

# CHE

## Chemistry

### CHE 115: Chemistry, Life, and Environment

This survey course introduces chemical principles by emphasizing the role chemistry plays in everyday life, the natural environment, the built environment, energy production, and in processes leading to environmental degradation. In addition, the role of chemistry in the development of alternative energy sources, remediation technologies, and eco-friendly products is discussed. This course for non-science majors introduces chemical principles using mostly qualitative approaches rather than quantitative approaches. Interactive tools and interactive visualization tools are extensively used to illustrate concepts, reactions, and processes. This course is offered as both CHE 115 and ENV 115.

**DEC:** E  
**SBC:** SNW

3 credits

### 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: 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 151. 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 151. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

*Mandatory co requisites: MAT 123 and CHE 130*

**DEC:** E  
**SBC:** SNW

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*

1 credit, S/U grading

### CHE 131: 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 an AP course or more than one year of chemistry in high school; such students should take CHE 152. Three lecture hours and one 80-minute workshop per week. May not be taken for credit in addition to CHE 129 or CHE 152. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

*Corequisite: MAT 125 or higher*

**DEC:** E  
**SBC:** SNW

4 credits

### CHE 132: 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 152. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

*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*

**DEC:** E  
**SBC:** SNW

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. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*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. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisites:* CHE 133

*Pre- or Corequisite:* CHE 132

1 credit

### CHE 152: Molecular Science I

Topics include atomic and molecular structure, chemical bonding, thermodynamics, equilibrium and aqueous chemistry, electrochemistry, kinetics and basics of organic chemistry. This is the initial course in a three semester sequence. Students with a strong background prior to entering the University can take the 152-331-332 sequence, which covers the same material as 131-132-321-322. Recommended for students who took advanced placement chemistry in high school or equivalent or students who have performed well on the summer chemistry placement exam. Three lecture hours and one 80-minute workshop per week. May not be taken for credit in addition to CHE 129, 131, 132, 141, or 142.

*Prerequisite:* Advanced Placement Chemistry score of 4 or 5 or satisfactory performance on the summer chemistry placement exam; co-registration in MAT 131 (preferred), MAT 125, AMS 151 or a higher calculus course

**DEC:** E

**SBC:** SNW

4 credits

### CHE 154: Molecular Science Laboratory I

Designed to familiarize students with chemical and physical properties of substances, techniques of quantitative chemistry, and aspects of scientific methodology. Four hours of lab per week. CHE 154 may not be taken for credit in addition to CHE 134. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Corequisite:* CHE 152

2 credits

### CHE 301: Physical Chemistry I

This course is the first half of a two-semester overview of modern physical chemistry, introducing students to the quantitative study of chemical systems. The fundamentals of thermodynamics from both macroscopic and microscopic standpoints are covered, with applications to chemical problems. May not be taken for credit by students who have completed CHE 312.

*Prerequisite:* CHE 132 or 151; MAT 132 or 142 or 127 or 171 or AMS 161

*Pre- or Corequisite:* PHY 121/123 or 125 or 131/133 or 141

**SBC:** STEM+

4 credits

### CHE 302: Physical Chemistry II

Introduction to quantum theory and its application to the study of chemical bonding, molecular spectroscopy, statistical thermodynamics, chemical kinetics and molecular reaction dynamics.

*Prerequisites:* CHE 301; MAT 211 or 203 or 205 or AMS 161

*Pre- or Corequisite:* PHY 122/124 or 132/134 or 142 or PHY 126/127

4 credits

### CHE 303: Solution Chemistry Laboratory

Quantitative techniques of solution chemistry. Measurement: accuracy and precision, analysis, computation, and reporting. Spectrophotometry. Solution equilibria and kinetics. Use of computers is introduced. Six hours of laboratory and discussion. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisite:* CHE 134 or 144

*Corequisite:* CHE 301

**SBC:** ESI, WRTD

2 credits

### CHE 304: Chemical Instrumentation Laboratory

Electrochemical and thermochemical measurements. Electronics in chemical instrumentation. Vacuum techniques. Electrical and magnetic properties of materials. Data-handling methods. Six hours of laboratory and discussion. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisite:* CHE 303. *Corequisites:* CHE 302 and 385

*Advisory Prereq:* Knowledge of computer programming

**SBC:** TECH, WRTD

2 credits

### CHE 310: 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. Not for credit in addition to ENV 320.

*Prerequisite:* CHE 132 or CHE 152

**DEC:** H

**SBC:** STAS

3 credits

### CHE 312: Physical Chemistry for the Life Sciences

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

**SBC:** STEM+

3 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. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

*Prerequisite:* C or higher in CHE 132

**SBC:** STEM+

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. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

*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. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

*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. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisite: CHE 133 or 143; CHE 134 or 144*

*Pre- or Corequisite: CHE 321 or CHE 331*

2 credits

### **CHE 331: Molecular Science II**

Topics include the structural, mechanistic and synthetic aspects of organic chemistry, transition metal chemistry, catalysis, supramolecular chemistry, and polymer chemistry. This is the second course in a three semester sequence. Students with a strong background prior to entering the University can take the 152-331-332 sequence, which covers the same material as 131-132-321-322. Three lecture hours and one 80-minute workshop per week. May not be taken for credit in addition to CHE 321.

