

Electrical Engineering

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Degrees Offered: B.S. in Electrical Engineering; M.S. in Electrical Engineering

Mission

The mission of the New Mexico Tech Electrical Engineering Department is two-fold: (1) to develop and maintain a program of excellence in teaching which ensures that our graduates have technical knowledge and professional skills they need to become effective engineers in the rapidly-changing technical environment of today's society, so that these graduates will contribute to the growth and development of New Mexico and our nation, and (2) to develop and maintain state-of-the-art research programs which are responsive to the needs of industry and government, which provide excellent educational opportunities for students, and which provide an environment for intellectual growth and excitement.

Objectives

The objectives of our program are that our graduates will have:

1. A strong background in basic mathematics, science and engineering fundamentals.
2. A strong foundation in the basics of electrical engineering needed for professional competence and for graduate studies.
3. Depth in at least one area of electrical engineering.
4. The skills and ability to apply theoretical knowledge to the solution of real-world engineering problems.
5. The ability to communicate both orally and in writing.
6. The ability to work effectively in teams.
7. An understanding of the ethical choices inherent in the engineering profession.
8. An ability to solve complex engineering problems.

Undergraduate Program

The Department of Electrical Engineering concentrates on a high-quality undergraduate program in electronics and design, combined with a firm intellectual foundation in the fundamentals of circuits, signals, and systems. As with other degree programs at Tech, students are also provided with a breadth of knowledge in the basic sciences, mathematics, humanities, and social sciences.

Laboratories constitute an important part of the electrical engineering program. The laboratories are closely coupled with the lecture parts of courses and utilize modern, state-of-the-art equipment. Personal computer-based instruments and software packages provide students with up-to-date engineering and design techniques.

Design is integrated into all aspects of the curriculum. Students take an "Introduction to Design" course in the second semester of their junior year. This and their other course work prepare students for two Senior Design Project courses, in which students apply material learned in the classroom to real-world problems. Projects are available from the greater Tech community, including Tech research labs, Langmuir Laboratory for Atmospheric Research, the Energetic Materials Research and Testing Center, and the VLA and VLBA facilities of the National Radio Astronomy Observatory.

Five-year programs are available in which students obtain dual degrees in electrical engineering and in related fields such as computer science, physics, or mathematics.

Graduates of Tech's electrical engineering program will be well equipped with the practical skills necessary for immediate employment, as well as with the intellectual base for graduate studies and lifelong learning.

Bachelor of Science in Electrical Engineering

Minimum credit hours required—130

In addition to the General Degree Requirements (page 48), the following courses are required:

- Electrical Engineering core: EE 211 (3), 212 & 212L (4), 231 & 231L (4), 308 & 308L (4), 321 & 321L (4), 333 (3), 341 (3), 342 (3), 382 (3), 481 (3), 482 (3)
- Introduction to problem-solving and computer skills: CS 111 (4) and one of EE 101 (2); ES 110 (2); CS 122 (3).
- Mathematics core: MATH 231 (4), 254 (3), 332 (3), 382 (3)
- Electrical Engineering electives: a minimum of seven credit hours, including at least one lab credit hour, from Electrical Engineering 300- and 400-level courses, excluding the Electrical Engineering core classes listed above.
- Engineering/Computer Science electives. Six hours from the following:
 - Electrical Engineering courses numbered 200 and above (excluding EE core and elective classes)
 - Computer Science courses except CS 111 and 122
 - Other engineering dept. courses numbered 200 and above
 - Engineering Science courses numbered 200 and above, except ES 316 and 332

At least three credit hours must be from outside the Electrical Engineering Department.

- Electives to complete 130 credit hours. Without prior departmental approval, the following cannot be used for these electives: ENGL 103; MATH 101, 103, 104, 105; PR courses; or New Mexico Tech Community College courses.

To enroll in an Electrical Engineering Department class, the student must pass all prerequisites with a grade of C- or better. In addition, students must be in good academic standing to enroll in EE 382 and EE 481.

Students pursuing a B.S. degree in Electrical Engineering must take all Electrical Engineering courses for a letter grade.

