Electrical Engineering (ELEG)

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Department of Electrical Engineering Website (http://electrical-engineering.uark.edu/)

Electrical engineering is a professional engineering discipline that in its broader sense covers the study and application of electricity, electronics and electromagnetism. Electrical engineers are in charge of designing and utilizing electrical and electronic components, integrated circuits and computer chips, and electronic assemblies to benefit mankind. Fields of electrical engineering include analog and mixed-signal circuit design/test, biomedical, communications, computer hardware and digital circuit design, control systems, electronic packaging, embedded systems design, microwave and radar engineering, nanophotonics, nanotechnology/microelectronics/optoelectronics, pattern recognition and artificial intelligence, power electronics, and renewable energy/power.

The electrical engineering graduate is at the forefront of technologies leading to accelerated use of electric power, applications of real time embedded control systems for smart highways, smart vehicles and smart gadgets, global communications, the dominating influence of the computer and electronics on modern society, the use of electronic equipment for medical diagnosis, the use of wireless chemical and biological nanosensors for hazard detection, the miniaturization of electronics, microwave and optical technology for national defense, and a host of other developments. Therefore, the use of electrical and electronic equipment has spread into such diverse areas as agricultural production, automotives, computer hardware and networks, health care, information technology, manufacturing, marketing, recreation, renewable energy resources, outer space and underwater exploration, transportation, and many others. As a result, electrical engineering is the largest of all scientific disciplines and assures a continuing demand for electrical engineering graduates throughout private industry and government.

Undergraduate Program

The department also actively participates in the Honors Program to challenge superior students with a more in-depth academic program and research experience. The Honors program enables students to work more closely with faculty members and other students in a team environment. Please see the requirements given below.

In line with all the opportunities of our graduates, the Electrical Engineering Department has the mission and educational objectives to produce graduates who:

1. Are recruited in a competitive market and valued as reliable and competent employees by a wide variety of industries; in particular, electrical engineering industries,
2. Succeed in graduate studies such as engineering, science, law, medicine, business, and other professions, should they chose to pursue those studies.
3. Understand the need for life-long learning and continued professional development for a successful and rewarding career, and
4. Accept responsibility for leadership roles, in their profession, in their communities, and in the global society.

Accreditation

The Electrical Engineering Department offers undergraduate, graduate, and doctoral degrees. The department has offered a Bachelor of Science degree in Electrical Engineering (B.S.E.E.) for over 100 years. The B.S.E.E. degree is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org). Completion of the degree requirements provides graduates with the following learning outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics,
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors,
3. an ability to communicate effectively with a range of audiences,
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts,
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives,
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions,
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Graduate Program in Electrical Engineering

The graduate program offers a Master of Science degree in Electrical Engineering (on campus and online) and a Doctor of Philosophy degree in Engineering. The graduate program provides additional instruction and hands-on experience beyond the undergraduate level, and produces graduates who are prepared to promptly address critical issues and assume advanced positions in the profession, including management, design, teaching, research and development.

The research mission of the department is conducted mainly through the graduate program. Internal and external funded research projects serve to:

1. Discover new knowledge, address technical problems, and develop new electrical/electronic technologies;
2. Provide the tools and resources which keep the faculty at the cutting edge of electrical engineering;
3. Provide financial support for graduate students and gifted undergraduate students; and
4. Improve the quality of life for citizens of Arkansas and the world.

The graduate program supports the undergraduate program by giving top undergraduate students access to research laboratories with state-of-the-art equipment and software. Topics covered in graduate courses often migrate into senior undergraduate technical elective courses and eventually into required undergraduate courses.

Departmental Service Mission

Faculty, administrators, and staff work to provide the education necessary to establish the best foundation for electrical engineering students at all degree levels, and prepare them to be competitive local and national leaders, skillful at undertaking the current and future challenges facing our world. Everyone is encouraged to provide services to both the community and the profession. Hence, they are active in local, state, national, and international professional and service organizations, as well as public and private schools involving grades K-12

Degree Program Changes

A student must meet all requirements of the degree program and is expected to stay informed concerning current regulations, policies, and program requirements in a chosen field of study. Changes made in the electrical engineering curriculum at a level beyond that at which a student is enrolled may become graduation requirements for that student. Changes made in the curriculum at a level lower than the one at which a student is enrolled are not normally required for that student. Students should consult their adviser for additional information.

Potential Minors

Although electrical engineering students can pursue any minor they desire, there are several minors that require a minimal number of extra courses, such as Computer Science, Mathematics, Physics, etc. Students are advised to review the specific rules pertaining to the minor of interest in the section of the UA Catalog of Studies corresponding to the department granting that minor.

Undergraduate Program in Electrical Engineering

The Electrical Engineering program maintains the following student learning outcomes:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics,
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental, and economic factors,
3. An ability to communicate effectively with a range of audiences,
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts,
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives,
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions,
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

For more information visit www.abet.org (http://www.abet.org/).

