

# Chemistry and Environmental Science

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NJIT's Department of Chemistry and Environmental Science provides a unique focus for addressing some of today's most pressing scientific and social challenges. The chemistry program's solid grounding in science, mathematics and engineering, along with lab skills, allows students to apply theory to practical solutions based on chemistry. NJIT has particular strengths in analytical, medical and environmental chemistry. Students can conduct research with faculty mentors with expertise in such areas as energy, pharmaceuticals, materials and environmental chemistry. Through the environmental science program, students acquire a well-rounded background in the field, drawing on chemistry, geology and biological sciences. Students also learn to use computer modeling, data analysis, digital mapping and more — skills that clearly afford a significant advantage in the job market.

## NJIT Faculty

### B

Balasubramanian, Bhavani, University Lecturer

Bonchonsky, Michael P., University Lecturer

Bozzelli, Joseph W., Distinguished Professor

Butherus, Alexander D., University Lecturer

### C

Conley, Robert J., Emeritus

### D

Dauerman, Leonard, Associate Professor

### E

Ellis, Frank B., Senior University Lecturer

### F

Farinas, Edgardo T., Associate Professor

### G

Getzin, Donald, Associate Professor Emeritus

Gilbert, Kathleen M., University Lecturer

Gund, Tamara, Professor

### H

Huang, Haidong, Assistant Professor

### J

Jackson, Nancy L., Professor

### K

Kebbekus, Barbara B., Professor Emeritus

Khalizov, Alexei, Assistant Professor

Krasnoperov, Lev N., Professor

### L

Lambert, Donald G., Associate Professor Emeritus

Lei, George Y., Associate Professor Emeritus

**M**

Mitra, Somenath, Distinguished Professor

**P**

Petrova, Roumiana S., Senior University Lecturer

**Q**

Qiu, Zeyuan, Associate Professor

**S**

Skawinski, William, Senior University Lecturer

**V**

Venanzi, Carol A., Distinguished Professor Emeritus

**Programs**

- BioChemistry - B.S. (<http://catalog.njit.edu/undergraduate/science-liberal-arts/chemistry-environmental-science/biochemistry-bs>)
- Chemistry - B.S. (<http://catalog.njit.edu/undergraduate/science-liberal-arts/chemistry-environmental-science/chemistry-bs>)
- Environmental Science - B.S. (<http://catalog.njit.edu/undergraduate/science-liberal-arts/chemistry-environmental-science/environmental-science-bs>)

**Accelerated Programs** (<http://catalog.njit.edu/undergraduate/academic-policies-procedures/special-degree-options>)

- Chemistry - B.S. for Pre-Professional Students (<http://catalog.njit.edu/undergraduate/science-liberal-arts/chemistry-environmental-science/accelerated-bs>)
- Chemistry Minor (<http://catalog.njit.edu/undergraduate/science-liberal-arts/chemistry-environmental-science/chemistry-minor>) (not for Chemical Engineering majors)
- Chemistry Minor (<http://catalog.njit.edu/undergraduate/newark-college-engineering/chemical-biological-pharmaceutical/chemistry-minor-chemical-engineering-majors>) (for Chemical Engineering majors)
- Environmental Science Policy Minor (<http://catalog.njit.edu/undergraduate/science-liberal-arts/chemistry-environmental-science/environmental-science-policy-minor>)

**Chemistry and Environmental Science Courses****CHEM 105. Applied Chemical Principles. 4 credits, 5 contact hours (3;2;0).**

Prerequisite: high school algebra or equivalent. The fundamentals and relation of chemistry to living in today's society. Suitable laboratory experiments illustrate the course material. Not open to engineering or science students, or students who have completed a college level chemistry course.

**CHEM 108. College Chemistry I. 3 credits, 3 contact hours (3;0;0).**

Prerequisites: a one-year college prep high school chemistry course, high school math including algebra and trigonometry. Delivered as a telecourse, the course provides the first of a two-semester sequence of college chemistry for high school students and other distance learners seeking college credit and/or preparation for the AP Examination. Matriculated undergraduates may not receive credit for this course.

