Electrical and Computer Engineering Department

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Degrees Awarded
M.S. in Electrical Engineering; M.S. in Computer Engineering; Ph.D. in Electrical Engineering; Ph.D. in Computer Engineering

Web Site
http://www.stonybrook.edu/commcms/electrical/

Application
https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantLogin.asp?id=sunysb-gs

Electrical and Computer Engineering Department

The fields of electrical and computer engineering are in an extraordinary period of growth; new application areas and increased expectations are accelerating due to new technologies and decreased costs. The Electrical and Computer Engineering Department, in the College of Engineering and Applied Sciences, is involved in graduate teaching and research in many of these areas, including communications and signal processing, networking, computer engineering, semiconductor devices and quantum electronics, circuits and VLSI. The department has laboratories devoted to research and advanced teaching in the following areas: computing, engineering design methodology, high-performance computing and networking, parallel and neural processing, machine vision, fiber optic sensors and computer graphics, micro and optoelectronics, VLSI, telerobotics, DNA sequencing, digital signal processing, and communications.

Since Long Island contains one of the highest concentrations of engineering-oriented companies in the country, the department is particularly strongly committed to meeting the needs of local industry. As part of this commitment, most graduate courses are given in the late afternoon or evening, so as to be available to working engineers on Long Island.

The Department of Electrical and Computer Engineering offers graduate programs leading to the M.S. and Ph.D. degrees. Graduate programs are tailored to the needs of each student to provide a strong analytical background helpful to the study of advanced engineering problems. Ample opportunities exist for students to initiate independent study and to become involved in active research programs, both experimental and theoretical.

Areas of Emphasis in Graduate Study
Areas of emphasis in current research and instruction are: Communications and Signal Processing, Computer Engineering, Semiconductor Devices and Quantum Electronics, Circuits and VLSI.

Specialties that fall under one or more of the above categories include: VLSI, Image Processing, Computer Vision, Integrated Circuit Fabrication, Novel Electronic and Photonic Devices, Digital Communication, Biomedical Electronics, Computer-Aided Design, Computer Networks, Parallel Processing, Fault-Tolerant Computing, Microprocessors, Robotics, Network Theory, and Optical Signal Processing and Fiber Optic Sensors. Theoretical and experimental programs reflecting these areas are currently underway and students are encouraged to actively participate in these efforts. Outlined below is an overview of the Department's research areas.

Communications and Signal Processing
Subject areas of current interest include mobile, wireless and personal communications; high speed data and computer communication networks; communications traffic; data compression; coding and modulation techniques; inter-connection networks and high speed packet switching; digital communication; detection and estimation; statistical signal processing; spectrum estimation; image analysis and processing; computer vision.

Computer Engineering
The goal of computer engineering in the ECE department is to provide a balance view of hardware and software issues. The expertise in the program include parallel and/or high performance and/or energy efficient computer architecture, embedded microprocessor system design, fault tolerant computing, design communications and signal processing, parallel and distributed computing, computer networks, cybersecurity, computer vision, artificial neural networks and software engineering.

Semiconductor Devices, Quantum Electronics
The program of courses and of research pertinent to solid-state electronics, electromagnetics and optics ranges from a study of the fundamental electronic processes in solids through a description of the mechanism which yield useful devices to a study of the design simulation, and fabrication of semiconductor devices and integrated circuits. Program's scientific interests center on physics and technology of optoelectronic devices and systems. Over the past several years, major efforts were focused on the design and development of the novel semiconductor lasers and detectors. Additionally, the department has a strong experimental effort on the development of coherent optical processors, fiber optic sensors and integrated fiber optics.
Circuits and VLSI
The program in the Circuits and VLSI area addresses problems associated to modeling, simulation, design and fabrication of analog, digital, and mixed-signal integrated circuits. Analog and mixed-mode integrated circuit (IC) devices have important applications in many fields including avionics, space technology, and medical technology. The department offers basic and advanced courses covering the following subjects: integrated circuit technology, device modeling, software tools for circuit design and simulation, analog and digital circuit design, VLSI circuits, testing of analog and digital ICs, design automation for analog, digital and mixed-mode circuits, VLSI systems for communications and signal processing.

