CLARENCE M. MITCHELL, JR. SCHOOL OF ENGINEERING

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MASTER OF SCIENCE – ELECTRICAL ENGINEERING (M.S.)

Purpose

The primary purpose of the Master of Science in electrical engineering degree program is to prepare individuals for the practice of electrical engineering. The program emphasizes the theory and application of advanced electrical engineering principles utilizing theoretical, computational and analytical methods and tools. The goal of the program is to produce forward-looking engineering professionals who are capable of making significant contributions to society.

Objectives

The M.S. in electrical engineering degree program is designed to:

- Support the student to be successful in his/her academic and professional objectives;
- Develop an appreciation for research, application, engineering design and the product/process realization continuum;
- Develop a consciousness for and commitment to the importance of life-long learning; and
- Generate a cadre of well-trained engineering professionals.

Admission

Admission requirements to the M.S.E.E. degree program are commensurate with the admission requirements of the School of Graduate Studies. Applicants should hold a Bachelors of Science in electrical engineering from an Accreditation Board for Engineering and Technology (ABET) accredited institution. Applicants holding degrees in computer science, mathematics, physics, and other science and mathematics-related fields and who are currently pursuing careers closely aligned with engineering will be considered for admission to the program. An applicant who has deficiencies in foundation courses, as defined by an advisor or departmental committee, may be required to complete successfully a number of undergraduate courses with a goal of meeting minimum departmental requirements. Undergraduate courses, taken for this purpose, may not be used to fulfill any of the requirements for the master's degree. In addition, applicants must satisfy other requirements as specified by the School of Graduate Studies.

General Requirements

The Master of Science in electrical engineering will provide two degree options in one of four areas of concentration; 1) RADAR, 2) signals intelligence, 3) power and energy and 4) communications. Both options require nine core EEGR courses related to the area of concentration and a minimum of 18 electrical engineering courses taken towards the degree. The course only option requires 33 course credits and a scholarly project, and the thesis option requires 24 credits and two thesis courses (29 credits).

Program of Study

Below are the courses by area of concentration.

RADAR Concentration
Core Courses
EEGR 532: Microwave Transmission
EEGR 624: Detection and Estimation Theory
EEGR 635: Advanced Electromagnetic Theory

Electives Courses
EEGR 507: Applied Probability and Statistical Analysis
EEGR 508: Advanced Linear Systems
EEGR 524: Introduction to RADAR
EEGR 535: Active Microwave Circuit Design
EEGR 536: Antenna Theory and Design
EEGR 542: Microwave Power Devices
EEGR 543: Introduction to Microwaves
EEGR 637: Advanced Antenna Theory
EEGR 503: Communications Theory
EEGR 607: Information Theory
EEGR 610: Wireless Communications
EEGR 551: Digital Signal Processing
EEGR 622: Adaptive Signal Processing
EEGR 623: Pattern Recognition

Power and Energy Concentration
Core Courses
EEGR550: Fundamentals of Energy and Power Systems
EEGR555: Advanced Power Electronics
EEGR554: Renewable Energy Systems

Elective Courses
EEGR 542: Microwave Power Devices
EEGR553: Electric Drives and Machines
EEGR556: Modeling and Control Techniques in Power Electronics
EEGR557: Smart Grid and Building Energy Efficiency
EEGR 635: Advanced Electromagnetic Theory
IEGR512: Advanced Project Management
IEGR572 : Design & Analysis of Energy Systems
IEGR573: Applied Thermodynamics & combustion
IEGR571: Advanced Internal Combustion Engine
CEGR514: Environmental Engineering

Signals Intelligence Concentration
Core Courses
EEGR 507: Applied Probability and Statistical Analysis
EEGR 508: Advanced Linear Systems
EEGR 607: Information Theory

Electives Courses
EEGR 503: Communications Theory
EEGR 543: Introduction to Microwaves
EEGR580: Introduction to Cyber Security
EEGR581: Introduction to Network Security
EEGR582: Introduction to Communications Security
EEGR583: Introduction to Security Management
EEGR 520: Digital Image Processing
EEGR 522: Digital Signal & Speech Processing
EEGR 551: Digital Signal Processing
EEGR 620: Digital Image Processing
EEGR 622: Adaptive Signal Processing
EEGR 623: Pattern Recognition
EEGR 624: Detection and Estimation Theory
EEGR 626: Optimization/Numerical Methods
EEGR 679: Cryptography and Information Security
EEGR 722: Advanced Topics in Image Processing

Communications Concentration
Core Courses
EEGR 507: Applied Probability and Statistical Analysis
EEGR 508: Advanced Linear Systems
EEGR 607: Information Theory

Electives Courses
EEGR 503: Communications Theory
EEGR 510: Communications Networks
EEGR 605: Digital Communications
EEGR 607: Information Theory
EEGR 608: Error Control Coding
EEGR 610: Wireless Communications
EEGR 543: Introduction to Microwaves
EEGR 536: Antenna Theory and Design
EEGR 551: Digital Signal Processing
EEGR 612: Multi User Communications
EEGR 614: Queueing Networks
EEGR 615: High Speed Networks
EEGR 625: Optical Communication

EEGR 680: Switching Theory: High Speed Networks

EEGR 715: Advanced Topics in Communications

BACHELOR OF SCIENCE TO MASTER OF SCIENCE – ELECTRICAL ENGINEERING (B.S./M.S.)