*Prerequisite: C or higher in CHE 152*

**SBC:** STEM+

4 credits

### **CHE 332: Molecular Science III**

Topics include advanced structural, mechanistic and synthetic aspects of organic chemistry, the organic chemistry of biological pathways and biosynthesis. This is the final course in a three semester sequence. Students with a strong background prior to entering the University can take the 152-331-332 sequence, which covers the same material as 131-132-321-322. Three lecture hours and one

80-minute workshop per week. May not be taken for credit in addition to CHE 322.

*Prerequisite: C or higher in CHE 331*

4 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*

**SBC:** ESI, SPK

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.

*Prerequisites: CHE 321; permission of instructor*

*Corequisite: CHE 322 or 326*

**SBC:** ESI, SPK

1 credit

### **CHE 345: Structure and Reactivity in Organic Chemistry**

Electronic and stereochemical theories relating to organic structure and reactions. Topics such as bonding, strain, aromaticity, MO theory, molecular rearrangements, pericyclic reactions, and photochemistry are covered.

*Prerequisite: CHE 322, CHE 326, or CHE 332*

*Pre- or Corequisite: CHE 301 or 312*

3 credits

### **CHE 346: Biomolecular 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, CHE 326, or CHE 332; CHE 301 or CHE 312*

3 credits

### **CHE 348: 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.

*Prerequisite: CHE 322, CHE 326, or CHE 332*

3 credits

### **CHE 351: Quantum Chemistry**

Concepts of quantum theory, Schrodinger wave mechanics, and related mathematical techniques illustrated by application to systems of chemical bonding, spectroscopy, molecular structure, and molecular collision phenomena.

*Prerequisites: CHE 302; MAT 203 or 205*

3 credits

### **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 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. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*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 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 375: 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, CHE 326, or CHE 332*

3 credits

### **CHE 376: 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 378: 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 383: Introductory Synthetic and Spectroscopic Laboratory Techniques**

Fundamental laboratory techniques including methods of separation, purification, synthesis, and analysis. Emphasis is on organic with an introduction to inorganic problems. For students who require substantial laboratory skills, such as those planning careers in research. Not for credit in addition to CHE 327. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisite: CHE 134 or 144*

*Corequisite: CHE 321 or CHE 331*

*SBC: ESI*

2 credits

### **CHE 384: Intermediate Synthetic and Spectroscopic Laboratory Techniques**

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. This course has an associated fee. Please see [www.stonybrook.edu/coursefees](http://www.stonybrook.edu/coursefees) for more information.

*Prerequisite: CHE 383*

*Corequisites: CHE 322, CHE 326, or CHE 332; CHE 385*

*SBC: TECH, WRTD*

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*

*SBC: CER, SPK*

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 459: Write Effectively in Chemistry**

A zero credit course that may be taken in conjunction with any 300- or 400-level CHE course, with permission of the instructor. The course provides opportunity to practice the skills and techniques of effective academic writing and satisfies the learning outcomes of the Stony Brook Curriculum's WRTD learning objective.

*Prerequisite: WRT 102; permission of the instructor*

*SBC: WRTD*

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. The student is required to attend all the classes, do all the regularly assigned work, and meet with the faculty member at regularly scheduled times to discuss the intellectual and pedagogical matters relating to the course. Students may participate only in courses in which they have excelled.

*Prerequisite: Permission of department*

*SBC: EXP+*

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*

**SBC:** EXP+

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*

**SBC:** EXP+

S/U grading

### **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*

**SBC:** EXP+

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*

**SBC:** EXP+

0-6 credits, S/U grading

### **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 this work are to be submitted to the department in the form of a senior research report. The student is given an oral examination in May by a faculty committee consisting of the student's supervisor and three other faculty members. Students receive only one grade upon completion of the sequence CHE 495-496.

*Prerequisite: U4 standing; permission of instructor and department*

**SBC:** EXP+

3 credits

### **CHE 496: Senior Research**

Second course of a two-semester research program to be carried out under the supervision of a staff member. The results of this work are to be submitted to the department in the form of a senior research report. The student is given an oral examination in May by a faculty committee consisting of the student's supervisor and three other faculty members. Students receive only one grade upon completion of the sequence CHE 495-496.