Admission requirements of Electrical and Computer Engineering Department
For admission to graduate study in the Department of Electrical and Computer Engineering, the minimum requirements are:

A. A bachelor’s degree in electrical engineering from an accredited college or university. Outstanding applicants in other technical or scientific fields will be considered, though special make-up coursework over and above the normal requirements for a graduate degree may be required.

B. A minimum grade point average of B in all courses in engineering, mathematics, and science.

C. Official Results of the Graduate Record Examination (GRE) General Test.

D. Acceptance by both the Department of Electrical and Computer Engineering and the Graduate School.

Facilities of Electrical and Computer Engineering Department
The department operates laboratories for both teaching and research:

The Computer-Aided Design Laboratory offers access to large assortment of software tools used to analyze, model, simulate, and better understand various engineering concepts. The lab comprises 40 Dell PC’s, that are networked via switched Ethernet to a Dell file server.

The Computer Vision Laboratory has a network of PC’s, digital imaging hardware, and custom built Computer Vision Systems for experimental research in 3D vision and digital image processing.

The COSINE Laboratory supports the research efforts of faculty members and graduate and undergraduate students in the areas of signal processing, communications, and networking. Current and recent research projects involve Bayesian signal processing, inference, Monte Carlo signal processing, signal modeling, machine learning, deep networks, signal processing over networks, graph signal processing, sensor signal processing, positioning and navigation, biomedical signal processing, wireless networks, radio-frequency identification, the Internet of Things, computer networking, data transmission, multiple-access systems, scheduling, network performance evaluation, grid computing, information theory, and image processing.

The Digital Signal Processing Laboratory is involved in digital signal processing architectures and hardware and software research. The laboratory has extensive list of relevant software and hardware tools.

The Fluorescence Detection Laboratory is involved in the design and development as well as implementation and testing of various instruments for Life Sciences. Research areas include laser induced fluorescence detection, single photon counting techniques, fast data acquisition and transfer, design and development of analog and digital integrated circuits, signal processing, capillary electrophoresis phenomena, DNA sequencing, and microfluidics.

The Graduate Computing Laboratory has extensive computational capabilities to support student’s research and studies. Industry standard packages such as Cadence tools, Synopsys, Matlab, and many others are available.

The Hardware Generation and Optimization (HGO) Laboratory is dedicated to the design and optimization of digital systems, with a focus on field-programmable gate arrays (FPGAs). The lab is equipped with FPGA development systems (furnished in part through donations from Xilinx, Altera, and Intel), with all related tools.

The High Performance Computing and Networking Research Laboratory is equipped to conduct research in the broad area of networking and parallel/distributed computing with emphasis on wireless/mobile networks, cloud computing, data center networks, optical networks, high-speed networks, interconnection networks and multicast communication.

The Integrated Microsystems Laboratory focuses on advancing the performance of CMOS IC at analog sensor interfaces. We investigate design of miniature, low-power, highly accurate sensing Microsystems, that have a significant and pervasive impact on a large number of applications, ranging from new generation of biomedical devices for personal health monitors, hearing aids or implantable neural prostheses to communication devices and radiation detectors.

The Nanoscale Circuits and Systems (NanoCAS) Laboratory focuses on developing design methodologies for high performance as well as energy efficient integrated circuits with a variety of applications ranging from future processors to ultra-low power Internet-of-things (IoT) based devices. The NanoCAS Lab is equipped with a high performance processing and storage server, workstations, and all necessary EDA tools for modeling, design, and analysis.

The Mixed-Domain Embedded System Laboratory is equipped for research in the broad area of electronic system design and design automation. Current research projects involve design automation for mixed analog-digital systems and embedded systems for multimedia, sensor network applications and emerging technologies.
The Mobile Computing and Applications Laboratory conducts research in mobile computing systems, especially those using sensing devices for various applications in location based services, Internet-of-Things, and healthcare. The laboratory has various latest mobile and embedded devices, and access to a cloud computing facility.

The Mobile Systems Design Laboratory conducts research in the broad areas of VLSI system designs for signal processing, communication, and heterogeneous mobile sensors. The laboratory is equipped for design and simulation of complex hardware and software systems.

