

Chemistry and Environmental Science

Chemistry

Master of Science in Chemistry

An undergraduate degree in chemistry or chemical engineering is usually required. Students with baccalaureate degrees in other areas of science and engineering may be considered for admission and required to take an individually designed program that includes undergraduate courses before beginning the graduate program. These courses are not counted toward degree credit.

A minimum undergraduate GPA of 3.0 on a 4.0 scale, or equivalent, is typically required for admission. General GRE scores must be submitted by those seeking financial support and those whose last prior degree was from outside the United States. Subject GRE is not required. International students must achieve a minimum TOEFL score of 550 (paper and pencil) and 213 (computer based).

Off-Campus Programs: At the National Starch and Chemical Corporation, NJIT offers sufficient courses to fulfill all degree requirements. NJIT faculty teach all courses. For locations, see **Extension Programs** in this catalog. In addition, a distance-based, 12-credit graduate certificate in Applied Chemistry is available as a step toward this degree for employees of the corporation. For further information about extension programs and **Graduate Certificates**, call the Associate Vice President for Continuing and Distance Education, Division of Continuing Professional Education, 1 (800) 624-9850 or (973) 596-3060; e-mail: cpe@njit.edu.

Doctor of Philosophy in Chemistry

Doctoral candidates are expected to demonstrate creative thinking, self-motivation and a commitment to achieving quality in their research product. Departmental research includes a well-balanced mixture of experimental, computational, and theoretical projects in the areas of analytical, bio-, organic, inorganic, and physical chemistry. Chemistry doctoral students address real problems, have strong interactions with their advisors and are expected to solve pertinent chemical and environmental problems.

Qualified students may be accepted directly into the program with a bachelor's degree or after they have completed a master's degree in chemistry. A GPA in previous work of 3.5 or better is expected, and international students must submit a TOEFL score of at least 550 (214 on the computer based test). General GRE scores are also required for admission. GRE subject scores are not required. Although the program is intended for full-time students, courses may be taken on a part-time basis initially. A minimum of one year in full-time residency required for completion of the dissertation. Teaching assistantships (TAs) and Research Assistantships (RAs) are available on a competitive basis. In addition to tuition remission, assistantships include stipends for Ph.D. students.

Environmental Science

The environmental science graduate programs are offered through several departments at New Jersey Institute of Technology and at Rutgers Newark, collaborating in an interdisciplinary program of research and teaching. These are the departments of Chemistry and Environmental Science, Environmental Engineering and Environmental Policy at NJIT, the Federated Department of Biological Sciences, and the Rutgers-Newark Department of Earth & Environmental Sciences. The strong research program is supported by major grants from federal and state agencies, and industry. Environmental science plays a major role in several NJIT research centers, including the Otto York center for Environmental Engineering and Science.

Master of Science in Environmental Science

This is an interdisciplinary program intended for individuals with backgrounds in science or engineering who want advanced education in the identification, management, treatment and effects of hazardous and toxic materials in the environment. It may be taken on a part-time or full-time basis.

Admission Requirements

Applicants should have undergraduate degrees in chemistry, biology, chemical engineering, environmental engineering, environmental science, or related fields who have taken a minimum of one year of college chemistry and mathematics through calculus. Students who lack an appropriate background may be considered for admission and required to take a program of courses that is designed in consultation with the graduate advisor. These may include undergraduate courses which are not counted toward degree credit.

A minimum undergraduate GPA of 3.0 on a 4.0 scale, or equivalent, is typically required for admission. Those applying for financial support and those whose last prior degree was from outside the United States must submit GRE scores. International students must achieve a minimum TOEFL score of 550 (pencil and paper) and 213 (computer-based).

Doctor of Philosophy in Environmental Science

This is a research-oriented degree intended for full-time students. Although courses may be taken on a part-time basis, a minimum of one year of full-time residency is typically required for completion of the doctoral dissertation.

Admission Requirements for Students Entering with a Master's Degree

A master's degree in chemistry, biology, chemical engineering, environmental engineering, environmental science, or related fields is usually required. Highly qualified students with bachelor's degrees in these fields may also be accepted directly into the doctoral program.

A minimum master's GPA of 3.5 on a 4.0 scale, or equivalent, is typically required for admission. GRE scores must be submitted. International students must achieve a minimum TOEFL score of 550.

Admission Requirements for Students Entering with a Bachelor's Degree

Exceptional students with appropriate undergraduate degrees may apply directly for admission to the doctoral program. Applicants are evaluated on a case-by-case basis. A minimum undergraduate GPA of 3.5 on a 4.0 scale, or equivalent, is typically required for admission. GRE scores must be submitted. International students must achieve a minimum TOEFL score of 550.

Environmental and Sustainability Policy

The Graduate Program in Environmental and Sustainability Policy focuses on the role of the social sciences in the development, implementation, and evaluation of environmental policy. Building on the strengths of a technological university, students take a series of foundation courses (Tier One) in environmental social science, environmental science, research methods, and economics. Advanced courses (Tier Two) build on this initial framework and provide extensions in specific applications in environmental law, energy policy, and a selection of advanced topics.

