Interdisciplinary Programs

GRADUATE PROGRAMS

Interdisciplinary programs promote intellectual growth and offer distinct challenges to conventional thinking. They address areas that are too broad or too complex to be dealt with adequately by a single academic discipline. Interdisciplinary programs are essential for the education of graduate students involved in Technogenesis projects, i.e., projects concerned with the nurturing of technology from concept to realization. It is also the case that some interesting scholarly areas involve the blending of two or more academic disciplines, e.g., management science juxtaposes operations research and business. Students interested in an interdisciplinary program at either the master's level or the Ph.D. level may proceed as follows:

- The student outlines in writing the program that he or she would like to undertake and submits it to the Dean of Graduate Studies.
- If the Dean Graduate Studies approves the program, an interdisciplinary advisory committee is appointed to study the program.
- If the committee accepts the program, the student and the committee prepare a Study Plan and submit it to the Dean of Graduate Studies for approval.
- One member of the committee is appointed to be the student's Faculty Advisor and the committee performs the usual departmental functions.

In addition, Stevens offers a variety of specific interdisciplinary programs. These programs are described below.

Master of Science - Construction Management

The construction management curriculum offers an excellent opportunity for the construction professional and the engineering manager to direct construction firms and projects in an effective, efficient and professional manner while dealing with the delicate environmental issues of today's complex marketplace. The program consists of five core and five elective courses of a practical nature, including those dealing with financial, legal, safety and administrative aspects relevant to the construction industry. Theory is integrated into realistic problems that arise within today's competitive construction arena. The program has been designed with flexibility so that the student's interest in a special area can be satisfied. An undergraduate degree in engineering or related disciplines from a recognized school is a prerequisite for graduate study in construction management.

Core Courses

CM 509 Construction Cost Analysis and Estimating
CM 541 Project Management for Construction
CM 550 Construction Contract Law I
CM 571 Practicum in Construction Management
CM 580 Construction Management I

Master of Science - Information Systems

The following tracks are designed to meet the increasing need for information technology professionals with both managerial and technical skills. These interdisciplinary programs involve the School of Technology Management and the Computer Science department. For complete description and additional information about the Master of Science - Information Systems program, please refer to the **School of Technology Management** section of the Catalog.

Computer Science Concentration
E-Commerce Technical Track
Information Security

Integrated Information Architecture Track
Quantitative Software Engineering Track
Systems Engineering Track
Telecommunications Management Track

Master of Science - Telecommunications Management

The School of Technology Management administers the interdisciplinary graduate program in Telecommunications Management. This program, which leads to a Master of Science degree, is offered jointly with the Department of Electrical and Computer Engineering. A four-course graduate program leading to a Graduate Certificate in Telecommunications Management is also available. Please refer to the **School of Technology Management** section of this catalog for a complete description of this program and its courses.

Integrated Product Development

The increasing demand placed on the military and commercial sectors to improve the quality and reliability of engineering systems while cutting costs in a rapidly changing technological world are creating new challenges for industry and government personnel responsible for planning and leading multidisciplinary product development projects. The traditional disciplinary engineering programs do not address the skill set, competencies, and practices needed for integrated product development. The Charles V. Schaefer, Jr. School of Engineering, a leader in engineering education, is offering both graduate certificate and degree programs in Integrated Product Development that stress the design, manufacture, implementation, and life-cycle issues of engineering systems. The programs focus on innovative designs and methodologies, and on new materials and process technologies in new product development. The programs aim to provide an innovative view of the landscape of product development to practitioners from different engineering disciplines, to enhance their practice of engineering today and to position them for career growth in the global economy.

The Integrated Product Development degree is an integrated Master of Engineering degree program focusing on the integrated and multidisciplinary aspects of product development. The core courses emphasize the design, manufacture, implementation, and life-cycle issues of engineering systems. The remaining courses provide a disciplinary focus. The program embraces and balances qualitative as well as quantitative aspects, and utilizes state-of-the-art tools and methodologies. It aims to educate students in problem-solving methodologies, modeling, analysis, simulation, and technical management. The program trains engineers in relevant software applications and their productive deployment and integration in the workplace. A full description of this program can be found in the Mechanical Engineering department section.