The Optoelectronics Laboratory possesses the infrastructure for molecular beam epitaxial semiconductor heterostructure growth, advanced material characterization as well as fabrication (clean room) and sophisticated characterization and modeling of optoelectronics devices. The recent research projects include design and development of the novel infrared lasers, light emitting diodes, photodetectors and modulators. The laboratory is actively working on metamorphic epitaxial growth techniques to develop the new class of narrow and ultra-low bandgap alloys and superlattices for long-wave infrared photodetector and other applications.

The Ultra-High-Speed Computing Laboratory conducts research in high performance energy-efficient flux quantum computing and cybersecurity. It is equipped with powerful computing, networking, and storage facilities and advanced CAD tools for superconductor circuit design.

The Fiber Optic Sensors Laboratory (FOSL) - Research emphasis is on the development and fabrication of novel fiber optic systems for very diverse applications ranging from aerospace to biomedical. Research work has been supported by NSF, NASA, NIH and various state and industrial partners. Some of the current research projects include development of capillary waveguide based biosensors for detection of pathogens in a marine environment, laser debridement, cavity sensors for flight control surfaces, and photonic power conversion for mobile platforms. The laboratory is equipped with various capabilities for optical and electronic diagnosis. These include a fiber optic fusion splicer, fiber polisher, diamond saw, optical microscope, optical spectral analyzer, single photon-counting systems, a high speed digital autocorrelator and various laser sources. Additionally, the laboratory has the facilities for designing and fabricating printed circuit boards and fabricating optical and electronic sub-systems.

The Wireless and Networking Systems Laboratory conducts research in the area of wireless networking and mobile computing. The lab has extensive computing capabilities, a set of crossbow sensors, professional sensor test bed development kit, and other equipment for network and system research.

Requirements for the M.S. Degree in Electrical and Computer Engineering

The M.S. degree in the Department of Electrical and Computer Engineering requires the satisfactory completion of a minimum of 30 graduate credits with a cumulative and departmental grade point average of 3.0 or better. These requirements may be satisfied by either one of the following options:

Any non-ESE course will need prior approval given by the Graduate Program Director before a student can register.

I. Computer Engineering Non-Thesis Option
Admission to the M.S. program in Computer Engineering requires the student to have completed a Bachelor degree in Computer Engineering or Computer Science. Students with a Bachelor degree in Electrical Engineering could also be admitted if they have taken or will take the following courses or their equivalent:

ESE 345 Computer Architecture
ESE 380 Embedded Microprocessor Systems Design I
ESE 333 Real-Time Operating Systems

All non-ESE courses that are not on the pre-approved departmental list that you wish to use toward your degree must receive prior approval from the Graduate Program Director.

The courses listed below can only be used once to satisfy the degree requirements:

Computer Hardware: One course from the following: ESE/CSE 536 Switching and Routing in Parallel and Distributed Systems, ESE 545 Computer Architecture, ESE 565 Parallel Processing Architectures, ESE 566 Hardware-Software Co-Design of Embedded Systems, ESE 580 Microprocessor-Based Systems I, ESE 581 Microprocessor-Based Systems II.

At least three Computer Engineering courses with at least one course from each of the following three sub-areas:


At least three additional regular courses (lecture based courses) offered by the ECE department.

Up to six credits may be from ESE 597, ESE 599, or ESE 698 (only 3 credits of ESE 698 may be used)

ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are not counted as regular courses.

Also our Topics course, ESE 670, can be counted only once as a regular course credit toward the M.S. degree. Credits for ESE 597 can only be applied toward the Computer Engineering degree if the following requirements are satisfied:

Prior approval from the Graduate Program Director based on the student submitting a proposal and securing an advisor in the ECE department as well as a contact person at the company involved. Approval will only be granted if it can be demonstrated that the faculty advisor will be kept in close touch with work on the project. To this end, practicum not in the local geographic area will be discouraged.

To obtain satisfactory credit the faculty advisor must verify that a substantial engineering project was undertaken and completed. This will be based on his close contact during the entire period of the project with the student and the contact person and upon reviewing a mandatory written report submitted by the student at the project’s completion. The faculty advisor will determine the final grade for the course.

A candidate for the master’s degree may petition to transfer a maximum of 12 graduate credits from another institution towards the master’s degree requirements. Students transferring from non-matriculated status are also limited to a maximum of 12 credits for the master’s degree.

II. Computer Engineering Thesis Option

Students must inform the department in writing at the end of their first semester if they choose the M.S. Thesis Option.