The purpose of the Bachelor of Science/Masters of Science (B.S./M.S.) degree program is to enable well qualified and highly motivated undergraduates students majoring in Electrical Engineering to obtain both a bachelor's and master's degree in a minimum of five years. The B.S./M.S. program is applicable to the Bachelor of Science (B.S.) degree and the Master of Science (M.S.) degree in Electrical Engineering within the Clarence M. Mitchell, Jr. School of Engineering. The goal of the B.S./M.S. program is to accelerate the production of electrical engineering professionals who are capable of entering into the technology workforce and making significant contributions to society, while safeguarding the environment.

Admission Criteria

The B.S./M.S. program allows students to begin graduate study (concurrent with undergraduate work) in the second semester of their junior year. Students are allowed to apply for admission into the program upon completion of 79 credits. For consideration of admission into the B.S./M.S. program, a student must:

- Complete 85 credits (a minimum of 30 credits of general education requirements, a minimum of 20 credits of Science and Math requirements, and a minimum of 23 credits of electrical engineering requirements).
- Have a minimum grade point average (GPA) of 3.30.
- Submit a completed application form,
- Submit three (3) written recommendations from MSU faculty, one of which must be from an MSU faculty member within the Department of Electrical and Computer Engineering who would serve as the candidate's primary advisor, and
- Submit a plan of study, signed by the anticipated primary advisor, outlining the tentative courses to be pursued in the program and the anticipated concentration in the program of study.

The application is submitted in the first instance to the graduate coordinator in the Department of Electrical and Computer Engineering. Applications determined to be eligible, following review by a committee of electrical engineering faculty, shall be forwarded to the School of Graduate Studies.

General Requirements

All students who seek candidacy into the B.S./M.S. program will be required to complete the B.S. degree requirements and the M.S. degree requirements for electrical engineering. Up to six credits of graduate coursework may count towards the undergraduate degree. For the M.S., the thesis option requires 24 credits and two thesis courses (29 credits).

Program of Study

The Master of Science in electrical engineering will provide an M.S. degree in one of four areas of concentration; RADAR, signals intelligence, power and energy and communications. The degree requires nine core EEGR courses related to the area of concentration and a minimum of 18 electives taken towards the degree. Students must complete a thesis, which requires 24 course credits and two thesis courses (29 credits). Successful completion and oral defense of the Thesis is required. Students accepted for candidacy into the B.S./M.S. program may begin taking graduate courses in their junior year. Candidates will complete these courses during the fifth year.

Below are the courses by area of concentration.

RADAR Concentration

Core Courses
EEGR 532: Microwave Transmission
EEGR 624: Detection and Estimation Theory
EEGR 635: Advanced Electromagnetic Theory

Electives Courses
EEGR 507: Applied Probability and Statistical Analysis
EEGR 508: Advanced Linear Systems
EEGR 524: Introduction to RADAR
EEGR 535: Active Microwave Circuit Design
EEGR 536: Antenna Theory and Design
EEGR 542: Microwave Power Devices
EEGR 543: Introduction to Microwaves
EEGR 637: Advanced Antenna Theory
EEGR 503: Communications Theory
EEGR 607: Information Theory
EEGR 610: Wireless Communications
EEGR 551: Digital Signal Processing
EEGR 622: Adaptive Signal Processing
EEGR 623: Pattern Recognition

Signals Intelligence Concentration

Core Courses
EEGR 507: Applied Probability and Statistical Analysis
EEGR 508: Advanced Linear Systems
EEGR 607: Information Theory

Electives Courses
EEGR 503: Communications Theory
EEGR 543: Introduction to Microwaves
EEGR580: Introduction to Cyber Security
EEGR581: Introduction to Network Security
EEGR582: Introduction to Communications Security
EEGR583: Introduction to Security Management
EEGR 520: Digital Image Processing
EEGR 522: Digital Signal & Speech Processing
EEGR 551: Digital Signal Processing
EEGR 620: Digital Image Processing
EEGR 622: Adaptive Signal Processing
EEGR 623: Pattern Recognition
EEGR 624: Detection and Estimation Theory
EEGR 626: Optimization/Numerical Methods
EEGR 679: Cryptography and Information Security
EEGR 722: Advanced Topics in Image Processing

Power and Energy Concentration

Core Courses
EEGR550: Fundamentals of Energy and Power Systems
EEGR555: Advanced Power Electronics
EEGR554: Renewable Energy Systems