**CHEM 109. College Chemistry II. 3 credits, 4 contact hours (3;1;0).**

Prerequisite: CHEM 108. A continuation of CHEM 108.

**CHEM 121. Fundamentals of Chemical Principles I. 3 credits, 3 contact hours (3;0;0).**

Introduces the basic concepts of chemistry, including chemical reactions, and bonding, electronic and molecular structure, gases and thermochemistry.

**CHEM 122. Fundamentals of Chemical Principles II. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: Chem 121 with a grade C or better. Continuation of the Chem 121 sequence. Introduces the basic concepts of chemistry, including equilibrium, chemical kinetics, thermodynamics, electrochemistry, and nuclear chemistry.

**CHEM 124. General Chemistry Laboratory. 1 credit, 3 contact hours (0;3;0).**

Corequisite: CHEM 122 or CHEM 123 or CHEM 126 with a grade of C or better. Chemical principles studied in the CHEM 125 and CHEM 126 or CHEM 121, CHEM 122 and CHEM 123 sequence are illustrated and reinforced by performance of laboratory experiments.

**CHEM 125. General Chemistry I. 3 credits, 3 contact hours (3;0;0).**

Co-requisite Math 110, or Math 111, or Math 112 with a C or better. The first semester of a two-semester sequence in chemistry. Introduces the basic concepts of chemistry, including chemical reactions and bonding, electronic and molecular structure, gases and thermochemistry. Students majoring in chemistry or biochemistry should also register for lab Chem 125A.

**CHEM 125A. General Chemistry Lab I. 1 credit, 3 contact hours (0;3;0).**

General Chemistry Lab I is a laboratory course; it is designed to be taken currently with CHEM 125 or CHEM 121. Instructions are in the lab manual and concepts are from the text and lecture of the CHEM 125/121 courses. The experiments are designed to provide undergraduate students with practical experience and train students with laboratory techniques/equipment common to chemistry laboratories.

**CHEM 126. General Chemistry II. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: Math 110 or higher and Chem 125 with a C or better The second semester of a two-semester sequence in chemistry. Introduces the basic concepts of chemistry, including equilibrium, chemical kinetics, thermodynamics, and electrochemistry. Students majoring in chemistry or biochemistry should also register for lab Chem126A; all others for lab Chem 124.

**CHEM 126A. Gen Chemistry Lab II. 1 credit, 3 contact hours (0;3;0).****CHEM 221. Analytical Chemical Methods. 2 credits, 4 contact hours (0;4;0).**

Prerequisite: CHEM 222 with grade of C or better. Laboratory introducing quantitative chemical analyses by gravimetry, titration, spectroscopy, chromatography, and potentiometry.

**CHEM 222. Analytical Chemistry. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: CHEM 123 or CHEM 126, CHEM 124 with grade of C or better. Lecture course introducing concepts of chemical analyses by gravimetry, titration, spectroscopy, chromatography, and potentiometry.

**CHEM 231. Physical Chemistry I. 3 credits, 3 contact hours (3;0;0).**

Prerequisites: CHEM 122 or CHEM 126, PHYS 111 with a grade of C or better. Corequisite: MATH 211. The topics covered include the properties of ideal and non-ideal gases and liquids, solutions, thermochemistry, thermodynamics, the phase rule, and phase equilibria.

**CHEM 235. Physical Chemistry II. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: CHEM 231 with a grade of C or better. A continuation of CHEM 231. The topics include homogeneous and heterogeneous chemical equilibria, ionic equilibria, electrochemistry, kinetic theory of gases, transport phenomena, kinetics, and irreversible processes.

**CHEM 235A. Physical Chemistry II Laboratory. 2 credits, 4 contact hours (0;4;0).**

Prerequisite: CHEM 221, CHEM 235 with a grade of C or better. Corequisite: MATH 225 (special section for chemical engineering and chemistry majors). Laboratory experiments apply and extend the basic knowledge of physical chemistry acquired in the lecture. Reports and presentations are an essential part of the course.

