DEPARTMENT OF CHEMISTRY

http://chem.tamu.edu

Head: S. W. North

Graduate Advisor: S. W. North

The Department of Chemistry offers a program of study leading to a PhD degree in Chemistry.

The Ph.D. degree curriculum in chemistry is designed to 1) provide students with an understanding of chemical principles 2) train students to become independent chemical researchers, 3) teach students how to effectively communicate the results of chemical research, and 4) prepare students to become professional chemists. Upon completion of the PhD program in chemistry students are qualified to obtain jobs as senior scientists in industrial and government labs or as postdoctoral researchers or junior faculty members at academic institutions.

The Ph.D. degree program is designed to ensure that students receive extensive research experience. Opportunities for research are available to graduate students in all areas of modern chemistry including analytical, atmospheric, biological, catalysis, computational, energy, inorganic, materials, nuclear, organic, organometallic, physical and polymer chemistry. Students are trained in state-of-the-art instrumentation facilities, laboratories and shops. In addition to research, graduate students in the Department of Chemistry are required to enroll in chemistry coursework, serve as teaching assistants for at least two semesters, present seminars, attend seminars and pass a series of cumulative exams.

Chemistry graduate students are generally admitted into the Ph.D program. However, with approval, a student may pursue a research-based M.S. degree with thesis. In addition to research, these graduate students in the Department of Chemistry are required to enroll in chemistry coursework, serve as teaching assistants for at least two semesters, present seminars and attend seminars.

For further details about programs, faculty, facilities and financial assistance, write to the Graduate Advisor of the Department of Chemistry, or send an email message to gradmail@chem.tamu.edu. Additional information may be found on the departmental website at http://chem.tamu.edu.

Faculty

Banerjee, Sarbajit, Professor
Chemistry
PHD, State University of New York at Stony Brook, 2004

Barondeau, David P, Associate Professor
Chemistry
PHD, Texas A&M University, 1996

Batteas, James D, Professor
Chemistry
PHD, University of California, Berkeley, 1995

Begley, Tadhg P, Distinguished Professor
Chemistry
PHD, California Institute of Technology, 1983

Bergbreiter, David E, Professor
Chemistry
PHD, Massachusetts Institute of Technology, 1974

Bethel, Ryan D, Lecturer
Chemistry
PHD, Texas A&M University, 2014

Bluemel, Janet F, Professor
Chemistry
PHD, Technical University of Munich, Germany, 1989

Brown, Lawrence S, Instructional Associate Professor
Chemistry
PHD, Princeton University, 1983

Burgess, Kevin, Professor
Chemistry
PHD, The University of Cambridge, 1983

Clearfield, Abraham, Distinguished Professor
Chemistry
PHD, Rutgers, The State University of New Jersey, 1954

Collins, Daniel P, Associate Professor
Chemistry
PHD, University of South Carolina, 2012

Cummins, Christopher C, Associate Professor
Chemistry
PHD, Massachussetts Institute of Technology, 1993

Darensbourg, Donald J, Distinguished Professor
Chemistry
PHD, University of Illinois at Urbana-Champaign, 1968

Darensbourg, Marcetta, Distinguished Professor
Chemistry
PHD, University of Illinois at Urbana-Champaign, 1967

Dunbar, Kim R, Distinguished Professor
Chemistry
PHD, Purdue University, 1984

Eller, Michael J, Lecturer
Chemistry
PHD, Texas A&M University, 2016

Escobedo Cruz, Francisco V, Lab Instructor
Chemistry
PHD, Texas A&M University, 2016

Fang, Lei, Assistant Professor
Chemistry
PHD, Northwestern University, 2010

Folden, Charles M, Associate Professor
Chemistry
PHD, University of California, Berkeley, 2004

Gabbai, Francois P, Professor
Chemistry
PHD, Technische Universität München, Germany, 1999
Gaede, Holly C, Instructional Associate Professor
Chemistry
PHD, University of California, Berkeley, 1995

Gladysz, John A, Distinguished Professor
Chemistry
PHD, Stanford University, 1974

Goodey, Joanna R, Instructional Assistant Professor
Chemistry
PHD, University of Houston, 2001

