Chemistry (CHE)

Majors and Minor in Chemistry

Department of Chemistry, College of Arts and Sciences

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Minors of particular interest to students majoring in Chemistry: Biology (BIO), Environmental Studies (ENS), Marine Sciences (MAR), Science and Engineering (LSE)

Department Information - Chemistry (CHE)

The Bachelor of Science program in Chemistry is designed to prepare the student for graduate study in chemistry or for industrial or other employment. It includes options in biological chemistry, chemical physics, and environmental chemistry, in addition to the traditional chemical science option. The B.S. program of the Department of Chemistry is approved by the Committee on Professional Training of the American Chemical Society.

The Bachelor of Arts program allows more flexibility in the choice of electives, accommodating the needs of pre-medical students and others whose career objectives may call for a substantial introduction to chemistry. It can also accommodate students who wish to obtain a strong undergraduate background in another science or mathematics while earning a degree in chemistry.

Students interested in combining the study of chemistry with the study of materials science should see also the Interdisciplinary Program in Engineering Chemistry.

Requirements for the Majors and Minor in Chemistry (CHE)

Requirements for the Major (Bachelor of Science Degree)

Up to three chemistry courses passed with a C- may be applied to the major; all other courses offered for the major must be passed with a letter grade of C or higher. No transferred course with a grade lower than C may be used to fulfill any major requirement.

Completion of the major requires approximately 66 to 69 credits.

A. Core Requirements
1. CHE 131, 132 General Chemistry I, II or CHE 141, 142 Honors Chemistry
2. CHE 133, 134 General Chemistry Lab I, II or CHE 143, 144 Honors Chemistry Laboratory I, II
3. CHE 301, 302 Physical Chemistry I, II
4. CHE 303 Solution Chemistry Laboratory
5. CHE 321, 326 Organic Chemistry I, II
6. CHE 375 Inorganic Chemistry I
7. CHE 383 Introductory Synthetic and Spectroscopic Laboratory Techniques
8. CHE 385 Tools of Chemistry
9. MAT 131, 132 Calculus I, II (See Note 1 for possible substitutions)
10. AMS 210 Applied Linear Algebra or MAT 211 Linear Algebra (See Note 1 for possible substitutions)
11. PHY 131/133, 132/134 Classical Physics I, II (See Note 2 for possible substitutions)

B. Area Requirements

One of the following options:

1. Chemical Science Option
   CHE 304 Chemical Instrumentation Laboratory
   CHE 357 Molecular Structure and Spectroscopy Laboratory
   CHE 384 Intermediate Synthetic and Spectroscopic Laboratory Techniques
   CHE 482 Senior Laboratory Projects in Chemistry or CHE 496 Senior Research
   Two electives chosen from CHE 345, 346, 351, 376, 378, PHY 251, or ESG 281

2. Biological Chemistry Option
   CHE 384 Intermediate Synthetic and Spectroscopic Laboratory Techniques
One organic or inorganic chemistry elective chosen from CHE 345, 346, 376, 378, or 496
BIO 202 Fundamentals of Biology: Cell and Molecular Biology
BIO 361 Biochemistry I
BIO 310 Cell Biology or BIO 362 Biochemistry II

3. Chemical Physics Option
CHE 304 Chemical Instrumentation Laboratory
CHE 351 Quantum Chemistry or CHE 353 Chemical Thermodynamics
CHE 357 Molecular Structure and Spectroscopy Laboratory
MAT 205 Calculus III (See Note 1 for possible substitutions)
PHY 251/252 Modern Physics and Laboratory
One elective chosen from PHY 262, 301, 303, or 306

4. Environmental Chemistry Option
CHE 304 Chemical Instrumentation Laboratory
CHE 310 Chemistry in Technology and the Environment
CHE 357 Molecular Structure and Spectroscopy Laboratory
CHE 384 Intermediate Synthetic and Spectroscopic Laboratory Techniques
BIO 201 Fundamentals of Biology: Organisms to Ecosystems or BIO 113 Applied Ecology
ATM 397 Air Pollution and Its Control

5. Marine and Atmospheric Chemistry Option
ATM 205 Introduction to Atmospheric Sciences
MAR 308 Principles of Instrumental Analysis
MAR 333 Coastal Oceanography
MAR 351 Introduction to Ocean Chemistry
ATM 305 Global Atmospheric Change and ATM 397 Air Pollution and Its Control

C. Upper-Division Writing Requirement
Each student majoring in chemistry must take CHE 385, Tools of Chemistry, until a satisfactory grade is achieved. The course requires several papers which are evaluated for cogency, clarity, and mechanics.

