DEPARTMENT OF CHEMISTRY

An understanding of chemistry is critical to an understanding of life and its associated activities. Chemistry and chemical principles profoundly influence the way we live, communicate, and interact with one another, so it is little wonder that a strong background in chemistry provides a solid foundation for a variety of careers of major importance in the twenty-first century. Chemistry is uniquely positioned at the crossroad between the biological and physical sciences. By exploiting their understanding of both realms, chemists and other professionals with strong backgrounds in chemistry have made, and continue to make, major contributions to improve the human condition. Major technological and biological discoveries almost always depend on a fundamental understanding of chemistry and the pursuit of these discoveries, as a way to improve the world in which we live, drives those who seek to be a part of the process.

The Department of Chemistry offers coursework and research in all the major areas of chemistry, organized into programs leading to the degrees of Bachelor of Arts and Bachelor of Science. Both degree programs are suitable as terminal degree programs as well as for preparation for more advanced study in chemistry and related areas or as preparation for many professional programs in a variety of career fields. The BS program is more rigorous with respect to required mathematics and chemistry courses. It is particularly appropriate for those students who plan a career in the chemical industry or who intend to pursue advanced degrees in chemistry, biochemistry, chemical physics or forensics. An attractive number of free electives in this degree program allows students to take courses in interdisciplinary focus areas. The BA program offers the greatest degree of flexibility for students who see chemistry as a springboard into a related career field such as medicine, pharmacy, law, science writing, teaching or business for example. Chemistry majors are counseled by PhD chemistry faculty advisors fully familiar with the many options available in the chemistry and other departments, so as to optimize each student’s program of study to meet individual needs. The Department of Chemistry (http://chem.tamu.edu) website provides additional information about the degree plans, advising, and career opportunities for chemistry majors.

Although students may choose a variety of electives and/or minors in either the BA or BS degree programs, the following chemistry tracks have been developed to guide students in choosing electives.

Chemistry Tracks

In addition to the traditional BS degree (which allows for optional minors) and the traditional BA degree (minor required), the Department of Chemistry offers five tracks to guide students in their selection of electives for particular career paths in biological chemistry, environmental chemistry, chemical education, medicine, dentistry and pharmacy. A traditional minor requires that all minor courses must be taken from the same department and approved by the department granting the minor. These tracks provide the student an opportunity to replace a traditional minor with a broad spectrum of elective courses focused, not in a single department, but in an area of emphasis. A list of the recommended elective courses for each track may be obtained from the Office of the Undergraduate Advisor in Room 104 Chemistry Building or from the Department of Chemistry (http://chem.tamu.edu) website.

Cooperative Education Program in Chemistry

Under suitable circumstances, chemistry majors may participate in a cooperative education program in which the student alternates periods of attendance at the University with periods of employment in industry. This year-round cooperative program of college study and industrial experience is educationally enriching and meaningful, and also has the benefit of providing substantial financial assistance to the student without unduly prolonging the completion of the BS or BA degree program.