Elective Courses
EEGR 542: Microwave Power Devices
EEGR553: Electric Drives and Machines
EEGR556: Modeling and Control Techniques in Power Electronics
EEGR557: Smart Grid and Building Energy Efficiency
EEGR 635: Advanced Electromagnetic Theory
IEGR512: Advanced Project Management
IEGR572 : Design & Analysis of Energy Systems
IEGR573: Applied Thermodynamics & combustion
IEGR571: Advanced Internal Combustion Engine
CEGR514: Environmental Engineering

Communications Concentration

Core Courses
EEGR 507: Applied Probability and Statistical Analysis
EEGR 508: Advanced Linear Systems
EEGR 607: Information Theory

Electives Courses
EEGR 503: Communications Theory
EEGR 510: Communications Networks
EEGR 605: Digital Communications
EEGR 607: Information Theory
EEGR 608: Error Control Coding
EEGR 610: Wireless Communications
EEGR 543: Introduction to Microwaves
EEGR 536: Antenna Theory and Design
EEGR 551: Digital Signal Processing
EEGR 612: Multi User Communications
EEGR 614: Queueing Networks
EEGR 615: High Speed Networks
EEGR 625: Optical Communication
EEGR 680: Switching Theory: High Speed Networks
EEGR 715: Advanced Topics in Communications

Maintaining Eligibility

Candidates in the B.S./M.S. Program are expected to maintain a high level of scholastic achievement. Admitted students must maintain a minimum GPA of 3.0 to remain in good standing as required by the School of Graduate Studies. Candidates who fall below the minimum cumulative grade point average of 3.0 for two consecutive semesters will be removed from the program.

A student may decide to opt out of the B.S./M.S. program; however, they must complete all requirements for the traditional B.S. degree program. The B.S./M.S. program curriculum is designed such that candidates who successfully complete their coursework through the end of the senior year will automatically qualify them for completion of the B.S. degree requirements. Graduate courses successfully completed up to this time, may be applied to the traditional graduate program. Once a candidate has opted out of the program, the candidate is no longer eligible for the B.S./M.S. program degree. In order to receive a Master's degree at Morgan State University, the student will then have to apply to a traditional two year program.

Candidates who are removed from the program or otherwise opt out of the program are eligible to receive the traditional bachelor's degree in electrical engineering upon completion of the requirements for the BS degree.

Degrees Received

Upon completion of minimum requirements, students receive both the Bachelor of Science and the Master of Science degrees. The Bachelors of Science degree will be awarded from the Electrical & Computer Engineering department. The M.S. degree will be awarded from the School of Graduate Studies. A student may elect to receive only a B.S. degree, but must complete the requirements for the traditional B.S. degree program.

CLARENCE M. MITCHELL, JR. SCHOOL OF ENGINEERING

COURSE DESCRIPTIONS

ELECTRICAL AND COMPUTER ENGINEERING

EEGR 503: Communications Theory
Three Hours: 3 Credits
This course introduces students to the basic concepts in communication theory. It includes an introduction to analog AM and FM modulation, digital modulation, baseband and bandpass digital communication, communication link analysis, channel coding, modulation and coding trade-offs.

EEGR 505: Advanced Engineering Mathematics with Computational Methods
Three Hours: 3 Credits
Advanced math topics including matrix analysis, vector and tensor calculus and complex variables. Infinite series expansions and their use as solutions of variable coefficient differential equations. Partial differential equations, nonlinear differential equations and systems of differential equations. Integral transforms. Evaluation of infinite integrals. Elliptical integrals and functions; Green's functions; Bessel, Laguerre, and Legendre functions; Tensor analysis; Jacobians; diffusion, wave, Laplace and Poisson equations.

EEGR 507: Applied Probability and Statistical Analysis
Three Hours: 3 Credits
Modeling and analysis of random processes. Random variables, transforms and their probability laws. Probability assessment and decision analysis. Limit theorems. Applications using numerical methods.

EEGR 508: Advanced Linear Systems
Three Hours: 3 Credits
This course focuses on fundamental concepts for the analysis of linear systems in the discrete and continuous domains. A discussion of core topics in linear algebra for the analysis of systems of equations, including matrix representations of linear operators, eigenvector-eigenvalue analysis, and the Cayley-Hamilton theorem will be covered. Additionally, topics in system theory including system stability, controllability and observability will be discussed.

EEGR 510: Communications Networks
Three Hours: 3 Credits
An introduction to communication networks. Includes the OSI layering model of networks with emphasis on the physical, data link, and network layers; and network topologies. Introduction to a variety of computer, satellite, and local-area communication networks, including Ethernet, Internet, packet radio, and the telephone network.

EEGR 520: Digital Image Processing
Three Hours: 3 Credits
This course covers topics relevant to the understanding, feature extraction, and modification of images. Included in this course will be the necessary theoretical background as well as practical exercises in image processing. Topics include 2-D system theory, image transforms, image analysis, image enhancement and restoration, image coding, automatic pattern recognition, image processing hardware and software.