Notes:

1. Alternate Mathematics Sequences
The following alternate sequences may be substituted for major requirements or prerequisites: MAT 125, 126, 127 or 141, 142 or 171 or AMS 151, 161 for MAT 131, 132; MAT 203 or 205 for AMS 210 or MAT 211. Equivalency for MAT courses as indicated by earning the appropriate score on a placement examination will be accepted as fulfillment of the requirement without the necessity of substituting other credits.

2. Alternate Physics Sequences
The following alternate sequences may be substituted for physics requirements or prerequisites: PHY 121/123, 122/124 or PHY 141, 142 or PHY 125, 126, 127 for PHY 131/133, 132/134.

3. Transfer Credit
At least 12 credits of upper-division work in chemistry must be taken at Stony Brook; these must be taken in at least two of the major subdisciplines (inorganic, physical, and organic chemistry).

4. The American Chemical Society's Committee on Professional Training has set nationally recognized standards for professional preparation in chemistry. The Chemistry faculty recommends that students intending to pursue careers in the chemical sciences secure ACS certification along with their Bachelor of Science degree.
To obtain ACS certification, students electing the chemical science option must complete CHE 346. Students electing the biological chemistry option must complete one additional elective in chemistry or a related field and the laboratories CHE 304, 357, and CHE 496. Students electing the chemical physics or the marine and atmospheric chemistry option must complete CHE 346 and the laboratories CHE 384 and CHE 496. Students electing the environmental chemistry option must complete CHE 346 and CHE 496.

5. Additional Areas of Study
Because knowledge of computer programming is of great value to all chemists, a course in computer programming is recommended.
For those students who plan to pursue graduate studies in chemistry, it is recommended that they attain a reading knowledge of German and of French or Russian.

Requirements for the Major (Bachelor of Arts Degree)
Up to three chemistry courses passed with a C- may be applied to the major; all other courses offered for the major must be passed with a letter grade of C or higher. No transferred course with a grade lower than C may be used to fulfill any major requirement.
Completion of the major requires approximately 55 to 56 credits.

A. Study Within the Area of Chemistry
1. CHE 131, 132 General Chemistry I, II or CHE 141, 142 Honors Chemistry I, II
2. CHE 133, 134 General Chemistry Lab I, II or CHE 143, 144 Honors Chemistry Laboratory I, II
3. CHE 301, 302 Physical Chemistry I, II
4. CHE 303 Solution Chemistry Laboratory and one additional laboratory course (304 or 384)
5. CHE 321, 326 Organic Chemistry I, IIB
6. CHE 327 Organic Chemistry Laboratory or CHE 383 Introductory Synthetic and Spectroscopic Laboratory Techniques
7. CHE 375 Inorganic Chemistry I
8. CHE 385 Tools of Chemistry

B. Courses in Related Fields
1. MAT 131, 132 Calculus I, II and AMS 210 Applied Linear Algebra
   or MAT 211 Linear Algebra (See Note 1)
2. PHY 131/133, 132/134 Classical Physics I, II and labs (See Note 2)

C. Upper-Division Writing Requirement
Each student majoring in chemistry must take CHE 385, Tools of Chemistry, until a satisfactory grade is achieved. The course requires several papers which are evaluated for cogency, clarity, and mechanics.

Notes:
1. Alternate Mathematics Sequences
   The following alternate sequences may be substituted for major requirements or prerequisites: MAT 125, 126, 127 or 141, 142 or AMS 151, 161 for MAT 131, 132; MAT 203 or 205 for AMS 210 or MAT 211. Equivalency for MAT courses as indicated by earning the appropriate score on a placement examination will be accepted as fulfillment of the requirement without the necessity of substituting other credits.

2. Alternate Physics Sequences
   The following alternate sequences may be substituted for physics requirements or prerequisites: PHY 121/123, 122/124 or 125, 126, 127, or 141, 142 for PHY 131/133, 132/134.