The electrical engineering curriculum is designed to provide students with knowledge of scientific principles and methods of engineering analysis to form a solid foundation for a career in design, research and development, manufacturing and processing, measurement and characterization, or management. Students progressively build their design experience throughout the curriculum and demonstrate this ability in the senior electrical engineering design laboratories. The curriculum also introduces students to subjects in the humanities, social sciences, and ethics so they may better understand the interaction of technology and society.

The electrical engineering curriculum is divided into three phases. The first year concentrates on the development of a sound understanding of basic sciences and mathematics. The second and third years further develop scientific principles and cover the basic core of electrical engineering. The fourth year is composed primarily of senior-level elective courses. At this time, the students, in consultation with their advisers, may choose classes related to one or more of the major areas of electrical engineering detailed (e.g., analog and mixed-signal circuit design/test, biomedical, communications, computer hardware and digital circuit design, control systems, electronic packaging, embedded systems design, microwave and radar engineering, nanophotonics, nanotechnology/microelectronics/optoelectronics, pattern recognition and artificial intelligence, power electronics, and renewable energy and power). This final year permits the student to tailor a program suited to her or his individual career objectives. The graduation requirement in electrical engineering is 125 semester hours as given below.

Recommended Technical Studies

Students in electrical engineering are required to complete 21 semester hours of technical electives of which a minimum of 9 semester hours must be 4000- or 5000-level electrical engineering elective courses. A student may select the remaining 12 semester hours from 4000- or 5000-level electrical engineering elective courses or upper-division technical courses in mathematics, engineering, and the sciences with the approval of an adviser. One of these courses may be an approved Math/Science Elective and another may be an approved Engineering Science Elective. History and social science courses taught by Math and Science departments are not eligible for technical elective credit. Not more than 6 semester hours total of ELEG 4880V and ELEG 400HV may be credited toward technical electives. Students who have taken full-time co-op experiences under GNEG 38101, and whose grades in these courses were A or B, may get credit for not more than three hours of non-ELEG technical electives if the work performed is of comparable quality to a technical elective; consult with the Department Co-op Coordinator. Descriptions of all electrical engineering courses are in the Course Descriptions chapter of this Catalog of Studies. The schedule of technical electives offered in a given semester is determined the previous semester since the selection depends on a number of varying factors such as student interest in a particular topic, the importance of a particular technology for the student's professional career, and teaching faculty availability.

Electrical Engineering B.S.E.E. Eight-Semester Degree Program

The following section contains the list of courses required for the Bachelor of Science in Electrical Engineering and a suggested eight-semester sequence. See the Eight-Semester Degree Policy (http://catalog.uark.edu/undergraduatecatalog/academicregulations/eightsemesterdegreecompletionpolicy/) for more details. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites.

First Year	Units	
	Fall	Spring
GNEG 11101 Introduction to Engineering I	1	
ENGL 10103 Composition I (ACTS Equivalency = ENGL 1013) (Satisfies General Education Outcome 1.1)	3	
MATH 24004 Calculus I (ACTS Equivalency = MATH 2405) (Satisfies General Education Outcome 2.1)[1]	4	
CHEM 14103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture)	3	
Select one of the following (Satisfies General Education Outcome 4.2):	3	
HIST 20003 History of the American People to 1877 (ACTS Equivalency = HIST 2113)		
HIST 20103 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123)		
PLSC 20003 American National Government (ACTS Equivalency = PLSC 2003)		
GNEG 11201 Introduction to Engineering II		1
ENGL 10303 Technical Composition II (ACTS Equivalency = ENGL 1023) (Satisfies General Education Outcome 1.2)		3
MATH 25004 Calculus II		4
PHYS 20304 University Physics I (ACTS Equivalency = PHYS 2034) (Satisfies General Education Outcome 3.4)		4
Sophomore Science Elective[2]		4
Year Total:	14	16

Second Year	Units	
	Fall	Spring
ELEG 21003 Electric Circuits I	3	
ELEG 21001 Electric Circuits I Laboratory	1	
MATH 25804 Elementary Differential Equations	4	
PHYS 20404 University Physics II (ACTS Equivalency = PHYS 2044 Lecture)	4	
Humanities Elective (Satisfies General Education Outcome 3.2 & 5.1)[3]	3	
ELEG 21103 Electric Circuits II		3
ELEG 21101 Electric Circuits II Laboratory		1
CSCE 20004 Programming Foundations I		4
MATH 26004 Calculus III		4
ELEG 29004 Digital Design		4
Year Total:	15	16