EEGR 522: Digital Signal and Speech Processing
Three Hours: 3 Credits
The course covers of digital signal processing and an introduction to techniques for speech signal processing. Includes: linear predictive coding (LPC), pattern recognition, compression, speech physiology, and other topics of interest.

EEGR 524: Introduction to RADAR
Three Hours: 3 Credits

This course introduces the student to the fundamentals and basic principles of radar system engineering. The radar range equation, radar transmitters, antennas, and receivers are covered. Concepts of matched filtering, pulse compression, and fundamentals of radar target detection in a noise background are discussed.

EEGR 531: Linear Control Systems
Three Hours: 3 Credits
This course deals with the analysis of time and frequency response of closed loop systems, Routh-Hurwitz and Nyquist criteria for stability, Root locus method, and System specifications.

EEGR 532: Microwave Transmission
Three Hours: 3 Credits
This course will cover the fundamental concepts of Maxwell's equations, wave propagation, network analysis, and design principles as applied to modern microwave engineering. Topics include planar transmission lines, bipolar and field effect transistors, dielectric resonators, low-noise amplifiers, transistor oscillators, PIN diode control circuits and monolithic integrated circuits.

EEGR 534: Microwave System and Components
Three Hours: 3 Credits
This course provides the practical aspects of microwave systems and components. An overview of communication and radar systems is followed by detailed analysis of key components. Topics include linear and nonlinear characteristics of individual components and their relationship to system performance.

EEGR 535: Active Microwave Circuit Design
Three Hours: 3 Credits
This course will provide a brief overview of Smith Charts and transmission line theory, microstrip lines, and impedance matching. It will introduce power gain equations, stability considerations, and solid state microwave circuits such as amplifiers, oscillators, active mixers, attenuators, and frequency multipliers.

EEGR 536: Antenna Theory and Design
Three Hours: 3 Credits
This course deals with the analysis and design of basic antenna structures such as linear dipoles, antenna arrays, horns, and patch antennas. Computer-aided design software will be used to optimize antenna performance, placement of feeds, and gain.

EEGR537: Radio Frequency Integrated Circuit Design
Three Hours: 3 Credits
This course covers the design and analysis of radio-frequency integrated circuits at the transistor level using state-of-the-art complementary metal-oxide-semiconductor (CMOS) and bipolar technologies. It focuses on system-level trade-offs in transceiver design, practical radio-frequency circuit techniques, and a physical understanding of device parasitics.

EEGR 540: Solid State Electronics
Three Hours: 3 Credits
This course will focus on the fundamentals of solid state physics as it applies to electronic materials and devices. A discussion of core topics including three-dimensional bulk material properties and recent developments in low-dimensional semiconductor structures, such as heterostructures, superlattices and quantum wells will be covered. In addition, various material growth and device fabrication techniques will be discussed.

EEGR 542: Microwave Power Devices
Three Hours: 3 Credits
This course introduces microwave power devices and circuits including amplifiers, P-i-N and Schottky power rectifiers, power MOSFETs, conductivity-modulated high-power devices, wide band gap semiconductors, and emerging material technologies in relation to device modeling.

EEGR 543: Introduction to Microwaves
Three Hours: 3 Credits
This course deals with electromagnetic wave types, transmission lines and waveguides, Smith Chart, S-parameters, and passive components associated with microwave signals and circuits.

EEGR550 Fundamentals of Energy and Power Systems
Three Hours: 3 Credits
This course will provide a high level view of energy and power from a systems perspective. Major components of power systems and the technical specifications in relation to various industries will be explored.

EEGR 551 Digital Signal Processing
Three Hours: 3 Credits
This course provides an emphasis on applications of digital signal processing. It includes the theory and application of the discrete Fourier transform, Fast Fourier Transform, Sampling, Quantization, and Digital filter design.

EEGR553 Electric Drives and Machines
Three Hours: 3 Credits
This course provides an integrated approach to electric drives and subsystems that make up electric drives: electric machines, power electronics based converters, mechanical system requirements, feedback controller design, and the interaction of drives with the utility grid.

EEGR554 Renewable Energy Systems
Three Hours: 3 Credits
This course provides a multidisciplinary approach that encompasses economic, social, and environmental, policy, and engineering issues related to renewable energy. The renewable systems covered will be solar PV, solar thermal, geothermal, bioenergy, wind, and hydroelectric.

EEGR555 Advanced Power Electronics
Three Hours: 3 Credits
This course provides an approach to the design power electronic converters. Topics include state average modeling, inverter design, resonant converters, snubber circuits, and feedback control design.

EEGR556 Modeling and Control Techniques in Power Electronics
Three Hours: 3 Credits
The objective of this course is to provide the theory of control technology with various control strategies to effectively control power systems. Microprocessors and control algorithms based on PWM will be investigated in relation to switching devices and feedback control.

EEGR557 Smart Grid and Building Energy Efficiency
Three Hours: 3 Credits
This course provides a comprehensive approach towards smart grid that encompasses sensors, communications technologies, computational ability, control, and feedback mechanisms that effectively combined to create the smart grid system.