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, Massachusetts Institute of Technology, 1993
<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Department</th>
<th>Institution</th>
<th>Year</th>
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<tbody>
<tr>
<td>Darensbourg, Donald J</td>
<td>Distinguished Professor</td>
<td>Chemistry</td>
<td>University of Illinois at Urbana-Champaign, 1968</td>
<td></td>
</tr>
<tr>
<td>Darensbourg, Marcetta</td>
<td>Distinguished Professor</td>
<td>Chemistry</td>
<td>University of Illinois at Urbana-Champaign, 1967</td>
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<tr>
<td>Dunbar, Kim R</td>
<td>Distinguished Professor</td>
<td>Chemistry</td>
<td>Purdue University, 1984</td>
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<tr>
<td>Eller, Michael J</td>
<td>Lecturer</td>
<td>Chemistry</td>
<td>Texas A&amp;M University, 2016</td>
<td></td>
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<tr>
<td>Escobedo Cruz, Francisco V</td>
<td>Lab Instructor</td>
<td>Chemistry</td>
<td>Texas A&amp;M University, 2016</td>
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<tr>
<td>Fang, Lei</td>
<td>Assistant Professor</td>
<td>Chemistry</td>
<td>Northwestern University, 2010</td>
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<tr>
<td>Folden, Charles M</td>
<td>Associate Professor</td>
<td>Chemistry</td>
<td>University of California, Berkeley, 2004</td>
<td></td>
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<tr>
<td>Gabbai, Francois P</td>
<td>Professor</td>
<td>Chemistry</td>
<td>Technische Universitat Munchen, Germany, 1999</td>
<td></td>
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<tr>
<td>Gaede, Holly C</td>
<td>Instructional Associate Professor</td>
<td>Chemistry</td>
<td>University of California, Berkeley, 1995</td>
<td></td>
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<tr>
<td>Gladysz, John A</td>
<td>Distinguished Professor</td>
<td>Chemistry</td>
<td>Stanford University, 1974</td>
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<tr>
<td>Goodey, Joanna R</td>
<td>Instructional Assistant Professor</td>
<td>Chemistry</td>
<td>University of Houston, 2001</td>
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<tr>
<td>Gopalakrishnan, Ganesa</td>
<td>Senior Lecturer</td>
<td>Chemistry</td>
<td>University of Madras, India, 1977</td>
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<td>Hall, Michael B</td>
<td>Professor</td>
<td>Chemistry</td>
<td>University of Wisconsin - Madison, 1971</td>
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<td>Hilty, Christian B</td>
<td>Professor</td>
<td>Chemistry</td>
<td>Swiss Federal Institute of Technology Zurich, 2004</td>
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<td>Hughbanks, Timothy R</td>
<td>Professor</td>
<td>Chemistry</td>
<td>Cornell University, 1983</td>
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<td>Jiang, Lin</td>
<td>Lecturer</td>
<td>Chemistry</td>
<td>Miami University, 2013</td>
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<td>Laane, Jaan</td>
<td>Professor</td>
<td>Chemistry</td>
<td>Massachusetts Institute of Technology, 1967</td>
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<td>Laganowsky, Arthur D</td>
<td>Assistant Professor</td>
<td>Chemistry</td>
<td>University of California, Los Angeles, 2011</td>
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<td>Lim, Soon Mi</td>
<td>Senior Lecturer</td>
<td>Chemistry</td>
<td>Texas A&amp;M University, 2006</td>
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<td>Lindahl, Paul A</td>
<td>Professor</td>
<td>Chemistry</td>
<td>Massachusetts Institute of Technology, 1985</td>
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<td>Liu, Wenshe</td>
<td>Professor</td>
<td>Chemistry</td>
<td>University of California, Davis, 2005</td>
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<td>Lucchese, Robert R</td>
<td>Professor</td>
<td>Chemistry</td>
<td>California Institute of Technology, 1982</td>
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<tr>
<td>Mawr, Elmo J</td>
<td>Instructional Assistant Professor</td>
<td>Chemistry</td>
<td>Texas A&amp;M University, 1999</td>
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<td>McCartney, Stephanie A</td>
<td>Lecturer</td>
<td>Chemistry</td>
<td>The George Washington University, 2009</td>
<td></td>
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<tr>
<td>Mullen, Christine A</td>
<td>Senior Lecturer</td>
<td>Chemistry</td>
<td>University of California, San Diego, 2000</td>
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<tr>
<td>Nippe, Michael</td>
<td>Assistant Professor</td>
<td>Chemistry</td>
<td>University of Wisconsin - Madison, 2011</td>
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<td>North, Simon W</td>
<td>Professor</td>
<td>Chemistry</td>
<td>University of California, Berkeley, 1995</td>
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<tr>
<td>Ozerov, Oleg V</td>
<td>Professor</td>
<td>Chemistry</td>
<td>University of Kentucky, 2000</td>
<td></td>
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<tr>
<td>Pennington, James D</td>
<td>Instructional Associate Professor</td>
<td>Chemistry</td>
<td>University of Michigan, 1998</td>
<td></td>
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<tr>
<td>Ponnampalam, Krishan</td>
<td>Senior Lecturer</td>
<td>Chemistry</td>
<td>University of Cambridge, 1992</td>
<td></td>
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<tr>
<td>Potts, Jessica L</td>
<td>Lab Instructor</td>
<td>Chemistry</td>
<td>Texas State University, 2014</td>
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<tr>
<td>Powers, David C</td>
<td>Assistant Professor</td>
<td>Chemistry</td>
<td>Harvard University, 2011</td>
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</tbody>
</table>
Powers, Tamara M, Lecturer
Chemistry
PHD, Harvard University, 2013