Third Year	Units	
	Fall	Spring
ELEG 31204 System & Signal Analysis	4	
ELEG 32103 Electronics I	3	
ELEG 32101 Electronics I Laboratory	1	
ELEG 39204 Microprocessor Systems Design	4	
ELEG 37004 Applied Electromagnetics	4	
ELEG 31403 Probability & Stochastic Processes		3
ELEG 32203 Electronics II		3
ELEG 32201 Electronics II Laboratory		1
ELEG 33004 Energy Systems		4
Social Sciences Elective (Satisfies General Education Outcome 3.3 & 4.1)[4]		3
Technical Elective[5]		3
Year Total:	16	17

Fourth Year	Units	
	Fall	Spring
Technical Elective[5]	3	
Two Electrical Engineering Technical Elective[6]	6	
ELEG 40603 Electrical Engineering Design I	3	
Select one of the following:	3	
ECON 21003 Principles of Macroeconomics (ACTS Equivalency = ECON 2103)		
ECON 22003 Principles of Microeconomics (ACTS Equivalency = ECON 2203)		
ECON 21403 Basic Economics: Theory and Practice		
Electrical Engineering Technical Elective[6]		6
ELEG 40701 Electrical Engineering Design II (Satisfies General Education Outcome 6.1)		1
Technical Elective[5]		3
Social Sciences Elective [7]		3
Fine Arts Elective (Satisfies General Education Outcome 3.1)[8]		3
Year Total:	15	16

Total Units in Sequence:	**125**

1 Students have demonstrated successful completion of the learning indicators identified for learning outcome 2.1, by meeting the prerequisites for MATH 24004.

2 CHEM 14203/CHEM 14201 or BIOL 10103/BIOL 10101 or BIOL 24103/BIOL 24001, or PHYS 20504 or GEOL 11103/GEOL 11101

3 The Humanities Elective courses that satisfy General Education Outcomes 3.2 and 5.1 include: CLST 10003, CLST 100H3, CLST 10103, HUMN 112H4, PHIL 20003, PHIL 200H3, PHIL 21003.

4 The Social Sciences Elective courses that satisfy General Education Outcomes 3.3 and 4.1 include: ANTH 10203, COMM 10203, HDFS 14003, HDFS 24103, HIST 11193, HIST 111H3, HIST 1123, HIST 112H3, HIST 20903, HUMN 111H4, HUMN 211H4, INST 28103, INST 281H3, PLSC 20103, PLSC 28103, PLSC 281H3, RESM 28503, SOCI 10103, SOCI 201H3, or SOCI 20103.

5 Technical Elective is defined as any 20000-level or higher engineering, science, or math course. (BIOL 10103 lecture and BIOL 10101 lab), (BIOL 101H3 lecture and BIOL 101H1 lab), (CHEM 14203 lecture and CHEM 14201 lab), or (CHEM 142H3 lecture and CHEM 142H1 lab) can also be used. Courses not eligible for Technical Elective credit include ELEG 39003, ELEG 39903 and any history courses in math and the sciences (e.g., MATH 31303). ELEG 4880V or ELEG 5880V can count as a Technical Elective.

6 Electrical Engineering Technical Elective is defined as any ELEG 40000-level or higher course not required for the degree except for ELEG 4880V and ELEG 5880V.

[7] The Social Sciences Elective courses which satisfy General Education Outcome 3.3 include: AGEC 11003, AGEC 21003, ANTH 10203, COMM 10203, ECON 21003, ECON 22003, ECON 21403, EDST 20003, HDFS 14003, HDFS 24103, HDFS 26003, HIST 11193, HIST 111H3, HIST 11293, HIST 112H3, HIST 20003, HIST 20103, HIST 20903, HUMN 111H4, HUMN 211H4, INST 2013, INST 28103, INST 281H3, PLSC 20003, PLSC 20103, PLSC 21003, PLSC 28103, PLSC 281H3, PSYC 20003, RESM 28503, SOCI 10103, SOCI 201H3, SOCI 20103. Note, courses cannot be counted twice in degree requirements.

[8] The Fine Arts Elective courses which satisfy General Education Outcome 3.1 include: ARCH 10003, ARHS 10003, COMM 10003, DANC 10003, LARC 10003, MUSC 10003, MUSC 100H3, MUSC 10103, MUSC 101H3, MUSC 13303, THTR 10003, THTR 10103, or THTR 101H3.

Students should become very familiar with the Academic Regulations chapter for university requirements that apply to the electrical engineering program as well as the College of Engineering requirements (in particular the “D rule” and the “Transfer of Credit” for courses taken at another institution). Students are required to complete 40 hours of upper division courses (3000-4000 level). It is recommended that students consult with their adviser when making course selections. In addition to these graduation requirements, candidates for an electrical engineering degree must have earned a grade-point average of no less than 2.00 on all ELEG courses.