**CHEM 236. Physical Chemistry for Chemical Engineers. 4 credits, 5 contact hours (5;0;0).**

Prerequisites: (CHEM 122 or CHEM 126)and CHEM 124 and (CHE 230 or CHE 232) with a grade C or better. This course will introduce the chemical engineering students to the concepts of order, disorder, chemical equilibrium and phase equilibrium. Credit for this course will not be given if credit for CHEM 235 has been given.

**CHEM 238. Analytical/Organic Chem Lab for Chemical Engineers. 2 credits, 4 contact hours (0;4;0).**

Prerequisite: CHEM 124 and CHEM 245 with a grade of C or better. This course will offer the CHE students experience in organic and analytical laboratory experiments. These experiments will reinforce concepts learned in the organic chemistry lecture classes. This laboratory course will also provide exposure to analytical and other techniques useful in the chemistry and chemical engineering laboratories.

**CHEM 243. Organic Chemistry I. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: CHEM 123 or CHEM 126 with a grade of C or better. The preparation and properties of the various classes of organic compounds are discussed, with attention given to industrial sources such as coal and petroleum. Also covers the commercial utilization of these materials in the synthesis of useful products used in areas such as foods, cosmetics, textiles, plastics, and pharmaceuticals.

**CHEM 244. Organic Chemistry II. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: CHEM 243 with a grade of C or better.

**CHEM 244A. Organic Chemistry II Laboratory. 2 credits, 4 contact hours (0;4;0).**

Prerequisite: CHEM 124 with a grade C or better. Corequisite: CHEM 244. Synthesis and characterization of organic compounds are performed in a unique multi-scale manner: micro, macro and a kilo scale.

**CHEM 245. Organic Chemistry for Chemical Engineers. 4 credits, 5 contact hours (5;0;0).**

Prerequisite: CHEM 126 or CHEM 122 with a grade of C or better. This course is a one-semester course(opposed to classic two-semester sequence) to provide chemical engineering students with a basic understanding of organic compounds and their reactions.

**CHEM 246A. Organic Chemistry Laboratory. 4 credits, 4 contact hours (0;4;0).**

Prerequisite: CHEM 244A with a grade of C or better. This course will cover some common reaction types that are not included in CHEM 244A. The experiments will be carried out in microscale. Students will learn new concepts in organic synthesis, including multi-step synthesis, organometallic reagents, and green chemistry for chemical synthesis, catalytic reactions, protecting groups, and peptide couplings. NMR and IR will be used for compound characterization.

**CHEM 301. Chemical Technology. 3 credits, 4 contact hours (2;2;0).**

Prerequisite: high school algebra and trigonometry or equivalent with a grade of C or better. Designed for engineering technology majors. Not open to students who have completed a college level chemistry course. Covers principles of chemistry, with a focus on chemical energetics and chemistry of materials. Suitable laboratory experiments illustrate the course material.

**CHEM 310. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).**

Restriction: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report. Cannot be used for degree credit. Note: Normal grading applies to this COOP Experience.

**CHEM 311. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).**

Prerequisites: CHE 310 with a grade C or better.

**CHEM 336. Physical Chemistry III. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: CHEM 235 with a grade of C or better. An introduction to quantum mechanics, statistical mechanics, spectroscopy, and solid state.

**CHEM 339. Analytical/Physical Chem Lab for Chemical Engineers. 2 credits, 4 contact hours (0;4;0).**

Prerequisites: CHEM 236 with grade C or better. Co-requisite: MATH 225 This course will offer students an introduction to physical and analytical chemistry laboratory techniques. The application of principles learned in lecture will be reinforced by the experiments done in this lab. They will also provide exposure to analytical and other techniques used in chemistry and chemical engineering.

**CHEM 340. Chemistry and Engineering of Materials. 3 credits, 3 contact hours (3;0;0).**

Prerequisites: CHEM 235, CHEM 244 with a grade of C or better. Emphasizes processing/property relationships for a variety of engineering materials, including polymers, metals, ceramics, composites, semiconductors, optical fibers, and biomaterials. Introduces concepts of chemical structure, bonding and crystallinity. Covers important chemical, physical, electrical, and mechanical properties and corrosion and materials degradation. Also includes materials selection in the chemical process industries.

