

MS in Electrical Engineering

NTU's MS in Electrical Engineering program is designed to provide students with the technical background for the analysis, design, development, operation, or research of electrical or electronic systems. Subject areas include communications, integrated circuits, and microelectronics/semiconductors. *NTU is not accepting applications in the specialty areas of control, electric power, or electromagnetics while their curricula are under review.*

The curriculum features substantial choice of courses, thereby enabling students to customize programs to meet their specific needs and fulfill their particular aspirations. Completion of the curriculum requires approximately one-and-a-half years of full-time graduate study. Part-time students enrolled through NTU, whose work schedules prevent full-time study, should expect to fulfill the requirements within five years by registering for two or three courses each academic year.

Admissions Requirements

Students must meet the following eligibility requirements for regular admission into the Electrical Engineering program:

- BS degree in electrical engineering from an ABET-accredited engineering program in the United States or a CEAB-accredited program in Canada; or the equivalent from a foreign institution.*
- Cumulative undergraduate G.P.A. of at least 2.9 on a 4.0 scale.

**Applicants without undergraduate degrees in electrical engineering will be required to complete Foundation courses prior to full admission to the program.*

Students who do not meet these requirements may be granted provisional admission into the program, depending on academic background and experience. For additional information about provisional admission status, see the Admission section of this bulletin.

Curriculum Overview

Students must complete a minimum of 33 credits for graduation. The curriculum offers specializations in the following sub-areas of electrical engineering:

- Communications
- Integrated Circuits
- Microelectronics/Semiconductors

Course requirements are specific to each specialization. For all specializations, the 33 credits must satisfy the following distribution requirements: three core courses, six concentration courses, and two elective courses.

Core Curriculum (9 credits)

The core curriculum consists of three courses and enables students to develop knowledge in topics basic to a specialized area of electrical engineering. Students should complete the core courses prior to pursuing concentration and elective courses.

Concentrations (18 credits)

Within each specialization, students select at least six courses from an area of concentration that represents the technical emphasis most compatible with their educational or career goals. Areas of concentration include signal processing, data communications, control systems, RF and microwaves, optics, digital integrated circuits, analog integrated circuits, industrial power systems, and power electronics. Students should consult an advisor or visit the NTU Web site for information about currently offered concentration areas and courses available in those areas.

Electives (6 credits)

Students may select their two elective courses from any of NTU's graduate-level courses to meet the elective requirement and to bring their total credits to a minimum of 33. Elective credits are designed to give students the opportunity to tailor the program to their individual and organizational goals and needs. Students are encouraged to consult with an NTU advisor to select appropriate elective courses.

Thesis Option

Most students are expected to pursue a non-thesis Master of Science degree program. However, when desirable and appropriate, as determined by the student in consultation with his or her academic NTU advisor, a thesis option, constituting a maximum of six credits, is available and may be substituted for the elective courses. For additional information about the thesis option and guidelines, see the Academic Information section of this bulletin.

Program of Study Plan

Admitted students should submit a Program of Study Plan (PSP) to NTU prior to completion of six semester credit hours. Failure to submit a PSP increases the possibility of students completing duplicate courses or courses that are not applicable to their degree programs. Although NTU cannot guarantee preferred course availability in any given term, the PSP documents do guide course selection from partner universities. It may be necessary for a student to revise an approved PSP when course availability does not comply with the student's needs. The PSP form should be submitted through the NTU Web site.

The following list of courses illustrates the choice of academic material available to students wishing to obtain an MS in Electrical Engineering. Individual course descriptions may be found on the NTU Web site at www.ntu.edu. *Specific courses and course requirements may change. Updates will be posted on the NTU Web site.*

Communications Specialization

Core Courses (9 credits)

Students must take the following courses to satisfy the core requirement:

CC 511	Communications Systems
CC 560	Digital Signal Processing
CC 714	Random Processes for Engineering Applications

Concentration Courses (18 credits)

Students select six courses from one concentration area to satisfy this requirement. Courses for several concentration areas in the Communications specialization are given below. Students should consult an advisor or visit the NTU Web site for information about other concentration areas and courses available in those areas.