Microelectronics and Photonics Science and Technology

The Physics and Engineering Physics, Electrical and Computer Engineering (ECE) and Materials Engineering each offer a Master of Engineering degree with an interdisciplinary concentration in Microelectronics and Photonics Science and Technology. Students are required to take the departmental degree core courses and EE/Mt/PEP 507 Introduction to Microelectronics and Photonics. A full description of the program can be found in the Chemical, Biomedical and Materials Engineering department section.

Product-Architecture and Engineering Program

The Master of Engineering in Product-Architecture and Engineering degree program is intended to integrate the study of Product Design, Computational Architecture and Engineering with production methodologies and emerging materials. The program is supported by The Product - Architecture Lab. All students in the program must complete 10 courses (30 credits) comprised of five core courses and up to five elective courses. Three of the five electives must be taken from the recommended list (see below) of relevant graduate courses offered by the mechanical engineering department. The remaining two courses (6 credits) constitute the student's elective field and will consist of at least one course of "600-level or higher" offered within the Product-Architecture and Engineering program. Student may elect to complete a Thesis (PAE 900: Thesis in Product-Architecture and Engineering) in lieu of completing of the two open electives.

A Bachelor of Science degree in Engineering, a BID, (BFA, BA, or BS) in Industrial Design, or a BArch (Bachelor in Architecture) is needed for acceptance to the program. Applicants with undergraduate degrees in other engineering or design disciplines may be required to take appropriate undergraduate courses before being formally admitted into the program.

Core Courses

PAE 610 The Creative Form and the Digital Environment
PAE 620 The Creative Form and the Production Environment
PAE 630 Introduction to Interactive Digital Media
PAE 640 Performative Environments
PAE 800 Product Architecture and Engineering Design Project

The recommended courses from the Mechanical Engineering offerings are:

ME 520 Analysis and Design of Composites
ME 564 Principles of Optimum Design and Manufacture
ME 635 Simulation and Modeling
ME 566 Design for Manufacturability

In order to graduate with a Master of Engineering in Product-Architecture and Engineering, a student must obtain a minimum of "B" average in the major field as well as an overall average of "B" in all the courses needed to meet the 30-credit requirement for the degree. Please see the Office of Graduate Studies section on Student Status.

Doctoral Program (Interdisciplinary)

An interdisciplinary Ph.D. program in Integrated Product Development may be arranged by the Dean of Graduate Studies at the request of the student. To oversee and approve such a program, the Dean of Graduate Studies, on the advice of faculty responsible for the programs involved, will designate a professor from each of the pertinent disciplinary areas to serve on a special advisory committee. The committee chairman will ordinarily be the professor who supervises research.

To earn a doctoral degree, a student needs to complete at least 90 credits of which at least 30 are thesis credits. The mix of credits will be decided upon by the student's principal advisor. Doctoral study plans typically include all core course subjects in concurrent engineering.

Doctoral students are also required to successfully complete two days of qualifying examinations. The first day will be devoted to the concentrated area of study and will cover topics studied in the core courses. The second day of examinations will be organized by the student's doctoral committee and will include selected topics from the student's focused area of concentration. The student, with guidance from the student's doctoral committee, will also present the thesis proposal and an oral defense of the thesis as per the guidelines published in the Graduate Student Handbook.

Interdisciplinary Ph.D. Program Involving Physics and Materials

An interdisciplinary Ph.D. program is jointly offered by the Department of Physics and Engineering Physics and the Materials Program in the Department of Chemical, Biomedical and Materials Engineering. This program aims to address the increasingly cross-cutting nature of doctoral research in these two traditional disciplines, particularly in the area of solid state electronics and photonics and in the area of plasma and thin-film technology. The interdisciplinary Ph.D. program aims to take advantage of the complementary educational offerings and research opportunities in these areas offered by both programs. Any student who wishes to enter this interdisciplinary program needs to obtain the consent of the two departments and the subsequent approval by the Dean of Graduate Studies. The student will follow a study plan designed by his/her faculty advisor(s). The student will be granted official candidacy in the program upon successful completion of the qualifying exam that will be administered according to the applicable guidelines of the Office of Graduate Studies. All policies of the Office of Graduate Studies that govern the credit and thesis requirements apply to students enrolled in this interdisciplinary program. Interested students should follow the normal graduate application procedures through the Dean of Graduate Studies.