The faculty is multidisciplinary with strengths in environmental social science, economics, geography, and law. Graduates of the program have secured employment in both the public and private sectors including with the United States Environmental Protection Agency, the New Jersey Department of Environmental Protection, regional planning commissions, local community development programs, and engineering and planning firms. Graduates have also entered doctoral-level programs in environmental science, policy, and law.

The Ph.D. in Environmental Science (Policy Concentration) is offered by the Department of Chemistry and Environmental Science of which the Graduate Program in Environmental Policy is a constituent part. Successful environmental policies must rest on the development of reliable models for assessing change to the biophysical environment in the presence of human action. The Department offers a research-oriented doctoral degree in Environmental Science with a concentration in Environmental Policy. The program emphasis is on the integration of environmental and social sciences to develop more effective responses to contemporary problems of resource management. For more information about degree requirements, please visit the website of the Department of Chemistry and Environmental Science.

Master of Science in Environmental and Sustainability Policy

The Master of Science in Environmental and Sustainability Policy is designed to provide students with the opportunity to acquire skills in the methods and tools used in environmental problem solving and policy analysis. The Program may be completed on a part-time or full-time basis. Courses are offered both online and on a face-to-face basis.

Admission Requirements

The following criteria are applied when considering an applicant for admission to the program:

- An undergraduate degree in earth sciences (e.g. physical geography, geology, meteorology, ecology), social sciences (e.g. human geography, economics, sociology), engineering (e.g. environmental, civil, chemical) or another related discipline.
- An undergraduate GPA of at least 3.0 and at least 3.5 in major field (on a scale of 4.0).
- A minimum of one semester of statistics at the undergraduate level; an advanced statistics course at the undergraduate level is highly desirable.
- A combined GRE score (verbal and quantitative) of at least 1100

The following materials must be submitted to be considered for admission:

- Application for Admission to Graduate Study form
- MS-EPS Supplemental Materials form
- Official transcripts of all prior work and certificate of graduation
- Personal statement (two to three pages)
- Three letters of recommendation
- Graduate Record Examination (GRE) scores
- International students are required to pass the TOEFL at 550 (pencil and paper), 213 (computer based) or above.

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

Cummings, Linda J., Interim Chair

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

- Chemistry - M.S. (<http://catalog.njit.edu/graduate/science-liberal-arts/chemistry-environmental-science/chemistry-ms>)
- Environmental Science - M.S. (<http://catalog.njit.edu/graduate/science-liberal-arts/chemistry-environmental-science/environmental-science-ms>)
- Environmental and Sustainability Policy - M.S. (<http://catalog.njit.edu/graduate/science-liberal-arts/chemistry-environmental-science/environmental-sustainability-policy-ms>)
- Pharmaceutical Chemistry - M.S. (<http://catalog.njit.edu/graduate/science-liberal-arts/chemistry-environmental-science/pharmaceutical-chemistry-ms>)

Programs

- Chemistry - Ph.D. (<http://catalog.njit.edu/graduate/science-liberal-arts/chemistry-environmental-science/chemistry-phd>)
- Environmental Science - Ph.D. (<http://catalog.njit.edu/graduate/science-liberal-arts/chemistry-environmental-science/environmental-science-phd>)

Chemistry and Environmental Science Courses

CHEM 590. Graduate Co-Op Work Exper I. 3 credits, 3 contact hours.

CHEM 591. Graduate Co-Op Ork Exper II. 3 credits, 3 contact hours.

CHEM 592. Graduate Co-Op Work Exper III. 3 credits, 3 contact hours.

CHEM 593. Graduate Co-op Work Experience IV. 0 credits, 0 contact hours.

Restriction: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work.

CHEM 599. Methods for Teaching Assistants and Graduate Assistants. 3 credits, 3 contact hours.

Restriction: graduate standing. Required for all chemistry teaching assistants and graduate assistants. Covers techniques of teaching, interaction with students, and safety. Does not count as degree credit.

CHEM 601. Special Topics in Chemistry I. 3 credits, 3 contact hours.

Restriction: graduate standing and permission of the instructor. Topics of current interest in chemistry.

CHEM 605. Advanced Organic Chemistry I: Structure. 3 credits, 3 contact hours.

Prerequisite: undergraduate organic chemistry. Structure of organic molecules. Topics include atomic and molecular structure, stereochemistry, reactive intermediates (cations, anions, radicals, and carbenes), orbital symmetry, and spectroscopy.

CHEM 606. Physical Organic Chemistry. 3 credits, 3 contact hours.

Prerequisite: CHEM 502 or equivalent. Emphasis is placed on the physical aspects of the subject. Determination of reaction mechanisms, equilibria, and kinetics using simple molecular orbital theory and absolute reaction rate theory.

CHEM 610. Advanced Inorganic Chemistry. 3 credits, 3 contact hours.