EEGR 560: Computer Networks
Three Hours: 3 Credits
ISO open systems reference model, protocol layers, TCP/IP, channel coding, data communication concepts, local area network (LAN) topologies and transmission media, queuing theory applied to LAN performance modeling, LAN access techniques, network interconnection, network reliability, network security, performance analysis of ring and bus topology networks, reliability of fiber optic ring networks.

EEGR 562: Computer Architecture, Networks, and Operating Systems
Three Hours: 3 Credits

Quantitative basis of modem computer architecture, processor designs memory hierarchy, and input/output methods. Layered operating system structures, process and storage management Layered network organization, network protocols, switching, local and wide area networks. Examples from Unix and the Internet.

EEGR 570: Advanced Digital System Design
Three Hours: 3 Credits
Introduces alternative means by which a logic system may be realized and the variety of technologies available. Reviews logical factors of digital systems and the architecture of FPGAs along with the options and trade-offs for diverse approaches. Small and modest sized design implementations on different FPGA architectures will be covered.

EEGR 575: Software Engineering: Systems Implementation
Three Hours: 3 Credits
Implementation aspects of software engineering; Programming languages; architectural designs; program design; structured programming; peripheral storage devices; I/O programming, debugging and evaluation.

EEGR580 Introduction to Cyber Security
Three Hours: 3 Credits
This course will provide an overview of all aspects of cyber-security including business, policy and procedures, communications security, network security, security management, legal issues, political issues, and technical issues. This serves as the introduction to the cyber security program.

EEGR581: Introduction to Network Security
Three Hours: 3 Credits
This course will provide a background in the many aspects of security associated with today's modern computer networks including local area networks and the internet. It includes the fundamentals of network architecture, vulnerabilities, and security mechanisms including firewalls, guards, intrusion detection, access control, malware scanners and biometrics.

EEGR582 Introduction to Communications Security
Three Hours: 3 Credits
This course will provide a background in the many aspects of communications security associated with today's modern communications and networks. It includes the fundamentals of cryptography, encryption, public and private key structures, digital signature and secure hash functions.

EEGR583 Introduction to Security Management
Three Hours: 3 Credits
This course will provide a background in the many aspects of security management associated with today's modern communications and networks. It includes the fundamentals of Risk Analysis, Risk Management, Security Policy, Security Operations, Legal issues, Business issues and Secure Systems Development.

EEGR 605: Digital Communications
Three Hours: 3 Credits
Digital Communications Systems is a foundation course for digital communications. It provides a brief review of signals, probability, stochastic processes and information theory followed by the development of source encoding, modulation systems, optimum receiver design, demodulation systems, and error correction coding. Special topics will be included based on time available and student interest.

EEGR 607: Information Theory
Three Hours: 3 Credits
This course presents measures of information, information sources, coding for discrete sources, the noiseless coding theorems, Huffman coding, channel capacity, the noisy-channel coding theorems and block and convolu-tional error-control coding and decoding techniques.

EEGR 608: Error Control Coding
Three Hours: 3 Credits
This course includes a review of information theory with the theory and design of error detection and correction schemes. Includes block and convolutional codes, interleaving, ARQ schemes, error detection schemes, and a variety of applications on wired and wireless networks.

EEGR 610: Wireless Communications
Three Hours: 3 Credits
This course presents current techniques on wireless digital communications, such as wireless channel modeling, channel distortion due to multipath and Doppler, digital modulation and demodulation (MODEM) techniques, and multiple access methods including TDMA, FDMA and CDMA systems.

EEGR 612: Multi User Communications
Three Hours: 3 Credits
Review of network architectures using OSI layering strategies. Includes Queueing theory application to various queues; and reservation, polling, and token passing systems. Protocol designs for radio multichannel networks with various contention strategies. Local area network protocols, performance and strategies.

EEGR 614: Queueing Networks
Three Hours: 3 Credits
Addresses the fundamentals of stochastic processes and queuing theory. Includes Poisson processes, Markov chains, renewal processes, tandem queues, networks of queues, priority and bulk queues, computational methods, and simulation. Application and performance with a variety of computer and communications applications.

EEGR 615: High Speed Networks
Three Hours: 3 Credits
Introduction to the design of high data rate, integrated services protocols that designed for high speed multi-media applications such as video, voice, data and internet traffic. The TCP/IP, IEEE8O2.x LAN, and Asynchronous Transfer Mode (ATM). Introduction to Routing and Queuing Theory is included. Topics include switching architectures, network management and control.

EEGR 620: Digital Image Processing
Three Hours: 3 Credits
This is an introduction course on the fundamentals of digital image processing with an emphasis on signal processing. Topics included: image formation, images transforms, image enhancement image restoration, image reconstruction, image compression, image segmentation and image representation.