The Systems Integration Initiative: The System Design and Operational Effectiveness Program

As part of this initiative in the Charles V. Schaefer, Jr. School of Engineering participants can pursue a number of interdisciplinary graduate certificate programs leading to a Master’s degree (ME) or a Doctoral degree in Systems Engineering. All graduate programs offered through this initiative involve a

multidisciplinary approach to engineering education by providing a blend of engineering, systems, and management subjects. The traditional engineer and scientist often lacks preparation in the human, financial, and systems integration skills necessary to make project teams more productive, improve product and process quality, and promote the advancement of high technology for complex systems. Our programs are unique in that we strive to create an engineer who is well prepared for a future in the conception, definition, architecting, modeling and simulation, integration, sustenance, and management of modern complex systems in a variety of market domains.

As technology advances, systems tend to become more complex. Complexity can greatly increase the cost of a system over its life cycle. Short-term costs including research, design, test, and production are only part of the life-cycle cost. Post-production costs associated with system operation, maintenance, and support are often 70% to 80% of the total cost.

The traditional approach to system design focuses on key performance characteristics plus cost and schedule. Only near the end of design is it determined exactly how the system-as-already-designed is to be supported. This approach for complex systems compromises their reliability, maintainability, and supportability, thus greatly increasing total ownership costs. At the same time, users are demanding more quality. That is, users want more reliability and availability at a lower total cost.

An integrated approach to system design and development can result in an improved balance between system effectiveness and total ownership cost. Such an approach must concurrently consider all aspects of the entire life cycle of the system/product from design to manufacture, maintenance, repair, and disposal; and bring potential cost drivers to the attention of decision-makers early and in compelling ways.

The Charles V. Schaefer, Jr. School of Engineering, as a leader in engineering education, is offering a graduate degree in Systems Engineering and a variety of certificate programs that stresses system design, modeling, analysis, operations, and life-cycle support. The program objective is to provide an innovative view of the landscape of system design to practitioners from different engineering disciplines, to enhance their practice of engineering today, and to position them for career growth in the global economy

Uniqueness of the Curriculum and Delivery Format in the System Design and Operational Effectiveness (SDOE) Program

The curriculum in the SDOE Program is focused on the requirements of system integrators across a multitude of domains in the commercial and aerospace sectors. A synopsis of the topical clusters is reflected in the figure. These topical clusters were identified in collaboration with our partners in the aerospace and defense, telecommunications, IT, and automotive industries. Courses within the program address all these functional clusters. A more detailed description of these clusters can be obtained from the SDOE Program website (www.stevens.edu/engineering/sdoe).

The delivery mechanism of our courses is also unique. All courses in our program are offered in a unique week-long modular format or offered in a completely web-based format. Modes of instruction of the SDOE program have been structured to allow flexibility. The week-long modular format minimizes time away from “home base” while live and intensive weeklong courses, and associated group exercises, ensure development of team building skills, leadership development, and the real-time negotiation and tradeoffs that characterize reality. Participants are given reading assignments prior to the instructional week. Further, participants pursing a degree or graduate certificate have ten weeks subsequent to the instructional week to complete their homework assignments and projects.

Systems Engineering Master’s Degree in the SDOE Executive Education Program

The Systems Engineering degree is a multidisciplinary program that includes a blend of engineering, systems thinking, and management subjects. The increasing complexity of systems, the pervasive realities of global competitiveness, the enhanced focus on cost and profitability, and ever more challenging customer expectations have led a number of premiere organizations in the defense and commercial sectors to assume the role of system integrators. These organizations are increasingly adopting an evolving business model that emphasizes the selling of functionality, a solution, or a capability, instead of focusing on selling and providing systems, system elements, and products. The curriculum emphasizes the development of large-scale, complex, and multifunctional systems in a number of domains, while also addressing the requirements of time-to-market focused organizations in the commercial sector. Core course in the SDOE Program have a strong case study and project orientation to facilitate understanding of the concepts discussed.