Prerequisite: undergraduate physical chemistry or permission of the instructor. Theories of observed chemical and physical properties of the elements and their compounds; prediction of reactivity and properties of proposed new compounds.

CHEM 617. Mass Spectrometry and Interpretation of Mass Spectra. 3 credits, 3 contact hours.

Prerequisite: CHEM 125 and CHEM 126 or equivalent. Historical background, fundamentals and mechanics of operation for components incorporated into modern Mass Spectrometers: vacuum system, ion sources, mass filter, ion detection, plus computer operation and data collection. Explanation and interpretation of mass spectra and fragmentation patterns are a fundamental theme throughout the course. Lecture material includes principles of operation and appropriate applications for modern types of mass spectrometers: magnetic sector, quadrupole, time of flight, ion trap, FT-ICR. Theory and applications of electron impact, chemical, electrospray, and other ionization techniques including atmospheric sampling are covered. High resolution analysis using magnetic sector and FT - ion cyclotron instruments. Analytical applications in environmental, petroleum and biochemical analysis and applications and coupling of mass spectrometry with other instruments (GC, LC, AES,) are illustrated.

CHEM 658. Advanced Physical Chemistry. 3 credits, 3 contact hours.

Prerequisite: one year of undergraduate physical chemistry. Principles and applications of quantum chemistry; the wave equation, its properties and mathematics; the Schrodinger equation and wave functions; the harmonic oscillator; variational and perturbational methods; atomic theory, structure, and properties; simple molecules, LCAO and valence bond theories; semi-empirical methods; time dependence, and introduction to electronic and vibration-rotation spectroscopy.

CHEM 661. Instrumental Analysis Laboratory. 3 credits, 3 contact hours.

Prerequisite: one year of undergraduate physical chemistry. Instruments for chemical analysis are discussed in class and used in the laboratory; basic theory; sample preparation; use of instruments and interpretation of data are covered for spectroscopy including UV/VIS, FTIR, AA, and NMR; HPLC, GC, ion chromatography, mass spectrometry. Applications to food science, pharmaceuticals, polymers, and other chemical areas.

CHEM 662. Air Pollution Analysis. 3 credits, 4 contact hours.

Prerequisite: undergraduate physical chemistry. Chemical and physical principles of gaseous species and trace level measurement techniques for airborne vapors and particulates. Emphasis on analyzing real air samples at the parts-per-billion level, meteorological dispersion and life times of pollutants are covered. Laboratory work in air pollution sampling methods for vapor and particulate species. Determination of primary air pollutants using wet chemical and instrumental techniques.

CHEM 664. Advanced Analytical Chemistry. 3 credits, 3 contact hours.

Prerequisite: undergraduate physical chemistry. The principles of chemical analysis as they apply to chromatography, electrochemistry, and spectroscopy. Sampling considerations, separations, and sample preparation steps. This course is a useful adjunct to CHEM 661, where these analytical techniques are considered in a more practical way.

CHEM 673. Biochemistry. 3 credits, 3 contact hours.

Prerequisite: undergraduate organic and physical chemistry, or suitable background in these subjects. Fundamentals of biochemistry related to physical organic chemistry for students who have an interest in biomedical engineering, chemistry, chemical engineering, or environmental science.

CHEM 700. Masters Project. 0 credits, 0 contact hours.

Prerequisite: matriculation for the master's degree. An extensive report involving an experimental, theoretical, or literature investigation is required. The literature investigation should result in a critical review of a specific area. Approval to register for the master's project must be obtained from the project advisor. Students must continue to register for at least 3 credits each semester until the project is completed and a written report is accepted. Only a total of 3 credits will count toward the degree.

CHEM 700B. Masters Project. 3 credits, 3 contact hours.

Restriction: matriculation for the master's degree. An extensive report involving an experimental, theoretical, or literature investigation is required. The literature investigation should result in a critical review of a specific area. Approval to register for the master's project must be obtained from the project advisor. Students must continue to register for at least 3 credits each semester until the project is completed and a written report is accepted. Only a total of 3 credits will count toward the degree.

CHEM 701. Master's Thesis. 0 credits, 0 contact hours.

Prerequisite: matriculation for the master's degree in applied chemistry. Approval of thesis advisor is necessary for registration. Original research under the guidance of a departmental advisor. The final product must be a written thesis approved by at least three faculty members: the primary advisor, another from the department, and one other faculty member. Once registration for thesis has begun, a student must continue to register for a minimum of 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

CHEM 701B. Masters Thesis. 3 credits, 3 contact hours.**CHEM 701C. Masters Thesis. 6 credits, 3 contact hours.****CHEM 702. Special Topics in Chemistry II. 3 credits, 3 contact hours.**

Restriction: Graduate standing. Topics of current interest in chemistry.

CHEM 714. Pharmaceutical Analysis. 3 credits, 3 contact hours.