All engineering majors are required to take the Fundamentals in Engineering (FE) exam as a requirement for graduation.

While fulfilling the General Degree Requirements (page 48), Electrical Engineering students must also satisfy a depth requirement in the humanities or social sciences. Each Electrical Engineering student is required to take at least nine credit hours in a single area chosen from the following. Three of the credit hours must be 300-level or above.

1. Literature (including SPAN 352)
2. Philosophy
3. History
4. Economics (ES 316 is excluded)
5. Psychology
6. A single foreign language that is not the student's native language. *Note: Lower-division language courses do not fulfill the humanities requirement*

Students may substitute sequences in Art History or Music after obtaining the consent of the Electrical Engineering Department.

Sample Curriculum for the Bachelor of Science in Electrical Engineering

Semester 1

- 4 MATH 131 (calculus)
- 5 PHYS 121 & 121L or 131 & 131L (general)
- 4 CHEM 121 & 121L (general)
- 3 ENGL 111 (college English)

16 Total credit hours

Semester 2

- 4 MATH 132 (calculus)
- 5 PHYS 122 & 122L or 132 & 132L (general)
- 4 CHEM 122 & 122L (general)
- 2 EE 101 (introduction to electrical engineering)

15 Total credit hours

Semester 3

4	MATH 231 (calculus)
3	EE 211 (circuits)
4	EE 231 & 231L (digital electronics)
4	CS 111 (programming)
3	ENGL 112 (college English)
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18	Total credit hours

Semester 4

3	MATH 254 (linear algebra)
3	MATH 332 (vector analysis)
4	EE 212 & 212L (circuits)
4	EE 308 & 308L (microcontrollers)
3	Social Science
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17	Total credit hours

Semester 5

4	EE 321 & 321L (analog electronics)
3	EE 333 (electricity and magnetism)
3	EE 341 (continuous time signals)
3	ENGL 341 (technical writing)
3	Humanities
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16	Total credit hours

Semester 6

3	EE 342 (discrete time signals)
3	EE 382 (introduction to design)
3	MATH 382 (probability)
3	Electrical Engineering Elective
3	Humanities
3	Social Science
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18	Total credit hours

Semester 7

3	EE 481 (senior design project)
4	Electrical Engineering Elective with lab
3	Engineering/Computer Science Elective
3	Social Science
2	Free Electives
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15	Total credit hours

Semester 8

3	EE 482 (senior design project)
3	Engineering/Computer Science Elective
3	Humanities/Social Science
6	Free Elective
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15	Total credit hours

Sample Curriculum for Dual Degrees in Electrical Engineering and Mathematics—160 Credit Hours Total*Semester 1*

4	MATH 131 (calculus)
5	PHYS 121 & 121L or PHYS 131 & 131L (general)
4	CHEM 121 & 121L (general)
3	ENGL 111 (college English)
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16	Total credit hours

Semester 2

4	MATH 132 (calculus)
5	PHYS 122 & 122L or 132 & 132L (general)
4	CHEM 122 & 122L (general)
2	EE 101 (introduction to electrical engineering)
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15	Total credit hours

Semester 3

4	MATH 231 (calculus)
3	MATH 254 (linear algebra)
4	EE 231 & 231L (digital electronics)
4	CS 111 (programming)
3	Social Science
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18	Total credit hours

Semester 4

3	MATH 335 (applied analysis)
3	MATH 352 (basic concepts)
4	EE 308 & 308L (microcontrollers)
3	ENGL 112 (college English)
3	Humanities
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16	Total credit hours

Semester 5

3	EE 211 (circuits)
3	MATH 332 (vector analysis)
3	MATH 372 (basic analysis)
3	Engineering/Computer Science Elective
3	Social Science
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15	Total credit hours

Semester 6

4	EE 212 & 212L (circuits)
3	MATH 221 (discrete mathematics)
3	MATH 382 (probability)
3	MATH 454 (linear algebra)
3	Humanities
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16	Total credit hours

