School of
Engineering & Computing Sciences

Heskia Heskiaoff, Eng.Sc.D., *Dean*

Master of Science in Computer Science

Master of Science in Information, Network and Computer Security

Master of Science in Electrical and Computer Engineering

Ayat Jafari, Ph.D., *Chairperson*

Yoshi Saito, Ph.D., *Chairperson*

Master of Science in Energy Management

Robert N. Amundsen, Ph.D., *Director*

Master of Science in Environmental Technology

Stanley M. Greenwald, P.E., *Chairperson*

Master of Science in Computer Science with concentration in computer security

The graduate program leading to the Master of Science in Computer Science is designed to serve a wide range of professional interests and within this framework takes a broad-based approach to practical computer applications.

The program is suited for persons holding a baccalaureate degree in computer science, engineering, operations research, mathematics or related fields of interest. Its curriculum is consistent with the recommendations of the Association for Computing Machinery.

Emphasis is on the relationship between computers and their areas of applications and as such is ideal for individuals interested in systems analysis and systems engineering, application software, software engineering, systems programming, data communications, microprocessors or computer graphics.

The curriculum consists of 36 credits; 24 of which are allocated to required core courses in computer science. The remaining twelve credits permit students to specialize in areas appropriate to individual needs. In order to accommodate working professionals, courses are offered during evening hours at the Old Westbury and Manhattan Campuses.

Objectives

Specific objectives of this program provide students with a comprehensive background in:

1. theory and design of high-level languages and applications in design and development of systems software;
2. development of algorithms, data organization and process optimization;
3. theory and design of assemblers, compilers and operating systems;
4. architecture and operation of a variety of computer systems including microprocessors and large-scale computer systems;
5. other topics specific to the student's particular area of specialization such as software engineering, computer graphics and artificial intelligence.

Admission Requirements

The Master of Science in Computer Science is principally designed for graduates of baccalaureate programs in computer science, engineering, operation research, mathematics and related areas. Students who are admitted to the program with insufficient background in mathematics or computer science may be required to take one or more of the following undergraduate prerequisite courses:

CSCI	130	Computer Organization
CSCI	160	Computer Programming I
CSCI	170	Introduction to Computer Architecture
CSCI	210	Computer Programming II

CSCI 260 Data Structures
CSCI 330 Operating Systems
MATH 170 Calculus I
MATH 180 Calculus II
MATH 310 Linear Algebra

Note that these are prerequisite courses for the master's program in computer science and credits earned for these courses will not be counted toward the 36 credits required for the degree. Applicants must have at least a 2.85 GPA for full matriculation status. At the Dean's discretion, scores on the Graduate Record Examination, or other diagnostics tests, may be requested to assist in evaluation of the applicant's credentials. Applicants who do not qualify for full matriculation may be admitted provisionally. Upon completion of twelve (12) graduate credits and satisfaction of prerequisite requirements the student's status may be reviewed for upgrade to full matriculation.

Graduates of foreign universities must:

1. take the Graduate Record Examination;
2. take the Test of English as a Foreign Language (TOEFL) examination if there is reason to question the applicant's fluency in English.

Note: At the dean's discretion, scores on the Graduate Record Examination or other diagnostic tests may be requested to assist in evaluation of a candidate's credentials.

Transfer Credits

Up to six transfer credits from an accredited graduate program may be granted to students in this program for appropriate courses in which a minimum grade of B was earned.

Fellowships and Assistantships

Fellowships and teaching assistantships are available to qualified candidates. These financial aids are usually for a ten-month period and they may include partial remission of tuition and fees.

Curriculum Requirements for the Master of Science in Computer Science (36 credits)

Required Courses

I. Fundamental Courses — 9 credits
CSCI 641 Computer Architecture
CSCI 651 Algorithm Concept
CSCI 870 Project

II. Computation (Select one course from the following:) — 3 credits
CSCI 610 Theoretical Concept of Computer and Computation
CSCI 635 Probability and Stochastic Processes
CSCI 645 Numerical Analysis I

III. System Programming (Select two courses from the following:) — 6 credits
CSCI 621 Programming Languages
CSCI 620 Operating System Security
CSCI 731 Compiler I

IV. Application (Select two courses from the following:)			6 credits
CSCI	665	Software Engineering	
CSCI	670	Computer Graphics	
CSCI	690	Computer Networks	
CSCI	755	Artificial Intelligence I	
CSCI	760	Database Systems	
Electives		Select 12 credits from the CS curriculum.	12 credits*
Total			**36 credits**

Master of Science Program in Information, Network and Computer Security

The department of Computer Science offers an additional Master of Science degree in Information Network and Computer Security. The program, applied in nature, is focused on the study of several important security skills that are in short supply. The program addresses aspects of security from the network layer up to the application layer, providing a comprehensive understanding of security and its implications on the network, web services infrastructure, databases, and software design. The specific areas of study include, but not limited to, best practices in security, network protection, intrusion detection, and hacker exploits.

The degree is ideally suited for students with engineering and computer science background who intend to play a leading role in implementation as well as the management of computer and network security systems.

The program is supported by the Network and Information Security Laboratory funded by the Office of Naval Research.

The objective of the program is to provide the students with depth and breadth in the area of information, network, and computer security. The program will prepare students for work and further graduate studies in computer science and computer security.

Admissions and other requirements for the program are identical to those of Computer Science.

Curriculum

The curriculum is comprised of 36 credits and is divided into four groups. Requirements include three fundamental core groups which are mandatory. In addition, students choose 9 elective credits from the fourth group, in consultation with an advisor, which will be geared to the individual's interests and professional goals.

*Students who choose to concentrate in computer security must take 12 credits of information, network and computer security courses approved by academic advisors.

Curriculum Requirements for the Master of Science in Information, Network, and Computer Security (36 Credits)

Required Courses (27 Credits)

I.	COMPUTER SCIENCE		6 credits
CSCI	620	Operating System Security	
CSCI	651	Algorithm Concepts	
II.	MANAGEMENT		6 credits
MGMT	706	Cyber Law, Policy and Ethics	
MGMT	755	Security Risk Analysis	
III.	COMPUTER SECURITY		15 credits
INCS	615	Network Security and Perimeter Protection	
INCS	735	Secure Software Engineering	
INCS	741	Cryptography	
INCS	745	Intrusion Detection and Hacker Exploits	
INCS	870	Project I	
Electives (3 courses from the following list):			9 credits
CSCI	606	Distributed Systems	
CSCI	760	Database Systems	
INCS	712	Computer Forensics	
INCS	775	Data Center Security	
INCS	810	Topics in Computer Security	
INCS	880	Project II	
Total			**36 credits**

COURSE DESCRIPTIONS

CSCI 600 Maintain Matriculation 0 credits
Matriculated students who do not register for coursework in a regular semester (excluding summer) are expected to maintain matriculation by registering for this course.

CSCI 606 Distributed Systems 3 credits
This course introduces the principles and practice underlying the design of distributed systems, both Internet-based and otherwise. Major topics include interprocess communication and remote invocation, distributed naming, distributed file systems, data replication, distributed transaction mechanisms, and distributed shared objects, secure communication, authentication and access control, mobile code, transactions and persistent storage mechanisms. A course project is required to construct working distributed applications using contemporary languages, tools and environments. *Prerequisite*: CSCI 370 or equivalent.

CSCI 610 Theoretical Concepts in Computers 3 credits
and Computation 3 credits
Selected topics in set theory, Boolean Algebra, graph theory, and combinatorics. Formal languages, regular expressions and grammars. Automata and Turing machines. Algorithms and computability.

CSCI 620 Operating System Security 3 credits
In this course students are introduced to advanced concepts in operating systems with emphasis on security. Students will study contemporary operating systems including UNIX and Windows. Topics include the application of policies for security administration, directory services, file system security, audit and logging, cryptographic enabled applications, cryptographic programming interfaces, and operating system integrity verification techniques. Equivalent to ITEC 445. *Prerequisite*: CSCI 370, ITEC 385 or equivalents.

CSCI 621 Programming Languages 3 credits
The general principles of modern programming language design: Imperative (as exemplified by Pascal, C and Ada), functional (Lisp), and logical (Prolog) languages. Data management, abstract data types, packages, and object-oriented languages (Ada, C + +). Control structures. Syntax and formal semantics. While some implementation techniques are mentioned, the primary thrust of the course is concerned with the abstract semantics of programming languages. *Corequisite:* CSCI 651.

CSCI 625 Computer Data Acquisition 3 credits
The characteristics of microcomputers and their effect on programming are discussed. Hardware components, computer architecture and computer function are described. The application of microcomputers in real-time and other systems is covered with emphasis on interfacing, analog-to-digital and digital-to-analog conversion, input-output processing, direct-memory access and interrupt processing. *Prerequisite:* Knowledge of undergraduate computer organization.