All non-ESE courses that are not on the pre-approved departmental list that you wish to use toward your degree must receive prior approval from the Graduate Program Director.

The M.S. degree with thesis option requires at least 30 graduate credits with a cumulative and departmental grade point average of 3.0 or better. Among these 30 credits, at least six credits of ESE 599, with a maximum of 12 credits total being taken from ESE 597, ESE 599, or ESE 698.

PLEASE NOTE: Only 3 credits of ESE 698 may be used in above.

The courses listed below can only be used once to satisfy the degree requirements:

Computer Hardware: One course from the following: ESE/CSE 536 Switching and Routing in Parallel and Distributed Systems, ESE 545 Computer Architecture, ESE 565 Parallel Processing Architectures, ESE 566 Hardware-Software Co-Design of Embedded Systems, ESE 580 Microprocessor-Based Systems I, ESE 581 Microprocessor-Based Systems II.

At least three Computer Engineering courses with at least one course from each of the following three sub-areas:


At least one additional regular course offered by the ECE department.

ESE 597, ESE 599, ESE 697, ESE 698, and ESE 699 are not counted as regular courses.

Also our Topics course, ESE 670, can be counted only once as a regular course credit toward the M.S. degree. Credits for ESE 597 can only be applied toward the Computer Engineering degree if the following requirements are satisfied:

Prior approval from the Graduate Program Director based on the student submitting a proposal and securing an advisor in the ECE department as well as a contact person at the company involved. Approval will only be granted if it can be demonstrated that the faculty advisor will be kept in close touch with work on the project. To this end, practicum not in the local geographic area will be discouraged.

To obtain satisfactory credit the faculty advisor must verify that a substantial engineering project was undertaken and completed. This will be based on his close contact during the entire period of the project with the student and the contact person and upon reviewing a mandatory written report submitted by the student at the project’s completion. The faculty advisor will determine the final grade for the course.

A candidate for the master’s degree may petition to transfer a maximum of 12 graduate credits from another institution towards the master’s degree requirements. Students transferring from non-matriculated status are also limited to a maximum of 12 credits for master’s degrees.

Students must satisfactorily complete a thesis.

Requirements for the Ph.D. Degree in Electrical and Computer Engineering
A. Qualifying Examination
There is a major and minor part to the qualifying examination. The written examination is offered once every year, in April. Students must pass one major written examination in two consecutive tries. The two consecutive tries do not need to be in the same area. The minor requirement can be satisfied by taking and passing a second major written examination or by taking three graduate courses in a different area than the major. Previous examinations are available in the departmental office for review, however, students must make their own copies. Please refer to the department’s Graduate Student Guide for additional information on the qualifying examination.

B. Course Requirements
1. A minimum of six regular courses beyond the M.S. degree or 14 regular courses beyond the bachelor’s degree. The choice must have the prior approval of the designated faculty academic advisor. ESE 697 Practicum in Teaching (3 credits) is required to satisfy the teaching requirement. Students must be G-5 status in order to take this course. The courses ESE 597, ESE 598, ESE 599, ESE 698, and ESE 699 are not counted as regular courses. Courses presented under the title ESE 670 Topics in Electrical Sciences that have different subject matters, and are offered as formal lecture courses, are considered different regular courses but may not be counted more than once as a regular course for credit toward the M.S. degree, and not more than twice for all graduate degrees awarded by the Department of Electrical and Computer Engineering.

2. The student must satisfy the stipulations of a plan of study which must be filed with the graduate program committee within six months after the student passes the qualifying examination. The study plan, which will include the six regular courses as required in item 1, will be developed under the aegis of the designated faculty advisor (who may or may not be the eventual thesis advisor). Modification of the study plan may be made by the preliminary examination committee and at any later time by the thesis advisor. An up-to-date plan must always be placed on file with the graduate program committee each time a modification is made.

C. Preliminary Examination
A student must pass the preliminary examination within 3 years of passing the qualifying examination. Both a thesis topic and the thesis background area are emphasized.

D. Advancement to Candidacy
After successfully completing all requirements for the degree other than the dissertation, the student is eligible to be recommended for advancement to candidacy. This status is conferred by the dean of the Graduate School upon recommendation from the chairperson of the department. Students must advance advance to candidacy and pass the Preliminary Exam at least one year prior to the dissertation defense.