The objective of this course is to provide an overview of instrumental techniques used in the analysis of different pharmaceutical products. Many different types of analysis are carried out in the pharmaceutical industry pertaining to active ingredients, formulations as well as impurities and degradants. The focus will be on instrumentation such as chromatography, mass spectroscopy, different types of spectroscopy, quality assurance and GMP.

CHEM 716. Integrated Drug Dev & Discover. 3 credits, 3 contact hours.

Prerequisites: Strong background in organic chemistry This course offers an overview of the drug development process combined with hands-on experience in computer-aided drug design. Topics include pharmacokinetics, bioavailability, drug formulation, and structure-based drug design.

CHEM 717. Mass Spectrometry and Mass Spectral Interpretation. 3 credits, 3 contact hours.

Prerequisites: CHEM 125 and CHEM126 or equivalent. CHEM 717 and EVSC 617 are comprised of CHWM 717 and EVSC 617 plus a research project: Research projects usually comprise experimental and mass spectrometry interpretation studies. These can be performed at NJIT or in the students corporate mass spectrometry facility. Projects may also include theory, data interpretation or literature reviews pertinent to a current active area in mass spectrometry research. Projects should be approved or in consult with the instructors.

CHEM 718. Organic Synthesis. 3 credits, 3 contact hours.

Organic Synthesis is widely used in the production of organic materials and pharmaceutical drugs. The course introduces modern synthetic methods to the graduate students of NJIT. The first part of the course teaches organic reactions categorized by their roles in synthesis. Topics include substitution and addition of carbon nucleophiles, functional group conversion, oxidation, reduction, concerted cycloadditions, aromatic substitutions, and organometallic catalysis. The second part of the course teaches general strategies to develop synthetic plans, special considerations for difficult synthetic targets, and examples of natural product synthesis.

CHEM 719. Drug Delivery Systems. 3 credits, 3 contact hours.

Prerequisites: Strong background in organic chemistry This course emphasizes the importance of effective drug delivery to achieve specific therapeutic outcomes. Students learn current trends in research on the design of drug delivery systems to release drug content in a controllable and targeted manner.

CHEM 725. Independent Study I. 3 credits, 3 contact hours.

Prerequisite: permission from the graduate advisor (not thesis advisor) in chemistry, as well as courses prescribed by a supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which isn't of sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

CHEM 726. Independent Study II. 3 credits, 3 contact hours.

Restriction: written permission from the Associate Chairperson for Environmental Science plus courses prescribed by the supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which are not sufficiently broad to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

CHEM 727. Independent Study III. 3 credits, 3 contact hours.

Restriction: written permission from the Associate Chairperson for Environmental Science plus courses prescribed by the supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which are not sufficiently broad to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

CHEM 734. Thermochemical Kinetics-Detailed Mechanistic Modeling. 3 credits, 3 contact hours.

Prerequisite: graduate level course in either kinetics or reactor design, or permission of instructor. Quantitative estimation of thermochemical data and chemical reactions in the vapor phase, and to some extent in the liquid phase; theories of transition state, RRKM, and Quantum RRK; and detailed chemical modeling concepts for reactor design. Applied computer project is required.

CHEM 735. Combustion. 3 credits, 3 contact hours.

Prerequisite: thermodynamics and kinetics or equivalent, or permission of instructor. Thermodynamic properties of stable molecules and free radical species in combustion and oxidation of aliphatic hydrocarbons; reactions occurring in high temperature combustion systems; and related kinetic principles.

CHEM 737. Applications of Computational Chemistry and Molecular Modeling. 3 credits, 3 contact hours.

Students are exposed to hands-on applications and fundamental aspects of computational chemistry and molecular modeling in organic, inorganic, bio- and physical chemistry. The course provides methods to determine the thermochemistry of a reaction, and strength (energy) of interactions by organic drug-like molecules with proteins. The course teaches the student to evaluate relative energy of different structures plus chemical species stability, reactivity and equilibrium ratios in chemical environments.

CHEM 748. Nanomaterials. 3 credits, 3 contact hours.

New feature of the 700 level course will be hands-on small projects carried out by groups of two students in Professor Iqbal's laboratories during the second half of the semester. The projects will be selected from the topics covered in the course. A second feature will involve a lecture on a specialized nanomaterial topic given by an invited outside lecturer. This 3 credit interdisciplinary course is designed to teach and provide hands-on project experience to M.S. and Ph.D. graduate students in chemistry, physics/materials science, and chemical/biomedical/electrical engineering on the fundamentals, synthesis, characterization and applications of nanomaterials. 75% of the course will comprise of lectures-one or two of which will be given by invited outside lecturers. 25% of the course will involve small projects based on the syllabus and conducted in the research laboratories of the instructor.

CHEM 764. Advanced Analytical Chemistry. 3 credits, 3 contact hours.

Prerequisite: undergraduate General and Analytical Chemistry. The principles of chemical analysis as they apply to chromatography, electrochemistry, and spectroscopy. Sampling considerations, separations, and sample preparation steps. This course is a useful adjunct to CHEM 661, where these analytical techniques are considered in a more practical way.