EEGR 622: Adaptive Signal Processing
Three Hours: 3 Credits
This course addresses adaptive digital signal processing for applications such as equalization and array processing. Emphasizes the theory and design of finite-impulse response adaptive filters including stochastic processes, Weiner filter theory, the method of steepest descent, adaptive filters using gradient-methods, analysis of the LMS algorithm, least--squares methods, recursive least squares, and least squares Iattice adaptive filters.

EEGR 623: Pattern Recognition
Three Hours: 3 Credits
This course addresses the general pattern classification problem. It includes: statistical decision theory, multivariate probability functions, discriminants, parametric and nonparametric techniques, Bayesian and maximum likelihood estimation, feature selection, dimensionality reduction, transformations, and clustering.

EEGR 624: Detection and Estimation Theory
Three Hours: 3 Credits
This is a course on statistical decision theory, modeling of signals and noise, detection of various signals, and statistical estimation theory. Includes decision criteria, hypothesis testing, receiver operating characteristics,

detection of signals with unknown parameters, performance measures, Cramer Rao bounds, and optimum demodulation.

EEGR 625: Optical Communication
Three Hours: 3 Credits
Includes the characteristics of light as used in communications systems including propagation of rays in wave-guides, scalar diffraction theory, optical information processing systems, quantum statistical communication theory, heterodyning and receivers.

EEGR 626: Optimization/Numerical Methods
Three Hours: 3 Credits
This course investigates both classical deterministic optimization techniques and stochastic optimization techniques. The classical techniques will include linear and non-linear programming, steepest descent, and Newton-Raphson methods. Stochastic methods will include Robbins-Monro gradient-based stochastic approximation and the simultaneous perturbation stochastic approximation algorithms. Application cases will be included throughout the course, including neural-network training, nonlinear control, sensor configuration, image processing, and discrete-event systems. Simulation-based optimization and computer-based homework will be given.

EEGR 633: Automated Measurements, Devices and Systems
Three Hours: 3 Credits
This course will consider microwave active circuits utilizing semiconductor devices. Circuits using unipolar (FETs), bipolar (Transistor), and diode devices will be examined. Linear amplifier analysis techniques including unilateral gain, maximum available gain, noise figure circles, and stability circles will be covered. Students will be introduced to the fundamentals of high-frequency measurements and the latest techniques for accuracy-enhanced microwave measurements. Automated network analyzers and high-speed wafer probes are used in conjunction with state-of-the-art calibration techniques. Microwave computer-aided analysis and design tools will be used to evaluate active circuits. None-linear modeling of active devices will be introduced.

EEGR 634: Computational Electromagnetics
Three Hours: 3 Credits
The finite-element method (FEM), the finite-difference (FD), the finite-difference-time-domain (FDTD), and the method of moments (MoM) are versatile tools that find important applications in electromagnetic engineering. This course will focus on several electromagnetic field equations, such as Laplace's, Poisson's, and Helmholtz's equations, and the related numerical techniques for their approximate solutions to problems for which closed-form solutions may not be obtained.

EEGR 635: Advanced Electromagnetic Theory
Three Hours: 3 Credits
This course is a first-year graduate course on electromagnetic theory and applications. Topics include Stokes parameters, Poincare sphere, gyrotropic media, uniaxial media, phase matching, layered media, dielectric wave-guides, metallic waveguides and resonators, Cerenkov radiation, Hertzian dipole, equivalence principle, and reciprocity.

EEGR 636: Quantum Mechanics
Three Hours: 3 Credits
This is a survey course on quantum mechanics that covers a broad range of topics that are useful to students in electrical and computer engineering such as: Lagrangian and Hamiltonian equations, Schrodinger equation, wave packets, particle in a box, tunneling of particles, Dirac's description of quantum mechanical states and matrix formulation of quantum mechanics, and perturbation theory.

EEGR 637: Advanced Antenna Theory
Three Hours: 3 Credits

This course develops fundamental concepts used to analyze basic antenna systems. Topics include antenna patterns, optimum designs for rectangular and circular apertures, arbitrary side lobe topography, discrete arrays, mutual coupling, and feeding networks.

EEGR 640: Advanced Solid State Electronics
Three Hours: 3 Credits
This course will focus on the fundamentals of solid state physics as it applies to electronic materials and devices. A discussion of core topics including bulk material properties and recent developments in low-dimensional semiconductor structures, such as heterostructures, superlattices and quantum wells will be covered. Additionally, various material growth and device fabrication techniques will be discussed.

EEGR 642: Semiconductor Fabrication Technology
Three Hours: 3 Credits
An overview of the fundamental principles of semiconductor fabrication technology is presented. It covers both the practical and the theoretical aspects including the use of predictive engineering tools. Topics include basic material review; methods of oxidation; methods of deposition/diffusion and ion implantation, principles of epitaxial deposition/ growth, photolithographic technology ,chemical vapor deposition/nitride, silicon dioxide, metallization technology, evaporation/sputtering; and electrical inline wafer testing.