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

Rosynek, 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

Singleton, Daniel A, Professor
Chemistry
PHD, University of California, Berkeley, 2010

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

Werke, Carrie B, Lab Instructor
Chemistry
MS, Texas A&M University, 2014

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

Wooley, Karen L, Distinguished Professor
Chemistry
PHD, Cornell University, 1993

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

Yennello, Sherry J, Professor
Chemistry
PHD, Indiana University, 1990

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

**Majors**

- Bachelor of Arts in Chemistry (http://catalog.tamu.edu/undergraduate/science/chemistry/ba)
- Bachelor of Arts in Chemistry, Biological Chemistry or Medical, Dental, Pharmacy School Track (http://catalog.tamu.edu/undergraduate/science/chemistry/ba-biological-chemistry-medical-dental-pharmacy-track)
- Bachelor of Arts in Chemistry, Chemical Education Track (http://catalog.tamu.edu/undergraduate/science/chemistry/ba-chemical-education-track)
- Bachelor of Arts in Chemistry, Environmental Chemistry Track (http://catalog.tamu.edu/undergraduate/science/chemistry/ba-environmental-chemistry-track)
- Bachelor of Science in Chemistry (http://catalog.tamu.edu/undergraduate/science/chemistry/bachelor)
- Bachelor of Science in Chemistry, Biological Chemistry Track (http://catalog.tamu.edu/undergraduate/science/chemistry/bs-biological-chemistry-track)
- Bachelor of Science in Chemistry, Environmental Chemistry Track (http://catalog.tamu.edu/undergraduate/science/chemistry/bs-environmental-chemistry-track)

**Minors**

- Minor in Chemistry (http://catalog.tamu.edu/undergraduate/science/chemistry/minor)

**Courses**

CHEM 100 Horizons in Chemistry
Credit 1. 1 Lecture Hour.
An introduction to chemistry and its relationship to and influence on society; emphasis on chemical demonstrations and the practical application of chemical phenomena. For chemistry majors.
**Prerequisite:** Major in chemistry or approval of instructor.

CHEM 101 Fundamentals of Chemistry I
Credits 3. 3 Lecture Hours.
(CHEM 1311, 1411) Fundamentals of Chemistry I. Introduction to modern theories of atomic structure and chemical bonding; chemical reactions; stoichiometry; states of matter; solutions; equilibrium; acids and bases; coordination chemistry.
**Prerequisites:** Concurrent enrollment in CHEM 111.
CHEM 102 Fundamentals of Chemistry II
Credits 3. 3 Lecture Hours.
(CHEM 1312, 1412) Fundamentals of Chemistry II. Theory and applications of oxidation-reductions systems; thermodynamics and kinetics; complex equilibria and solubility product; nuclear chemistry; descriptive inorganic and organic chemistry.
Prerequisites: Concurrent enrollment in CHEM 112.

CHEM 103 Structure and Bonding
Credits 3. 3 Lecture Hours.
Rigorous treatment of chemical principles and their application.
Prerequisite: For entering students with satisfactory scores on math and chemistry placement examinations; concurrent enrollment in CHEM 113.