CHEM 777. Principles Pharm Chemistry. 3 credits, 3 contact hours.

Teaches about drug design, and the molecular mechanisms by which drugs act in the body. Covers pharmacodynamics, pharmacokinetics, molecular targets used by drugs, the interaction of a drug with a target, and the consequences of this interaction. Covers strategies used in discovering and designing new drugs, and surveys the "tools of the trade" involved, e.g., QSAR, combichem and computer aided design. Covers special topics like chlorinergics, analgesics, opiates, antibacterials, antivirals, and antiulcer agents.

CHEM 790. Doctoral Dissertation. 0 credits, 0 contact hours.

CHEM 790A. Doctoral Dissertation. 1 credit, 1 contact hour.

CHEM 790B. Doctoral Dissertation. 3 credits, 3 contact hours.

CHEM 790C. Doctoral Dissertation. 6 credits, 3 contact hours.

CHEM 790D. Doctoral Dissertation. 9 credits, 3 contact hours.

CHEM 790E. Doctoral Dissertation. 12 credits, 3 contact hours.

CHEM 790F. Doctoral Dissertation. 15 credits, 15 contact hours.

CHEM 790G. Doctoral Dissertation. 18 credits, 18 contact hours.

CHEM 791. Graduate Seminar. 0 credits, 0 contact hours.

Required of all chemistry graduate students receiving departmental or research-based awards and all doctoral students. The student must register each semester until completion of the degree. Outside speakers and department members present their research for general discussion.

CHEM 792. Pre-Doctoral Research. 3 credits, 3 contact hours.

CHEM 792B. Pre-Doctoral Research. 3 credits, 3 contact hours.

CHEM 792C. Pre-Doctoral Research. 6 credits, 6 contact hours.

EPS 601. Research Methods for Environment and Sustainability Policy. 3 credits, 3 contact hours.

Introduces the research methods necessary to conduct studies in environmental and sustainability policy. Topics covered include literature review, problem identification, hypothesis testing, and quantitative methods of data analysis and problem solving. Students are required to implement and present their independently designed projects.

EPS 602. Research Analysis for the Social and Policy Sciences. 3 credits, 3 contact hours.

Prerequisite: EPS 601. Distribution of social, political, economic and health-related data in both samples and populations using a general linear model with residuals. Test hypotheses using both the Fisher and Neyman-Pearson criteria. Use of software such as SPSS, Microsoft Excel and Resampling Stats. to develop and test models using correlation, regression and ANOV techniques.

EPS 609. Environmental Risk Assessment. 3 credits, 3 contact hours.

Methodology to assess the social and economic risks to present-day environmental resources of air and water; cost-benefit and trade-off analysis; technical characteristics of materials such as half-life, decomposition rates, and temperature sensitivity; and probabilities of various environmental situations.

EPS 612. Introduction to Environmental Policy Studies. 3 credits, 3 contact hours.

Introduction to six areas essential to a comprehensive understanding of environmental policy: concept of environmental policy; tools (law, economics, planning, science, engineering, ethics) for environmental policy; the U.S. perspective (NEPA, clean air and water acts, CERCLA); the international perspective (Club of Rome models, 1972 UNEP, 1992 Rio); industrial perspective (pollution prevention/life cycle engineering, privatization); and the local perspective (New Jersey DEP, NGOs, local industry, shoreline.) Same as MIP 612.

EPS 613. Environmental History and Policy. 3 credits, 3 contact hours.

Explores the dialogue between humanity and the environment in the United States, as well as its global implications. Surveys fundamental themes of history and policy from an environmental perspective: colonial development, independence, western expansion, industrialization, urbanization, and the rise of a consumer society. Gives special attention to the emergence of an environmental perspective: wilderness appreciation, the conservation movement, public health, the rise of the environmental movement since the 1960s, environmental science, and the legislative and regulatory process.

EPS 614. Environmental Economics and Management. 3 credits, 3 contact hours.

Overviews the complex and dynamic interactions between the economy and the environment from biological, economic, and institutional perspectives and investigates various strategies for resolving conflicts in resource management and pollution control. Topics include the basic principles of risk assessment, cost benefit analysis, and cost-effectiveness analysis in environment management and assessment of contemporary environment politics in air and water pollution control and waste and toxics management.

EPS 622. Sustainable Politics and Policy. 3 credits, 3 contact hours.

Identifies the origins of the concept of sustainability development and institutional efforts to implement strategies at various geopolitical scales: international, national, regional, and local. The course introduces tools to measure progress toward sustainability through the use of metrics such as ecological footprint analysis and life-cycle analysis. Other topics include steady-state economics, sustainable systems of production and consumption, and sustainability transitions.

EPS 638. Physical Geography. 3 credits, 3 contact hours.

Understanding the interaction between humans and the physical environment is important to the formulation of sound environmental policy. The course examines processes that shape the physical environment, the influence of human activities on these processes and the physical environment, and the application of this information to solving environmental problems.

EPS 644. The Rhetoric of Environmental Policy. 3 credits, 3 contact hours.