Semester 7

4	EE 321 & 321L (analog electronics)
3	EE 333 (electricity and magnetism)
3	EE 341 (continuous time signals)
3	ENGL 341 (technical writing)
3	Social Science
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16	Total credit hours

Semester 8

3	EE 342 (discrete time signals)
3	EE 382 (introduction to design)
3	Engineering/Computer Science Elective
3	Free Elective
3	Humanities/Social Science
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15	Total credit hours

Semester 9

3	EE 481 (senior design project)
4	Electrical Engineering Elective with Lab
3	Senior Math Sequence
3	MATH 430 (mathematical modeling)
4	Free Electives
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17	Total credit hours

Semester 10

3	EE 482 (senior design project)
3	Electrical Engineering Elective
3	Senior Math Sequence
7	Free Electives
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16	Total credit hours

Sample Curriculum for Dual Degrees in Electrical Engineering and Physics—160 Credit Hours Total*Semester 1*

4	MATH 131 (calculus)
5	PHYS 121 & 121L or PHYS 131 & 131L (general)
4	CHEM 121 & 121L (general)
3	ENGL 111 (college English)
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16	Total credit hours

Semester 2

4	MATH 132 (calculus)
5	PHYS 122 & 122L or 132 & 132L (general)
4	CHEM 122 & 122L (general)
2	EE 101 (introduction to electrical engineering)
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15	Total credit hours

Semester 3

4	MATH 231 (calculus)
3	MATH 254 (linear algebra)
4	EE 231 & 231L (digital electronics)
3	PHYS 232 (modern)
4	CS 111 (programming)
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18	Total credit hours

Semester 4

3	MATH 332 (vectors)
3	MATH 335 (applied analysis)
4	EE 308 & 308L (microcontrollers)
4	PHYS 242 (waves)
3	ENGL 112 (college English)
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17	Total credit hours

Semester 5

3	EE 211 (circuits)
3	PHYS 321 (mechanics)
3	PHYS 333 (electricity and magnetism)
3	Social Science
3	Foreign Language
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15	Total credit hours

Semester 6

4	EE 212 & 212L (circuits)
3	Physics 334 (electromagnetic waves)
1	PHYS 336L (electrical & magnetic measurements lab)
3	PHYS 340 (quantum theory)
3	Humanities
3	Foreign Language
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17	Total credit hours

Semester 7

4	EE 321 & 321L (analog electronics)
3	EE 341 (continuous time signals)
3	PHYS 411 (thermodynamics)
3	ENGL 341 (technical writing)
3	Engineering/Computer Science Elective
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16	Total credit hours

Semester 8

3	EE 342 (discrete time signals)
3	EE 382 (introduction to design)
3	MATH 382 (probability)
1	PHYS 380 (practicum in problem solving)
3	Engineering/Computer Science Elective
3	Social Science
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16	Total credit hours

Semester 9

3	EE 481 (senior design project)
4	Electrical Engineering Elective with Lab
3	PHYS 443 (atomic and nuclear)
3	Humanities
3	Social Science
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16	Total credit hours

Semester 10

3	EE 482 (senior design project)
3	Electrical Engineering Elective
3	MATH 336 (applied analysis)
2	PHYS 451 (senior lab)
3	Humanities/Social Science
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14	Total credit hours

Additional sample curricula can be found on the Electrical Engineering Department homepage at <http://www.ee.nmt.edu>

Minor in Electrical Engineering

Minimum credit hours required—21

The following courses are required:

- EE 211 (3), 212 & 212L (4), 231 & 231L (4), 321 & 321L (4)
- Six (6) additional credit hours of Electrical Engineering courses numbered 300 and above.

Graduate Program

Master of Science in Electrical Engineering

The Electrical Engineering graduate program provides students with unique research opportunities thanks to its close association with many research facilities. These facilities include Energetic Materials Research and Testing Center, Langmuir Laboratory, Magdalena Ridge Observatory, National Radio Astronomy Observatory, Incorporated Research Institutions for Seismology and Institute for Complex Additive Systems Analysis; 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 desirable 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 (page 27) 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 six (6) semester hours of advanced undergraduate course work may be used to satisfy the degree requirements. Students are required to take at least six (6) credit hours from outside the Electrical Engineering department. Students may choose between an M.S. with thesis (24 credit hours of courses with six (6) thesis hours) or an M.S. with independent study (27 credit hours of courses with three (3) independent study 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 five-year period. A combined minimum of 158 credit hours with at least 16 credit hours of 500-level courses and Directed 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.