CSCI 635 Probability and Stochastic Processes 3 credits
Elements of probability theory. Random variables, distributions, densities, moments, characteristic functions, functions of random variables and limit theorems. Correlation, spectral density, ergodicity and applications in linear systems. Normal, Poisson and Wiener processes, mean square estimation and Markov processes. Applications to electrical engineering-noise analysis. Equivalent to: EENG 635. *Prerequisite:* Knowledge of undergraduate probability theory.

CSCI 641 Computer Architecture I 3 credits
The study of the software/hardware boundary as defined in the Von Neumann Architecture. Review of the technological framework. Effects on machine instructions and formats, addressing techniques, microprogramming, fast arithmetic, and advanced memory and 110 practices. Equivalent to EENG 641. *Prerequisite:* Undergraduate Computer Architecture.

CSCI 645 Numerical Analysis I 3 credits
Real and complex zeros of a function and polynomials, interpolation, roundoff error, optimization techniques, least square techniques, orthogonal functions, Legendre and Chebyshev polynomials, numerical integration and differentiation, numerical solution of differential equations with initial and boundary values. The numerical methods developed will emphasize efficiency, accuracy and suitability to high-speed computing. Selected algorithms may be flowcharted and programmed for solution on a computer.

CSCI 651 Algorithm Concepts 3 credits
Abstract Data Structures and their algorithms for implementation are reviewed. The study and analysis of various topics such as storage and execution time requirements, graph algorithms, minimum spanning trees, shortest paths, maximal matchings, internal sorting, asymptotic analysis of recursive procedures, divide-and conquer, dynamic programming, local search algorithms, external sorting and large-scale storage organization, memory management, and complexity classes. *Prerequisite:* Undergraduate course in data structures.

CSCI 655 Automata Theory 3 credits
Theory of finite automata, identification of states. Turing Machines, neural nets, majority logic. Applications in pattern recognition and game playing. Hardware and software implementations. *Prerequisite:* Knowledge of computer organization.

CSCI 660 Introduction to VLSI Design 3 credits
An introduction to VLSI technology, NMDS devices, NMOS processing, electrical parameters, circuit design with NMOS, ratioed logic, pass transistors, static and dynamic logic, design rules, speed-time-power tradeoffs, effects of scaling, hierarchical design, the silicon foundry, design for testability, introduction to computer-aided design tools, design examples and student design projects. *Prerequisite:* Knowledge of digital electronics.

CSCI 665 Software Engineering 3 credits
Techniques for the development and implementation of high quality digital computer software are presented. Major areas covered in the course include software quality factors and metrics, software development outlines and specification languages, top-down vs. bottom-up design and development, complexity, testing and software reliability. *Prerequisite:* Knowledge of data structures.

CSCI 670 Computer Graphics 3 credits
Introduction to display system parameters; comparison of information retrieval and document retrieval; digitizing as an input process; picture models and data structures; display software; applications, hands-on laboratory experience. *Prerequisite:* Knowledge of data structures.

CSCI 675 Simulation Techniques 3 credits
The use of simulation methods for the analysis and design of various types of systems is discussed. The use of general purpose languages for simulation is covered along with the use of discrete and continuous simulation languages for probabilistic and analog systems. *Prerequisite:* Knowledge of data structures and probability.

CSCI 680 Operations Research 3 credits
Major topics in the area of operations research are discussed. Topics may include network analysis, game theory, decision analysis, Markov models, queuing models, scheduling and transportation problems. *Prerequisite:* Probability and statistics.

CSCI 690 Computer Networks 3 credits
Connection of multiple systems in a networked environment. Topics include physical connection alternatives, error management at the physical level, commercially available protocol support, packet switching, LANs, WANs and Gateways. *Prerequisite:* Knowledge of probability and statistics.

CSCI 701 Topics in Computer Security 3 credits
In this course we will introduce students to the techniques used by hackers to penetrate and compromise computer network based systems. For each hacker exploit, its counter defense methods will be studied. The exercises will enable students to study and carry-out hacking and counter defense methods in laboratory setting. *Prerequisite:* CSCI 690/EENG 755

CSCI 711 Operating Systems I 3 credits
The basic structure as well as the framework for the analysis and design of operating systems is developed. The operating system is viewed as a manager of resources (memory, processors, devices and information). The techniques and issues involved in managing these resources are discussed with examples. *Prerequisite:* Knowledge of probability and statistics and CSCI 651 and an undergraduate course in operating systems.

CSCI 721 Topics in Programming Languages 3 credits
This course covers important current topics in the field of programming languages. It is intended to reflect the current state of the art. The ADA programming language and its application is typical of the material covered. *Prerequisite:* CSCI 621.

CSCI 725 Java Networking 3 credits
In this class, students will study Input/Output, Java multi-threading, Java Graphic user interfaces, and TCP/IP fundamentals. Client-Server methodology, connection-oriented communication and server sockets as well as connectionless communication datagram sockets and packets will be studied. Java database connectivity, Java remote method innovation, and web servers and server-side Java, and Java Beans will be introduced.

CSCI 731 Compiler Theory I 3 credits
Review of general structures of a compiler. Finite state automata, regular expressions and lexical analysis. Review of BNF and context free syntax, recursive descent and operator precedence parsing. General table drive, top-down and bottom-up parsing methods. Syntax directed translation. Type checkings. Run-time environments. Introduction to intermediate code-generation. A compiler project is required. *Prerequisite:* CSCI 651 and an undergraduate course in compilers.

CSCI 741 Computer Architecture II 3 credits
Discussions of the advancements in computer architecture of and beyond the Von Neumann Architecture. This will include pipelined machines. RISC machines, parallel architectures, distributed architectures, and language directed architectures. Equivalent to EENG 741. *Prerequisite:* CSCI 641.

CSCI 745 Theory of Computation 3 credits
Functions which are computable by programs; Turing machines: unsolvable problems; hierarchies: abstract complexity; formal languages; classes of automata and recursive functions. *Prerequisite:* CSCI 610.

CSCI 751 Parallel Algorithms 3 credits
This covers the development and implementation of parallel algorithms. Topics may include surveys of parallel algorithms for searching graphs and finding connected components, minimum spanning trees, and shortest paths in graphs; results in parallel sorting, matrix multiplication, and parallel numerical algorithm. *Prerequisite:* CSCI 651.

CSCI 755 Artificial Intelligence I 3 credits
State-space representation in problem-solving, problem-reduction and searching methods. Application of the predicate calculus in problem-solving, resolution, production systems, LISP. *Prerequisite:* CSCI 651.

CSCI 760 Database Systems 3 credits
Design and implementation of databases. Hierarchal and network concepts; relational databases systems; entity-relationship model: query languages; relational design theory; security and authorization; access methods; concurrency control back-up and recovery. *Prerequisite:* CSCI 651.

CSCI 765 VLSI Systems 3 credits
This course assumes a basic knowledge of VLSI design and concentrates on the architecture, organization, implementation and technology issues of designing VLSI systems. A focus of the course will be significant student projects utilizing hierarchical design techniques, CAD design and simulation tools, and design for testability techniques. *Prerequisite:* CSCI 660.

CSCI 770 Pattern Recognition 3 credits
Theory of linear machines, piecewise linear machines, o-machines, parametric and nonparametric training methods, multicategory error-correction procedure, sequential classifier. *Prerequisite:* CSCI 651.

CSCI 775 Advanced Computer Graphics 3 credits
This course is a continuation of CSCI 670. It covers special topics in computer graphics and emphasis is on student projects. Students will have access to the graphics equipment. *Prerequisite:* CSCI 670.

CSCI 780 Topics in Software Engineering 3 credits
Students will engage in independent research projects in such areas as reliability, quality, matrix and structure design. *Prerequisite:* CSCI 665.

CSCI 790 Advanced Software Engineering 3 credits
The major emphasis in this course is on the structural design of software. Methods and concepts covered include cohesion and coupling; structured and composite design: Jackson methodology; higher order software; data abstraction and design of program families. *Prerequisite:* CSCI 665.

CSCI 811 Operating Systems II 3 credits
Using the framework developed in the previous course (CSCI 711), the course is concerned with the design of an operating system from a description of the data bases and routines needed, to the code for an operational implementation. The interrelationship among the managers of resources is studied, as well as techniques for performance evaluation. Various existing systems are studied. *Prerequisite:* CSCI 711.

CSCI 820 Topics in Database Systems 3 credits
Advanced topics in database systems. Topics may include: semantic modeling; object-oriented, knowledge-based, and deductive databases; distributed database systems. *Prerequisite:* CSCI 760.

CSCI 831 Compiler Theory II 3 credits
Review of parsing techniques. Use of the Lex and Vacc compiler writing tool. LR, SLR, LALR parsers. Error detection and recovery. Global data flow analysis and optimization. Code generation with formal methods. A compiler project using Lex and Vacc is required. *Prerequisite:* CSCI 731.

CSCI 840 Software Design for Real-Time Systems 3 credits
Methods for the design of software for real-time applications are covered in this course. Topics include execution time and memory requirements, interfacing high-level language features for real-time applications, interfacing assembly language routines and the use of coprocessors. *Prerequisite:* CSCI 665 and CSCI 711.