Gopalakrishnan, Ganesa, Senior Lecturer
Chemistry
PHD, University of Madras, India, 1977

Hall, Michael B, Professor
Chemistry
PHD, University of Wisconsin - Madison, 1971

Hilty, Christian B, Professor
Chemistry
PHD, Swiss Federal Institute of Technology Zurich, 2004

Hughbanks, Timothy R, Professor
Chemistry
PHD, Cornell University, 1983

Jiang, Lin, Lecturer
Chemistry
PHD, Miami University, 2013

Laane, Jaan, Professor
Chemistry
PHD, Massachusetts Institute of Technology, 1967

Laganowsky, Arthur D, Assistant Professor
Chemistry
PHD, University of California, Los Angeles, 2011

Lim, Soon Mi, Senior Lecturer
Chemistry
PHD, Texas A&M University, 2006

Lindahl, Paul A, Professor
Chemistry
PHD, Massachusetts Institute of Technology, 1985

Liu, Wenshe, Professor
Chemistry
PHD, University of California, Davis, 2005

Lucchese, Robert R, Professor
Chemistry
PHD, California Institute of Technology, 1982

Mawk, Elmo J, Instructional Assistant Professor
Chemistry
PHD, Texas A&M University, 1999

McCartney, Stephanie A, Lecturer
Chemistry
PHD, The George Washington University, 2009

Mullen, Christine A, Senior Lecturer
Chemistry
PHD, University of California, San Diego, 2000

Nippe, Michael, Assistant Professor
Chemistry
PHD, University of Wisconsin - Madison, 2011

North, Simon W, Professor
Chemistry
PHD, University of California, Berkeley, 1995

Ozerov, Oleg V, Professor
Chemistry
PHD, University of Kentucky, 2000

Pennington, James D, Instructional Associate Professor
Chemistry
PHD, University of Michigan, 1998

Ponnamperuma, Krishan, Senior Lecturer
Chemistry
PHD, University of Cambridge, 1992

Powers, David C, Assistant Professor
Chemistry
PHD, Harvard University, 2011

Powers, Tamara M, Lecturer
Chemistry
PHD, Harvard University, 2013

Rauschel, Frank M, Distinguished Professor
Chemistry
PHD, University of Wisconsin - Madison, 1976

Rosynik, Michael P, Professor
Chemistry
PHD, Rice University, 1972

Russell, David H, Professor
Chemistry
PHD, University of Nebraska - Lincoln, 1978

Santander, Patricio J, Senior Lecturer
Chemistry
PHD, Texas A&M University, 1987

Schaefer, Amber J, Lecturer
Chemistry
PHD, Rice University, 2007

Schweikert, Emile A, Professor
Chemistry
PHD, Universite de Paris, France, 1964

Scott, Kevin W, Lab Instructor
Chemistry
PHD, Texas A&M University, 2016

Sczepanski, Jonathan T, Assistant Professor
Chemistry
PHD, Johns Hopkins University, 2010
Sheldon, Matthew T, Assistant Professor
Chemistry
PHD, University of California, Berkeley, 2010

Singleton, Daniel A, Professor
Chemistry
PHD, University of Minnesota, Twin Cities, 1986

Son, Dong H, Professor
Chemistry
PHD, The University of Texas at Austin, 2002

Waas, Jack R, Lecturer
Chemistry
PHD, University of Michigan, 1997

Watanabe, Coran M, Associate Professor
Chemistry
PHD, Johns Hopkins University, 1998

Williamson, Vickie M, Instructional Professor
Chemistry
PHD, University of Oklahoma, 1992

Yeager, Danny L, Professor
Chemistry
PHD, California Institute of Technology, 1975

Zhou, Hongcai J, Professor
Chemistry
PHD, Texas A&M University, 2000

**Masters**

- Master of Science in Chemistry (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/science/chemistry/ms)

**Doctoral**

- Doctor of Philosophy in Chemistry (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/science/chemistry/phd)

**Courses**

**CHEM 601 Analytical Chemistry I**
Credits 3. 3 Lecture Hours.
Fundamentals of chemical instrumentation. Modular approach to instrumental methods of chemical analysis; modules to be covered include digital electronics, modern optics, basic quantification and signal-to-noise enhancements.
**Prerequisite:** Graduate classification in chemistry or approval of instructor.

