonding of organic molecules. Not open to students with credit in Chemistry 530.

CHEM 731. Synthetic Organic Chemistry (3)

Prerequisites: Chemistry 432, 432L.

Modern methods, strategies, and mechanisms in advanced organic synthesis. Retrosynthetic analysis of and synthetic routes towards biologically important compounds. Not open to students with credit in Chemistry 531.

CHEM 732. Mechanism of Pharmaceutical Synthesis (3)

Prerequisites: Chemistry 410B, 432.

Organic reactions and mechanisms frequently used in the pharmaceutical industry. Not open to students with credit in Chemistry 532.

CHEM 734. Organometallics (1-3)

Prerequisites: Chemistry 410A or 432; 457, 550.

Advanced or special topics in organometallic chemistry and applications to organic chemistry. Not open to students with credit in Chemistry 534.

CHEM 736. Spectroscopic Characterization of Organic Compounds (3)

Prerequisite: Chemistry 432 with a grade of C (2.0) or better.
Organic compounds using physical and spectroscopic methods. Establishment of purity and yields. Not open to students with credit in Chemistry 536.

CHEM 750. Advanced Topics in Analytical Chemistry (1-3)

Prerequisite: Chemistry 550.
Selected topics from the field of analytical chemistry. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

CHEM 751. Separations Science (1-3)

Prerequisite: Chemistry 550.
Theoretical basis for separation techniques important in analytical chemistry. Chemical and physical interactions between components of different classes of separation systems, including selection and optimization of operational parameters.

CHEM 752. Mass Spectrometry (1-3)

Prerequisites: Chemistry 410B and 550.
Theory and practice in analysis of volatile and nonvolatile organic and inorganic compounds, basic design principles, theory of ionization processes; interpretation of mass spectra.

CHEM 753. Analytical Spectroscopy (1-3)

Prerequisite: Chemistry 550.
Theory and application of atomic and molecular absorption, emission and fluorescence methods. Modern optical instrumentation and methods of analysis. Nonlinear laser spectroscopic methods in chemical analysis.

CHEM 761. Biophysical Chemistry (3)

Prerequisite: Chemistry 560.
Biological macromolecules to include absorption/circular dichroism/emission spectroscopy, calorimetry, centrifugation, electrophoresis, light/small-angle x-ray/neutron scattering, mass spectrometry, and x-ray crystallography.

CHEM 763. Cellular Regulation (1-3)

Prerequisite: Chemistry 563.
Biochemistry of cellular regulatory mechanisms in eucaryotic cells. Regulation of gene transcription, in mRNA translation and post-translational processes, including the mechanism and regulation of intracellular protein turnover.

CHEM 765. Molecular Mechanisms of Human Disease (3)

Prerequisite: Chemistry 365 for biology majors, 560 for biochemistry and chemistry majors, or graduate standing.
Protein dysfunction in cancer, HIV, and prion disorders. Altered catalytic function to include drug design/pharmacokinetics/ADME, global kinetics fitting software, hydrogen-deuterium exchange mass spectrometry, pre-steady-state kinetics, x-ray crystallography, and structural manipulation programs.

CHEM 790. Seminar (1-3)

An intensive study in advanced chemistry. May not be substituted for Chemistry 791. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

CHEM 791. Research Seminar (1)

Prerequisite: Consent of graduate adviser.
Presentation of current research by students working towards M.S. degrees. Must be completed before end of second year of study.

CHEM 792. Bibliography (1)

Exercise in the use of basic reference books, journals, and specialized bibliographies, preparatory to the writing of a master's project or thesis.

CHEM 795. Chemistry Seminar (1)

Prerequisite: Graduate standing.
Advanced study in all fields of chemistry. Maximum credit three units applicable to the master's degree or Ph.D. in chemistry.

CHEM 797. Research (1-3) Cr/NC/RP

Prerequisite: Consent of instructor.
Research in one of the fields of chemistry. Maximum credit six units applicable to a master's degree.

CHEM 798. Special Study (1-3) Cr/NC/RP

Prerequisite: Consent of staff; to be arranged with department chair and instructor.
Individual study. Maximum credit six units applicable to a master's degree.

CHEM 799A. Thesis (3) Cr/NC/RP

Prerequisites: An officially appointed thesis committee and advancement to candidacy.
Preparation of a project or thesis for the master's degree.

CHEM 799B. Thesis Extension (0) Cr/NC

Prerequisite: Prior registration in Thesis 799A with an assigned grade symbol of RP.
Registration required in any semester or term following assignment of RP in Course 799A in which the student expects to use the facilities and resources of the university; also student must be registered in the course when the completed thesis is granted final approval.

DOCTORAL COURSES**CHEM 897. Doctoral Research (1-15) Cr/NC/RP**

Prerequisite: Admission to the doctoral program.
Independent investigation in the general field of the dissertation.

CHEM 899. Doctoral Dissertation (1-15) Cr/NC/RP

Prerequisites: An officially constituted dissertation committee and advancement to candidacy.
Preparation of the dissertation for the doctoral degree. Enrollment is required during the term in which the dissertation is approved.