Electrical Engineering Honors Program

To graduate with Honors in electrical engineering, students must be a member of the Honors College, have a minimum cumulative GPA of 3.50, and complete a minimum of 12 hours of honors credit of which 6 hours must be Electrical Engineering Honors courses that include the following: ELEG 406H3 Honors Electrical Engineering Design I, ELEG 407H1 Honors Electrical Engineering Design II, and ELEG 400HV Honors Senior Thesis. Special problems credit hours (ELEG 4880V) will not be counted in the requirement for graduation with Honors in Electrical Engineering.

Electrical Engineering Honors Courses:

ELEG 3124H, ELEG 3143H, ELEG 3214H, ELEG 3224H, ELEG 3304H, ELEG 3724H, ELEG 3924H: Required ELEG junior courses with Honors section (all junior required courses include honors sections).

ELEG 4061H Honors Electrical Engineering Design I (Sp, Fa)

ELEG 4073H Honors Electrical Engineering Design II

ELEG 400VH Honors Senior Thesis (Sp, Su, Fa)

ELEG 4203H, ELEG 4233H, ELEG 4403H, ELEG 4503H, ELEG 4703H, ELEG 4783H, ELEG 4914H, ELEG 4963H: ELEG technical elective courses that have an Honors section
(Please check the offering of these Honors Sections for a particular semester).

ELEG 5000 or above**:** Any graduate level course.

Balda, Juan Carlos, Ph.D. (University of Natal), B.S. (Universidad Nacional del Sur), University Professor, Department of Electrical Engineering and Computer Science, 1989, 2013.
Chen, Zhong, Ph.D. (North Carolina State University), M.Eng. (National University of Singapore), B.S. (Zhejiang University), Assistant Professor, Department of Electrical Engineering and Computer Science, 2015.
El-Ghazaly, Samir M., Ph.D. (University of Texas at Austin), M.S., B.S. (Cairo University), Distinguished Professor, Department of Electrical Engineering and Computer Science, 2007.
El-Shenawee, Magda O., Ph.D. (University of Nebraska-Lincoln), M.S., B.S. (Assiut University, Egypt), Professor, Department of Electrical Engineering and Computer Science, 2001, 2010.
Farnell, Chris, Ph.D., M.S.E.E., B.S.E.E. (University of Arkansas), Assistant Professor, Department of Electrical Engineering and Computer Science, 2021, 2023.
Manasreh, Omar, Ph.D. (University of Arkansas), M.S. (University of Puerto Rico-Rio Piedras), B.S. (University of Jordan), Professor, Department of Electrical Engineering and Computer Science, 2003.
Mantooth, Alan, Ph.D. (Georgia Institute of Technology), M.S., B.S. (University of Arkansas), Distinguished Professor, Department of Electrical Engineering and Computer Science, Twenty-First Century Chair in Mixed-Signal IC Design and CAD, 1998, 2011.
Martin, Terry W., Ph.D., M.S.E.E., B.S.E.E. (University of Arkansas), Professor, Department of Electrical Engineering and Computer Science, 1990, 2002.
McCann, Roy A., Ph.D. (University of Dayton), M.S.E.E., B.S.E.E. (University of Illinois), Professor, Department of Electrical Engineering and Computer Science, 2003, 2009.
Naseem, Hameed A., Ph.D., M.S. (Virginia Polytechnic State University), M.Sc. (Panjab University), University Professor, Electrical Engineering Program, 1985.
Saunders, Robert F., M.S.E.E., M.S. (University of Arkansas), Instructor, Department of Electrical Engineering and Computer Science, 2012.
Song, Xiaoqing, Ph.D. (North Carolina State University), M.S., B.S. (Beijing Institute of Technology), Assistant Professor, Department of Electrical Engineering and Computer Science, 2022.
Spiesshoefer, Silke, Ph.D., M.S.E.E., B.S.Ch.E. (University of Arkansas), Clinical Assistant Professor, Department of Electrical Engineering and Computer Science, 2014.
Ware, Morgan, Ph.D. (North Carolina State University), B.S. (Florida State University), Assistant Professor, Department of Electrical Engineering and Computer Science, 2005.
Wu, Jingxian, Ph.D. (University of Missouri-Columbia), M.S. (Tsinghua University), B.S. (Beijing University of Aeronautics and Astronautics), Associate Professor, Department of Electrical Engineering and Computer Science, 2004, 2013.
Yu, Fisher, Ph.D. (Arizona State University), M.S., B.S. (Peking University), Associate Professor, Department of Electrical Engineering and Computer Science, 2008, 2014.
Zhao, Yue, Ph.D. (University of Nebraska-Lincoln), B.S. (Beijing University), Assistant Professor, Department of Electrical Engineering and Computer Science, 2015.