**CHEM 360. Environmental Chemistry I. 3 credits, 3 contact hours (3;0;0).**

Prerequisites: CHEM 126 or CHEM 122 and CHEM 124 or CHEM 125A and CHEM 126A with a grade of C or better. Chemistry of the environment with emphasis on the atmosphere. Included are an introduction to the composition and chemistry of the natural and polluted atmosphere, thermodynamics and kinetics of atmospheric reactions, indoor and outdoor air pollution, air quality and its impact on human health, air quality regulations, and climate change. Examples of specific environmental issues covered in this course are the stratospheric ozone depletion, classical and photochemical smog, acid rain, and climate change.

**CHEM 361. Environmental Chemistry II. 3 credits, 3 contact hours (3;0;0).**

Prerequisites: CHEM 360 with a grade of C or better. Chemistry of the environment, including the hydrosphere and geosphere. Principles of physical, inorganic, and organic chemistry are applied to understand the origins of environmental pollutants, their transport, distribution, and decomposition pathways in water and soil environments.

**CHEM 391. Research and Independent Study. 3 credits, 3 contact hours (0;0;3).**

Restriction: Junior standing in Chemistry. Provides an opportunity to work on a research project under the individual guidance of a member of the department.

**CHEM 412. Inorganic Chemistry. 3 credits, 4 contact hours (2;2;0).**

Prerequisite: Prerequisite: CHEM 231 with a grade of C or better. A lecture-recitation-laboratory course in practical inorganic chemistry. Covers the chemistry of most of the elements and their compounds. Preparation in the laboratory is followed by purification and characterization.

**CHEM 437. Applications of Computational Chemistry and Molecular Modeling. 3 credits, 3 contact hours (3;0;0).**

This class introduces students to applications and fundamental aspects of computational chemistry and molecular modeling for application and understanding in organic, bio- or physical chemistry. It is an introductory course involving hands-on applications of computational chemistry and molecular modeling. The course provides training application and computer programs for students to use in determining fundamental thermochemical parameters, elementary reaction paths, and design of molecular structures to try and optimize and/or improve biochemical / pharmaceutical products or industrial chemical processes. Students will use chemical software packages to perform calculations in order to identify optimum interaction structures for pharmaceutical or industrial chemical systems. The course teaches the student to evaluate relative energy of different structures plus chemical species stability, reactivity and equilibrium ratios in chemical environments. The course is relevant to organic, inorganic, physical bio- and pharmaceutical chemistry. It is also relevant to optimization of chemical engineering processes.

**CHEM 473. Biochemistry. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: CHEM 244 or CHEM 245 with a grade of C or better. Covers the fundamentals of biochemistry including buffers, blood, proteins, enzymes, carbohydrates, fats, and nucleic acids. Emphasis on the relationship of biochemistry to biotechnology and medicine.

**CHEM 474. Biochemistry II. 3 credits, 3 contact hours (3;0;0).**

Biochemistry II will focus on transducing and storing energy, synthesizing the molecules of life, and responding to environmental changes. Topics include basic concepts of metabolism, glycolysis and gluconeogenesis, citric acid cycle, oxidative phosphorylation, photosynthesis, fatty acid metabolism, protein turnover and amino acid catabolism, biosynthesis of amino acids, DNA replication and recombination, RNA synthesis and processing, protein synthesis, control of gene expression, the immune system, and drug development.

**CHEM 475. Biochemistry Lab I. 2 credits, 4 contact hours (0;4;0).**

Prerequisites: CHEM 244 or CHEM 473 with a grade of C or better. This course will offer the chemistry and related (chemical engineering, biology, bioinformatics, bioengineering) students fundamental laboratory approaches for biochemistry and biotechnology. These experiments will reinforce concepts learned in biochemistry lecture classes.

**CHEM 480. Instrumental Analysis. 2 credits, 4 contact hours (0;4;0).**

Prerequisite: CHEM 221, CHEM 222 or equivalent with a grade of C or better. Laboratory exploring the principles of operation of modern instruments for chemical analysis. Ultra-violet and infrared spectroscopy, mass spectrometry, gas chromatography, high performance liquid chromatography, voltammetry, and potentiometry are among the instruments utilized. Apply calibration methods, statistical data treatment, and sample preparation techniques are applied.