3. Transfer Credit
   At least 12 credits of chemistry courses must be taken at Stony Brook; these must be taken in at least two of the major subdisciplines (inorganic, physical, and organic chemistry).

Honors Program
Students who have maintained a minimum cumulative grade point average of 3.00 in science and mathematics through the junior year are eligible for Departmental honors in Chemistry. An additional requirement for honors is the submission of a senior thesis based on research performed during the senior year. The student will be given an oral examination in May by his or her research supervisor and the undergraduate research committee. The awarding of honors requires the recommendation of this committee and is a recognition of superior performance in research and scholarly endeavors. If the student has also achieved a 3.40 cumulative grade point average in chemistry courses taken in the senior year, honors will be conferred.

Chemistry Secondary Teacher Education Program
See the Education and Teacher Certification entry in the alphabetical listings of Approved Majors, Minors, and Programs.

Requirements for the Minor
The minor requires 22 credits, which include a General Chemistry Lecture sequence, a General Chemistry Laboratory sequence plus 12 credits of CHE 300 level courses or research. A minimum of 9 upper division CHE credits must be earned in courses not used towards the student's major.

Completion of the minor requires 22 credits including:
A. General Chemistry lecture sequence (8 credits)
   CHE 129-132 or CHE 131-132 or CHE 141-142
B. General Chemistry laboratory sequence (2 credits)
   CHE 133-134 or CHE 143-144
C. 12 credits of CHE 300 level courses or CHE research (CHE 487, 495, or 496)
   Special restriction: A minimum of 9 upper division CHE credits must be earned in courses not required for the student's major.

Bachelor of Science Degree / Master of Science Degree Program
A student interested in this research-intensive graduate program, intended to prepare students for professional employment in the chemical or pharmaceutical industries, may apply for admission at the end of the junior year. The program leads to a Bachelor of Science degree in Chemistry at the end of the fourth year and a Master of Science in Chemistry at the end of the fifth year. During the senior year, the student is expected to take two 500-level CHE courses and begin research. In the fifth year, the student works full-time on research, earning 24 credits in CHE 599.

Sample Course Sequence for the Major in Chemistry (Chemical Science Option, B.S. Degree)

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### Sample Course Sequence for the Major in Chemistry (B.A. Degree)

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<td>AMS 210 or MAT 211</td>
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*Only one of these two laboratory courses is required.*
CHE

Chemistry

CHE 125: Learning Strategies Essential for Success in Chemistry
Focuses on developing techniques, strategies, and advanced learning skills that are essential for success in college-level chemistry. Real world contexts, issues, and problems are explored from a chemistry perspective. Provides a bridge from high school to college courses and from CHE 131 to CHE 132. A grade of C or higher in CHE 125 satisfies the prerequisite for entry into CHE 132, provided CHE 129 or CHE 131 have been completed with a passing grade (D or higher).

3 credits, ABC/U grading

CHE 129 - E: General Chemistry IA
A broad introduction to the fundamental principles of chemistry, including substantial illustrative material drawn from the chemistry of inorganic, organic, and biochemical systems. Basic concepts, problem solving, and factual material are emphasized. This course provides the necessary foundation for students who wish to pursue further coursework in chemistry. CHE 129 is inappropriate for students who satisfy the prerequisites for CHE 131 or 141. Three lecture hours, one 80-minute workshop, and one problem-solving session per week. The content and grading match that of CHE 131 (see course description for CHE 131), but the math prerequisites differ, and students attend a CHE 130 problem-solving session per week. The problem-solving session provides a structured environment for developing quantitative reasoning and problem-solving skills. CHE 129 may not be taken for credit in addition to CHE 123/124, CHE 131 or 141.

Mandatory co requisites: MAT 123 and CHE 130
4 credits

CHE 130: Problem Solving in General Chemistry
This course provides a structured environment for completing CHE 129 homework assignments and helping students develop the quantitative reasoning and problem-solving skills needed in General Chemistry. Satisfactory/Unsatisfactory grading only. Grading is based on attendance and participation. Required for students taking CHE 129 along with MAT 123.