Courses

ELEG 21001. Electric Circuits I Laboratory. 1 Hour.
Experimental investigation of the steady-state behavior of resistive circuits excited by DC sources and transient behavior of simple R, L, and C circuits. Topics include fundamental laws of circuit theory applied to resistive networks and time response functions of R-L and R-C circuits. Corequisite: ELEG 21003. (Typically offered: Fall and Summer)

ELEG 21003. Electric Circuits I. 3 Hours.
Introduction to circuit variables, elements, and simple resistive circuits. Analysis techniques applied to resistive circuits. The concept of inductance, capacitance and mutual inductance. The natural and step responses of RL, RC, and RLC circuits. Corequisite: ELEG 21001. Pre- or Corequisite: MATH 25004 and PHYS 20404. Prerequisite: PHYS 20304. (Typically offered: Fall and Summer)

ELEG 21101. Electric Circuits II Laboratory. 1 Hour.
Experimental investigation of the steady-state behavior of circuits excited by sinusoidal sources. Topics include complex power, three-phase circuits, transformers, and resonance. Corequisite: ELEG 21103. (Typically offered: Spring and Summer)

ELEG 21103. Electric Circuits II. 3 Hours.
Introduction to complex numbers. Sinusoidal steady-state analysis of electric circuits, active, reactive, apparent and complex power; balanced and unbalanced three-phase circuits; mutual inductance; the use of the Laplace transform for electric circuit analysis and two-port networks. Corequisite: ELEG 21101. Pre- or Corequisite: MATH 25804. Prerequisite: ELEG 21003, ELEG 21001 and PHYS 20404. (Typically offered: Spring and Summer)

ELEG 2870V. Special Topics in Electrical Engineering. 1-4 Hour.
Consideration of current electrical engineering topics not covered in other courses. (Typically offered: Irregular) May be repeated for up to 4 hours of degree credit.

ELEG 29004. Digital Design. 4 Hours.
To introduce students to modern logic concepts, problem solving and design principles, and vocabulary and philosophy of the digital world. Corequisite: Lab component. Prerequisite: Engineering major. (Typically offered: Fall)
This course is cross-listed with CSCE 21104.

ELEG 31204. System & Signal Analysis. 4 Hours.
Definition and description of signals and systems; analog, digital, continuous- and discrete-time and frequency analysis of systems, Z- and Fourier Transforms, sampling and signal reconstruction, filter design and engineering applications. Pre- or Corequisite: MATH 25804. Corequisite: Lab component. Prerequisite: ELEG 21003 or ELEG 39003 or BMEG 29004. (Typically offered: Fall)

ELEG 312H4. Honors System & Signal Analysis. 4 Hours.
Definition and description of signals and systems; analog, digital, continuous- and discrete-time and frequency analysis of systems, Z- and Fourier Transforms, sampling and signal reconstruction, filter design and engineering applications. Pre- or Corequisite: MATH 25804. Corequisite: Lab component. Prerequisite: ELEG 21003 or ELEG 39003 or BMEG 29004. (Typically offered: Fall)
This course is equivalent to ELEG 31204.

ELEG 31403. Probability & Stochastic Processes. 3 Hours.
Review of system analysis, probability, random variables, stochastic processes, auto correlation, power spectral density, systems with random inputs in the time and frequency domain, and applications. Prerequisite: ELEG 31204. Pre- or Corequisite: MATH 26004. (Typically offered: Spring)

ELEG 314H3. Honors Probability & Stochastic Processes. 3 Hours.
Review of system analysis, probability, random variables, stochastic processes, auto correlation, power spectral density, systems with random inputs in the time and frequency domain, and applications. Pre- or Corequisite: ELEG 31204. (Typically offered: Spring)
This course is equivalent to ELEG 31403.

ELEG 32101. Electronics I Laboratory. 1 Hour.
Experimental investigation into electronic circuit analysis concepts. Topics include: diode behavior and applications, zener diode regulator design, bipolar junction transistor biasing, BJT common-emitter amplifier design, and operational amplifier fundamentals. Corequisite: ELEG 32103. (Typically offered: Fall and Spring)

ELEG 32103. Electronics I. 3 Hours.
Introduction to electronic systems and signal processing, operational amplifiers, diodes, non-linear circuit applications, MOSFETS, and BJTs. Course has a lab component. Pre- or Corequisite: MATH 26004 and ELEG 21103. Corequisite: ELEG 32101. Prerequisite: MATH 25804. (Typically offered: Fall and Spring)

ELEG 321H1. Honors Electronics I Laboratory. 1 Hour.
Experimental investigation into electronic circuit analysis concepts. Topics include: diode behavior and applications, zener diode regulator design, bipolar junction transistor biasing, BJT common-emitter amplifier design, and operational amplifier fundamentals. Corequisite: ELEG 321H3. Prerequisite: Honors standing. (Typically offered: Fall and Spring)
This course is equivalent to ELEG 32101.

ELEG 321H3. Honors Electronics I. 3 Hours.
Introduction to electronic systems and signal processing, operational amplifiers, diodes, non-linear circuit applications, MOSFETS, and BJTs. Pre- or Corequisite: MATH 26004 and ELEG 21103. Corequisite: ELEG 321H1. Prerequisite: Honors standing and PHYS 20404. (Typically offered: Fall and Spring)
This course is equivalent to ELEG 32103.