**CHEM 602 Analytical Chemistry II**
Credits 3. 3 Lecture Hours.
Modern analytical techniques, spectrosopies, chromatography, and "hyphenated" methods such as GC-FTIR, GC-MS, HPLC-MS, CE-LIF, and CE-MS are examined from the perspective of surface analysis, fundamentals of separation science and structural characterization of complex molecular systems.
**Prerequisite:** CHEM 601.

**CHEM 603 Modern Chromatographic Separation Methods**
Credits 3. 3 Lecture Hours.
Intended for graduate students in chemistry, chemical engineering, and the life sciences.
**Prerequisite:** Graduate standing.

**CHEM 610 Organic Reactions**
Credits 3. 3 Lecture Hours.
Introduction to mechanisms and scope of the basic organic reaction types as applied to major functional groups.
**Prerequisite:** CHEM 646 or approval of instructor.

**CHEM 615 Organic Synthesis**
Credits 3. 3 Lecture Hours.
Application of organic reactions to synthesis of complex organic molecules. Synthesis design and methodology, scope and limitations of reactions and experimental design.
**Prerequisite:** CHEM 610.

**CHEM 616 Organometallic Transformations for Organic Synthesis**
Credits 3. 3 Lecture Hours.
Introduction to transition and main group metal-mediated reactions in organic synthesis; organometallic mechanisms in the context of homogeneous catalytic systems currently employed in synthetic laboratories; emphasis on the properties of transition metal complexes and their interactions with organic substrates that promote useful chemical transformations.
**Prerequisite:** CHEM 646 recommended.

**CHEM 618 NMR Spectroscopy**
Credits 3. 3 Lecture Hours.
Theory and practice of modern nuclear magnetic resonance spectroscopy; Bloch equations, relaxation and relaxation mechanisms, chemical exchange, pulse and Fourier-transform methods, selective excitation, 2-D methods and solid-state nuclear magnetic resonance.
**Prerequisite:** Graduate classification in chemistry or approval of instructor.

**CHEM 619 Analytical Spectroscopy**
Credits 3. 3 Lecture Hours.
Fundamentals of optical spectroscopy and applications; quantum mechanical description of light-matter interaction, linear and nonlinear spectroscopy, optics and spectroscopic instrumentation, optical signal detection and data acquisition/processing, applications of spectroscopic techniques in nanoscience.
**Prerequisite:** CHEM 648 or approval of instructor.

**CHEM 621 Chemical Kinetics**
Credits 3. 3 Lecture Hours.
Present theories about chemical reaction rates and mechanisms.
**Prerequisite:** CHEM 328 or approval of instructor.
CHEM 623 Surface Chemistry  
Credits 3. 3 Lecture Hours.  
Nature, structure and chemistry of surfaces; characterization of surfaces from surface energy to structure; relation to chemical processes.  
Prerequisite: Graduate classification in chemistry or approval of instructor.

CHEM 627 Principles of Biological Chemistry  
Credits 3. 3 Lecture Hours.  
General principles of biological chemistry with an emphasis on the structures and mechanisms of action for proteins, nucleic acids and lipids.  
Prerequisite: Graduate classification.

CHEM 628 Coordination and Bioinorganic Chemistry  
Credits 3. 3 Lecture Hours.  
Structure and reactivity of coordination compounds; reactions of metal ions with small biomolecules and the reactions of toxic metal ions; role of metal ions in biological systems including the function of metal ions in enzymes.  
Prerequisite: CHEM 633.

CHEM 629 Main Group Chemistry  
Credits 3. 3 Lecture Hours.  
Chemistry of the ns and np elements of the periodic table and the noble gases including the organometallic chemistry of these elements.  
Prerequisite: CHEM 633.

CHEM 630 Bioorganic Chemistry  
Credits 3. 3 Lecture Hours.  
Biorganic Chemistry. Introduction to current research areas of bioorganic chemistry and chemical genetic tools in exploring biological systems; DNA recombinant technology; histone chemical biology; protein glycosylation; protein engineering methods; gene transcription regulation; semi-synthesis of proteins with PTM analogs.  
Prerequisites: CHEM 627 or approval of instructor.