Data Communications

CC 715	Digital Communications
CC 731	Estimation Theory
CC 740	Error Correction Coding
CC 745	Information Theory
CC 763	Advanced Digital Signal Processing
CC 781	Spread Spectrum and CDMA
CC 782	Computer Communications
CC 784	Broadband Networks and Multimedia Communications
CC 786	Principles of Broadband ISDN and ATM
CS 761	Network Computing
EM 513	Fiber Communications and Systems
ST 550	Computer Networking I
ST 754	Internet and Higher Layer Protocols

ST 760	Information Systems Security
ST 765	Cryptography
TC 583	Telecommunications Management and Regulation
TC 741	Telecommunications Network Design
TC 751	Wireless, Cellular, and Personal Telecommunications
TC 758	Wireless Internet
TC 774	Management of Telecommunications

Signal Processing

CC 731	Estimation Theory
CC 740	Error Correction Coding
CC 745	Information Theory
CC 760	Analog and Digital Filter Design
CC 764	VLSI Signal Processing
CC 766	Adaptive Signal Processing
CC 767	Electronics of Analog Signal Processing

Telecommunications and Communications Networks

CC 715	Digital Communications
CC 740	Error Correction Coding
CC 745	Information Theory
CC 782	Computer Communications
CC 784	Broadband Networks and Multimedia Communications
CC 786	Principles of Broadband ISDN and ATM
EM 513	Fiber Communications and Systems
EM 714	Advanced Fiber Optics
EM 715	Optical Detectors and Detector Systems
TC 502	Introduction to Telecommunications
TC 741	Telecommunications Network Design
TC 745	Wireless Networks
TC 751	Wireless, Cellular, and Personal Telecommunications

Wireless Communications

CC 718	Wireless Networks
CC 731	Estimation Theory
CC 740	Error Correction Coding
CC 745	Information Theory
CC 781	Spread Spectrum and CDMA
EM 530	Microwave Engineering I
EM 531	Microwave Engineering II
EM 552	Antennas and Radiowave Propagation for Personal Communications
EM 735	Microwave and RF Wireless Systems
EM 736	Active Microwave Circuits
EM 740	Electromagnetic Theory I
EM 750	Antenna Theory and Design
TC 502	Introduction to Telecommunications
TC 741	Telecommunications Network Design
TC 751	Wireless, Cellular, and Personal Telecommunications

Controls Specialization

NTU is currently not accepting applications to this concentration. The following information is intended for students admitted prior to November 2004.

Core Courses (9 credits)

Students must take the following courses to satisfy the core requirement:

CT 520	Feedback Control Systems
CT 712	Linear Systems Theory
CT 721	Control Systems Design

Concentration Courses (18 credits)

Students select six courses from one concentration area to satisfy this requirement. Courses for a concentration in the Controls specialization are given below. Students should consult an advisor or visit the NTU Web site for information about other concentration areas and courses available in those areas.

CT 570	Digital Control Systems
CT 741	Nonlinear Control
CT 511	Continuous System Modeling
CT 521	Principles of Mechatronic Control
CT 711	Dynamics of Controlled Systems
CT 722	Linear Control and Design for Multivariable Systems
CT 723	System Identification and Adaptive Control
CT 791	Modeling and Control of Electromechanical Systems

Electromagnetics Specialization

NTU is currently not accepting applications to this concentration. The following information is intended for students admitted prior to November 2004.

Core Courses (9 credits)

Students must take the following courses to satisfy the core requirement:

EM 740	Electromagnetic Theory I
MA 584	Ordinary Differential Equations
MA 780	Mathematical Methods for Science and Engineering

Concentration Courses (18 credits)

Students select six courses from one concentration area to satisfy this requirement. Courses for two concentration areas in the Electromagnetics specialization are given below. Students should consult an advisor or visit the NTU Web site for information about other concentration areas and courses available in those areas.

Optics

EM 513	Fiber Communications and Systems
EM 711	Introduction to Fourier Optics

EM 714	Advanced Fiber Optics
EM 715	Optical Detectors and Detector Systems
EM 718	Diffraction and Interferometry
EM 721	Introduction to Lasers
EM 722	Integrated Optics
CC 714	Random Processes for Engineering Applications

RF and Microwaves

EM 530	Microwave Engineering I
EM 531	Microwave Engineering II
EM 552	Antennas and Radiowave Propagation for Personal Communication
EM 735	Microwave and RF Wireless Systems
IC 545	RF Integrated Circuits
EM 750	Antenna Theory and Design
CC 510	Introduction to Communications and Signal Processing (formerly CC 510)
CC 511	Communications Systems
CC 714	Random Processes for Engineering Applications
CC 718	Wireless Networks
CC 781	Spread Spectrum and CDMA
CC 787	RF Electronics for Wireless Communication

Integrated Circuits Specialization

Core Courses (9 credits)

Students must take the following courses to satisfy the core requirement:

IC 520	Integrated Circuit Devices
CR 526	Design-Oriented Analysis of Electronic Circuits
IC 752	Computer-Aided Engineering for Integrated Circuits

Concentration Courses (18 credits)

Students select six courses from one concentration area to satisfy this requirement. Courses for several concentration areas in the Integrated Circuits specialization are given below. Students should consult an advisor or visit the NTU Web site for information about other concentration areas and courses available in those areas.