Mandatory corequisites: CHE 129 and MAT 123
S/U grading

CHE 131 - E: General Chemistry IB
A broad introduction to the fundamental principles of chemistry, including substantial illustrative material drawn from the chemistry of inorganic, organic, and biochemical systems. The principal topics covered are stoichiometry, the states of matter, chemical equilibrium and introductory thermodynamics, electrochemistry, chemical kinetics, electron structure and chemical bonding, and chemical periodicity. The sequence emphasizes basic concepts, problem solving, and factual material. It provides the necessary foundation for students who wish to pursue further coursework in chemistry. This sequence is inappropriate for students who have completed two or more years of chemistry in high school; such students should take CHE 141, 142. Three lecture hours and one 80-minute workshop per week. May not be taken for credit in addition to CHE 129 or CHE 141.

Corequisite: MAT 125 or higher
4 credits

CHE 132 - E: General Chemistry II
A continuation of either CHE 129 or 131, introducing the fundamental principles of chemistry, including substantial illustrative material drawn from the chemistry of inorganic, organic, and biochemical systems. The principal topics covered are stoichiometry, the states of matter, chemical equilibrium and introductory thermodynamics, electrochemistry, chemical kinetics, electron structure and chemical bonding, and chemical periodicity. The sequence emphasizes basic concepts, problem solving, and factual material. It provides the necessary foundation for students who wish to pursue further coursework in chemistry. This sequence is inappropriate for students who have completed two or more years of chemistry in high school; such students should take CHE 141, 142. Three lecture hours and one 80-minute workshop per week. May not be taken for credit in addition to CHE 142.

Prerequisite: C or higher in CHE 129 or CHE 131; or C or higher in CHE 125 and D or higher in CHE 129 or CHE 131. Pre- or Corequisite: MAT 125 for those who took CHE 129 or 130; MAT 126 or higher for all others
4 credits

CHE 133: General Chemistry Laboratory I
Designed to familiarize students with (1) some chemical and physical properties of substances, (2) techniques of quantitative chemistry, and (3) scientific methodology. Four hours of laboratory and discussion per week. CHE 133 may not be taken for credit in addition to CHE 143, and CHE 134 may not be taken for credit in addition to CHE 144.

Pre- or Corequisite: CHE 129 or 131
1 credit

CHE 134: General Chemistry Laboratory II
Designed to familiarize students with (1) some chemical and physical properties of substances, (2) techniques of quantitative chemistry, and (3) scientific methodology. Four hours of laboratory and discussion per week. CHE 133 may not be taken for credit in addition to CHE 143, and CHE 134 may not be taken for credit in addition to CHE 144.

Prerequisites: CHE 133
Pre- or Corequisite: CHE 132
1 credit

CHE 141 - E: Honors Chemistry I
The topics covered in this sequence are similar to those in CHE 131, 132, but draw more on students' previous background in science and mathematics in order to present the material in a more quantitative manner. Recommended for students with strong backgrounds in mathematics and science, especially chemistry and physics. Three lecture hours and one 80-minute workshop per week. CHE 141 may not be taken for credit in addition to CHE 131, and CHE 142 may not be taken for credit in addition to CHE 132. Priority given to students in the University's honors programs.

Prerequisite: High school chemistry; level 5 on the mathematics placement examination or co-registration in MAT 125 or higher calculus course or AMS 151
4 credits

CHE 142 - E: Honors Chemistry II
The topics covered in this sequence are similar to those in CHE 131, 132, but draw more on students' previous background in science and mathematics in order to present the material in a more quantitative manner. Recommended for students with strong backgrounds in mathematics and science, especially chemistry and physics. Three lecture hours and one 80-minute workshop per week. CHE 141 may not be taken for credit in addition to CHE 131, and CHE 142 may not be taken for credit in addition to CHE 132. Priority given to students in the University's honors programs.