Admission to the SDOE program generally requires an undergraduate degree in engineering or related disciplines with a "B" average or better from an accredited college or university. Outstanding applicants in other areas may be conditionally admitted subject to the satisfactory completion of several introductory courses within the program. Specific requirements are determined on an individual basis depending upon the student’s background. It is required that any applicants requesting research assistantship appointments and applicants to the Ph.D. program provide evidence of the ability to carry out independent work. Examples of such evidence include the master's degree thesis work and/or completed work-related projects. GRE scores are not required, but may be submitted in support of the application. International students must demonstrate their proficiency in the English language prior to admission by scoring at least 550 (210 for computer based) on the TOEFL examination. Applications for admission from qualified students are accepted at any time.

Graduates from this program will be prepared to work effectively at the interface between engineering and management and to assume professional positions of increasing responsibility. The program consists of four core courses that must be completed if the applicant is pursuing a Master's or Doctoral degree:

ALL students must take the following two course sequence:
SDOE 625 Operational Effectiveness and Life Cycle Analysis
SDOE 650 System Architecture and Design
OR, the following two course sequence:
SDOE 651 Agile Systems Engineering and Architecting
SDOE 780 Agile Development Strategies

Plus, two of the following **four options**:
- SDOE 611 Modeling and Simulation **or** SDOE 670 Forecasting and Demand Modeling
- SDOE 612 Project Management for Complex Systems
- SDOE 660 Decision and Risk Analysis **or** SDOE 675 Integrated Supply Chains
- SDOE 605 Systems Integration **or** SDOE 606 Accelerated Systems Integration and Testing

A candidate may propose a customized track of six elective courses leading to other specialties with approval from a faculty advisor. At least two of the electives must be taken from the SEEM/SDOE curriculum. Students should review other sections of the graduate catalog for certificate options. Students are encouraged to take an integrated four-course sequence leading to a graduate certificate for the remaining four electives or four additional courses in systems engineering. Many certificates are offered on-line via web-based instruction.

Students in the SDOE program are required to take either a 3-credit special project class (SDOE 800) or a 6-credit hour thesis (SDOE 900). Students should communicate with their academic advisor to develop a study plan to coordinate the thesis versus the project options and to match the student's background, experience, and interests while satisfying the requirements for any of the programs.

Doctoral Programs in Systems Engineering

The programs leading to the Doctor of Philosophy (Ph.D.) degree are designed to develop your ability to perform research or high-level design in systems engineering or engineering management. Admission to the doctoral program is made through the departmental graduate admissions committee and is based on review of your scholastic record. A master's degree is generally required before a student is admitted to the doctoral program. Your master's level academic performance must reflect your ability to pursue advanced studies and perform independent research. Typically a GPA of 3.5 or better is required for admission to the Ph.D. program.

Ninety credits of graduate work in an approved program of study beyond the bachelor's degree are required for completion of the doctoral program. Up to 30 credits obtained in a master's program can be included toward the doctoral degree. Of the remaining 60 credits, 15 to 30 credit hours of course work as well as 30 to 45 credit hours of dissertation work are required. Within two years from the time of admission to the doctoral program, you must form a Doctoral Advisory Committee (DAC) and take a written qualifying examination that is intended to test your comprehension of undergraduate and master's level engineering fundamentals associated with your general dissertation topic area.

The candidate's graduate advisor serves as the chair of the DAC, and the student should seek the assistance of his/her advisor in identifying faculty who might serve on the committee. The graduate committee should be composed of those faculty members who can best assist the student in completing his/her graduate research. Each member is added to the student's committee after consenting to serve. For the Ph.D., the advisory committee must include a minimum of four members and its composition consistent with those guidelines contained in the Graduate Student Handbook. Committee members are expected to attend meetings as a collective body. Under unusual circumstances, a member of the committee may attend a meeting via video or telephone. However, a student's advisory committee must be physically present at all such meetings. Faculty participation on graduate student committees is considered to be an important part of SEEM faculty responsibilities. To this end, full time SEEM faculty are expected to attend all committee meetings for students they advise or on the committees they serve.