Electrical Engineering Courses:

The Department of Electrical Engineering encourages students from other majors to take electrical engineering courses. Students from other disciplines who are interested in taking Electrical engineering courses should inquire at the department office.

EE 101, Introduction to Electrical Engineering 1 cr, 1 cl hr

Corequisite: MATH 103; EE 101L

A broad overview of electrical engineering, including an introduction to analog and digital circuitry. Practical exercises using the EE department's computer-based applications software and lab equipment.

EE 101L, Introduction to Electrical Engineering Lab, 1 cr, 3 lab hrs

Corequisite: EE 101

EE 211, Circuits and Signals I, 3 cr, 3 cl hrs

Prerequisite: MATH 132

Normally offered fall semester

Principles of electrical circuit analysis. Kirchhoff's laws, equivalent circuits, dependent sources, node and mesh analyses, signals, RLC components. Introductory circuits and operational amplifier circuits as examples.

EE 212, 212L, Circuits and Signals II, 4 cr, 3 cl hrs, 3 lab hrs

Prerequisite: EE 211

Corequisites: EE 212 and 212L are corequisites of each other.

Normally offered spring semester

Continuation of EE 211, Laplace transform techniques, transient response, steady-state sinusoidal response, and frequency response of RLC circuits.

EE 231, 231L, Digital Electronics, 4 cr, 3 cl hrs, 3 lab hrs

Corequisites: EE 101 or ES 111 or CS 111. EE 231 and 231L are corequisites of each other.

Normally offered fall semester

Foundation of combinational digital system analysis and design; including Boolean algebra, logic gates, and truth tables. Sequential digital design via finite state machines. Lab provides exposure to computer-aided design software and programmable logic hardware.

EE 308, 308L, Microcontrollers, 4 cr, 3 cl hrs, 3 lab hrs

Prerequisites: CS 111; EE 231 and 231L

Corequisites: EE 308 and 308L are corequisites of each other.

Normally offered spring semester

Introduction to microcontrollers. Elementary assembly- and C-language programming, bus structures, parallel and serial interfaces, support devices. Using logic analyzers and disassemblers in circuit testing. Using microcontrollers in measurement and control applications.

EE 321, 321L, Analog Electronics, 4 cr, 3 cl hrs, 3 lab hrs

Prerequisites: EE 212 and 212L; PHYS 122 or 132

Corequisites: EE 321 and 321L are corequisites of each other.

Normally offered fall semester

Basic principles and use of operational amplifiers, diodes, field-effect transistors, and bipolar junction transistors in electronic circuits.

EE 322, 322L, Advanced Electronics, 4 cr, 3 cl hrs, 3 lab hrs

Prerequisites: EE 231 and 231L, 321 and 321L, and 341

Corequisites: EE 322 and 322L are corequisites of each other.

Applications in analog electronics. Topics include timing and switching circuits, power supply techniques, active filters, switched capacitor circuits, oscillators, and phase-locked loops.

EE 324, Semiconductor Theory and Devices, 3 cr, 3 cl hrs

Prerequisite: PHYS 122 or 132

Corequisite: EE 321

Fundamentals of semiconductor materials and devices. Topics include introduction to quantum mechanics and electrical conduction in conductors, insulators, and semiconductors. The theory is applied to pn junctions, bipolar and field-effect transistors and opto-electronic devices.

EE 333, Electricity and Magnetism, 3 cr, 3 cl hrs

Prerequisites: MATH 332 and PHYS 122 or 132

Electric and magnetic fields in free space and in matter. Energy storage as a function of field quantities and the relation of this to capacitance and inductance. Maxwell's equations applied to simple electrostatic and magnetostatic problems, plane waves, and transmission lines. Transient and sinusoidal steady state solutions of uniform transmission line problems modeled in terms of circuit parameters.