CHEM 631 Statistical Thermodynamics  
Credits 3. 3 Lecture Hours.  
Methods of statistical mechanics based primarily on Boltzmann statistics; approach to thermodynamics through partition function; statistical concept of entropy.

CHEM 633 Principles of Inorganic Chemistry  
Credits 3. 3 Lecture Hours.  
General principles of inorganic chemistry treated with a view to applications in other subfields of chemistry.  
Prerequisite: Graduate classification in chemistry or approval of instructor.

CHEM 634 Physical Methods in Inorganic Chemistry  
Credits 3. 3 Lecture Hours.  
Determination of the molecular structure of inorganic and organometallic species; modern aspects of diffraction, magnetic resonance and vibrational methods.  
Prerequisite: CHEM 641 or CHEM 673.

CHEM 635 Introduction to X-ray Diffraction Methods  
Credits 3. 3 Lecture Hours.  
Fundamentals of diffraction theory by crystals and the solution of crystal structures using this methodology.  
Prerequisite: BS in Chemistry, Physics, or Engineering.

CHEM 636 Mechanistic Inorganic Chemistry  
Credits 2. 2 Lecture Hours.  
Reaction pathways in both main group and transition-metal complexes; factors which influence the reaction rate including nature of the metal, the coordination sphere, reaction conditions and catalytic intermediates.  
Prerequisite: CHEM 633.

CHEM 640 Laboratory Methods in Biological Chemistry  
Credits 3. 1 Lecture Hour. 6 Lab Hours.  
Application of chemical techniques to the investigation and/or manipulation of biological systems; laboratory methods provides a hands-on opportunity to gain an understanding and appreciation for chemical biology techniques.  
Prerequisite: Graduate classification or approval of instructor.

CHEM 641 Structural Inorganic Chemistry  
Credits 3. 3 Lecture Hours.  
Introduction to chemical bonding; ionic, covalent, coordinate and hydrogen bonding; relationship of molecular orbital and ligand field theories to experimental studies of the electronic structure of inorganic molecules.  
Prerequisites: CHEM 633 and CHEM 673.

CHEM 642 Organometallic Chemistry and Homogeneous Catalysis  
Credits 3. 3 Lecture Hours.  
Synthesis, structure and reactivity of organometallic compounds; elementary processes for general and radical reactions, mechanism of reactions at metal centers and applications to homogeneous catalysis.  
Prerequisite: CHEM 633.

CHEM 644 Natural Products Biosynthesis  
Credits 3. 3 Lecture Hours.  
Survey of the chemical reactions occurring in living systems, describe the experimental methods used to study these reactions and examine the biosynthesis of the major families of natural products; emphasis on the mechanistic chemistry of the biosynthetic pathway.  
Prerequisite: Graduate classification or approval of instructor.

CHEM 646 Physical Organic Chemistry  
Credits 3. 3 Lecture Hours.  
A detailed introduction to the theory and principles of organic chemistry; bonding and structure in organic chemistry, stereochemistry, reactive intermediates in organic chemistry and transition state theory; kinetics and thermodynamic approaches.  
Prerequisite: CHEM 228 or approval of instructor.

CHEM 647 Spectra of Organic Compounds  
Credits 3. 3 Lecture Hours.  
Correlations of molecular structure with spectroscopic and other physical properties; applications to modern problems in organic chemistry.  
Prerequisite: CHEM 646 or approval of instructor.

CHEM 648 Principles of Quantum Mechanics  
Credits 3. 3 Lecture Hours.  
Classical mechanics and development of wave mechanics; application of wave mechanics to special chemical problems.  
Prerequisite: Approval of instructor.

CHEM 658 Molecular Modeling  
Credits 2. 1 Lecture Hour. 3 Lab Hours.  
An introduction to molecular modeling with an emphasis on quantum level calculations. Lectures will cover the basic theory behind the calculations and lab work will focus on the practical application of modern computational chemistry codes.  
Prerequisite: Graduate classification or approval of instructor.
CHEM 660 Nuclear Chemistry  
Credits 3. 3 Lecture Hours. 0 Lab Hours.  
Radioactive decay, nuclear models, nuclear spectroscopy, nuclear reactions, fission and other topics of current interest in nuclear chemical research.  
Prerequisite: CHEM 464 or approval of instructor.