Prerequisite: C or higher in CHE 141
Pre- or Corequisite: MAT 126 or higher or AMS 161
4 credits

CHE 143: Honors Chemistry Laboratory I

CHEMISTRY (CHE) - COURSES

Spring 2010

CHE 301: Physical Chemistry I
The quantitative study of microscopic and macroscopic chemical systems, covering introductory quantum theory of atoms and molecules (energy levels and states), statistical thermodynamics, and fundamental thermodynamics with application to chemical reactions and simple systems.
Prerequisite: CHE 132 or 142
Corequisite: CHE 142
4 credits

CHE 302: Physical Chemistry II
Applications of thermodynamics to chemical equilibria, electrochemistry, and ideal solutions. Applications of quantum theory to chemical bonding, molecular structure, and spectroscopy.
Prerequisites: CHE 301; MAT 211 or 203 or 205 or AMS 161
Corequisite: PHY 121/123 or 125 or 131/133 or 141
4 credits

CHE 303: Solution Chemistry Laboratory
Prerequisite: CHE 134 or 144
Corequisite: CHE 301
2 credits

CHE 304: Chemical Instrumentation Laboratory
Prerequisite: CHE 303. Corequisites: CHE 302 and 385
Advisory Prereq: Knowledge of computer programming
2 credits

CHE 310 - H: Chemistry in Technology and the Environment
Use of chemical principles in understanding processes that occur in the modern technological world and in the natural environment. Certain ecological problems of a chemical nature are analyzed. Methods of controlling these problems are discussed.
Prerequisite: CHE 132 or 142
3 credits

CHE 312: Physical Chemistry (Short Course)
A one-semester treatment of fundamental concepts of physical chemistry, intended primarily for students of the biological sciences desiring an introduction to physical chemistry. Topics include equations of state; classical thermodynamics and its application to chemical equilibrium in reaction systems, multiphase systems, and electrochemical cells; kinetic theory of gases; transport properties; chemical kinetics. May not be taken for credit by students who have completed CHE 301. Not for major credit.
Prerequisite: CHE 132 or 142; MAT 132 or 142 or 127 or 171 or AMS 161
Pre- or Corequisite: PHY 121/123 or 125 or 131/133 or 141
4 credits

CHE 321: Organic Chemistry I
An introduction to the structure, reactivity, and properties of organic compounds is presented using modern views of chemical bonding. These fundamental ideas are applied to topics ranging from synthetic chemistry to complex functional structures such as lipid bilayers.
Prerequisite: C or higher in CHE 312 or 142
4 credits

CHE 322: Organic Chemistry IIA
Discussion of the structure, reactivity, and properties of organic compounds introduced in CHE 321 is continued. The chemistry of substances important in biology, medicine, and technology is emphasized. CHE 322 may not be taken for credit in addition to CHE 326.
Prerequisite: C or higher in CHE 321
4 credits

CHE 326: Organic Chemistry IIB
Similar to CHE 322 but providing a more fundamental view of organic compounds, reaction mechanisms, and synthesis, based somewhat more explicitly on thermodynamics and kinetics. Especially for those who may major in chemistry, biochemistry, or another physical science. CHE 326 may not be taken for credit in addition to CHE 322.
Prerequisite: C or higher in CHE 321
4 credits

CHE 327: Organic Chemistry Laboratory
Techniques of isolating and handling organic substances, including biological materials. A one-semester course that provides a basic organic laboratory experience. It is recommended that students take CHE 327 at the same time as or immediately following CHE 322 or 332. Four laboratory hours and one lecture hour per week. Not for credit in addition to CHE 383.
Prerequisite: CHE 133 or 143; CHE 134 or 144
Pre- or Corequisite: CHE 321
2 credits

CHE 341: Organic Chemistry Honors Seminar I
Advanced topics in organic chemistry within the scope but beyond the reach of CHE 321 (Organic Chemistry I) will be discussed along with an introduction to contemporary research topics. Permission to enroll will be granted to students who have demonstrated excellence in their General Chemistry courses.
Prerequisites: CHE 132 or 142; permission of instructor
Corequisite: CHE 321
1 credit

CHE 342: Organic Chemistry Honors Seminar II
Advanced topics in organic chemistry within the scope but beyond the reach of CHE 322 and CHE 326 (Organic Chemistry II) will be discussed along with topics in contemporary research. Permission to enroll will be granted to students who have demonstrated excellence in CHE 321.
CHE 353: Chemical Thermodynamics
A rigorous development of thermodynamics and its application to systems of interest to chemists, including electrochemical cells, gases, polymers, and homogeneous and heterogeneous equilibrium. An introduction to statistical mechanics is included.