Analog Integrated Circuits

IC 534	Microelectronics Test Engineering
IC 570	Linear Integrated Circuits
IC 771	Advanced Analog Integrated Circuits
IC 776	Analysis and Design of VLSI-Analog-Digital Interface Integration
CC 760	Analog and Digital Filter Design
CR 551	Analog Signal Processing and Filtering
CT 712	Linear Systems Theory

Digital Integrated Circuits

IC 541	Introduction to Digital Integrated Circuits
IC 742	Advanced Digital Integrated Circuits

IC 776	Analysis and Design of VLSI-Analog-Digital Interface Integration
DS 710	Digital Hardware Synthesis
DS 765	Digital System Design with Hardware Description Languages
DS 766	Digital System Design and Interfacing with Verilog
DS 770	Testing and Diagnosis of VLSI Systems

Integrated Circuits for Communications

IC 545	RF Integrated Circuits
IC 570	Linear Integrated Circuits
IC 574	Integrated Circuits for Communications
IC 775	Advanced Integrated Circuits for Communications
IC 776	Analysis and Design of VLSI-Analog-Digital Interface Integration
EM 735	Microwave and RF Wireless Systems
CC 511	Communication Systems
CC 760	Analog and Digital Filter Design
CR 551	Analog Signal Processing and Filtering
CT 712	Linear Systems Theory
CC 510	Introduction to Communications and Signal Processing
CC 714	Random Processes for Engineering Applications
CC 787	RF Electronics for Wireless Communications

Power Systems Specialization

NTU is currently not accepting applications to this concentration. The following information is intended for students admitted prior to November 2004.

Core Courses (9 credits)

Students must take the following courses to satisfy the core requirement:

CM 740	Advanced Numerical Analysis
CT 712	Linear Systems Theory
EM 740	Electromagnetic Theory I

Concentration Courses (18 credits)

Students select six courses from one concentration area to satisfy this requirement. Courses for several concentration areas in the Power Systems specialization are given below. Students should consult an advisor or visit the NTU Web site for information about other concentration areas and courses available in those areas.

Bulk Power Systems

PS 512	Power Systems Analysis
PS 713	Analysis of Distribution Systems
PS 752	Power System Stability
PS 755	Power System Protection
PS 757	Power Quality Phenomena in Power Systems
PS 761	Power Economics and Regulation

PS 735	Direct Energy Conversion
PS 562	Electricity Resource Planning
PS 760	Power System Operation in a Less Regulated Environment
PS 731	Energy Conversion

Industrial Power Systems

PS 512	Power Systems Analysis
PS 713	Analysis of Distribution Systems
PS 530	Introduction to Electric Drive Systems
PS 734	Dynamics and Control of AC Drives
PS 730	Electric Machinery Analysis
PS 742	Solid-State Power Conversion
PS 755	Power System Protection

Power Electronics and Drives

PS 512	Power Systems Analysis
PS 713	Analysis of Distribution Systems
PS 530	Introduction to Electric Drive Systems
PS 734	Dynamics and Control of AC Drives
PS 741	Power Electronics
PS 747	Power Electronics II
PS 749	Power Electronics III

Elective Courses (6 credits)

Students may select their two elective courses from any of NTU's graduate-level courses, provided they have the appropriate prerequisite knowledge.

Foundation Courses

Foundation courses are available for those students who do not have an adequate preparation to begin a master's program in Electrical Engineering. Undergraduate Foundation courses for students entering graduate study in Electrical Engineering are available in the topical areas given below. Foundation courses cannot be taken for graduate credit. Please see the NTU Web site for a current set of Foundation courses.

CC 310-319	Communications Systems (formerly BE 40-49 Systems)
CR 310-319	General Circuit Theory (formerly BE 10-19 Circuits)
DS 360-369	Digital Hardware Design (formerly BC 20-29 Digital Logic Design)
EM 340-349	Electromagnetic Field Theory (formerly BE 30-39 Electromagnetics)
IC 320-329	Electronic Devices and Modeling (formerly BE 20-29 Electronics)
PS 330-339	Energy Conversion (formerly BE 50-59 Systems)