

Graduate Program in Electrical Engineering

The graduate program is beginning in the spring semester of 2004. We are ramping the program up so please be aware when reading the program description that not all graduate courses are being offered at this time. The following material is offered for reference only and will be superseded by information in the NMTech course catalog.

Master of Science in Electrical Engineering

The Electrical Engineering graduate program provides students with unique research opportunities due to its close association with many research facilities. These facilities include Energetic Materials Research Testing Center, Langmuir Laboratory, Magdalena Ridge Observatory, National Radio Astronomy Observatory, Incorporated Research Institutions for Seismology and Institute for Complex Additive Systems; all easily accessible from campus. These facilities can provide opportunities for students to participate in research related to leading scientific and engineering projects and allow them to achieve highly desired educational and research experiences.

The student's course of study must be approved by the student's advisory committee, must fulfill the general requirements for the master's degree and must include any two of the following courses:

- EE 521 Measurement and Instrumentation
- EE 531 Advanced Digital Design
- EE 544 Modern Control Systems
- EE 554 Embedded Control Systems
- EE 570 Advanced Topics in Electrical Engineering

At least 12 semester hours must be approved Electrical Engineering courses. No more than 6 semester hours of advanced undergraduate course work may be used to satisfy the degree requirements. Students are required to take at least 6 credit hours from outside the Electrical Engineering department. Students may choose between an M.S. with thesis (24 credit hours of courses with 6 thesis hours) or an M.S. with independent study (27 credit hours of courses with 3 thesis hours). Students may be required to take an appropriate software course if they don't have an appropriate programming background.

A five-year B.S. / M.S. Electrical Engineering degree can be achieved by fulfilling the separate requirements of both an undergraduate degree and a graduate degree in Electrical Engineering in a 5 year period. A combined minimum of 158 credit hours with at least 16 credit hours of 500 level courses and Independent Study (EE 581) is required. Students in the Electrical Engineering five-year program must normally apply for graduate standing at the end of their seventh semester. Graduate admission will be contingent upon adherence to the approved program of studies. Graduate status will be granted on fulfillment of the requirements for the B.S. degree.

Graduate Electrical Engineering Courses:

EE 500: Directed Research: cr to be arranged.

Prerequisites: Graduate Standing.

Offered both Spring and Fall semester. Credits cannot be applied towards the 30 credit hours required for graduation. Research under the guidance of a EE faculty member.

EE 521: Measurement and Instrumentation: 4cr, 3cl +11 hrs

Prerequisites: EE308, EE322, and EE 342 (or equivalent) or instructor's consent.

Survey of various sensors and transducers for measuring physical quantities; measurement errors; analog and digital interfaces; sampling; quantization; actuators; and sensing devices in closed-loop control. Digital interfacing to the measurement devices for both experimentation and microprocessor control will be performed using a computer equipped with data acquisition hardware and software.

EE 531: Advanced Digital Design: 4cr, 3cl +11 hrs

Prerequisites: EE 231 (or equivalent) or instructor's consent.

Advanced topics in digital design. Synchronous and asynchronous state machines. Timing issues in high-speed digital design. Design of a complex system using the VHDL programming language in a CAD environment. Shares lecture/lab with EE 431, but is graded separately and additional graduate-level work is required.

EE 533: Optical/RF Engineering: 3cr, 3cl hrs

Prerequisites: EE 324, EE 334 (or equivalent) or instructor's consent.

Explore various topics in data links and telemetry including RF links, antennas, satellite communications, and optical fiber links. Projects will include design and fabrication of basic RF antenna and a case study of a satellite communications system.

EE 537: Photonics: 4cr, 3cl hrs + 11 hrs

Prerequisites: Graduate standing, EE334 or instructor's consent.

Topics include the generation, propagation, manipulation and detection of light from low to high energy. Uses and applications of optical systems: simple optics, binary and Fourier optics, electro-optics, wavefront analysis, modal decomposition, inversion techniques for wavefront reconstruction and correction and optical signal processing. Other advanced topics in optics.

EE 544: Modern Control Theory: 4cr, 3cl + 11 hrs

Prerequisites: EE443 and MATH 454 (or equivalent) or instructor's consent.