Prerequisites: CHE 321; permission of instructor
Corequisite: CHE 322 or 326
1 credit

CHE 354: Spectroscopic Laboratory Techniques
Cover material pertaining to the experimental and mechanistic determinations. Lectures and laboratory techniques to organic and inorganic problems are included. Specific topics include catalysis, biomimicry, protein and DNA modification, binding and target recognition, and correlation between three-dimensional structure and reactivity.

Pre- or Corequisites: CHE 322 or 326
Pre- or Corequisites: CHE 301 or 312
3 credits

CHE 355: Reaction Mechanisms in Organic Chemistry
Important classes of mechanisms of reactions useful in synthesis are explored. The kinetics and thermodynamics of these reactions are analyzed using modern structural theories. Examples of reaction types are substitutions, rearrangements, additions, eliminations, and selected organometallic reactions.

Prerequisites: CHE 322 or CHE 326
3 credits

CHE 356: Bioenergetics
A rigorous development of thermodynamics and its application to systems of interest to chemists, including electrochemical cells, gases, polymers, and homogeneous and heterogeneous equilibrium. An introduction to statistical mechanics is included.

Prerequisites: CHE 302; CHE 321
3 credits

CHE 357: Molecular Structure and Spectroscopy Laboratory
Optical and magnetic resonance spectroscopy are used to investigate the structural, dynamic, and quantum mechanical properties of some basic chemical systems. Emphasis is on the quantitative measurement of molecular parameters and transformations.

Prerequisites: CHE 304 and 383
2 credits

CHE 358: Scientific Computing
The basic methods of numerical analysis and the design of computer programs that use them are discussed within the framework of solving a variety of exciting problems chosen from many areas of science. The presentation makes extensive use of powerful scientific computational environments, such as Mathematica, and Matlab, but guidance to other scientific high-level computer languages is also provided. No previous knowledge of scientific programming is assumed. Extensive use of personal or SINC-site computers outside the classroom is required.

Prerequisite: MAT 127 or MAT 132 or MAT 142 or MAT 171 or AMS 161
2 credits

CHE 359: Micromolecular Structure and Reactivity
The reactivity and physiological function of biological macromolecules and their monomeric constituents are described at the chemical level. The course reflects the most recent advances at the interface of organic chemistry and biochemistry. Specific topics include catalysis, biomimicry, protein and DNA modification, binding and target recognition, and correlation between three-dimensional structure and reactivity.

Pre- or Corequisites: CHE 322 or 326
Pre- or Corequisites: CHE 301 or 312
3 credits

CHE 360: Molecular Structure and Reactivity
The reactivity and physiological function of biological macromolecules and their monomeric constituents are described at the chemical level. The course reflects the most recent advances at the interface of organic chemistry and biochemistry. Specific topics include catalysis, biomimicry, protein and DNA modification, binding and target recognition, and correlation between three-dimensional structure and reactivity.

Pre- or Corequisites: CHE 322 or 326
Pre- or Corequisites: CHE 301 or 312
3 credits

CHE 361: Nuclear Chemistry
Properties of radioactive substances and their use in the study of chemical problems, nuclear stability and structure, nuclear reactions, radioactive decay, interactions of radiation with matter, nuclear medicine, isotope applications, and environmental control. Offered in summer only.

Prerequisites: Four semesters of chemistry; PHY 126 and 127, or 132/134 or 142 or 171; AMS 161 or MAT 127 or 132 or 142; permission of department through application by January 30; permission of instructor
Corequisite: CHE 362
3 credits

CHE 362: Nuclear Chemistry Laboratory
Detection and measurement of radiation, electronic instrumentation, radiation safety, and application of radioactivity to chemical problems. Offered in summer only.

Corequisite: CHE 361
3 credits

CHE 363: Inorganic Chemistry I
A survey of inorganic chemistry covering various classes of inorganic compounds and reactions with emphasis on the structural aspects. Wherever possible, the subject is treated on the basis of modern concepts of chemical bonding. Thermodynamic and kinetic aspects of inorganic reactions are included.

Prerequisite: CHE 322 or 326
3 credits

CHE 364: Inorganic Chemistry II
The chemistry of the elements with an emphasis on the transition metals. Reaction mechanisms, synthesis, and structure are covered. Specific areas of concern include coordination chemistry, organometallic chemistry, bioinorganic chemistry, and selected topics from solid-state and non-transition metal chemistry.