CHEM 104 Chemistry of the Elements
Credits 3. 3 Lecture Hours.
Continuation of CHEM 103.
Prerequisite: CHEM 103 and CHEM 113; concurrent enrollment in CHEM 114.

CHEM 106 Molecular Science for Citizens
Credits 3. 3 Lecture Hours.
(CHEM 1305, 1405) Molecular Science for Citizens. Molecules that control daily life explored via a conceptual approach to molecular science; properties, synthesis, transformations and utility of important molecules and fuels, fibers, metals, pharmaceuticals, foods, biomolecules and structural materials; pollution, consumerism, energy production, disease, biotechnology and risk-benefit analysis considered.
Prerequisite: Concurrent enrollment in CHEM 116.

CHEM 107 General Chemistry for Engineering Students
Credits 3. 3 Lecture Hours.
Introduction to important concepts and principles of chemistry; emphasis on areas considered most relevant in an engineering context; practical applications of chemical principles in engineering and technology. Students completing CHEM 107 and changing majors to curricula requiring CHEM 101 and CHEM 102 may substitute CHEM 107 for CHEM 101. Students may not receive credit for both CHEM 107 and CHEM 101.
Prerequisite: Concurrent enrollment in CHEM 117.

CHEM 111 Fundamentals of Chemistry Laboratory I
Credit 1. 3 Lab Hours.
(CHEM 1111) Fundamentals of Chemistry Laboratory I. Introduction to methods and techniques of chemical experimentation; qualitative and semiquantitative procedures applied to investigative situations.
Prerequisite: CHEM 101 or registration therein.

CHEM 112 Fundamentals of Chemistry Laboratory II
Credit 1. 3 Lab Hours.
(CHEM 1112) Fundamentals of Chemistry Laboratory II. Introduction to analytical and synthetic methods and to quantitative techniques to both inorganic and organic compounds with emphasis on an investigative approach.
Prerequisites: CHEM 101 and 111 or equivalent; CHEM 102 or registration therein.

CHEM 113 Physical and Chemical Principles
Credit 1. 3 Lab Hours.
Elementary experiments in physical chemistry and quantitative analysis.
Prerequisite: CHEM 103 or registration therein.

CHEM 114 Qualitative Analysis
Credit 1. 3 Lab Hours.
Qualitative analysis, elementary inorganic syntheses and quantitative aspects of chemical equilibrium.
Prerequisites: CHEM 104 or registration therein; CHEM 113.

CHEM 116 Molecular Science for Citizens Laboratory
Credit 1. 3 Lab Hours.
(CHEM 1105, 1405) Molecular Science for Citizens Laboratory. The importance of molecular science to daily life illustrated by using experiments, demonstration and videos; designed to accompany CHEM 106.
Prerequisite: CHEM 106 or registration therein.

CHEM 117 General Chemistry for Engineering Students Laboratory
Credit 1. 3 Lab Hours.
Introduction to important concepts and principles of chemistry in the laboratory; emphasis on areas considered most relevant in an engineering context; practical applications of chemical principles in engineering and technology. Students completing CHEM 117 and changing majors to curricula requiring CHEM 111 and CHEM 112 may substitute CHEM 117 for CHEM 111. Students may not receive credit for both CHEM 117 and CHEM 111.
Prerequisites: CHEM 107 or registration therein.

CHEM 220/MSEN 220 Physics and Chemistry of Inorganic Materials
Credits 3. 3 Lecture Hours.
Structure, properties and function of materials developed from an atomistic and molecular perspective emphasizing quantum chemical descriptions; elements of solid-state chemistry and physics including bonding, crystal structure and symmetry, origin of electronic band structure, synthesis and characterization tools in materials chemistry and role of finite size effects.
Prerequisite: PHYS 208 or CHEM 102, or concurrent enrollment.
Cross Listing: MSEN 220/CHM 220.