ELEG 32201. Electronics II Laboratory. 1 Hour.
Selected experiments to illustrate and complement topics covered in companion course ELEG 32203 - Electronics II Laboratory. Corequisite: ELEG 32203. (Typically offered: Spring)

ELEG 32203. Electronics II. 3 Hours.
Differential pair amplifier, current mirrors, active loads, multistage amplifiers, amplifier frequency response, bode plots, Millers theorem, short circuit and open circuit time constant methods, feedback amplifiers, and stability of feedback amplifiers. Corequisite: ELEG 32201. Prerequisite: ELEG 32103 and ELEG 21103. (Typically offered: Spring)

ELEG 322H1. Honors Electronics II Laboratory. 1 Hour.
Selected experiments to illustrate and complement topics covered in companion course ELEG 32203 - Electronics II Laboratory. Corequisite: ELEG 322H3. Prerequisite: Honors standing. (Typically offered: Spring)
This course is equivalent to ELEG 32201.

ELEG 322H3. Honors Electronics II. 3 Hours.
Differential pair amplifier, current mirrors, active loads, multistage amplifiers, amplifier frequency response, bode plots, Millers theorem, short circuit and open circuit time constant methods, feedback amplifiers, and stability of feedback amplifiers. Corequisite: ELEG 322H1. Prerequisite: Honors standing, ELEG 32103 and MATH 25804. (Typically offered: Spring)
This course is equivalent to ELEG 32203.

ELEG 33004. Energy Systems. 4 Hours.
Steady state analysis of DC machines, transformers, induction machines and synchronous machines. Introduction to speed control of electric machines using power electronics. Corequisite: Lab component. Prerequisite: ELEG 21103. (Typically offered: Spring)

ELEG 330H4. Honors Energy Systems. 4 Hours.
Steady state analysis of DC machines, transformers, induction machines and synchronous machines. Introduction to speed control of electric machines using power electronics. Corequisite: Lab component. Prerequisite: ELEG 21103. (Typically offered: Spring)
This course is equivalent to ELEG 33004.

ELEG 37004. Applied Electromagnetics. 4 Hours.
Analysis of transmission lines with sinusoidal and transient excitation. Development and use of the Smith Chart and methods of impedance matching. Vector analysis, static form of Maxwell's equations, electrostatics, and magnetostatics. Corequisite: Lab component. Pre- or Corequisite: PHYS 20404. Prerequisite: ELEG 21103 and MATH 26004. (Typically offered: Fall)

ELEG 370H4. Honors Applied Electromagnetics. 4 Hours.
Analysis of transmission lines with sinusoidal and transient excitation. Development and use of the Smith Chart and methods of impedance matching. Vector analysis, static form of Maxwell's equations, electrostatics, and magnetostatics. Corequisite: Lab component. Pre- or Corequisite: PHYS 20404 and MATH 26004. Prerequisite: ELEG 21103. (Typically offered: Fall)
This course is equivalent to ELEG 37004.

ELEG 3870V. Special Topics in Electrical Engineering. 1-4 Hour.
Consideration of current electrical engineering topics not covered in other courses. (Typically offered: Irregular) May be repeated for up to 9 hours of degree credit.

ELEG 39003. Electric Circuits and Machines. 3 Hours.
Basic electrical principles and circuits; Introduction to sinusoidal steady-state analysis of electric circuits, active, reactive, and complex power; balanced three-phase circuits; Steady-state analysis of electric machines and transformers. Introduction to power electronics for machine speed control and alternative energy sources. For engineering students other than those in electrical engineering. Prerequisite: MATH 25004 and PHYS 20404. (Typically offered: Fall and Spring)

ELEG 39204. Microprocessor Systems Design. 4 Hours.
Introduction to 8-bit microprocessors and their application. Microprocessor architecture and assembly language; interface devices; system design using microprocessors. Corequisite: Lab component. Pre- or Corequisite: ELEG 29004. (Typically offered: Fall)

ELEG 392H4. Honors Microprocessor Systems Design. 4 Hours.
Introduction to 8-bit microprocessors and their application. Microprocessor architecture and assembly language; interface devices; system design using microprocessors. Corequisite: Lab component. Prerequisite: ELEG 29004. (Typically offered: Fall)
This course is equivalent to ELEG 39204.

ELEG 39903. Circuits & Electronics. 3 Hours.
Basic principles of electric and electronic circuits and devices. For engineering students who are not pursuing a degree in electrical engineering. Prerequisite: MATH 25804 and PHYS 20404. (Typically offered: Spring)

ELEG 400HV. Honors Senior Thesis. 1-3 Hour.
Honors senior thesis. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer)

ELEG 40603. Electrical Engineering Design I. 3 Hours.
Capstone design and application in electrical engineering. Prerequisite: ELEG 32203 and ELEG 39204. (Typically offered: Fall and Spring)

ELEG 406H3. Honors Electrical Engineering Design I. 3 Hours.
Design and application in electrical engineering. Prerequisite: ELEG 32203 and ELEG 39204. (Typically offered: Fall and Spring)
This course is equivalent to ELEG 40603.