Introduces students to the major types of rhetorical analysis as well as assures that students can analyze and write technology policy that is informed by core rhetorical principles of that analysis.

EPS 651. Introduction to Urban and Environmental Health. 3 credits, 3 contact hours.

Health problems associated with the social and psychological factors found in urban areas and health problems stemming from contamination of air, water, food, the work place and other special environments. Policies required to promote healthful living behavior and those required to regulate negative externalities.

EPS 660. Ethics and Environmental Policy. 3 credits, 3 contact hours.

Contemporary environmental problems from the perspective of ethics or moral philosophy. Is there a moral obligation to preserve or protect the natural environment? What are the ethical presumptions and values underlying environmental policy? Are traditional theories of moral philosophy applicable to contemporary environmental problems, or is a new conception of the relationship between humanity and nature needed?.

EPS 698. ST.: 3 credits, 3 contact hours.

Course considers advanced topics of special or current interest related to environmental and sustainability policy.

EPS 699. ST.: 3 credits, 3 contact hours.

Course considers advanced topics of special or current interest related to environmental and sustainability policy.

EPS 700. Master'S Project. 0 credits, 0 contact hours.**EPS 700B. Master'S Project. 3 credits, 3 contact hours.****EPS 701. Master'S Thesis. 0 credits, 0 contact hours.**

Prerequisite: matriculation for the master's degree, advisor's and departmental approval. Projects involving fieldwork, experimental, or theoretical investigation carried out under the supervision of a designated member of the departmental faculty. The completed thesis should be of a quality as to warrant publication, in whole or in part, in a professional journal. A minimum of 3 credits per semester is required until completion.

EPS 701B. Master'S Thesis. 3 credits, 3 contact hours.

Restriction: approval of graduate advisor; completion of core courses. Demonstrates ability to conceive and execute an extended writing project with professional graphics and to make an oral and visual presentation of the work. The completed written thesis should warrant publication in a technical journal. Thesis Committee consists of program-approved faculty advisor, one other faculty member, and external reviewer. A student must register continuously for a minimum of 3 credits per semester until thesis is completed. Total will be limited to 6 credits.

EPS 701C. Master'S Thesis. 6 credits, 3 contact hours.

Restriction: approval of graduate advisor; completion of core courses. Demonstrates ability to conceive and execute an extended writing project with professional graphics and to make an oral and visual presentation of the work. The completed written thesis should warrant publication in a technical journal. Thesis Committee consists of program-approved faculty advisor, one other faculty member, and external reviewer. A student must register continuously for a minimum of 3 credits per semester until thesis is completed. Total will be limited to 6 credits.

EPS 702. Special Topics. 3 credits, 3 contact hours.

Restriction: Approval of graduate advisor in Environmental Science. Topics of current interest in the field of environmental policy. Doctoral level course.

EPS 712. Advanced Studies in Environmental and Sustainability Policy. 3 credits, 3 contact hours.

Evaluates strategies to reduce energy and material throughput including eco-efficiency, relocation of production and consumption, and green consumerism. Also considered are debates surrounding innovative policies to foster work-time reduction, to develop alternative measures of well-being, and to include societal values shifts.

EPS 714. Environmental and Natural Resources Economics. 3 credits, 3 contact hours.

Examines environmental regulation of firms and natural resource use with emphasis on the theoretical foundations required for public policy. Students focus primarily on the application of economic tools to improve environmental quality.

EPS 725. Independent Study I. 3 credits, 3 contact hours.

Restriction: matriculation for the master's degree, advisor's and departmental approval. Projects not within the scope of existing courses are carried out under the supervision of a designated member of the departmental faculty.

EPS 726. Independent Study II. 3 credits, 3 contact hours.

Restriction: matriculation for the master's degree, advisor's and departmental approval. Projects not within the scope of existing courses are carried out under the supervision of a designated member of the departmental faculty.

EVSC 591. Graduate Work Experience. 3 credits, 3 contact hours.**EVSC 592. Graduate Work Experience. 3 credits, 3 contact hours.**

Restriction: permission of the associate chairperson for environmental science and the Division of Career Development Services. Provides on-the-job reinforcement of environmental science assignments. Projects are developed by the co-op office in consultation with the associate chairperson for environmental science. Cannot be used for degree credit.

EVSC 593. Graduate Co-op Work Experience IV. 0 credits, 0 contact hours.

Prerequisite: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work.

EVSC 600. Environmental Science Seminar. 0 credits, 3 contact hours.

Restriction: graduate standing. Current environmental topics of interest to the environmental professional are presented. Required every semester for environmental science graduate students receiving departmental or research-based awards and for all doctoral students.

EVSC 602. Special Topics in Environmental Science I. 3 credits, 3 contact hours.

Restriction: approval of graduate advisor in environmental science. Topics of current interest in the environmental field.

EVSC 603. Hazardous Waste Operations and Emergency Response. 3 credits, 3 contact hours.