EE 334, Electromagnetic Wave Transmission and Radiation, 3 cr, 3 cl hrs

Prerequisite: EE 333

Reflection and refraction of plane waves at planar interfaces. The propagation characteristics of metallic and dielectric waveguides with particular emphasis on fiber optics. Radiation from linear current elements and planar apertures and arrays of these elements. Analysis of simple communication links.

EE 341, Continuous Time Signals and Systems, 3 cr, 3 cl hrs

Prerequisites: EE 212 and MATH 254

Principles of linear time-invariant systems. Dynamic systems, Laplace transforms, system functions, poles and zeros, frequency domain, Fourier transforms, feedback systems, continuous-time convolution.

EE 342, Discrete Time Signals and Systems, 3 cr, 3 cl hrs

Prerequisite: EE 341

Normally offered spring semester

Discrete time systems, z-transform, discrete-time convolution. Impulse response, sampling in time and frequency domains, modulation, discrete Fourier transform.

EE 352, Microcomputer Interfacing, 2 cr

Prerequisite: EE 308 and 308L

Design of hardware and software for microcomputer interfacing. Bus signals and timing. Interrupt and direct memory access handling. Students will design, build, program, and test a simple interface card for a common microcomputer bus.

EE 382, Introduction to Design, 3 cr

Prerequisites: EE 308, 308L, 321, 321L, and 341

Normally offered spring semester

A course in design methodology as applied to a particular problem in electronics. For a given project, students will integrate their formal course work with the use of computer-aided tools to design, construct, evaluate, and document a prototype electronic system.

EE 408, Cooperative Education

On-the-job training to supplement the academic program. Students alternate periods (usually six months long) of full-time semiprofessional employment in Electrical Engineering with periods of full-time academic study. A written report of the student's activities will be required at the end of the training.

EE 435L, RF and Microwave Laboratory, 1 cr, 3 lab hrs

Corequisite: EE 334

Experiments in radio frequency and microwave techniques and measurements.

EE 443, Intermediate Control Theory, 3 cr, 3 cl hrs

Prerequisite: EE 341

Modeling of dynamical systems via differential equations, transfer functions, and state-space methods. Performance, characterization, and behavior of linear feedback-systems. Design of various types of control schemes to meet performance specifications.

EE 443L, Intermediate Control Theory Lab, 1 cr, 3 cl hrs

Corequisite: EE 443 or MENG 405

Use of computer based data acquisition and control (DAC) hardware and software. Model validation and verification of physical systems. Implementation of real-time control schemes utilizing actuators and sensors.

EE 446, Introduction to Communications Theory, 3 cr, 3 cl hrs

Prerequisite: MATH 382

Corequisite: EE 342

Principles of communication theory. Modulation techniques, random signals and noise, analysis of communication systems in presence of noise, digital communication, matched filters, channel capacity, multiple access.

EE 448, Robotics: Modeling, Control and Sensing, 3 cr, 3 cl hrs

Prerequisite: EE 342 or MENG 405

An introduction to the multi-disciplinary field of robotics. Emphasis is placed on learning how to characterize, model, and control robotic manipulators. Provides an appreciation of the importance of sensing to robotic applications.

EE 451, Digital Signal Processing, 3 cr, 3 cl hrs

Prerequisites: EE 308 and 342

Principles of digital signal processing. Infinite and finite impulse response filters, discrete and fast Fourier transforms, multirate processing, spectral estimation, quantization effects, system design.

EE 451L, Digital Signal Processing Lab, 1 cr, 3 lab hrs

Corequisite: EE 451

Implementation of real-time DSP algorithms on state-of-the-art hardware. Principles discussed in class will be demonstrated with real applications. Labs include design and implementation of infinite and finite impulse response filters, communication systems, sound processing, and other applications.