The written and oral components of the qualification examination must be successfully completed by all Ph.D. students. The intent of the examination is to establish that the student is qualified to pursue creative, original, independent research at a level expected of Ph.D. students. The written portion of the examination requires two weeks for completion. The oral component of the examination is administered two weeks after the completion of the written portion. Students must be registered during the semester that the examination is taken. Students may not schedule the qualification examination until they have an

approved Study Plan. The qualification examination is administered by the student's DAC and at most one negative vote by a committee member is permitted for the successful completion of the examination. All members of the student's advisory committee must attend the oral portion of the examination. If performance on the examination is unsatisfactory, one full semester must lapse (15 weeks) before the examination is administered a second time. Students failing the examination twice will be dismissed from the program. At the discretion of the committee, a candidate may be allowed to change his or her degree option from a Ph.D. to a Master's. The result of the examination is recorded on a form furnished by the Registrar's office on the day of the oral portion of the examination. This form must be signed by each member of the student's advisory committee.

Students pursuing the Ph.D. are required to complete research in the course of graduate study. To initiate the research effort students are required to pass a preliminary examination upon successful completion of the qualifying examination. The student is required to prepare a research proposal that describes the content of the research, the outcome anticipated, the contribution to the field of endeavor, and the creative content of the effort. This proposal must be in a written form and must be presented to his/her committee at a meeting where all committee members are present. Approval of the research effort is signified by signatures of each committee member on the cover page of the proposal. The signed research proposal must be delivered to the SEEM/SDOE student records office for inclusion in the student's academic record. A student pursuing the Ph.D. degree should demonstrate, through the dissertation, the ability to carry out original and creative research. The results of the research should be sufficiently significant to be publishable in a major technical journal. The writing style, grammar, and spelling of the dissertation should reflect a high level of skill in written communication. Between the research proposal and the final examination the student is required to provide at least one progress report to his/her advisory committee at a meeting where all committee members are present. The time of this meeting is determined by the student's DAC.

At the completion of the research, you must defend your thesis in a public presentation. Doctoral candidates are encouraged to hold a private defense with his or her committee several weeks prior to the public defense. At that time, the committee should raise issues with the candidate prior to the public defense. The final examination must be scheduled through the Registrar's office, at least two weeks prior to its administration. To pass the final examination, a degree candidate must have a favorable vote from a majority of the examining/advisory committee, with a maximum of one negative vote. If a student fails the final examination, there must be a lapse of one full semester (15 weeks) before rescheduling the examination. A student is allowed no more than two opportunities to pass the final examination.

SDOE Graduate Certificate Programs

All graduate certificate programs require a minimum of 12 credit hours of course work. An undergraduate degree in engineering or related disciplines with a "B" average or better from an accredited college or university is generally required for graduate study in any one of our programs. Outstanding applicants in other areas may be conditionally admitted subject to the satisfactory completion of several ramp courses or introductory courses within the specific program. The specific requirements will be determined on an individual basis depending upon the student's background. International students must demonstrate their proficiency in the English language prior to admission by scoring at least 550 (210 for computer based) on the TOEFL examination. Applications for admission from qualified students are accepted at any time.

Each of the graduate certificate programs is a stepping stone towards the Master's degree in Systems Engineering.