CSCI 845 Seminar in Computer Graphics 3 credits
Selected topics such as color, interactive techniques, animation techniques and image processing will be covered. *Prerequisite:* CSCI 775.

CSCI 850 Seminar in Artificial Intelligence 3 credits
Special topics in speech recognition, syntax recognition, picture processing and graph theory to the solution of problems by a machine. *Prerequisite:* CSCI 755.

CSCI 855 Artificial Intelligence II 3 credits
Concepts of integrated artificial intelligence, cooperating expert systems, distributed artificial intelligence, time critical artificial intelligence and the construction and analysis of domain dependent specific shells will be discussed. Advanced knowledge engineering methodologies, as well as justification and explanation facilities, learning and verification and validation of the resultant overall expert system will also be covered. *Prerequisite:* CSCI 755.

CSCI 860 Special Topics 3 credits
This course provides an opportunity for students to study, in a variety of formats, advanced topics which may not be included elsewhere in the curriculum. The topics may be of mutual interest to the student and faculty member or appropriate for group study. *Prerequisite:* Permission of chairman.

CSCI 870 Project I 3 credits
Independent research project. *Prerequisite:* Approval of chairman.

CSCI 880 Project II 3 credits
Independent research project. *Prerequisite:* Approval of chairman.

CSCI 890 Master's Thesis 3 credits
Independent research project. May be required as continuation of CSCI 880 in order to complete a master's thesis. Students enrolled in this course will earn 3 credits beyond the 36 required credits for the degree. This course cannot be used to satisfy the 36 required credits. *Prerequisite:* CSCI 880 and approval of the thesis advisors.

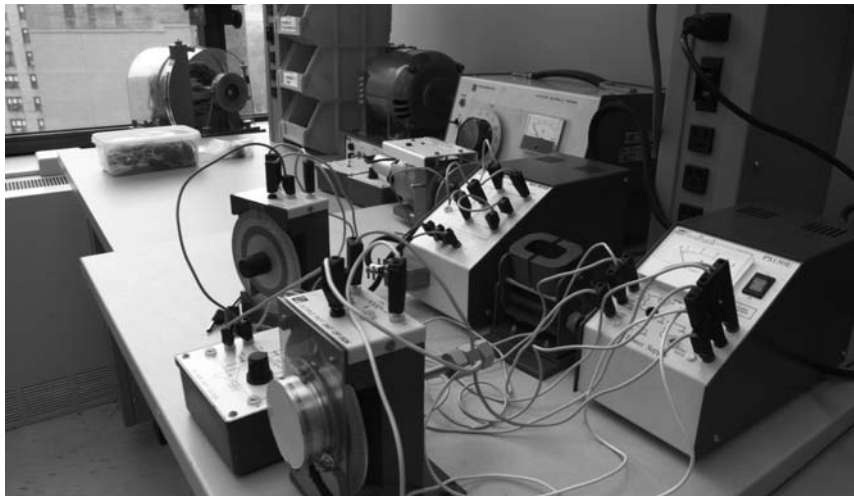
ETCS 670 Externship for the Technical Profession 3 credits
This course provides students with an opportunity to work in a professional environment in areas appropriate to their field of study. To be eligible, students must have completed 24 credits and have a GPA of 3.25 or better, and the permission of his/her chairperson. The grade is on a Pass/Fail basis and is to be determined by the faculty advisor in consultation with the student's supervisor. A term paper, with presentation, is required. This course will be in addition to the required courses for the degree. This course may be repeated.

INCS 615 Network Security and Perimeter Protection 3 credits
This course will cover infrastructure security issues. Network operating systems and network architectures will be discussed together with the respective security related issues. The students will learn about the threats to computer networks through exploitation of weaknesses in the design of network infrastructure and security flaws in the network infrastructure protocols. Issues related to the security of content and applications such as email, DNS, web servers will be discussed. Security techniques including intrusion detection, forensics, cryptography, authentication and access control are analyzed. Developments in IPSEC, transport protocols, secure mail, directory services, and multimedia services are discussed. Equivalent to ITEC 440. *Prerequisites*: CSCI 370, *Corequisite*: CSCI 385 or equivalent.

INCS 712 Computer Forensics 3 credits
Computer forensics is concerned with the post-analysis of computer systems that have already been compromised. Forensic tools and techniques combine information accumulated from various systems to reconstruct the behaviors and actions of cyber criminals. Computer forensics focuses on the reconstruction of events that have lead to the system corruption, with the goals of recovering critical data, aiding authorities in tracking those who may have caused the security breach, and learning techniques used by hackers to improve the protection of systems and prevent similar breaches in the future. *Prerequisite*: INCS 615, CSCI 620.

INCS 735 Secure Software Engineering 3 credits
Developing software that is secure and robust requires the implementation of established methodologies in software engineering with a particular orientation towards security. This course introduces advanced topics in the methodology of secure software design, development and testing. Topics in enterprise as well as web based secure software development are discussed. Secure programming for operating systems, databases, web servers, services and their frameworks are a few of the topics addressed. *Prerequisite*: CSCI 620, CSCI 651.

INCS 741 Cryptography 3 credits
In this course we introduce the students to key issues in cryptography. Topics covered include definitions of security, digital signatures, cryptographic hash functions, authentication, symmetric and asymmetric encryption, stream ciphers, and zero-knowledge proof systems. *Prerequisite*: Knowledge of undergraduate Intro to computer and networking security or equivalent, and discrete math.



INCS 745 Intrusion Detection and Hacker Exploits 3 credits
Methods used in computer and network hacking are studied with the intention of learning how better to protect systems from such intrusions. Methods used by hackers and include reconnaissance techniques, system scanning, and gaining system access by network and application level attacks, and denial-of-service attacks. The course will extensively study Internet related protocols, methods of traffic analysis, tools and techniques for implementing traffic filtering and monitoring, and intrusion techniques. Combining various hacker techniques to provide common methods and procedures used in a compromising system are studied. Students will utilize the Center for Network and Information security laboratory to implement a security related project. *Prerequisite*: INCS 615, CSCI 620.

INCS 775 Data Center Security 3 credits
Data Center Security is concerned with the study of computer architectures and systems that provide critical computing infrastructure. This infrastructure combines hardware devices including computers, firewalls, routers, switches, and software applications such as email systems, web servers, computer desktop operating systems, to implement and manage organization-wide secure computing capability. Examples of critical systems include intranet, extranet and Internet systems. *Prerequisite*: INCS 745.

INCS 810 Topics in Computer Security 3 credits
This course provides an opportunity for students to study advanced topics in computer security, which may not be included elsewhere in the curriculum. Students will undertake a significant hands-on security related project using NYIT's Center for Network and Information security laboratory facilities. *Prerequisite*: Departmental Approval.

INCS 870 Project I 3 credits
Students will undertake an independent research project in an area of information, network and computer security. *Prerequisite*: Departmental approval.

INCS 880 Project II 3 credits
Students will undertake an independent research project in an area of information, network and computer security. *Prerequisite*: Departmental approval.

Master of Science in Electrical and Computer Engineering

The graduate program leading to Master of Science in Electrical and Computer Engineering is intended to provide advanced knowledge and skills for the working electrical and computer engineer or student who wishes to pursue further graduate study. The curriculum emphasizes applied and design oriented engineering skills coupled to the underlying theoretical concepts.

Objectives

This program provides both the seasoned engineer and the recent graduate with advanced engineering education and state-of-the-art specialization.

Curriculum

The curriculum is comprised of 36 credits and is divided into three groups. First, four courses are required for all master's students. Second, two courses are selected from a group of five. The remaining courses establish an option, in consultation with an advisor, where the student develops competency in a specialty. An optional six credit project allows for study in a student's specialized area of interest.

I. Required Courses **12 credits**

EENG	635	Probability and Stochastic Processes
EENG	641	Computer Architecture I
EENG	665	Linear Systems
EENG	770	Digital Communications

II. Select 6 Credits from the Following List **6 credits**

EENG	633	Parallel Computing Systems
EENG	741	Computer Architecture II
EENG	755	Computer Networks
CSCI	660	Intro to VLSI Design
CSCI	765	VLSI Systems

III. Electrical/Computer Electives* **18 credits**

*Maximum of 9 credits may be selected from the graduate Computer Science program with department approval, in addition to CSCI 660 and CSCI 765.

Admission Requirements

Admission is based on the ability of applicants to satisfy the faculty of the Department of Electrical and Computer Engineering of the School of Engineering and Computing Sciences, that they have the motivation and academic capacity to perform successfully at the graduate level. Initial judgment will normally be made on the basis of the applicant's undergraduate quality point average. However, the faculty may also call for the Quantitative Graduate Record Examination or other supporting materials, if deemed advisable. Further, the prospective graduate student must have earned:

1. Bachelor of Science in Electrical or Computer Engineering from an ABET-accredited program; or
2. Bachelor of Science in a closely related field with appropriate undergraduate courses including calculus through differential equations and linear algebra, physics and the usual electrical engineering core courses:

Graduate students admitted with a status of accepted with conditions must maintain a minimum "B" average in their first four graduate courses in order to be upgraded to a status of accepted without conditions.