EE 481, 481L, Senior Design Project I, 3 cr*Prerequisites: EE 342 and 382**Normally offered fall semester*

Student design teams begin an academic year long capstone design project under the supervision of a faculty advisor. Each team may undertake a different project and will build a team, determine design requirements, perform detailed planning, identify project needs and establish goals leading toward the successful completion of the project. Periodic design reviews and reports, applications of engineering skills, project management and formal presentations are major components of the program. Successful completion of the project requires the application of electronics, applied physics, numerical computation, signal processing and other electrical engineering techniques to real-world engineering problems.

EE 482, 482L, Senior Design Project II, 3 cr*Prerequisite: EE 481**Normally offered spring semester*

A continuation of the capstone design projects begun in EE 481. The student teams bring their design projects to successful conclusion. Status reports, a final presentation to faculty and reviewers and the submission of a senior thesis are included in the program.

EE 491, Special Topics, hrs and crs to be arranged**EE 500, Directed Research, cr to be arranged***Prerequisite: 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, 4 cr, 3 cl hrs, 3 lab hrs*Prerequisites: EE 308, 322, and 342 or equivalent or consent of instructor*

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: 4 cr, 3 cl hrs, 3 lab hrs*Prerequisite: EE 231 or equivalent or consent of instructor*

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, 3 cr, 3 cl hrs*Prerequisites: EE 324 and 334 or equivalent or consent of instructor*

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, 4 cr, 3 cl hrs, 3 lab hrs*Prerequisites: Graduate standing; EE 334; or consent of instructor*

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, 4 cr, 3 cl hrs, 3 lab hrs*Prerequisites: EE 443; MATH 454; or equivalent or consent of instructor*

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, 3 cr, 3 cl hrs*Prerequisite: EE 446 or equivalent or consent of instructor*

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, 3 cr, 3 cl hrs*Prerequisite: EE 546 or consent of instructor*

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: 4 cr, 3 cl hrs, 3 lab hrs*Prerequisite: EE 443 or equivalent or consent of instructor*

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. (Same as EM 548)

EE 551, Discrete-Time Signal Processing, Filtering, and Estimation, 3 cr, 3 cl hrs*Prerequisites: EE 451; MATH 254 and 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, 3 cr, 3 cl hrs*Prerequisites: EE 451; MATH 254 and 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, 4 cr, 3 cl hrs, 3 lab hrs*Prerequisites: EE 308 and 443 or equivalent or consent of instructor*

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. (Same as EM 554)

EE 562, Microwave Engineering & Radar, 3 cr, 3 cl hrs*Prerequisite: EE 334 or equivalent or consent of instructor*

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, 3 cr, 3 cl hrs*Prerequisite: EE 446 or equivalent courses or consent of instructor*

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, 4 cr, 3 cl hrs, 3 lab hrs*Prerequisite: E & M or equivalent or consent of instructor*

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*Prerequisite: Permission of graduate advisor*

EE 590, Independent Study, cr to be arranged

Prerequisite: 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, 1 cr, 1 cl hr**

Prerequisites: Graduate standing

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

Staff Research Interests

R. Bond—Design for Test/Manufacturability, Teaching Effectiveness

Bruder—Robotics and Control, Embedded Control

Calloni—Gravitational Wave Interferometry

El-Kady—Optics and Photonics Systems

El-Osery—Wireless Communications, Control Systems, Soft Computing

P. Krehbiel—Lightning, Thunderstorms, Radar

Mansfield—Radar Systems

Meason—Nuclear, Electromagnetic and Space Radiation Effects and Directed Energy

Reicher—Physics and Simulation of Thin Films

Restaino—Adaptive Optics, Novel Optical Systems

Rison—Atmospheric Electricity, Instrumentation, Lightning Protection

Robinett—Controls, Optimization, Sensors, Computer Vision

Sarkodie-Gyan—Machine Vision, Biomedical Engineering, Mechatronic Systems

Shanechi—Power Systems

Teare—Experimental Adaptive Optics, Radiation Effects and Directed Energy

Thomas—Lightning, Thunderstorms and Instrumentation

Wedeward—Adaptive Control, Robotic Systems, Complex Systems

Wick—Experimental Adaptive and Active Optics

Xiao—Photonic/Fiber Sensors, Intelligent Sensor Networks, Optical Communications, Computer Vision