*Prerequisite: U4 standing; permission of instructor and department*

**SBC:** ESI, EXP+, SPK

3 credits

## **ESG**

### **Engineering Science**

#### **ESG 100: Introduction to Engineering Science**

An overview of the development and application of engineering principles in response to social, industrial, and environmental problems. Engineering methods and theory through case studies and real-world applications. Introduction to modern engineering design and problem solving through discussion of design theory and tools with an emphasis on design for manufacturing and reliability, engineering ethics including value sensitive design, and participation in a design project.

**SBC:** TECH

3 credits

#### **ESG 111: C Programming for Engineers**

Introduces computer programming techniques for engineering students who are not planning to take advanced computer science courses. Students learn C programming language as applied to various scientific and engineering problems. Includes advanced simulation packages such as Labview to introduce computer control of experimental systems. Not intended for students who have completed a C programming course.

*Pre- or Corequisites: AMS 151 or MAT 125 or 131 or 141; PHY 125/133 or 131/133 or 141*

3 credits

### **ESG 198: Fundamentals of Engineering Chemistry**

A quantitative introduction to chemistry (stoichiometry, bonding, states of matter, equilibrium) with emphasis on topics of interest to students in engineering (metals and semiconductors; thermochemistry; electrochemistry and corrosion; polymers). Labs include an introduction to analytical techniques, electrochemistry and chemical synthesis. Both quantitative and qualitative methods are emphasized. May not be taken for credit in addition to CHE 131/133, 141/143 or 198/199.

*Pre- or Corequisites: PHY 132 or PHY 142 or PHY 126 and PHY 127; MAT 127 or MAT 132 or MAT 142 or AMS 161*

4 credits

### **ESG 199: Introduction to Undergraduate Research**

An introduction to independent research and basic research skills. Students perform an independent research project in engineering science under the supervision of a faculty member. May be repeated.

*Prerequisite: Permission of instructor*

0-3 credits

### **ESG 201: Learning from Disasters**

The role of the engineer is to respond to a need by building or creating something along a certain set of guidelines (or specifications) which performs a given function. Just as importantly, that device, plan or creation should perform its function without fail. Everything, however, does eventually fail and, in some cases, fails with catastrophic results. Through discussion and analysis of engineering disasters from nuclear meltdowns to lost spacecraft to stock market crashes, this course will focus on how modern engineers learn from their mistakes in order to create designs that decrease the chance and severity of failure.

*Prerequisite: one D.E.C. E or SNW course*

**DEC:** H

**SBC:** STAS

3 credits

### **ESG 281: Engineering Introduction to the Solid State**

A discussion of relativity followed by review of the atom and its constituents. Lectures treat the quantization of light and of atomic energy levels, matter waves, and introduce the Schrodinger equation, first in one dimension, then in three dimensions. Electron spin and magnetic effects are discussed, followed by multielectron atoms and the periodic table.

Radiation and lasers, molecules and solids, including conductors, semiconductors, and insulators.

*Prerequisite: PHY 132/134 or 142 or 126/127/134*

4 credits

### ESG 300: Writing in Engineering Science

See Requirements for the Major in Engineering Science, Upper-Division Writing Requirement.

*Prerequisites: WRT 102; ESG major; U2 standing*

*Corequisite: ESG 312*

*S/U grading*

### ESG 301: Sustainability of the Long Island Pine Barrens

The ecologically diverse Long Island Pine Barrens region provides a habitat for a large number of rare and endangered species, but faces challenges associated with protection of a natural ecosystem that lies in close proximity to an economically vibrant urban area that exerts intense development pressure. In this course we will consider the interaction of the ecological, developmental and economic factors that impact the Pine Barrens and the effectiveness of decision support systems in promoting sustainability of the Pine Barrens. This course is offered as BIO 301, GEO 301, ECO 301, ENV 301, and ESG 301.

*Prerequisites: U3 or U4 status and one of the following: BIO 201, CHE 131, ECO 108, ESG 100, ESG 198, GEO 101, GEO 102*

**DEC:** H

**SBC:** SPK, STAS

3 credits

### ESG 302: Thermodynamics of Materials

The basic laws and concepts of thermodynamics are elucidated, and the important thermodynamic relationships are systematically developed with reference to the behavior of materials. The thermodynamics of solids is discussed, including the thermodynamics of solutions and the calculation of reaction-free energies and equilibria in condensed phase reactions such as phase transformations, oxidation, and diffusion.