Graduate Certificate in Agile Systems Engineering

SDOE 651 Agile Systems Engineering and Architecting: Methods, Processes and Practices
SDOE 606 Accelerated Systems Integration and Testing
SDOE 655 Robust Engineering Design
SDOE 780 Agile Development Strategy

Graduate Certificate in Systems and Supportability Engineering

SDOE 625 System Operational Effectiveness and Life Cycle Analysis (SYS 625WS is the web-based version)
SDOE 640 System Supportability and Logistics
SDOE 645 Design for System Reliability, Maintainability, and Supportability
SDOE 650 System Architecture and Design (SYS 650WS is the web-based

version)

Graduate Certificate in Systems Engineering and Architecting

SDOE 625 Systems Operational Effectiveness and Life-Cycle Analysis
SDOE 650 System Architecture and Design
SDOE 612 Project Management of Complex Systems or Mgt 550 Introduction to Project Management (for students wishing to obtain an additional certificate in Project Management)
SDOE 605 Systems Integration

Graduate Certificate in Value Chain Enterprise Systems

SDOE 640 Supportability and Logistics (SYS 640WS is the web-based version)
SDOE 665 Integrated Supply Chains
SDOE 670 Forecasting and Demand Modeling Systems or EM 744 Advanced Data Analysis and Forecasting or SYS 611 Modeling and Simulation
SDOE 675 Dynamic Pricing Systems or SDOE 660 Decision and Risk Analysis

Interdisciplinary Graduate Certificate Programs

Atmospheric and Environmental Science and Engineering (Interdisciplinary)

Pep 575 Fundamentals of Atmospheric Radiation and Climate
CE 691 Introduction to Dynamic Meteorology
ME 532/EN 506 Air Pollution Principles and Control
EN 550 Environmental Chemistry and Atmospheric Processes

Information Security

Mgt 645 CyberSecurity Principles
Mgt 762 Enterprise Architecture for Information
CS 573 Fundamentals of Computer Security
CS 694 E-Business Security & Information Assurance

Integrated Product Development

IPD 601 Integrated Product Development I
IPD 602 Integrated Product Development II
IPD 611 Simulation and Modeling
IPD 612 Project Management and Organizational Design

Pharmaceutical Manufacturing Practices

The Graduate Certificate in Pharmaceutical Manufacturing Practices is an interdisciplinary School of Engineering certificate developed by the Department of Mechanical Engineering and the Department of Chemical, Biomedical and Materials Engineering. This certificate is intended to provide professionals with skills required to work in the pharmaceutical industry. The focus is on engineering aspects of manufacturing and the design of facilities for pharmaceutical manufacturing, within the framework of the regulatory requirements in the pharmaceutical industry.

The certificate is designed for technologists in primary manufacturers, including pharmaceutical, biotechnology, medical device, diagnostic, and cosmetic companies, as well as in related companies and organizations, including architect/engineer/construction firms, equipment manufacturers and suppliers, government agencies, and universities.

(Interdisciplinary between Mechanical Engineering and Chemical Engineering)

PME 530 Introduction to Pharmaceutical Manufacturing
PME 531 Process Safety Management (ChE Graduate Course)
PME 535 Good Manufacturing Practice in Pharmaceutical Facilities

Design
PME 540 Validation and Regulatory Affairs in Pharmaceutical Manufacturing
and one of the following electives:
PME 628 Pharmaceutical Finishing and Packaging Systems
PME 538 Chemical Technology Processes in API Manufacturing
PME 649 Design of Water, Steam, and CIP Utility Systems for Pharmaceutical Manufacturing (M.E Graduate Course)

Microelectronics

EE/MT/PEP 507 Introduction to Microelectronics and Photonics
EE/MT/PEP 561 Solid State Electronics I
EE/MT/PEP 562 Solid State Electronics II
CpE/MT/PEP 690 Introduction to VLSI Design

Microdevices and Microsystems

EE/MT/PEP 507 Introduction to Microelectronics and Photonics
EE/MT/PEP 595 Reliability and Failure of Solid State Devices
EE/MT/PEP 596 Micro-Fabrication Techniques
EE/MT/PEP 685 Physical Design of Wireless Systems
Any ONE elective in the three certificates above may be replaced with another within the Microelectronics and Photonics (MP) curriculum upon approval from the MP Program Director.

Photonics

EE/MT/PEP 507 Introduction to Microelectronics and Photonics
EE/MT/PEP 515 Photonics I
EE/MT/PEP 516 Photonics II
EE/MT/PEP 626 Optical Communication Systems