ELEG 40701. Electrical Engineering Design II. 1 Hour.
Design and application in electrical engineering. Prerequisite: ELEG 40603. (Typically offered: Fall and Spring)

ELEG 407H1. Honors Electrical Engineering Design II. 1 Hour.
Design and application in electrical engineering. Prerequisite: ELEG 40603. (Typically offered: Fall and Spring)
This course is equivalent to ELEG 40701.

ELEG 42003. Semiconductor Devices. 3 Hours.
Crystal properties and growth of semiconductors, energy bands and charge carriers in semiconductors, excess carriers in semiconductors, analysis and design of p/n junctions, analysis and design of bipolar junction transistors, and analysis and design of field-effect transistors. Students may not receive credit for both ELEG 42003 and ELEG 52003. Prerequisite: MATH 25804 and ELEG 32103, or graduate standing. (Typically offered: Irregular)

ELEG 420H3. Honors Semiconductor Devices. 3 Hours.
Crystal properties and growth of semiconductors, energy bands and charge carriers in semiconductors, excess carriers in semiconductors, analysis and design of p/n junctions, analysis and design of bipolar junction transistors, and analysis and design of field-effect transistors. Students may not receive credit for both ELEG 42003 and ELEG 52003. Prerequisite: MATH 25804 and ELEG 32103, or graduate standing. (Typically offered: Irregular)
This course is equivalent to ELEG 42003.

ELEG 42303. Introduction to Integrated Circuit Design. 3 Hours.
Design and layout of large scale digital integrated circuits using CMOS technology. Topics include MOS devices and basic circuits, integrated circuit layout and fabrication, dynamic logic, circuit design, and layout strategies for large scale CMOS circuits. Students may not receive credit for both ELEG 42303 and ELEG 59203. Prerequisite: ELEG 32103 or ELEG 39903 and ELEG 29004 or equivalent. (Typically offered: Fall)

ELEG 42403. Analog Integrated Circuits. 3 Hours.
Theory and design techniques for linear and analog integrated circuits. Current mirrors, voltage to base emitter matching, active loads, compensation, level shifting, amplifier design techniques, circuit simulation using computer-assisted design programs. Prerequisite: ELEG 32203. (Typically offered: Irregular)

ELEG 42503. Integrated Circuit Design Lab I. 3 Hours.
This course will cover digital VLSI design and integrated circuit design tools. The course is structured with lectures. This course is offered to both senior undergraduate and graduate students. Students cannot get credit for both the undergraduate and graduate version of the course. Students cannot receive credit for both ELEG 42503 and ELEG 52503. Prerequisite: ELEG 42303 or ELEG 59203. (Typically offered: Spring)

ELEG 42803. Mixed Signal Test Engineering I. 3 Hours.
Overview of mixed signal testing, the test specification process, DC and parametric measurements, measurement accuracy, tester hardware, sampling theory, DSP-based testing, analog channel testing, digital channel testing. Prerequisite: Senior or graduate standing. (Typically offered: Irregular)

ELEG 43003. Introduction to Nanomaterials and Devices. 3 Hours.
This course provides the students with an introduction to nanomaterials and devices. The students will be introduced to the quantization of energy levels in nanomaterials, growth of nanomaterials, electrical and optical properties, and devices based on these nanomaterials, such as tunneling resonant diodes, transistors, detector, and emitters. Graduate students will be given additional or different assignments. Graduate students will be expected to explore and demonstrate an understanding of the material with a greater level of depth and breadth than the undergraduates. Each group of students will have different expectations and grading systems. The instructor will prepare and distribute two distinct syllabi. Corequisite: ELEG 42003. Prerequisite: ELEG 32103 and PHYS 20404. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

ELEG 44003. Control Systems. 3 Hours.
Mathematical modeling of dynamic systems, stability analysis, control system architectures and sensor technologies. Time-domain and frequency-domain design of feedback control systems: lead, lag, PID compensators. Special topics in microprocessor implementation. Students may not receive credit for both ELEG 44003 and ELEG 54003. Prerequisite: ELEG 31204. (Typically offered: Irregular)

ELEG 440H3. Honors Control Systems. 3 Hours.
Mathematical modeling of dynamic systems, stability analysis, control system architectures and sensor technologies. Time-domain and frequency-domain design of feedback control systems: lead, lag, PID compensators. Special topics in microprocessor implementation. Students may not receive credit for both ELEG 44003 and ELEG 54003. Prerequisite: ELEG 31204. (Typically offered: Irregular)