Explores the safe operation of hazardous waste sites as well as emergency responses to hazardous releases. Overview of OSHA regulations and NIOSH standards concerning toxicological hazards and medical surveillance requirements. Emphasis on recognition and monitoring of site hazards. A written health and safety plan, and participation in a group problem involving a simulated hazardous site entry using actual protective equipment is required. Course satisfies the regulatory compliance mandates to meet 29 CFR 1910.120 for OSHA, with certification valid for one year.

EVSC 610. Environmental Chemical Science. 3 credits, 3 contact hours.

Restriction: graduate standing. Principles of physical, inorganic and organic chemistry are applied to understanding the origins of environmental pollutants, their transport, distribution and decomposition pathways.

EVSC 611. Hazardous Waste Management. 3 credits, 3 contact hours.

Restriction: graduate standing. An overview of hazardous waste management; case histories; legislation and regulations; treatment, disposal and cleanup technologies; sampling and analysis methodology; persistence and fate in the environment; emergency response procedures.

EVSC 612. Environmental Analysis. 3 credits, 4 contact hours.

Restriction: graduate standing. 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.

EVSC 613. Environmental Problem Solving. 3 credits, 3 contact hours.

Restriction: graduate standing. This course is designed to study solutions for current environmental problems. Students are asked to respond to an imaginary Request for Proposal (RFP) in writing and before a team of technical experts at an oral presentation. Solutions proposed in student RFPs must reflect knowledge of environmental science and technology in current use.

EVSC 614. Quantitative Environmental Risk Assessment. 3 credits, 3 contact hours.

Restriction: graduate standing. Applications of quantitative risk assessment concepts to the management of environmental problems.

EVSC 615. Global Environmental Problems. 3 credits, 3 contact hours.

Restriction: graduate standing. With an understanding that environmental problems are not restricted by geographical boundaries, relationships of the earth's temperature balance, global air circulation patterns, global energy needs, and control and remediation technologies are studied.

EVSC 616. Toxicology. 3 credits, 3 contact hours.

Restriction: graduate standing. The general principles of toxicology are presented and applied 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 617. Mass Spectrometry and Interpretation of Mass Spectra. 3 credits, 3 contact hours.

Prerequisite: CHEM 125 and CHEM 126 or equivalent. Historical background, fundamentals and mechanics of operation for components incorporated into modern Mass Spectrometers: vacuum system, ion sources, mass filter, ion detection, plus computer operation and data collection. Explanation and interpretation of mass spectra and fragmentation patterns are a fundamental theme throughout the course. Lecture material includes principles of operation and appropriate applications for modern types of mass spectrometers: magnetic sector, quadrupole, time of flight, ion trap, FT-ICR. Theory and applications of electron impact, chemical, electrospray, and other ionization techniques including atmospheric sampling are covered. High resolution analysis using magnetic sector and FT - ion cyclotron instruments. Analytical applications in environmental, petroleum and biochemical analysis and applications and coupling of mass spectrometry with other instruments (GC, LC, AES,) are illustrated.

EVSC 621. Ecological Risk Assessment. 3 credits, 3 contact hours.**EVSC 622. Bioremediation. 3 credits, 3 contact hours.****EVSC 623. Environmental Health. 3 credits, 3 contact hours.****EVSC 624. Environmental Analysis Methods and Laboratory. 3 credits, 4 contact hours.**

Basic theory, methods, instruments, and data interpretation for chemical analysis of environmental samples are described in lectures and used in the laboratory; sampling; sample preparation; quality assurance, chain of custody. Instrument methods and uses include: UV-VIS, FTIR, AA, HPLC, GC, Ion Chromatography, and Mass Spectrometry as applied to environmental samples.

EVSC 625. Social Dimensions of Risk. 3 credits, 3 contact hours.

Low-probability/high consequence events involving terrorism, food safety, and extreme weather offer ample evidence the prevalent approaches of economics and statistics are not able to deal with the complex ways that risk permeates modern societies. This course treats risk analysis as a broad interdisciplinary activity and draws on the full range of the social sciences to explore the multifaceted way that risk infuses itself into the fabric of contemporary affairs.

EVSC 626. Hydrogeology. 3 credits, 3 contact hours.

This course covers the principles of ground water flow, advanced water cycle properties, aquifer flow and aquifer recharge. Contaminant migration and remediation methods are discussed. Basic groundwater chemistry and quality is covered.

EVSC 627. Environmental Microbiology. 3 credits, 3 contact hours.

Prerequisite: R120 101, R120 102, (General Biology I and II) or permission of instructor. This course offers an overview of 1) basic microbiology: biochemical principles, cell structure organization, microbial nutrition and growth, 2) the important microbes involved in environmental microbiology and address the environments where they are found, and 3) how they are detected and monitored, and their effects on humans, and the environment. Traditional lectures and exams are supplemented with discussions of current research articles.

EVSC 700. Masters Project. 0 credits, 0 contact hours.