Students applying for admission must complete a formal application and arrange to have official transcripts sent to Graduate Admissions.

Prerequisites
Students with insufficient background will be required to take prerequisite undergraduate courses. These prerequisite courses will not be counted toward the 36 credits required for the degree.

Transfer Credit
Up to six (6) transfer credits may be accepted from appropriate programs in which a minimum grade of B was earned.

International Students
Graduates of foreign universities must take the Quantitative GRE Examination and, when appropriate, the Test of English as a Foreign Language examination. Additional information for foreign students is provided in this catalog.

COURSE DESCRIPTIONS

EENG 610 Advanced Engineering Mathematics 3 credits
Linear vector space and matrix theory, linear and nonlinear differential and difference equations, complex variables, vector field theory, optimization theory. Applications of each topic to practical areas of electrical engineering are stressed and use of computers is emphasized.

EENG 620 Electronics 3 credits
Small and large signal models for bipolar and field effect transistors. Current applications of solid-state devices along with use of computer packages such as SPICE. High frequency models. Frequency and pulse response with analog and digital circuits.

EENG 625 Quantum Computing and Engineering 3 credits
The course is an introduction to the emerging field of quantum computing and engineering. Topics covered in this course include, but are not limited to, quantum measurement theory, quantum teleportation, quantum circuits, quantum computers, quantum noise and quantum cryptography.

EENG 633 Parallel Computing Systems 3 credits
The course introduces students to parallel computer systems. The course covers topics such as sequential and parallel execution, synchronization, pipelines and vector processing. SIMD and MIMD machines are studied. Multi-stage and computer interconnection networks are presented. The routing and the flow control in these networks are discussed. Shared

memory, multicomputer systems, caches and cache coherence are covered. Data flow systems are introduced and analyzed. *Prerequisite:* Knowledge of undergraduate microprocessors.

EENG 635 Probability and Stochastic Processes 3 credits
Elements of probability theory. Random variables, distributions, densities, moments, characteristic functions, functions of random variables and limit theorems. Correlation, spectral density, ergodicity and applications in linear systems. Normal, Poisson and Wiener processes, mean square estimation and Markov processes. Application to electrical engineering-noise analysis. Equivalent to CSCI 635. *Prerequisite:* Undergraduate level knowledge of probability theory.

EENG 640 Solid-State Electronics 3 credits
The study of physical phenomena within solid-state devices. Energy levels in solids, statistics of electrons and holes and semiconductors. Physics of p-n junctions, bipolar transistors, unipolar field effect transistors—JFET and MOS. Phenomena such as tunneling, Schottky barriers, Gunn effect, and more, will be considered.

EENG 641 Computer Architecture I 3 credits
The study of the software/hardware boundary as defined in the Von Neumann Architecture. Review of the technological framework. Effects on machine instructions and formats, addressing techniques, microprogramming, fast arithmetic, and advanced memory and 110 practices. Equivalent to: CSCI 641. *Prerequisite:* Undergraduate knowledge of computer architecture.

EENG 655 Automata Theory 3 credits
Theory of finite automata, identification of states. Turning Machines, neural nets, majority logic. Applications in pattern recognition and game playing. Hardware and software implementations. Equivalent to: CSCI 655. *Prerequisite:* Undergraduate knowledge of computer organization.

EENG 665 Linear Systems 3 credits
This course will cover fundamental concepts in linear system theory such as matrix algebra, linear vector space, linear operator. Linearity, causality and time invariance will be discussed. Input-output and state-space models will be presented. The concepts of controllability, observability, and stability of linear systems will be studied.

EENG 670 Electromagnetic Theory 3 credits
Basic concepts of electromagnetic fields are reviewed and relevant mathematical methods systematically introduced. Emphasis on in-depth understanding of electromagnetic wave phenomena such as propagation of plane wares, in isotropic and anisotropic media, microwave networks, and radiation. Engineering application to microwave, optical, and radiating systems are discussed.

EENG 675 Coding and Information Theory 3 credits
Fundamentals of information theory are covered in this course. Topics such as information measure, entropy, and channel capacity are discussed. Source encoding and decoding, rate distortion theory, linear codes, block codes, convolutional codes, Viterbi algorithm, encryption and decryption are presented. *Prerequisite:* EENG 635.

EENG 685 Detection and Estimation 3 credits
The course will introduce students to the classical theory of detection and estimation of signals in noise. Topics covered include Bayesian hypothesis testing, minimax hypothesis testing, Neyman-Pearson hypothesis testing, composite hypothesis testing, signal detection in discrete time, and sequential detection. Also covered are topics such as nonparametric and

robust detection parameter estimation, Bayesian estimation, maximum likelihood estimation Kalman-Bucy filtering, linear estimation, Wiener-Kolmogorov filtering, and applications to communications. *Prerequisite:* EENG 635.

EENG 710 Robotics of Flexible Automation 3 credits
This course presents analysis, design and implementation of robots. To he discussed are robot geometries, kinmetrics, dynamics, trajectory planning and control systems. The impact of these theoretical concepts on robot design will be covered and the integration of robots into flexible automation system will he discussed. *Prerequisites:* EENG 665, EENG 633.

EENG 720 Modern Control Theory 3 credits
Continuous-time control system analysis and design. Sampled data and discrete-time control system analysis and design. Nonlinear Systems and stability. *Prerequisite:* EENG 665.

EENG 725 Queuing Theory 3 credits
The queuing problem is described. The Poisson process, the Markovian property of the exponential distribution, stochastic processes and Markov chains are studied. Simple Markovian birth-death queuing models as well as advanced Markovian queuing models are considered. Networks, series, and cyclic queues, models with general arrival and service patterns are presented. *Prerequisite:* EENG 382.

EENG 726 Fundamentals of Markov Processes 3 credits
The account of the elementary theory of Markov chains with appli-cations is presented. Topics include discrete-time Markov chains and the Ergodic Theorem, continuous Markov Chains, exponential distribution, Poisson processes, and Brownian motion. Applications in Queueing theory, Decision theory, Markov chains and Monte Carlo methods will be discussed. *Prerequisite:* EENG 635, EENG 665

EENG 730 Nanotechnology 3 credits
An introduction to Nanotechnology is presented via the pragmatic criterion of usefulness. This includes an introduction to the Solid State Physics, methods of measuring nanosecond properties and individual Nano Particles, Carbon nanostructures, Nanostructure Ferromagnetism, Optical Spectroscopy, Quantum Wells, and Nano Machines and Devices.

EENG 741 Computer Architecture II 3 credits
Discussions of the advancements in computer architecture of and beyond the Von Neumann Architecture. This will include pipelined machines. RISC machines, parallel architectures, distributed architectures, and language directed architectures. Equivalent to: CSCI 741. *Prerequisite:* CSCI 741.

EENG 750 Optoelectronics 3 credits
Mirrors and inferometers. Optical fibers and integrated optical circuits. Couplers, distributed feedback structures, modulators and optical detectors are described with emphasis on the design methodology. *Prerequisite:* EENG 670.

EENG 751 Signal Processing I 3 credits
Fundamental processing of digital signals. Design of analog and digital filters. Applications of signal processing, industrial signal processing, image processing and speech synthesis with emphasis on design. *Prerequisite:* EENG 665.

EENG 755 Computer Networks 3 credits
Quantitative approaches to the design of data and computer networks including the telephone network. Applications of queuing theory - blocking and delay. Packet switching and OSI standards. Concepts of a layered architecture. The data link layer. Flow and congestion control in a network, routing, higher layers. An introduction to local area networks. A design project is part of this course. *Prerequisite:* EENG 635.

EENG 760 Antenna Theory and Wave Propagation 3 credits
Development of fundamental concepts: vector potential integral, radiation pattern, directivity. Wire Antennas: dipole, loop, helix, method of moments. Antenna arrays: analysis and synthesis, mutual coupling, optimization methods. Aperture antennas: horns, reflector systems, physical optics, uniform theory of diffraction. Frequency independent antennas: spiral, log periodic. Microstrip antennas. Adaptive arrays. Numerical procedures using computer software will be stressed. *Prerequisite:* EENG 670.

EENG 765 Microwave Circuits 3 credits
The method of equivalent networks for electromagnetic structures is introduced and then employed to analyze the propagation of waves in metallic and dielectric guiding structures. Circuit models for waveguide discontinuities are developed. Impedance and scattering matrix descriptions of equivalent circuits are discussed. Metallic waveguides and cavities for microwaves, optical fibers and planar dielectric waveguides for integrated optics are treated in detail. *Prerequisite:* EENG 670.

EENG 770 Digital Communications 3 credits
Design techniques for modern communication systems. Digital signal representation, sampling, quantization, noise representation, modulation methods and multiplexing. System performance in the presence of noise with emphasis on design. *Prerequisite:* EENG 635.