Treatment of modern approach to control system design primarily via state-space analysis techniques for both continuous and discrete time systems. Topics include the realization of MIMO models for real-systems, linear feedback control, the design of observers, optimal control, and concepts in stability. The latter part of

the course will address recent advanced topics of current relevance. Associated hardware and software-based lab/project(s) will include the use of PC based data acquisition systems. Shares lecture/lab with EE 444, but is graded separately and additional graduate-level work is required.

EE 545: Digital Communication I: 3cr, 3cl hrs

Prerequisites: EE 446 (or equivalent) or instructor's consent.

Digital communication systems; response time requirements and control of user errors. Spread spectrum modulation and the fundamental limitations dictated by information theory. Various types of modulation and multiplexing including BPSK, QAM, QPSK, OQPSK. Statistical analysis of various modulation schemes.

EE 546: Digital Communication II: 3cr, 3cl hrs

Prerequisites: EE 546 or instructor's consent.

Spread-spectrum modulation, frequency hopping techniques, error control coding, multiple access techniques including TDMA (time division multiple access) and CDMA (code division multiple access). Various advanced case studies. Analysis of imperfections; noise and distortion line failures, data errors, delays and blocking, treatment of errors.

EE 548: Manipulator based Robotics: 4cr, 3cl hrs + 1l hrs

Prerequisites: EE443 (or equivalent) or instructor's consent.

Fundamentals of the multi-disciplinary field of robotics. Emphasis is placed on understanding how to model and control robotic manipulators while providing an appreciation of the importance of sensing to robotic applications. Topics include: forward, inverse, and motion kinematics; dynamic modeling; position, velocity, and force control. Shares lecture/lab with EE 448, but is graded separately and additional graduate-level work is required.

EE 551: Discrete-Time Signal Processing, Filtering, and Estimation: 3cr, 3cl hrs,

Prerequisites: EE 451, MATH 254, and MATH 382

The Fast-Fourier transform and its computer implementation; spectral estimation; analytic signals; multi-dimensional signal processing; digital filters. Signal detection and estimation, Kalman Filters, linear predictive coding, and adaptive filters. Project(s) include the design and implement a Kalman filter for GPS data processing and LPC for speech recognition.

EE 552: Image Processing and Data Compression Techniques: 3cr, 3cl hrs

Prerequisites: EE 451, MATH 254, and MATH 382

The basics of two-Dimensional digital Signal Processing, image representation and human vision including color models, image transformation and video compression techniques (including JPEG and MPEG). Study of relevant current applications including HDTV.

EE 554: Embedded Control Systems: 4cr, 3cl +1l hrs

Prerequisites: EE 308 and EE443 (or equivalent) or instructor's consent.

Micro-controller or microcomputer based embedded control systems. A comparative survey of currently available embedded computers/controllers including SBC's, PICs, basic-stamps, and single-chip computer solutions. Real time operating systems, including real-time LINUX, and hard real-time process requirements. Projects will include the implementation of an embedded real-time control solution.

EE 562: Microwave Engineering & Radar: 3cr, 3cl hrs

Prerequisites: EE 334 (or equivalent) or instructor's consent.

Transmission media: waveguides, microstrip and glass fiber. Ferrite devices and cavity resonators. Equivalent circuits using scattering and transmission matrices. Active components in microwave circuits.

EE 569: Wireless Communications: 3cr, 3cl hrs

Prerequisites: EE 446 (or equivalent courses) or instructor's consent.

Signaling: exchange, subscriber loops, and local loops, transmission media, and multiplexing. Switching: network switching, space-division and panel switching, and various digital-switching methods. Cellular telephony, data networks and communication protocols.

EE 570: Advanced Topics in Electrical Engineering: 4cr, 3cl +1l hrs

Prerequisites: E&M (or equivalent) or instructor's consent.

Emerging technologies and specializations in Electrical Engineering addressed from the perspective of embedded systems and advanced design.

EE 581: Directed Study: cr to be arranged.

Prerequisites: Permission of graduate advisor.

EE 590: Independent Study: cr to be arranged.

Prerequisites: Permission of graduate advisor.

Independent research supervised by a faculty member. It is expected that this work will culminate in a paper to be published and an oral presentation is required.

EE 591: Thesis (Master's Program): cr to be arranged.

EE 592: Graduate Seminar: 1cr, 1cl hrs.

Prerequisites: Graduate Standing.

Offered both Spring and Fall semester. Credits cannot be applied towards the 30 credit hours required for graduation.