EEGR 643: Advanced Semiconductor Characterization
Three Hours: 3 Credits
This course is an advanced approach to the measurement of physical principles underlying semiconductor device operation. This concept is reinforced through the application of these measurements to specific devices. Topics include measurement techniques of the critical relevant physical parameters in semiconductor material and device structures such as: impurity profiling, carrier transport, and deep and shallow level trap characterization.

EEGR 645: Optical Engineering
Three Hours: 3 Credits
This course presents the engineering concepts necessary to understand and evaluate optical systems. It begins with a brief but rigorous treatment of geometric optics, including matrix methods, aberrations, with practical examples of optical instruments and electro-optical systems. Other topics include polarization, interference, diffraction, and optical properties of crystals, thin-films, optical resonators, guided waves, modulators and detectors. The concepts are presented with examples from modern optical systems such as fiber-optical sensors, rangefinders, infrared systems, and optical communication systems.

EEGR 646: Optical Communication
Three Hours: 3 Credits
This course provides an overview of communication systems, light and electromagnetic waves, optical fibers, lasers, LED, photodetectors, receivers, optical fiber communication systems.

EEGR 660: Computer Architecture and Design
Three Hours: 3 Credits
Principles and advanced concepts and state-of-the-art developments in computer architecture: memory systems, pipelining, instruction-level parallelism, storage systems, multiprocessors, relationships between computer design and application requirements, and cost/performance tradeoffs. Additional topics include particular emphasis will be placed on architectures for DSP applications.

EEGR 662: Parallel Processing Architecture
Three Hours: 3 Credits
This course addresses fundamental issues in the design and use of large-scale multiprocessors. Both software and hardware issues are addressed. In the software area, the course will examine parallel applications and their computation requirements, including how they are expressed using parallel programming languages. The course will also look at runtime software that provides the system-level support needed in a parallel architecture. In the

hardware area, the course will examine all facets of the design of multiprocessors, including processor support for parallelism, memory system design, and interconnection networks.

EEGR 664: Introduction to Parallel Computation
Three Hours: 3 Credits
Motivation for parallel processing, technological constraints, complexity, performance-characterization, communications, interconnection networks, reconfiguration and fault tolerance, systolic arrays, memory systems, large-bandwidth input/output, disk arrays, on-line visualization, coarse and fine-grain processor design, parallel FORTRAN and C, finite-difference and finite-elements, parallel optimization and transformation algorithms, selected signal and image processing applications, selected architectures: DAP, NCUBE, CM-2, and MasPar.

EEGR 666: Parallel Algorithms
Three Hours: 3 Credits
The design and analysis of efficient algorithms for parallel computers. Fundamental problem areas, such as sorting, matrix multiplication, and graph theory, are considered for a variety of parallel architectures. Simulations of one architecture by another.

EEGR 668: Topics in Networking and Network Applications
Three Hours: 3 Credits
We will discuss how existing and emerging data communication technologies can meet special application requirements. The course covers LAN and WAN Technologies, Bridging, Switching, Routing, Networking Protocols, Management, Design and Security as well as Multicast, Videoconferencing, Multimedia Collaboration Technologies and Audio/Video compression and coding. The course material is designed as an introduction to the field and a practical guide for designing and planning networks. Note that the word “topics” in the title means that the course content will vary to reflect current or interesting topics and applications in the field.

EEGR 670: **DSP VLSI Design**
Three Hours: 3 Credits
DSP VLSI architecture and algorithms; design strategies; design methodologies; system-level design; area/delay/power trade-offs; high performance systems; multi-chip modules; low-power design; hardware/software co-design; design for testability, design for manufacturability; algorithm, architecture, and component design for adaptive computing systems; prototype system development and test, possible chip fabrication by MOSIS and subsequent chip testing.

EEGR 672Computer Graphics
Three Hours: 3 Credits
This course gives a multi perspective overview of computer graphics with emphasis on high performance hardware and software techniques to model, render and display computer imagery. Representative topics include: geometric and raster algorithms, curves and surfaces, object hierarchy, display technologies, video controllers and processors, and input devices.

EEGR 675: Computer Vision
Three Hours: 3 Credits
Image formation and visual perception. Images, line structure, and line drawings. Preprocessing, boundary detection, texture, and region growing. Image representation in terms of boundaries, regions, and shape. Three-dimensional structures and their projections. Analysis, manipulation, and classification of image data. Knowledge-based approaches to image understanding. Applications from fields of robot vision, biomedical-image analysis, and satellite and aerial image interpretation.

EEGR 677: Object Oriented Analysis and Design: Modeling, Analysis, and Optimization of Embedded Software
Three Hours: 3 Credits
Modeling, Analysis, and Optimization of Embedded Software. Current techniques in software engineering with topics selected from economics, reusability, reliable software, program analysis, reverse engineering, CASE tools, automatic code generation, and project management techniques.