EENG 775 Communication Systems 3 credits
Design techniques for modern communication systems. Signal processing and noise representation in conjunction with linear systems. Modulation and demodulation techniques. System performance in the presence of noise. Emphasis on design using examples from current space, radar and satellite communications. *Prerequisite:* EENG 635.

EENG 810 Array Signal Processing 3 credits
This course is an introduction to the mathematical principles of array signal processing and their applications. Topics such as beamformer design, optimum array processing structures, detection and direction of arrival estimation and modern subspace methods are covered. Adaptive algorithms, their convergence properties and shortcomings are studied. Degradation of array performance resulting from nonideal operating conditions and techniques of compensation are investigated. Applications of array signal processing are introduced. *Prerequisite:* EENG 751

EENG 820 Microwave Devices 3 credits
Principles and operations of microwave tubes and semiconductor devices are covered. Microwave tubes such as Klystrons, traveling wave tubes, magnetrons and gyrotrons are discussed in depth. Physical properties and equivalent circuits are developed for semiconductor devices such as varactors, chottky diodes, Gunn diodes, Impatt diodes, silicon bipolar transistors and gallium arsenide FET's. *Prerequisites:* EENG 640, EENG 760.

EENG 830 RF Electronic Circuits 3 credits
The course introduces the student to RF electronic circuits. Almost sinusoidal oscillators, mixers, RF and IF frequency converters, frequency synthesizers, power amplifiers, and PM modulation and demodulation circuits are covered. The augmentation of conventional models of communication electronics by the principles of fields and waves at SHF mobile-radio band is discussed. *Prerequisite:* EENG 770

EENG 851 Signal Processing II 3 credits
Random signals and linear systems. Structure, application and implementation of adaptive linear systems. Systems identification, spectral estimation and adaptive control. Transversal and lattice implementations. Wiener and Kallman filters, sensitivity and stability. Decision theory. *Prerequisite:* EENG 751.

EENG 860 **Special Topics** **3 credits**
This course provides an opportunity for students to study, in a variety of formats, advanced topics which may not be included elsewhere in the curriculum. The topics may be of mutual interest to the student and faculty member or appropriate for group study.

EENG 870 **Design Project I** **3 credits**
Major design project under the supervision of a faculty adviser. The project is open-ended and integrates student's knowledge and skills in the analysis and synthesis of an industrial system. *Prerequisite:* Approval of the chairperson.

EENG 880 **Design Project II** **3 credits**
Continuation of major design project under faculty adviser supervision. *Prerequisite:* EENG 870, and approval of the chairperson.

Master of Science in Energy Management

With the projected expenditure of billions of dollars per year during this decade for energy efficiency equipment, energy management systems, resource recovery plants and cost-effective alternative energy systems, there is a growing need for energy managers conversant with business management and energy technology to fill executive positions in corporate and government organizations. Energy managers develop and implement organization policy for analyzing and improving energy efficiency in commercial and industrial processes, building operation, new design and construction, and they direct the operation of new plants designed for cogeneration, resource recovery, biomass conversion, wind energy, geothermal power and small-scale hydroelectric power.

Responding to this need, NYIT's School of Engineering and Computing Sciences offers a Master of Science degree in Energy Management which pursues several objectives, one of which is to provide professionals in business management or engineering and college graduates in compatible fields with the most up-to-date knowledge in energy management. Another objective is to equip these professionals with the interdisciplinary skills required of the new class of energy managers, in particular, modern energy technology, business practice, policy development, program analysis, cost-benefit evaluation and computer-assisted management techniques.

For energy employers nationwide and for energy management students and graduates, the school operates a Job Clearinghouse for Energy Professionals. Employers make use of the clearinghouse, at no cost, to locate qualified job candidates from among the program's ranks.

For organizations involved in energy generation and transmission, building operation and design, and industrial energy utilization, the school offers specialized professional certificate programs to increase the knowledge and skills of personnel who attend classes either at their place of work or at an NYIT campus.

For energy professionals with busy schedules and homebases outside the New York metropolitan region, the school conducts intensive professional seminars on technical subjects of importance to the energy field, and offers courses online via the Internet.

Combined B.S. in Mechanical Engineering and M.S. in Energy Management Program

The School of Engineering and Computing Sciences offers a combined, five-year Bachelor of Science in Mechanical Engineering and Master of Science in Energy Management program. Students in the B.S./M.S. program who have taken 6 graduate credits in Mechanical Engineering as undergraduate electives, and have received a waiver of ENGY 670, are required to complete 30 additional graduate credits for the M.S. in Energy Management degree. This program provides students with a strong technical background, and provides specialized preparation for a variety of career options.

Combined B.S. in Architectural Technology and M.S. in Energy Management Program

For qualified upperclass undergraduate architecture students, the School of Engineering and Computing Sciences, in conjunction with the NYIT School of Architecture, offers a choice of a combined Bachelor and Master of Science degree program in Architectural Technology and Energy Management or an energy management minor within the undergraduate's four-year degree program. The former program involves attainment of the combined degrees in five years of full-time study rather than the six and one-half years ordinarily required.

Program Format

Courses are offered in a convenient and flexible weekend and evening format in Old Westbury. A weekend course meets four hours and twenty minutes every other Saturday for eight sessions; an evening course meets two hours and ten minutes once a week for 15 sessions. In addition, courses are available online and in Manhattan. Fall, spring and summer semesters are scheduled.

Transfer Credit

Credit for graduate courses taken at other accredited institutions will be accepted for transfer based on review and evaluation consistent with the standards of the college and center. Application for approval of graduate transfer credit must be made to the director's office. Up to nine credits of graduate work may be accepted from an accredited program from another institution provided those credits have not been applied to another degree and the course content is the same as offered in this program. In order to be accepted for transfer credit, courses, in general, must have been completed within the last five years with a grade of B or higher.

Faculty

Faculty consists of academicians known nationally for their energy expertise; practicing energy management professionals who, while teaching in the program, are in their daily lives ranking administrators, engineers and operating officials of corporate and governmental organizations; and a select group of scholars associated with other appropriate graduate programs at NYIT.

Curriculum

In all cases, the curriculum consists of a core of six courses (or five courses for the technologically qualified applicant); including a thesis or practicum course; and six elective courses to be chosen on the basis of specialization objectives.

In order to earn the Master of Science degree in Energy Management, a student must complete the prescribed curriculum of 36 graduate-level credits (or 33 for the qualified technologist).

Prerequisites

A business management or engineering background is desirable but not required. Undergraduate prerequisite courses are required in physics and economics. Prerequisite courses may be taken concurrently with any graduate courses provided they are not prior requirements for that course.

Prerequisite courses, although required, may not be counted toward meeting the 33 to 36 credits specified for the degree.

Work covering the same materials but taken elsewhere and satisfactorily completed, may be accepted for prerequisite credit. Students may meet prerequisite requirements through proficiency examinations prepared by the College Proficiency Examination Program of New York State or CLEP Program Testing Service. Further information on all testing programs is available in the Graduate Admissions Office.

The following is a list of prerequisite courses offered at NYIT:

PHYS 115 Humanity & the Physical Universe 3 prerequisite credits
Students without undergraduate credit in physics may enroll in the NYIT undergraduate physical science survey course, PHYS 115.

ECON 101 or ECON 595 Survey of Economics 3 prerequisite credits
Students without undergraduate credit in economics may enroll in the NYIT undergraduate courses, ECON 105 or ECON 101.

Admission Requirements

Students who hold a bachelor's degree with an index of 2.85 or higher from an accredited institution with the U.S. will be admitted directly into the M.S. in Energy program. Students whose indices fall between 2.50 and 2.84 will be admitted as

accepted with conditions—and must achieve a 3.00 index in the first four courses in order to be updated.

Students whose QPA falls below 2.50 will be required to submit an acceptable score on the GRE examination to be considered for admission. International students will also be required to submit an acceptable GRE score and/or TOEFL (if requested), before they can be considered for admission or for the issuance of the I-20 form.

Candidates who hold a master's degree from an accredited institution in the U.S. will be admitted directly into the program.

All students must furnish official transcripts from all schools attended as part of application to NYIT.

Curriculum Requirements—Master of Science in Energy Management

Required Core Courses for all Energy Management Options

ENGY 610	Energy Management	3 cr
ENGY 670**	Energy Technology in Perspective	3 cr
ENGY 690	Energy Policy, Economics and Technology	3 cr
ENGY 890	Thesis, Practicum or Other Research	3 cr
ENVT 601	Introduction to Environmental Technology	3 cr
MGMT 605*	Organizational Development and Behavioral Factors	3 cr
Total core requirement		**18 credits**

**See course descriptions listed under Master of Business Administration. **Some students are expected to possess sufficient knowledge to permit the waiving of ENGY 670. For these students, 33 credits are required for the degree earned in five core courses and six electives.*

M.S. In Energy Management-Elective Courses

Eighteen graduate credits of elective work are required. Any combination of graduate-level ENGY, ENVT and M.B.A. courses may be used to satisfy the elective requirement. Course selections must be approved by the Director of the Energy Management program. Recommended electives are listed below.