CHEM 222 Elements of Organic and Biological Chemistry
Credits 3. 3 Lecture Hours.
Organic chemistry and its applications to biological and agricultural chemistry, including chemistry of functional groups, acid-base and redox chemistry, stereochemistry and chemistry of important biological compounds. Not to be used as the basis for further study in organic chemistry or biochemistry.
Prerequisite: CHEM 101 or CHEM 103.

CHEM 227 Organic Chemistry I
Credits 3. 3 Lecture Hours.
(CHEM 2323, 2423) Organic Chemistry I. Introduction to chemistry of compounds of carbon; general principles and their application to various industrial and biological processes.
Prerequisite: CHEM 102 or CHEM 104. Concurrent registration in CHEM 237 is suggested.

CHEM 228 Organic Chemistry II
Credits 3. 3 Lecture Hours.
(CHEM 2325, 2425) Organic Chemistry II. Continuation of CHEM 227.
Prerequisite: CHEM 227. Concurrent registration in CHEM 238 is suggested.

CHEM 231 Techniques of Organic Chemistry
Credits 2. 1 Lecture Hour. 3 Lab Hours.
Techniques of organic chemistry; preparation, properties of typical organic compounds; separation, purification, analysis, and characterization of organic compounds.
Prerequisites: CHEM 112 or CHEM 114; CHEM 227 or registration therein.
CHEM 234 Organic Synthesis and Analysis IV  
Credits 3. 1 Lecture Hour. 6 Lab Hours.  
The synthesis of significant types of organic compounds and study of their properties; laboratory separations of mixtures of organic substances, identification of compounds by functional group tests and preparation of derivatives; instrumental methods of separation, identification and analysis.  
Prerequisites: CHEM 228 or registration therein; CHEM 231 or CHEM 237.

CHEM 237 Organic Chemistry Laboratory  
Credit 1. 3 Lab Hours.  
Prerequisites: CHEM 2123, 2223, 2423 Organic Chemistry Laboratory, Operations and techniques of elementary organic chemistry laboratory; preparation, reactions and properties of representative organic compounds.

CHEM 238 Organic Chemistry Laboratory  
Credit 1. 3 Lab Hours.  
Prerequisites: CHEM 102, CHEM 104 or CHEM 112, CHEM 114; CHEM 227 or registration therein.

CHEM 242 Elementary Organic Chemistry Laboratory  
Credit 1. 3 Lab Hours.  
Operations and techniques of elementary organic chemistry laboratory with emphasis on experiments for students of agriculture.  
Prerequisite: CHEM 222 or registration therein.

CHEM 285 Directed Studies  
Credits 1 to 4. 1 to 4 Other Hours.  
Introduction to research, library and laboratory work designed for the freshman or sophomore students.  
Prerequisite: Approval of department head.

CHEM 289 Special Topics in...  
Credits 0 to 4. 0 to 4 Lecture Hours.  
Selected topics in an identified area of chemistry. May be repeated for credit.  
Prerequisite: Approval of instructor.

CHEM 291 Research  
Credits 0 to 4. 0 to 4 Other Hours.  
Research conducted under the direction of faculty member in chemistry. May be repeated 2 times for credit.  
Prerequisites: Freshman or sophomore classification and approval of instructor.

CHEM 315 Fundamentals of Quantitative Analysis  
Credits 3. 3 Lecture Hours.  
Quantitative and statistical methods of analysis; solution chemistry; chemical equilibrium of analytically useful reactions; advanced analytical methods including electrochemistry, separations and kinetic methods.  
Prerequisite: CHEM 102 or CHEM 104.

CHEM 316 Quantitative Analysis  
Credits 2. 2 Lecture Hours.  
Introduction to the fundamental principles and applications of modern instrumental techniques of quantitative analysis, with emphasis on spectroscopic and chromatographic methods.  
Prerequisite: CHEM 316.