**CHEM 490. Special Topics in Chemistry. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: depends upon the nature of the course given. Course is offered in specific areas as interest develops.

**CHEM 491. Research and Independent Study I. 3 credits, 3 contact hours (0;0;3).**

Prerequisite: senior standing in chemistry or chemical engineering. Provides an opportunity to work on a research project under the individual guidance of a member of the department.

**CHEM 492. Research and Independent Study II. 3 credits, 3 contact hours (0;0;3).**

Prerequisite: CHEM 491 with a grade of C or better. A continuation of CHEM 491.

**EVSC 125. Fundamentals of Environmental Sciences. 3 credits, 3 contact hours (3;0;0).**

An introductory course that will present freshman EVSC students with general concepts and topics on Environment, including chemistry, ecosystems, geological and soil resources, water quality, agricultural and Environment, atmosphere, noise and ionizing radiation.

**EVSC 325. Energy and Environment. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: CHEM 125 with a grade C or better and PHYS 111 with grade C or better. An advanced course to instruct EVSC students, topics on energy and environmental issues such as introduction to energy, natural energy conservation, environmental issues of energy production and consumption, regulation and legislation related to energy, public policy development in energy and environment.

**EVSC 335. Environmental Law. 3 credits, 3 contact hours (3;0;0).**

Prerequisite: HUM 102 with a grade of C or better. The prerequisite is a college ability to communicate competently in the English language including the ability to research and prepare essay compositions and to articulate the major points in a presentation format. The introduction to Environmental Law will cover the regulatory system developed over time that has forged a complex system of environmental rules influencing industrial and other private and public actions that impact the environment. The course will review these rules from the vantage point of the practicing technical environmental engineer and scientist. Students will become familiar with the background and derivation of these laws as well as the major operational features such as environmental permits and enforcement. Several major environmental cases will be analyzed that give definition to the key features of these laws. Each class module will direct itself to the practical application of these laws.

**EVSC 375. Environmental Biology. 3 credits, 3 contact hours (3;0;0).**

An introductory ecological approach to understanding man's impact and dependence on the natural environment. Broad topics include ecosystems, nutrient cycles, pollution, pest management, conservation of natural resources, energy, and human population.

**EVSC 381. Geomorphology. 3 credits, 3 contact hours (3;0;0).**

This is a course in geomorphology, the study of landforms and the contemporary processes that create and modify them. The course will emphasize earth surface processes and quantitative analysis of landform change. Lectures will stress geomorphic principles and two field-based problems will enable students to apply these principles to contemporary geomorphic problems in engineering and management with a focus on the natural environment.

**EVSC 385. Environmental Microbiology. 3 credits, 3 contact hours (3;0;0).**

Prerequisites: R120 101 and R120 102 with minimum grade of C. The main goals of this course are to present an overview of the important microbes involved in environmental microbiology, to discuss the environments where they are found, to learn how they are detected and monitored, and to describe their effects on humans. Traditional lectures and exams will be supplemented with discussions of experimental design and data interpretation by reading current research articles.

**EVSC 391. Research and Independent Study. 3 credits, 3 contact hours (0;0;3).**

Provides an opportunity to work on a research project under the individual guidance of a member of the department.

**EVSC 416. Environmental Toxicology. 3 credits, 3 contact hours (3;0;0).**

The course is intended to explore the general principles of toxicology and apply them to the assessment of acute, subacute and chronic effects of hazardous and toxic chemicals. Qualitative and quantitative measures of toxicity and testing protocols are addressed. The role of toxicology in risk assessment and risk management is discussed.

**EVSC 484. Environmental Analysis. 3 credits, 4 contact hours (2;2;0).**

The analysis of environmental samples is studied from the acquisition of representative samples, through sample handling, chain of custody, sample storage, analytical method selection, analysis, and data treatment.

## Rutgers-Newark Courses