EEGR678: Network Security
Three Hours: 3 Credits
This course will provide a background in the many aspects of security associated with the protection of computer networks It includes Network attacks and advanced topics in vulnerabilities, networks security management, firewalls, guards, intrusion detection, access control, malware scanners and biometrics.

EEGR 679: Security in Network and Link Applications
Three Hours: 3 Credits
Security Architecture for open, closed and mixed network topologies. Introduction to security mechanism design and implementation.

EEGR 680: Switching Theory: High Speed Networks
Three Hours: 3 Credits
This course reviews the development and performance of state-of-the-art switching architectures of broadband networks based on the current standards. Of particular interest will be networks based on the ATM standard because of their gaining global popularity for flexibility in providing integrated transmission of sound, image and data signals.

EEGR 682: Design Patterns of Object Oriented Software Systems
Three Hours: 3 Credits
This course introduces students to the principles of design patterns applied to the design of complex systems. It covers foundational patterns, creational pattern types, structural pattern types, behavioral pattern types, and applications of design patterns.

EEGR 684: Machine Learning Algorithms
Three Hours: 3 Credits
This course introduces students to the principles of machine learning to solve complex computational engineering problems. Topics to be covered include neural networks, evolutionary algorithms, and swarm intelligence.

EEGR/CEGR 695: Discrete-Time Control Engineering
Three Hours: 3 Credits
Design of controllers for discrete-time systems, with emphasis on linear sampled-data control. Single-loop digital controllers. Discrete-time state space design. Discrete-time optimal control; dynamic programming, H-2 and H infinity optimal linear sampled-data control. Digital computer simulation of sampled-data control systems. Realization of microcomputer real-time control systems. Design problems and applications with hands-on experience.

EEGR 710: Wireless Communications II
Three Hours: 3 Credits
This is an advanced topic in wireless which encompasses advanced signal processing and communications techniques applied to wireless applications including: Spread Spectrum, adaptive equalization, rake receiver design, multiple access schemes, wireless protocols and wireless networks. Applications include cellular, satellite, wireless LAN, and wireless internet.

EEGR 715: Advanced Topics in Communications
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 720: Advanced Topics in Signal Processing
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 722: Advanced Topics in Image Processing
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 725: Advanced Topics in Control Theory
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 730: Special Topics in Microwave Engineering
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 732: Special Topics in Electromagnetics
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 740: Special Topics in Solid State and Optical Electronics
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 742: Special Topics in Microelectronics
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 760: Special Topics in Computer Engineering
Three Hours: 3 Credits
This course will address selected advanced topics on this subject that are of interest to the students and instructor.

EEGR 788: Seminar I
One Hour: 1 Credit
This is the first part of an advanced seminar course taken during the first two semesters of the master of engineering program in which students from different engineering disciplines (Civil, Electrical, and Industrial Engineering) work together to identify and solve problems.

EEGR 789: Seminar II
One Hour: 1 Credit
This is the second part of an advanced seminar course taken during the first two semesters of the master of engineering program in which students from different engineering disciplines (Civil, Electrical, and Industrial Engineering) work together to identify and solve problems.

EEGR 790: Independent Study
2 to 6 Credits
The course of Independent Study is a program of research consisting of directed reading and/or laboratory work under the direction of a graduate faculty member. The program of study will be performed in accordance with an agreed upon plan and culminate in a report or paper. This course can be taken for 2 to 6 credits consistent with the proposed effort.

EEGR 795: Project Report I
Two Hours: 2 Credits
Project report I is to let students learn how to prepare a real project. This course emphasizes the continued analysis and the design of a specific electrical engineering problem under the guidance of a faculty advisor.

EEGR 796: Project Report II
Two Hours: 2 Credits
Project report II is to let students learn how to conduct a real project. This course emphasizes the continued analysis and the design of a specific electrical engineering problem under the guidance of a faculty advisor.

EEGR 797: Thesis Guidance
Two Hours: 2 Credits
Thesis guidance provides students who have not completed their thesis in EEGR 799 a mechanism for continuing work under faculty supervision. Thesis Guidance courses earn “S” grades.

EEGR 799: Thesis Seminar
Three Hours: 3 Credits
This is the initial course for students conducting research and writing a thesis under faculty supervision. The grade is “CS” until the thesis is completed and approved. Students are required to take EEGR 799 before EEGR 797.

EEGR 997: Dissertation Guidance
Three Hours: 3 Credits
Dissertation guidance provides students who have not completed their dissertation in EEGR 998 a mechanism for continuing their work under faculty supervision. Dissertation Guidance courses earn “S” grades.

EEGR 998: Dissertation Seminar
Six Hours: 6 Credits
Dissertation seminar provides for the overall guidance of a doctoral student by the Doctoral Advisory Committee in the preparation of the dissertation. In particular, the Major Advisor, who is also Chair of the Doctoral Advisory Committee, provides direct and continuous guidance in the development of a proposal, proposal defense, research implementation, and dissertation defense. The grade is “CS” until the dissertation is completed and approved. Students are required to take EEGR 998 before EEGR 997.