Prerequisite: graduate standing and approval of the graduate advisor in environmental science. Written report requiring experimental or theoretical research, or an extensive literature analysis. Registration must be approved by an advisor. Students must continue to register for 3 credits each semester until completion and a written report is accepted. Only a total of 3 credits will count toward the degree.

EVSC 700B. Masters Project. 3 credits, 3 contact hours.

Restriction: graduate standing and approval of the graduate advisor in environmental science. Written report requiring experimental or theoretical research, or an extensive literature analysis. Registration must be approved by an advisor. Students must continue to register for 3 credits each semester until completion and a written report is accepted. Only a total of 3 credits will count toward the degree.

EVSC 701. Masters Thesis. 0 credits, 0 contact hours.

Prerequisite: matriculation for a master's degree in environmental science. Approval to register for the thesis must be obtained from the advisor. Original research under the supervision of a designated faculty member. The final product must be a written thesis approved by three faculty members: the student's primary advisor, another from the program and one other faculty member. Once registration for thesis has begun, a student must continue to register for a minimum 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

EVSC 701B. Masters Thesis. 3 credits, 3 contact hours.

Restriction: matriculation for a master's degree in environmental science. Approval to register for the thesis must be obtained from the advisor. Original research under the supervision of a designated faculty member. The final product must be a written thesis approved by three faculty members: the student's primary advisor, another from the program and one other faculty member. Once registration for thesis has begun, a student must continue to register for a minimum 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

EVSC 701C. Masters Thesis. 6 credits, 3 contact hours.

Restriction: matriculation for a master's degree in environmental science. Approval to register for the thesis must be obtained from the advisor. Original research under the supervision of a designated faculty member. The final product must be a written thesis approved by three faculty members: the student's primary advisor, another from the program and one other faculty member. Once registration for thesis has begun, a student must continue to register for a minimum 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

EVSC 702. Special Topics in Environmental Science II. 3 credits, 3 contact hours.

Restriction: approval of graduate advisor in environmental science. Topics of current interest in the environmental field.

EVSC 711. Advanced Environmental Analysis. 3 credits, 3 contact hours.

Prerequisite: EVSC 612 or equivalent. Analysis of complex environmental samples is studied, from the acquisition of representative samples, through sample handling, chain of custody, sample storage, analytical method selection, analysis and data handling. Collection and analysis of samples from air, water, soil, and biological systems will be discussed. Emphasis on the study of current literature.

EVSC 712. Hazardous Substance Management. 3 credits, 3 contact hours.

Restriction: Graduate standing. The course material comprises an overview of hazardous materials and hazardous waste management and control in an industrial setting. The course examines the technical approaches utilized in the control, remediation, and prevention of hazardous substances and waste. It also includes the major technical elements of federal regulations that govern operations involving the handling of hazardous materials.

EVSC 715. Energy and Sustainability. 3 credits, 3 contact hours.

This course comprises an interdisciplinary review of energy fundamentals including the basic principles necessary to understand energy systems. The technological and engineered systems for processing and using different energy non-renewable and renewable sources. The social and environmental consequences of energy production, distribution, and use, including a comparison of socioeconomic models of global energy applications.

EVSC 717. Mass Spectrometry and Mass Spectral Interpretation. 3 credits, 3 contact hours.

Prerequisite: CHEM 125 and CHEM 126 or equivalent. CHEM 717 and EVSC 617 are comprised of CHEM 717 and EVSC 617 plus a research project. Research projects usually comprise experimental and mass spectrometry interpretation studies. These can be performed at NJIT or in the students corporate mass spectrometry facility. Projects may also include theory, data interpretation or literature reviews pertinent to a current active area in mass spectrometry research. Projects should be approved or in consult with the instructors.

EVSC 725. Independent Study I. 3 credits, 3 contact hours.

Restriction: written permission from the Associate Chairperson for Environmental Science plus courses prescribed by the supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which are not sufficiently broad to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

EVSC 726. Independent Study II. 3 credits, 3 contact hours.

See description for EVSC 725.

EVSC 790. Doctoral Dissertation. 0 credits, 0 contact hours.

Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EVSC 790A. Doctoral Dissertation. 1 credit, 1 contact hour.

Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EVSC 790B. Doctoral Dissertation. 3 credits, 3 contact hours.

Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EVSC 790C. Doct Dissertation & Res. 6 credits, 3 contact hours.

Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EVSC 790D. Doct Dissertation & Res. 9 credits, 3 contact hours.

Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EVSC 790E. Doct Dissertation & Res. 12 credits, 3 contact hours.

Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EVSC 790F. Doctoral Dissertation. 15 credits, 15 contact hours.

Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EVSC 791. Graduate Seminar. 0 credits, 1 contact hour.

Required of all environmental science graduate students receiving departmental or research-based awards and all doctoral students. The student must register each semester until completion of the degree. Outside speakers and department members present their research for general discussion.

EVSC 792. Pre-Doctoral Research. 3 credits, 3 contact hours.**EVSC 792B. Pre-Doctoral Research. 3 credits, 3 contact hours.**