E. Dissertation
The most important requirement for the Ph.D. degree is the completion of a dissertation, which must be an original scholarly investigation. The dissertation must represent a significant contribution to the scientific and engineering literature, and its quality must be compatible with the publication standards of appropriate and reputable scholarly journals.

F. Approval and Defense of Dissertation
The dissertation must be orally defended before a dissertation examination committee, and the candidate must obtain approval of the dissertation from this committee. The committee must have a minimum of four members (at least three of whom are faculty members from the department), including the research advisor, at least one person from outside the department, and a committee chair. (Neither the research advisor nor the outside member may serve as the chair). On the basis of the recommendation of this committee, the dean of engineering and applied sciences will recommend acceptance or rejection of the dissertation to the dean of the Graduate School. All requirements for the degree will have been satisfied upon the successful defense of the dissertation.

G. Residency Requirement
The student must complete two consecutive semesters of full-time graduate study. Full-time study is 12 credits per semester until 24 graduate credits have been earned. After 24 graduate credits have been earned, the student may take only nine credits per semester for full-time status.

H. Time Limit
All requirements for the Ph.D. degree must be completed within seven years after completing 24 credits of graduate courses in the department.

Requirements for the Networking & Wireless Communications Certificate (Matriculated students only)
Networking and wireless communications are key technologies in today’s technological world. Networks such as the Internet as well as telephone, cable and wireless networks serve to interconnect people and computers in a ubiquitous and cost effective way. The area of wireless communications in particular has grown rapidly in recent years and has utilized networking technology to be successful. There is a large industrial base involving networking and wireless communications in terms of equipment and software providers, service providers and end users. Moreover this technology has made the average consumer’s life more productive, flexible and enjoyable.

The Stony Brook Certificate Program in Networking and Wireless Communications is designed to give matriculated students validated graduate level instruction in this area of much recent interest. The program can be completed in a reasonable amount of time as it involves only four courses. These are regular Stony Brook graduate level courses taught by Stony Brook faculty. The SUNY approved certificate program can be tailored to the needs of the individual student. Courses used for the certificate program can also be used toward the MS or PhD degree by matriculated students.

Important Note: Admission to the certificate program is limited to students enrolled in either the MS or PhD programs in the Dept. of Electrical & Computer Engineering. Students may receive the certificate if they have no more than 12 graduate credits in the department as of the start of Fall 2015.

To receive the Stony Brook Certificate in Networking and Wireless Communications, a student must complete FOUR required courses as specified below, with at least a B grade in each course.
At least ONE course from the following:

- ESE 505: Wireless Communications
- ESE 506: Wireless Networking

At least ONE course from the following:

- ESE 532: Theory of Digital Communications
- ESE 546: Networking Algorithms and Analysis
- ESE 548: Local and Wide Area Networks

In addition to the above, if needed, courses may be selected from:

- ESE 503: Stochastic Systems
- ESE 504: Performance Evaluation of Communication and Computer Systems
- ESE 522: Fiber Optic Systems
- ESE 528: Communication Systems
- ESE 531: Detection and Estimation Theory
- ESE 535: Information Theory and Reliable Communication
- ESE 536: Switching and Routing in Parallel and Distributed Systems
- ESE 543: Mobile Cloud Computing
- ESE 544: Network Security Engineering
- ESE 547: Digital Signal Processing
- ESE 550: Network Management and Planning
- ESE 552: Interconnection Networks

Students must request the Certificate from Professor Thomas Robertazzi via Email Thomas.Robertazzi@stonybrook.edu once the program is completed.

Faculty of Electrical and Computer Engineering Department

Distinguished Professors

Belenky, Gregory, Doctor of Physical and Mathematical Sciences, 1979, Institute of Physics, Baku, USSR: Design, manufacturing, and characterization of optoelectronic and microelectronic semiconductor devices; physics of semiconductors and semiconductor devices.

Djuric, Petar M., Chairperson, Ph.D., 1990, University of Rhode Island: Signal analysis, modeling and processing; wireless communications and sensor networks.

Luryi, Serge, Ph.D., 1978, University of Toronto, Canada: High speed solid-state electronic and photonic devices, physics and technology.