Facilities Management Electives

ENGY 615	Energy Equipment Assessment
ENGY 620	Facilities Operation and Maintenance
ENGY 625	Facilities Management Seminar
ENGY 710	Power Plant Systems
ENGY 730	Computer Applications for Energy Management
ENGY 820	Automated Building Energy Control Systems
ENVT 715	Pollution Prevention and Waste Minimization
ENVT 720	Environmental Audits and Monitoring

Environmental Technology Electives

ENGY	775	Alternative Energy Systems
ENVT	620	Introduction to Waste Management
ENVT	655	Fundamentals of Air Pollution
ENVT	710	Environmental Instrumentation Lab
ENVT	725	Environmental Issues in the New York Area
ENVT	730	Geographical Information Systems
ENVT	735	Environmental Modeling Techniques
ENVT	750	Environmental Risk Assessment

Management Electives

ACCT	745	Legal Environment of Business
ENGY	655	Environmental Economics
ENGY	750	Energy and Environmental Law
ENGY	790	Competitive Energy Markets
INTL	725	Multinational Business Management
MGMT	610	Operations Management
MRKT	601	Marketing Management
MRKT	725	Management of New Products

Total elective credits	**18 cr**
Total credit requirement for the degree	**36 credits**

Note: Not all courses are offered each term.

Advanced Certificate in Energy Technology

Alternate sources of energy, experimental vehicles, automated energy control systems, and advanced resource recovery facilities, have been developed in order to maximize the efficiency of energy utilization.

The Advanced Certificate in Energy Technology requires eighteen credits of graduate coursework in Energy Technology and related areas. All course selections must be approved by the Energy Management Program Director. For more information, please contact the department.

Advanced Certificate in Facilities Management

The complexity of modern buildings has increased with the advent of sophisticated lighting systems, building controls, and air conditioning equipment. There are numerous career opportunities for Facilities Managers, who operate and maintain buildings and related infrastructure. Facilities Managers need to be able to control costs, while maintaining high standards of safety, comfort and performance. As part of the M.S. in Energy Management program, NYIT offers an Advanced Certificate in Facilities Management.

Courses which have been applied to the Certificate, may be applied to the M.S. in Energy Management degree. The Certificate consists of six courses for a total of 18 graduate credits.

Choose six of the following courses:

ENGY 610	Energy Management
ENGY 615	Energy Equipment Assessment
ENGY 620	Facilities Operation and Maintenance
ENGY 625	Facilities Management Seminar
ENGY 630	Facility Security and Contingency Planning
ENGY 635	Security Systems and Technology
ENGY 640	Independent Guided Project
ENGY 710	Power Plant Systems
ENGY 715	Energy-Efficient Lighting
ENGY 725	Seminar in New Products and Technology
ENGY 730	Computer Applications for Energy Management
ENGY 790	Competitive Energy Markets
ENGY 820	Automated Building Energy Control Systems
ENGY 840	Energy Conservation Analysis
ENGY 850	Advanced Topics Seminar
ENVT 715	Pollution Prevention and Waste Minimization
ENVT 720	Environmental Audits and Monitoring
MENG 810	Total Energy Systems
MENG 820	Environmental Control
MENG 850	Special Topics in Mechanical Engineering

Advanced Certificate in Environmental Management

The environmental debate has attracted widespread attention among policy-makers and the general public as evidenced by headlines in the nation's newspapers. Strict new environmental regulations have created a need for managers with an understanding of environmental issues. Environmental quality is inextricably linked with energy consumption. Automobiles, power plants and furnaces release pollutants as products of combustion. Coal, oil and gas resources can not be developed without careful consideration of the environmental impacts. Therefore, the focus of the energy field has broadened to include more environmental issues.

Environmental Management courses are offered within the M.S. in Energy Management degree program for managers, planners, engineers, and policy-makers who must consider environmental issues when making decisions. Students who obtain the Certificate may continue their studies by completing the M.S. in Energy Management degree. Students who have completed the M.S. in Energy Management core course may choose to specialize in Environmental Management by taking the environmental courses as electives.

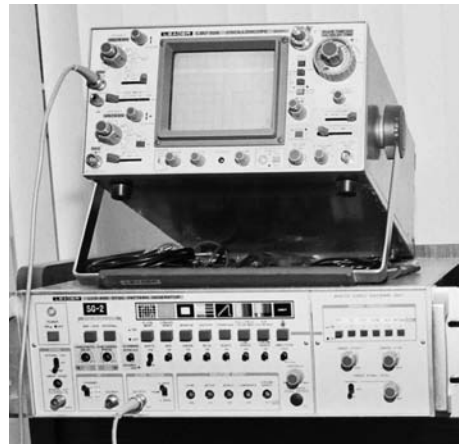
The Advanced Certificate in Environmental Management consists of six graduate-level environmental courses, for a total of 18 graduate credits. These courses explore technical, economic and regulatory framework of environmental protection and conservation.

Choose (3) Environmental Management courses (ENGY) AND (3) Environmental Technology courses (ENVT). Course selections must be approved by the Energy Management program director. The following courses are recommended:

ENGY 640	Independent Guided Project
ENGY 655	Environmental Economics
ENGY 660	Environmental Policy Seminar
ENGY 690	Energy Policy, Economics and Technology
ENGY 750	Energy and Environmental Law
ENGY 760	Transportation Technology Seminar
ENGY 775	Alternative Energy Systems
ENGY 850	Advanced Topics Seminar
ENVT 601	Introduction to Environmental Technology
ENVT 605	Hydrology and Groundwater Contamination
ENVT 620	Introduction to Waste Management
ENVT 655	Fundamentals of Air Pollution
ENVT 710	Environmental Instrumentation Lab
ENVT 715	Pollution Prevention and Waste Minimization
ENVT 720	Environmental Audits and Monitoring
ENVT 725	Environmental Issues in the New York Area
ENVT 730	Geographical Information Systems
ENVT 735	Environmental Modeling Techniques
ENVT 750	Environmental Risk Assessment

Advanced Certificate in Facility and Infrastructure Security

Today, we depend on trained professionals to identify security concerns and to develop effective response strategies to protect facilities and infrastructures. These individuals use advanced technology for fire protection, crime prevention, and environmental monitoring. They ensure that critical systems, such as back-up power, life safety equipment, and water infrastructure, are fully operational and in compliance with all regulatory requirements. This 18-credit certificate includes coursework in facilities management, contingency planning, security systems technology, and environmental risk assessment.



Choose six courses (18 cr.) from the following:

ENGY 620	Facilities Operation and Maintenance
ENGY 625	Facilities Management Seminar
ENGY 630	Facility Security and Contingency Planning
ENGY 635	Security Systems and Technology
ENGY 710	Power Plant Systems
ENVT 650	Hazardous Waste Operations
ENVT 710	Environmental Instrumentation Lab
ENVT 720	Environmental Audits and Monitoring
ENVT 730	Geographical Information Systems
ENVT 750	Environmental Risk Assessment
ENVT 775	Water Infrastructure Security

Certificate Program Requirements

The admission requirements of the M.S. in Energy Management program also apply to the Advanced Certificate programs. Courses may not be applied to more than one Certificate, and the 18 credits must be completed with a minimum 3.0 cumulative average. A separate application for graduate admission must be filed at least one semester before completing a Certificate.

COURSE DESCRIPTIONS

ENGY 600 Maintain Matriculation 0 credits
Matriculated students who do not register for course work in a regular semester (excluding summer) are expected to maintain matriculation by registering for this course. Students working exclusively on an ENGY 890 project must maintain matriculation by registering for ENGY 600.

ENGY 610 Energy Management 3 credits
Examination of a total management system needed for planning and control of energy resources in an organization, setting of objectives, developing policies and procedures, organizing and staffing, reporting and controlling, dealing with top management. Conducting preliminary and detailed energy audits, preparing energy balances, identifying conservation opportunities, ranking and analyzing capital projects (pay back, discounted cash flow, net present value methods). Cost accounting systems designed to highlight energy costs, setting up performance evaluation systems.

ENGY 615 Energy Equipment Assessment 3 credits
An assessment of energy consuming equipment, control equipment and conservation equipment commonly utilized by large facilities. Vendor catalogs, guest lecturers and field trips used to study various equipment and systems including heating, cooling, refrigeration, lighting, HVAC distribution and control, insulation, passive design and computerized energy management systems. Based on first-hand observation and investigation, students are required to prepare and deliver an oral and written presentation analyzing energy efficiency aspects of selected families of equipment. *Prerequisites:* ENGY 610.

ENGY 620 Facilities Operation and Maintenance 3 credits
This course covers management of building operations, development of maintenance programs, administration of capital projects, and planning of facility improvements. Evaluation of facilities for compliance with regulations, reduction of operating costs, and forecasting of maintenance requirements.