CHEM 317 Quantitative Analysis Laboratory  
Credit 1. 3 Lab Hours.  
Laboratory work consists of selected experiments in quantitative analysis designed to typify operations of general analytical lab, including chemical analyses by volumetric and gravimetric methods; introduction to chemical measurements by spectroscopic and separations techniques and associated instrumentation.  
Prerequisites: CHEM 112 or CHEM 114; CHEM 315 or CHEM 316 or registration therein.

CHEM 320 Instrumental Analysis Laboratory  
Credit 2. 6 Lab Hours.  
Experimental studies using modern spectroscopic, chromatographic and electroanalytical methods.  
Prerequisites: CHEM 317 or registration therein; CHEM 318.

CHEM 321 Physical Chemistry for Engineers  
Credits 3. 3 Lecture Hours.  
Quantum theory, spectroscopy, statistical mechanics, kinetic theory, reaction kinetics, electrochemistry and macromolecules.  
Prerequisites: CHEM 102 or CHEM 104; CHEN 205 and CHEN 354; MATH 152 or equivalent.

CHEM 322 Physical Chemistry Laboratory I  
Credit 1. 3 Lab Hours.  
Quantitative experiments involving physical chemistry principles in areas such as thermodynamics, electrochemistry, molecular structure and equilibria using modern instrumentation.  
Prerequisite: CHEM 327 or registration therein.

CHEM 326 Physical Chemistry Laboratory II  
Credit 1. 3 Lab Hours.  
Quantitative experiments involving physical chemistry principles in such areas as kinetics, properties of gases, phase equilibria and macromolecules using modern instrumentation.  
Prerequisite: CHEM 328 or registration therein.

CHEM 327 Physical Chemistry I  
Credits 3. 3 Lecture Hours.  
Introduction to quantum mechanics, exactly solvable model problems; many electron systems and approximate methods; chemical bonding and the electronic structure of molecules; rotational, vibrational, and electronic spectroscopy; molecular symmetry.  
Prerequisite: MATH 152 or MATH 172; MATH 221, MATH 251 or MATH 253; encouraged: PHYS 208; PHYS 218. Replaces CHEM 324 in previous catalogs.

CHEM 328 Physical Chemistry II  
Credits 3. 3 Lecture Hours.  
A rigorous treatment of first, second, and third laws of thermodynamics; applications to gases (both ideal and real), liquids, solutions and phase equilibria; statistical thermodynamics; kinetic theory of gases; introduction to chemical kinetics.  
Prerequisite: CHEM 327. Replaces CHEM 323 in previous catalogs.
CHEM 362 Descriptive Inorganic Chemistry  
Credits 3. 3 Lecture Hours.  
Introduction to inorganic chemistry with a focus on descriptive inorganic chemistry, bonding theories in inorganic molecules and in the solid state, redox chemistry, descriptive main group and transition metal chemistry; ligand field theory, molecular magnetism and electronic spectra in transition metal complexes.  
Prerequisites: CHEM 102, CHEM 104 or equivalent.

CHEM 383 Chemistry of Environmental Pollution  
Credits 3. 3 Lecture Hours.  
Chemical pollutants in the air, in water and on land; their generation, chemical reactivity, action on environment and disappearance through chemical mechanisms; chemistry of existing pollution abatement.  
Prerequisites: CHEM 102 or CHEM 104; junior or senior classification.

CHEM 415 Analytical Chemistry  
Credits 3. 3 Lecture Hours.  
Theory and practical aspects of modern instrumental methods of quantitative analysis; instrumental approaches to selectivity and sensitivity; examples of major, minor and trace component analysis.  
Prerequisite: CHEM 315.

CHEM 433 Advanced Inorganic Chemistry Laboratory  
Credits 2. 6 Lab Hours.  
Preparation, characterization and properties of bioinorganic, organometallic and macromolecular inorganic compounds; special techniques (glove box manipulations and double-manifold Schlenk lines) for handling air-sensitive materials.  
Prerequisite: CHEM 362 or registration therein.