*Prerequisite: ESG 198 or CHE 131/132/133 and AMS 161*

*Advisory Prerequisite: AMS 261*

4 credits

### ESG 312: Engineering Laboratory

Laboratory exercises and lectures covering the theory, practice, and design of engineering

experimentation. The course has three components: error analysis and data message; electrical circuits and experiment control; and mechanical and optical measurement. Laboratory fee required.

*Prerequisites: PHY 126 and 127 or PHY 132/134; U2 standing*

*Corequisite: ESG 300*

4 credits

### ESG 316: Engineering Science Design Methods

Design and design-planning methods are developed from the conceptual stages through the application stages using lecture and laboratory. Includes synthesis, optimization, modeling, and simulation and systems engineering. Case studies illustrate the design process. Students undertake a number of laboratory projects employing various design tools. Laboratory fee required.

*Prerequisites: ESG major; U2 standing or higher; ESG 100; AMS 161 or MAT 127 or MAT 132 or MAT 142 or MAT 171*

4 credits

### ESG 332: Materials Science I: Structure and Properties of Materials

A study of the relationship between the structure and properties of engineering materials and the principles by which materials' properties are controlled. The structure and structural imperfections in simple crystalline materials and the role that these factors play in defining electrical conductivity, chemical reactivity, strength, and ductility are considered. The molecular structure of polymers is discussed and related to the behavior of plastics, rubbers, and synthetic fibers. The principles of phase equilibria and phase transformation in multicomponent systems are developed. These principles are applied to the control of the properties of semiconductors, commercial plastics, and engineering alloys by thermochemical treatment. Corrosion, oxidation, and other deterioration processes are interpreted through the interaction of materials with their environment.

*Prerequisites: CHE 131 or CHE 141 or ESG 198 and ESG 302 or PHY 306 or CME 304 or CHE 353 (or Mechanical Engineering majors may use MEC 301 as a corequisite)*

4 credits

### ESG 333: Materials Science II: Electronic Properties

After a review of quantum mechanics and atomic physics, the binding energy and electronic energy levels in molecules and solids are discussed. The free-electron

theory of metals is introduced and applied to the quantitative treatment of a number of electron emission effects. The band theory of solids is developed quantitatively via the Kronig-Penney model, and the transport properties of metals and semiconductors are discussed in detail. The physical principle of pn junctions, transistors, tunnel diodes, etc. is explained. Fundamentals and applications of photoconductors, lasers, magnetic materials, and superconductors are also discussed. (ESG 332 is not a prerequisite.)

*Prerequisites: ESG 281 or PHY 251; ESG 302 or CME 304*

4 credits

### ESG 339: Thin Film Processing of Advanced Materials

Fundamental aspects of thin film materials design, fabrication, and characterization. Overviews of semiconductor fabrication, surface analysis, and vacuum system design. This course includes a design content of one credit, achieved through a design exercise related to thin film fabrication.

*Prerequisite: ESG 332, or ESE 331 for ESE majors*

4 credits

### ESG 375: Fundamentals of Professional Engineering

The course provides an overview of professional licensure and focuses on the general fundamentals of the engineering exam. Students take a practice exam for both the general exam and in-depth general exam option and review the results.

*Prerequisite: Junior or Senior Standing*

1 credit

### ESG 420: Fluid Flow, Heat & Mass Transport

This course introduces the description of phenomena associated with fluid statics and fluid flow and the unifying principles and analytical description of phenomena of momentum transport (viscous flow), energy transport (heat conduction and convection) and mass transport (diffusion) in continuous media; similarities and differences in these phenomena. Not for credit in addition to MEC 364.

*Prerequisites: PHY 127/134 or PHY 132/134 or PHY 142; AMS 361 or MAT 303 or MAT 305*

3 credits

### ESG 440: Capstone Engineering Design I

Lectures by faculty members and visitors on typical design problems encountered in engineering practice. During this semester each student chooses a senior design project. A preliminary design report is required. Not counted as a technical elective. Laboratory fee required.

*Prerequisites: ESG 312; ESG 316; ESG 332; ESG major; U4 standing; permission of the department*

*3 credits*

### **ESG 441: Capstone Engineering Design II**

Student groups carry out the detailed design of the senior projects chosen during the first semester. A final and detailed design report is prepared. Not counted as a technical elective. Laboratory fee required.

*Prerequisite: ESG 440*

*3 credits*

### **ESG 487: Cooperative Research in Technological Solutions**

An independent research course in which students apply principles of engineering design, technological problem solving, mathematical analysis, computer-assisted engineering, and effective teamwork and communication to develop solutions for a need in a governmental, educational, non-profit, or community organization in a multidisciplinary setting.

*Prerequisites: U3 or U4 standing; an abstract of the project; permission of instructor*

*0-3 credits*