ENGY 625 Facilities Management Seminar 3 credits
Discussion of issues and problems commonly encountered in facilities management, including cost estimation, vendor selection, code compliance, space planning and risk reduction. Case studies are utilized to illustrate methods for improving the safety, appearance, efficiency and productivity of facilities.

ENGY 630 Facility Security and Contingency Planning 3 credits
In this course we examine the technical and legal requirements for emergency planning at power plants and various other energy facilities. Security concerns are identified, and effective response strategies are presented. Among the topics covered are access control, hazard classifications, evacuation plans, and back-up power equipment.

ENGY 635 Security Systems and Technology 3 credits
In this course, students will be introduced to the integrated security systems which protect modern facilities. Students will examine how wireless and hardwired equipment for fire protection, crime prevention, and environmental monitoring can be centrally controlled. Intrusion countermeasures, such as barriers, detectors, and smart cards, are evaluated. The legal implications of surveillance and biometric authentication systems, including fingerprint, iris and retinal scanners, are discussed.

ENGY 640 Independent Guided Project 3 credits
Research projects, literature reviews, annotated bibliographies, development and validation of instructional sequences undertaken in this format should be in-depth studies not available within the program offerings and comparable in work demands to the regular credit-hour design. One credit of Guided Project is equal to three hours of academic work per week for fifteen weeks.

ENGY 655 Environmental Economics 3 credits
Discussion of efficiency, externalities, social costs, public goods, equity, regulation, and economic incentives. Other topics include water quality, air quality, toxic pollutants, solid wastes, population growth, and conservation of natural resources. Particular attention is paid to specific issues such as acid rain, nuclear safety, and the "greenhouse effect."

ENGY 660 Environmental Policy Seminar 3 credits
The social, ethical, political and economic dimensions of environmental issues are explored to provide a balanced framework for policy development. Criteria and objectives for environmental policy are related to the roles of individuals, businesses, and government. Technology, energy utilization, and natural resource management are viewed from the perspective of citizen participation, ecological lifestyles, sustainable societies, global consequences of human activities are examined in the context of international relations, Third World development, and the worldwide environmental movement. *Prerequisite:* Director's permission.

ENGY 670 Energy Technology in Perspective 3 credits
This course covers principles of power generation and energy conversion. Conventional and alternative energy technologies are described. Energy supply and utilization options are evaluated from technical, economic, and environmental perspectives.

ENGY 690 Energy Policy, Economics and Technology 3 credits
Analysis of past energy production and consumption patterns, production and distribution in U.S. and abroad, examination of present and future energy technology, alternative energy sources and storage systems, energy pricing and production decisions, regulations, taxation, economic efficiency, social welfare, analysis of energy policies, with special emphasis on feasibility and desirability of available and evolving alternatives. *Prerequisite:* Undergraduate economics.

ENGY 710 Power Plant Systems 3 credits
Analyzed from a management point of view, study of power plant electrical systems and conventional fuel sources: transformation and distribution systems; reliability; power pools; reserve capability; generation of steam; generation planning; dispatching algorithms; turbines; and environmental controls. *Prerequisite:* Director's permission.

ENGY 715 Energy-Efficient Lighting 3 credits
Principles of illumination are introduced, with particular emphasis on techniques for reducing energy costs associated with lighting. Criteria for the selection of bulbs, fixtures, ballasts and reflectors will be studied.

ENGY 725 Seminar in New Products and Technology 3 credits
Designed to emphasize the emerging products and technologies. New energy conservation equipment, generation and transmission equipment, and process and HVAC control equipment will be discussed with the help of vendor catalogs and guest lecturers. Typical term project will include comparing all the available techniques and/or products for performing a certain function. *Prerequisite:* ENGY 610.

ENGY 730 Computer Applications for Energy Management 3 credits
In this course students study various applications of computers in the Energy Management field. Off-the-shelf software is applied to load forecasting, utility operations, life cycle costings, and project management. Specialized software is applied to building energy analysis, heating/cooling calculations, facility maintenance management, and evaluation of alternative energy systems. Practical applications and problem-solving skills are emphasized throughout the course. *Prerequisite:* ENGY 610.

ENGY 750 Energy and Environmental Law 3 credits
Analysis of strategies to simultaneously insure compliance with environmental law and energy project facilitation through detailed examination of legal remedies and policy options to regulate, control and abate energy-related environmental impact. Emphasis placed on understanding specific environmental impacts stemming from utilization and pricing of conventional and renewable energy resources including toxic pollution, solid wastes, air and water quality, greenhouse effect, acid rain and conservation of natural resources; and to specific legal provisions of the National Energy Act, the Public Utility Regulatory Policies Act, the Clean Air Act and the Clean Water Act.

ENGY 760 Transportation Technology Seminar 3 credits
The various modes of transportation are studied, from the perspectives of energy efficiency, environmental impact, economic feasibility, and land use implications. Vehicle design and capabilities are reviewed, in the context of an overall transportation network. Emerging transportation technologies are discussed, such as alternative fuel vehicles, electric vehicles, hybrid vehicles, and high-speed rail systems.

ENGY 775 Alternative Energy Systems 3 credits
In this course the wide range of alternative energy options which are available for heating, cooling, transportation and power generation are presented. Renewable energy resources, such as solar, wind, hydro, geothermal, and biomass, are discussed in depth. Distributed generation systems, including fuel cells, photovoltaics, and mircroturbines, are analyzed from technical, economic, and environmental perspectives.

ENGY 790 Competitive Energy Markets 3 credits
The changing structure of the utility industry, and the effects of deregulation, are discussed, in order to develop strategies for adapting to competitive energy markets. The roles of utilities, power brokers, and independent power producers, are examined. Methods for increasing efficiency and customer satisfaction, are introduced. Reliability, access, wheeling, and stranded costs, are considered.

ENGY 820 Automated Building Energy Control Systems 3 credits
Design of control systems for heating, ventilating, and air-conditioning, and for total building system control. Localized automatic control systems: pneumatic, electrical, electronic, self-powered, and hybrid systems. Centralized control and monitoring systems, computerized energy and building management systems for optimal energy utilization. Energy management and control system functions, applications, and design. *Prerequisite*: Permission of the director.

ENGY 830 Externship Program 3 credits
Students enrolled in this course will be given the opportunity to work in a field assigned in the area of their specialization and will be asked to meet professional standards set down by the organization to which they are assigned. Conferences will be held with the student during this period and the organization using the service will be asked to cooperate by reporting on the progress of the student. A pass/fail grade is recorded for this course; a written evaluation of performance is provided by the sponsoring agency or professional. One hundred fifty working hours are required to complete the externship. Written permission from the center must be obtained before registering.

ENGY 840 Energy Conservation Analysis 3 Credits
This course covers energy conservation methods for industrial, commercial and residential buildings. Facility energy systems, including heating, ventilation, air conditioning, refrigeration and lighting, are analyzed. Students will learn how to evaluate energy system performance, improve energy efficiency, and demonstrate cost savings attainable through energy conservation. *Prerequisite*: Permission of the Director.

ENGY 850 Advanced Topics Seminar 3 credits
Energy-related topics and issues of current interest will be discussed and analyzed. Course content will vary, in response to developments in the energy field. Discussions and assignments will focus on a particular area of study, such as total energy systems, experimental vehicles, or decentralized electricity production. This course may be repeated, if content has changed. *Prerequisite:* Permission of the director.

ENGY 890 Thesis, Practicum or Other Research 3 credits
Selection of an area of investigation by the student, subject to faculty approval, and completion in the form of an academic or practicum-based research study or a comprehensive examination (oral or written).

Students are allowed a total of one calendar year in which to complete ENGY 890, beginning at the first day of the semester in which they register for ENGY 890. Students must maintain matriculation until they have completed ENGY 890. If the student does not complete ENGY 890 within one calendar year, or if their progress is judged to be unsatisfactory, the student will be required to reregister for ENGY 890 at full tuition. *Prerequisite:* Director's permission.

MENG 610 Advanced Engineering Mathematics 3 credits
This course covers Infinite Series, the Delta Function, the Fourier Integral, vectors, surfaces and volumes; complex variables, linear spaces, the Eigenvalue problem, and partial differential equations.

MENG 810 Total Energy Systems 3 credits
Design of central energy plants for heating and cooling. Steam, low-temperature, medium-temperature, and high-temperature water systems are arranged for maximum utilization of input fuel energy. Integration of design of the project's electrical and thermal requirements with the energy plant for optimum thermodynamic, economic, and environmental benefit. *Prerequisite:* Permission of the director.

MENG 820 Environmental Control 3 credits
Design of control systems for heating, ventilating, and air conditioning, and for total building system control. Localized automatic control systems: pneumatic, electrical, electronic, self-powered, and hybrid systems. Centralized control and monitoring systems, computerized energy and building management systems for optimal energy utilization. Energy management and control system functions, applications, and design. *Prerequisite:* Permission of the director.