Prerequisite: CHE 375
3 credits

CHE 365: Materials Chemistry
Our high-technology world is driven forward by advances in materials chemistry. This class will discuss some of the materials that underpin these technologies, as well as some of the novel classes of materials that are being developed for future applications. The course will cover the synthesis, structures, and properties of advanced materials, focusing on a range of topics with current societal importance (e.g. energy, computers, nanoscience, etc.). Specific topics may include batteries, fuel cells, catalysts, metals, semiconductors, superconductors, magnetism, and polymers.

Prerequisite: CHE 375 or ESG 332
3 credits

CHE 366: Materials Chemistry Laboratory
Application of fundamental laboratory techniques to organic and inorganic problems including multistep syntheses and structural and mechanistic determinations. Lectures cover material pertaining to the experimental work, with an emphasis on spectroscopy.
Prerequisite: CHE 383
Corequisites: CHE 322 or 326; CHE 385
3 credits

CHE 385: Tools of Chemistry
A seminar course covering topics common to all areas of chemistry: scientific ethics, chemical literature and information retrieval, scientific writing, and oral presentation. Should be taken concurrently with the student's second 300-level chemistry laboratory course. Satisfactory completion of the course fulfills the Chemistry department's upper division writing requirement. A through C/ Unsatisfactory grading only.
Corequisite: CHE 304 or 384
1 credit, ABC/U grading

CHE 386: Professional Skills
Development and refinement of the professional skills used by scientists. The exploration of more sophisticated presentation skills used in oral and poster presentations. The incorporation of collaborative problem solving that mimics real world situations, including simple proposal writing. An exposure to professional societies and meetings. An exploration of career options and employment resources. Tips for resume preparation, and interviews will be presented. Recommended for upper division undergraduates and Masters students.
Prerequisite: CHE 385 or permission of instructor
2 credits, S/U grading

CHE 461: Selected Topics in Chemistry
Semester supplements to this Bulletin contain specific description when course is offered. May be repeated as the topic changes.
Prerequisite: Varying with topic
1-3 credits

CHE 475: Undergraduate Teaching Practicum I
Work with a faculty member as an assistant in one of the faculty member's regularly scheduled classes. Students assume greater responsibility in such areas as leading discussions and analyzing results of tests that have already been graded. Students may participate only in courses in which they have excelled. The course in which the student is permitted to work as a teaching assistant must be different from the course in which he or she previously served.
Prerequisite: Permission of department
3 credits, S/U grading

CHE 476: Undergraduate Teaching Practicum II
Work with a faculty member as an assistant in one of the faculty member's regularly scheduled classes. Students assume greater responsibility in such areas as leading discussions and analyzing results of tests that have already been graded. Students may participate only in courses in which they have excelled. The course in which the student is permitted to work as a teaching assistant must be different from the course in which he or she previously served.
Prerequisite: Permission of department
3 credits, S/U grading

CHE 477: Undergraduate Teaching Practicum III
Work with a faculty member as an assistant in one of the faculty member's regularly scheduled classes. Students may participate only in courses in which they have excelled. May be repeated.
Prerequisites: CHE 476; permission of instructor and department
S/U grading

CHE 478: Internship
Research participation in off-campus laboratories. Students are required to submit to the department a proposal at the time of registration and a research report at the end of the semester. May be repeated up to a limit of 12 credits.
Prerequisites: CHE 384; permission of instructor and department
0-6 credits

CHE 487: Research in Chemistry
Students pursue research or tutorial study in specialized areas of chemistry. May be repeated.
Prerequisites: Permission of instructor and department
0-6 credits

CHE 488: Internship
Research participation in off-campus laboratories. Students are required to submit to the department a proposal at the time of registration and a research report at the end of the semester. May be repeated up to a limit of 12 credits.
Prerequisites: CHE 384; permission of instructor and department
0-6 credits, S/U grading

CHE 490: Current Trends in Biological Chemistry
A discussion of current topics of research and methodology in modern biological chemistry. The course includes directed readings, attendance, and discussion at seminars presented by speakers from various academic and industrial institutions. May be repeated.
Prerequisite: CHE 322 or 326
Pre- or Corequisite: CHE 301 or 312
1 credit

CHE 495: Senior Research
First course of a two-semester research program to be carried out under the supervision of a staff member. The results of