CHEM 661 Radiochemistry  
Credits 3. 3 Lecture Hours.  
Fundamentals of radiochemistry, survey of the chemistry of radioelements, radiochemistry of the nuclear fuel cycle, environmental radiochemistry, and other topics of interest in current radiochemical research.  
Prerequisite: CHEM 464, NUEN 302, or approval of instructor.

CHEM 670 Physical Methods in Biological Chemistry  
Credits 3. 3 Lecture Hours.  
Overview of current methods for the characterization of biological macromolecules, including protein structure, protein-ligand interactions, protein folding; techniques discussed include nuclear magnetic resonance, optical spectroscopy, calorimetry, electron paramagnetic resonance, Mössbauer spectroscopy, X-ray crystallography, electron microscopy, and mass spectrometry.  
Prerequisite: Graduate classification or approval of instructor.

CHEM 672 Bioorganic Reaction Mechanisms  
Credits 3. 3 Lecture Hours.  
Proposed mechanisms of action of various enzymes and coenzymes from the "model systems" approach; new developments, theory and established mechanisms.  
Prerequisites: CHEM 646; BICH 624.

CHEM 673 Symmetry and Group Theory in Chemistry  
Credits 2 to 3. 2 to 3 Lecture Hours.  
Applications of symmetry and group theory to various types of chemical systems; classification of molecules into symmetry point groups and use of character tables.  
Prerequisite: Bachelor's degree in chemistry.

CHEM 681 Seminar  
Credit 1. 1 Lecture Hour.  
Oral presentations and discussions of recent advances in chemistry.

CHEM 684 Professional Internship  
Credits 1 to 4. 1 to 4 Other Hours.  
Supervised practical experience in professional functions appropriate to career goals in chemical education. Students will be required to complete a scholarly report of these activities acceptable to graduate committee. Enrollment limited to students pursuing a non-thesis MS degree, with emphasis on chemical education. Requires approval of committee chair and department head with non-thesis MS degree plan filed.  
Prerequisite: Graduate classification in chemistry.

CHEM 685 Directed Studies  
Credits 1 to 6. 1 to 6 Other Hours.  
Special topics to suit small group requirements; more recent problems and results in various branches of chemistry; laboratory work or conference and discussion.  
Prerequisite: Graduate classification.

CHEM 686 Ethics in Chemical Research and Scholarship  
Credit 1. 1 Lecture Hour.  
Ethical issues in chemical research and scholarship and methods for resolution of such issues; includes Texas A&M University Policies and Procedures, ethics and scientific truth, ethics and other scientists and ethics and society; case studies.  
Prerequisite: Graduate classification in chemistry or biochemistry.

CHEM 689 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 8 Lab Hours.  
Selected topics in an identified area of chemistry. May be repeated for credit.  
Prerequisites: Graduate classification and approval of instructor.

CHEM 690 Theory of Chemical Research  
Credits 3. 3 Lecture Hours.  
The design of research experiments in various subfields of chemistry and the evaluation of research results with the aid of examples taken from the current scientific literature. May be repeated for credit.

CHEM 691 Research  
Credits 1 to 23. 1 to 23 Other Hours.  
Research for thesis or dissertation.

CHEM 695 Frontiers in Chemical Research  
Credit 1. 1 Lecture Hour.  
Present status of research in a variety of significant chemical fields; content depends on the availability of visiting lecturers who will be selected because of distinguished international recognition in their fields of research. May be taken twice.  
Prerequisite: Graduate classification.

CHEM 697 Methods in Teaching Chemistry Laboratory  
Credit 1. 1 Lecture Hour. 1 Lab Hour.  
An introduction to teaching methods associated with the teaching of introductory chemistry laboratories using graduate teaching assistants. Emphasis placed on effective communication, preparation, record keeping, and safe and effective management of an instructional laboratory. May be repeated for credit.  
Prerequisite: Graduate classification in chemistry.