MENG 850 Special Topics in Mechanical Engineering 3 credits
This course is devoted to the study of special topics. Work is carried out under supervision of a graduate school faculty member and must be approved by the chairperson of the Mechanical Engineering department.

Master of Science in Environmental Technology

A practice-oriented graduate program leading to the Master of Science degree that will be of interest to engineers, scientific, and other technical personnel looking to enhance their career choices. It is becoming obvious that increasing security and environmental concerns coupled with government regulations require individuals with advanced training in environmental technology and infrastructure security. Most students complete the program offered at both Old Westbury and Manhattan campuses in two years of part-time study.

Curriculum

The 36-credit program will provide advanced training in topics such as waste management, environmental management, infrastructure security and pollution prevention. In addition to 21 credits of required study, the student will have the opportunity to select 15 credits from an extensive offering of elective courses including a new 12-credit concentration in Infrastructure Security. A six-credit one year thesis course, the Audit or Design Project, will require the graduate to demonstrate an ability to solve a significant environmental problem under the guidance of a senior faculty member.

Faculty

All of the faculty are practicing professionals with extensive teaching, consulting or research experience.

Admission Requirements

A baccalaureate degree is required for admission preferably in engineering, technology or the sciences. However, individuals with other areas of study may also be admitted into the program. Prerequisite courses are required of all students and include undergraduate coursework in chemistry or biology and physics. A maximum of six credits of graduate work satisfactory completed at other institutions may be transferred into the program.

Curriculum Requirements

Required Courses **21 credits**

ENVT	601	Introduction to Environmental Technology
ENVT	605	Hydrology and Groundwater Contamination
ENVT	620	Introduction to Waste Management
ENVT	655	Fundamentals of Air Pollution
ENVT	801	Audit or Design Project
ENVT	802	Audit or Design Project II
ENGY	750	Energy and Environmental Law

Elective Courses—choose from the following: **15 credits**

ENVT	615	Water and Wastewater Environmental Technology
ENVT	650	Hazardous Waste Operations—40-hr OSHA course
ENVT	710	Environmental Instrumentation Lab
ENVT	715	Pollution Prevention & Waste Minimization
ENVT	720	Environmental Audits and Monitoring
ENVT	725	Environmental Issues in the New York Area
ENVT	730	Geographical Information Systems
ENVT	735	Environmental Modeling Techniques
ENVT	750	Environmental Risk Assessment
ENVT	760	Advanced Topics Seminar
ENVT	765*	Environmental Practicum
ENVT	775	Water Infrastructure Security
ENGY	610	Energy Management
ENGY	630	Facility Security and Contingency Planning
ENGY	670	Energy Technology in Perspective
ENGY	690	Energy Policy, Economics and Technology
ENGY	710	Power Plant Systems
ENGY	775	Alternative Energy Systems

(Other courses may be approved by the Chair)

Total credit requirement for the degree **36 credits**

**Not required for the degree.*

Concentration in Infrastructure Security
(Select 12 credits from the following)

ENVT	650	Hazardous Waste Operations	3 cr
ENVT	750	Environmental Risk Assessment	3 cr
ENVT	760	Advanced Topics Seminar	3 cr
ENVT	775	Water Infrastructure Security	3 cr
ENGY	630	Facility Security and Contingency Planning	3 cr
ENGY	710	Power Plant Systems	3 cr
ENGY	760	Transportation Technology Seminar	3 cr

COURSE DESCRIPTIONS

ENVT 601 Introduction to Environmental Technology 3 credits
An introduction to the various components of Environmental Technology including environmental impact, analysis, regulations, water quality, recycling and alternative solutions.

ENVT 605 Hydrology and Groundwater Contamination 3 credits
Introduction to hydrology, watershed response, groundwater modeling techniques, contaminant transport and remediation techniques. Water quality standards, well installation, hazardous spill evaluation and remediation will also be covered.

ENVT 615 Water and Wastewater Environmental Technology 3 credits
Physical, chemical and biological principles involved in process design and treatment of water and wastewater.

ENVT 620 Introduction to Waste Management 3 credits
A survey of waste collection, salvage and disposal techniques. Design optimization, cost analysis, classification, storage, transportation and government regulations will be covered.

ENVT 625 Hazardous Waste Management Under RCRA 3 credits
Requirements of the Resource Conservation and Recovery Act (RCRA) and proper procedures for the accumulation, storage, transportation and disposal of hazardous waste. *Prerequisite:* ENVT 620.

ENVT 630 Hazardous Waste Site Remediation 3 credits
Analysis and testing of waste sites, techniques, economics and government regulations concerning remediation efforts. Field screening, exposure monitoring and removal techniques will be covered. *Prerequisite:* ENVT 620.

ENVT 640 Radioactive Waste Management 3 credits
Origins of low-level and high-level waste, radon ad minimization techniques. Decontamination techniques, worker exposure and NRC regulation, equipment design, mechanical systems, chemical systems, transportation and burial technology will be covered. *Prerequisite:* ENVT 620.

ENVT 650 Hazardous Waste Operations 3 credits
A 40-hour OSHA training course designed for individuals who are engaged in hazardous substance removal or are exposed to potentially hazardous substances and health hazards. The instructor will offer hands-on practice in the use of monitoring equipment, cleaning/use/storage of SCBA and personal protective equipment, clean-up methods and practice in decontamination.

ENVT 655 Fundamentals of Air Pollution 3 credits
A study of the causes of air pollution including fossil fuels, smog, ozone depletion and acid rain. Design and operational techniques to minimize pollution will be studied. *Prerequisite:* ENVT 620.

ENVT 705 Environmental Toxicology 3 credits
A survey of the terminology and biochemical and biophysical phenomena associated with chemicals in the environment. Methods used to determine levels of toxicity in animals and man will be studied. *Prerequisite:* BIOL 110.

ENVT 710 Environmental Instrumentation Lab 3 credits
Principles and latest developments used to analyze air and water pollution, toxic wastes, radiation, and noise. Experimental Analysis, automated systems, field samplings, and more, will be covered in class.

ENVT 715 Pollution Prevention and Waste Minimization 3 credits
Pollution prevention is the proper use of materials, processes and practices that reduce or eliminate the creation of pollutants or wastes at the source. The course will focus on life cycle analysis, product development and necessary design and manufacturing process changes in addition to recycling, reuse and substitution of less toxic materials.

ENVT 720 Environmental Audits and Monitoring 3 credits
The course will cover environmental compliance audits, reviews and monitoring techniques for surface and subsurface site inspections including petrochemical contamination and underground storage tanks.

ENVT 725 Environmental Issues in the New York Area 3 credits
A study of the major environmental issues in the New York area including solid waste disposal and the confrontation between open space utilization, groundwater protection and economic development.

ENVT 730 Geographical Information Systems 3 credits
Geographical information system (GIS) is a computer mapping and analysis technology that utilizes a powerful information database for analysis of spatial data. It is currently used for environmental monitoring and analysis, resource and facilities management, and planning of utility and transportation networks.

ENVT 735 Environmental Modeling Techniques 3 credits
The study and development of system modeling to predict ecosystem changes and environmental impacts. A variety of topics are addressed, including: dispersion effects for air and water pollution, population changes, forest growth, solar energy, traffic flows, and urban development. Computer applications are mandatory. Students are expected to use spreadsheets and programs such as MathCad or MathLab. Software applications will be demonstrated in class, and utilized by students in projects and assignments.

ENVT 750 Environmental Risk Assessment 3 credits
The assessment of risk and understanding of natural and technological hazards that are harmful to the environment. This case study course will focus on hazards involving energy, oil, transportation, manufacturing, chemicals, nuclear power and biotechnology.

ENVT 760 Advanced Topics Seminar Program 3 credits
The fast paced changing field of environmental technology includes a variety of the state-of-the-art topics of current interest to professionals. This course will include seminars conducted by distinguished outside speakers.

ENVT 765 Environmental Practicum 1 credit
Students enrolled in this course are expected to perform a minimum of 150 hours of professional service per term in an environmental organization including manufacturing, transportation, consulting, government or non-profit public service corporation. Conferences and meetings will be held with students and their supervisor. Note: this course will be in addition to those courses required for the degree. *Prerequisite:* Approval of chairman.

ENVT 775 Water Infrastructure Security 3 credits
In this course students will be introduced to the actions, programs and technologies that can be utilized to evaluate the vulnerability of water and wastewater infrastructure. Students will explore security enhancements and examine the federal and state requirements for vulnerability assessments and the models that are being used for such assessments.

ENVT 801 Audit or Design Project I 3 credits
A capstone project to demonstrate the student's grasp of Environmental Technology. The design of a system, compliance program, or audit of waste site are typical of the project requirements. *Prerequisite:* Approval of chairperson.

ENVT 802 Audit or Design Project II 3 credits
A second capstone project to demonstrate the student's grasp of compliance program, or audit of waste site are typical of the project requirements. *Prerequisite:* ENVT 801.