CHEM 434 Analytical Instrumentation Laboratory  
Credits 2. 6 Lab Hours.  
Practical application of modern instrumental methods of quantitative analysis; atomic and molecular techniques to conduct chemical characterizations and analyses.  
Prerequisite: CHEM 415 or registration therein.

CHEM 446 Organic Chemistry III  
Credits 3. 3 Lecture Hours.  
Principles and applications for students in chemistry, chemical engineering and biological and physical sciences; bonding, chemical reactivity, stereochemistry and synthesis.  
Prerequisites: CHEM 228 and CHEM 328 or concurrent enrollment in CHEM 328.

CHEM 456 Chemical Biology  
Credits 3. 3 Lecture Hours.  
Application of chemical principles to biological phenomena; capstone course for advanced students, integrating organic or inorganic chemistry with biology.  
Prerequisites: CHEM 228 or equivalent; junior or senior classification.

CHEM 462 Inorganic Chemistry  
Credits 3. 3 Lecture Hours.  
Periodic relationship of elements, their compounds, principles of their bonding and applications.  
Prerequisites: CHEM 328 and CHEM 362.

CHEM 464 Nuclear Chemistry  
Credits 3. 3 Lecture Hours.  
Properties of the nucleus; radioactivity; decay kinetics; nuclear masses; theory of radioactive decay; nuclear reactions; radiochemistry; nuclear energy; hands-on demonstrations; applications to non-nuclear problems.  
Prerequisites: CHEM 322 or CHEM 327; CHEM 315 or CHEM 316 recommended.

CHEM 466 Polymer Chemistry  
Credits 3. 3 Lecture Hours.  
Mechanisms of polymerization reactions of monomers and molecular weight distributions of products; principles, limitations and advantages of most important methods of molecular weight determination; relationship of physical properties to structure and composition; correlations of applications with chemical constitution.  
Prerequisites: CHEM 228 and CHEM 315 or equivalents.

CHEM 468 Materials Chemistry of Inorganic Materials  
Credits 3. 3 Lecture Hours.  
Structure, bonding and reactivity of inorganic solids developed from a perspective emphasizing models of chemical bonding, symmetry and electronic structure; methods for characterizing extended periodic solids; descriptions of band structure and contrasts to molecular orbital theory; synthetic routes, quantum confinement and finite size effects of relevance to nanoscale materials.  
Prerequisites: CHEM 102; PHYS 208; junior or senior classification.

CHEM 470 Industrial Chemistry  
Credits 3. 3 Lecture Hours.  
Applications of organic and inorganic chemical reactions in the manufacture of commercial products; chemistry of petroleum refining and petrochemical processing; industrial polymerization processes; commodity and fine chemical production; influence of kinetics and thermodynamics on economics of industrial chemical production; pollution abatement technology.  
Prerequisites: CHEM 228; junior or senior classification.

CHEM 481 Seminar  
Credits 2. 2 Lecture Hours.  
Preparation of oral and written reports on selected topics from recent technical publications.

CHEM 483 Green Chemistry  
Credits 3. 3 Lecture Hours.  
Environmentally benign chemistry; the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances; twelve principles of Green Chemistry; atom economy; use of renewable resources; catalysis for Green Chemistry; alternative solvents and reaction media; energy and the environment.  
Prerequisites: CHEM 228; CHEM 362 recommended; junior or senior classification.

CHEM 485 Directed Studies  
Credits 1 to 16. 1 to 16 Other Hours.  
Introduction to research, library and laboratory work.  
Prerequisites: Senior classification and approval of chemistry advisor.

CHEM 489 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours.  
Selected topics in an identified area of chemistry. May be repeated for credit.

CHEM 491 Research  
Credits 0 to 10. 0 to 10 Other Hours.  
Active research of basic nature under the supervision of Department of Chemistry faculty member. Registration in multiple sections of this course is possible within a given semester provided that the per semester credit hour limit is not exceeded.  
Prerequisites: Chemistry major; junior classification or approval of chemistry advisor.