Yang, Yuanyuan, Ph.D., 1992, Johns Hopkins University: Wireless and mobile networks, cloud computing, data center networks, optical networks, high speed networks, parallel and distributed computing systems, multicast communication, high performance computer architecture, and computer algorithms.

Professors

Doboli, Alex, Ph.D., 2000, University of Cincinnati: VLSI CAD and design, synthesis and simulation of mixed analog-digital systems, hardware/software co-design of embedded systems, and high-level synthesis of digital circuits.

Hong, Sangjin, Ph.D., 1999, University of Michigan: Low-power VLSI design of multimedia wireless communications and digital signal processing systems, including SOC design methodology and optimization.

Parekh, Jayant P., Ph.D., 1971, Polytechnic Institute of Brooklyn: Microwave acoustics; microwave magnetics; microwave electronics; microcomputer applications.

Robertazzi, Thomas G., 1981, Princeton University: Computer networking; grid computing; performance evaluation; parallel processing; e-commerce technology.

Short, Kenneth L., Ph.D., 1973, University at Stony Brook: Digital system design; microprocessors; instrumentation.

Subbarao, Murali, Ph.D., 1986, University of Maryland: Computer vision; image processing; pattern recognition.

Associate Professors

Bugallo, Monica, Ph.D., 2001, Universidade da Coruna (Spain): Statistical signal processing with the emphasis in the topics of Bayesian analysis, sequential Monte Carlo methods, adaptive filtering, and stochastic optimization.

Dhadwal, Harbans, Ph.D., 1980, University of London, England: Laser light scattering; fiber optics; optical signal processing and instrumentation.
Donetski, Dmitri, Ph.D., 2000, Stony Brook University: Design and technology of optoelectronic devices and systems including photovoltaic and photoconductive detectors, diode lasers and diode laser arrays.

Dorojevets, Mikhail, Ph.D., 1988 Siberian Division of the USSR Academy of Sciences, Novosibirsk: Computer architectures, systems design.

Gindi, Gene, Ph.D., 1981, University of Arizona: Medical image processing; image analysis.

Gorfinkel, Vera, Ph.D., 1980, A.F. Iaffe Physical-Technical Institute, St. Petersburg, Russia: Semiconductor devices, including microwave and optoelectronics, DNA sequencing instrumentation, single photon counting techniques.

Kamoua, Ridha, Undergraduate Program Director, Ph.D., 1992, University of Michigan: Solid-state devices and circuits; microwave devices and integrated circuits.

Salman, Emre, Ph.D. 2009, University of Rochester: Nanoscale integrated circuit design, emerging technologies for future electronic systems, highly heterogeneous integrated systems, digital and mixed-signal circuits.

Shterengas, Leon, Graduate Program Director, Ph.D. 2004, Stony Brook University: High power and high speed light emitters, carrier dynamics in nanostructures, nanofabrication and molecular beam epitaxy of semiconductor nanostructures.

Stanacevic, Milutin, Ph.D., 2005, Johns Hopkins University: Analog and mixed-signal VLSI integrated circuits and systems; adaptive Microsystems; implantable electronics.


Wang, Xin, Ph.D., 2001, Columbia University: Mobile and ubiquitous computing, wireless communications and networks, grid and distributed computing, advanced applications and services over Internet and wireless networks.

**Assistant Professors**

Eisaman, Matthew, Ph.D., 2006 Harvard University: Photovoltaic devices, especially light trapping nanostructures for improved solar cell efficiency, and spatial variations at the nanoscale.

Lin, Shan, Ph.D., 2010, University of Virginia: Cyber physical systems, networked information systems, wireless networks, sensing and control systems.

Milder, Peter, Ph.D. 2010, Carnegie –Mellon University: Digital hardware design, generation, and optimization focusing on signal processing, computer vision, and related domains; design for FPGA.

Westerfeld, David, Ph.D. 2005, Stony Brook University: Design and characterization of high-performance mid-infrared semiconductor light sources (LEDs and lasers).


Zhao, Yue, Ph.D., 2011, UCLA: Smart energy systems, renewable energy integration, electricity market, infrastructure security, sensing and signal processing, optimization theory, information theory, communication networks.

Number of Teaching, Graduate, and Research Assistants in Fall 2016: 54

*NOTE: The course descriptions for this program can be found in the corresponding program PDF or at COURSE SEARCH.*