ELEG 44103. Advanced Control Systems. 3 Hours.
A second course in linear control systems. Emphasis on multiple-input and multiple-output systems: State-space analysis, similarity transformations, eigenvalue and eigenvector decomposition, stability in the sense of Lyapunov, controllability and observability, pole placement, quadratic optimization. Students may not receive credit for both ELEG 44103 and ELEG 54103. Prerequisite: ELEG 44003 or equivalent course. (Typically offered: Irregular)

ELEG 44203. Optimal Control. 3 Hours.
Introductory theory of optimizing dynamic systems: Formulation of performance objectives; calculus of variations; linear quadratic optimal control; discrete-time optimization; robustness and frequency domain techniques; reinforcement learning and optimal adaptive control. Prerequisite: ELEG 44003. (Typically offered: Irregular)

ELEG 44603. Control Systems Laboratory. 3 Hours.
Experimental study of various control systems and components. The use of programmable logic controllers in the measurement of systems parameters, ladder-logic applications, process-control applications, and electromechanical systems. Prerequisite: ELEG 39204 and ELEG 31204. (Typically offered: Irregular)

ELEG 45003. Design of Advanced Electric Power Distribution Systems. 3 Hours.
Design considerations of electric power distribution systems, including distribution transformer usage, distribution system protection implementation, primary and secondary networks design, applications of advanced equipment based on power electronics, and use of capacitors and voltage regulation. Students may not receive credit for both ELEG 45003 and ELEG 55003. Prerequisite: ELEG 33004. (Typically offered: Irregular)

ELEG 45103. Power and Energy Systems Analysis. 3 Hours.
Modeling and analysis of electric power systems: Energy sources and conversion; load flow analysis; reference frame transformations; symmetrical and unsymmetrical fault conditions; load forecasting and economic dispatch. Students may not receive credit for both ELEG 45103 and ELEG 55103. Prerequisite: ELEG 21103. (Typically offered: Irregular)

ELEG 45303. Power Electronics and Motor Drives. 3 Hours.
Characteristics of Insulated Gate Bipolar Transistors (IGBTs), Silicon Carbide (SiC) MOSFETs, Gallium Nitride (GaN) devices, Design of driver and snubber circuits for IGBTs and SiC MOSFETs, and an introduction to electric motor drives. Students may not receive credit for both ELEG 45303 and ELEG 55303. Prerequisite: ELEG 33004 and ELEG 32203. (Typically offered: Irregular)

ELEG 45403. Introduction to Power Electronics. 3 Hours.
Presents basics of emerging areas in power electronics and a broad range of topics such as power switching devices, electric power conversion techniques and analysis, as well as their applications. Students may not receive credit for both ELEG 55403 and ELEG 45403. Prerequisite: ELEG 21103 and ELEG 32103. (Typically offered: Irregular)

ELEG 45503. Switch Mode Power Conversion. 3 Hours.
Basic switching converter topologies: buck, boost, buck-boost, Cuk, flyback, resonant; pulse-width modulation; integrated circuit controllers; switching converter design case studies; SPICE analyses of switching converters; state-space averaging and linearization; and switching converter transfer functions. Prerequisite: ELEG 32203 and ELEG 31204. (Typically offered: Irregular)

ELEG 45603. EMI in Power Electronics Converters: Generation, Propagation and Mitigation. 3 Hours.
Concepts of electro-magnetic-interference issues in power electronics converters. Basic concepts of EMI measurement, modeling and mitigation, with a focus on conducted EMI in power electronics converters. The course is structured with lectures and a lab session. Students can not receive credit for both ELEG 45603 and ELEG 55603. Prerequisite: ELEG 21003 or equivalent and MATH 26004. (Typically offered: Irregular)

ELEG 45803. Programming for Power Electronics: DSPs. 3 Hours.
This course will focus on the development of both theoretical and practical skills needed to design and implement controls for power electronic systems using a Digital Signal Processors (DSPs). The course is structured with lectures and utilizes a project-based approach. Students cannot receive credit for both ELEG 55803 and ELEG 45803. Prerequisite: Senior standing, ELEG 29004, ELEG 39204, and CSCE 20004. (Typically offered: Spring)

ELEG 45903. Programming for Power Electronics: FPGA. 3 Hours.
This course will focus on the development of both theoretical and practical skills needed to design and implement controls for power electronic system using Field Programmable Gate Arrays (FPGAs). The course is structured with lectures and utilizes a project-based approach. Students cannot receive credit for both ELEG 55903 and ELEG 45903. Prerequisite: Senior standing, ELEG 29004, ELEG 39204 and CSCE 20004. (Typically offered: Spring)

ELEG 46003. Deterministic Digital Signal Processing System Design. 3 Hours.
Design of Digital Signal Processing systems with deterministic inputs. Sampling, quantisizing, oversampling, ADC trade-offs, distortion, equalizers, anti-aliasing, coherency, frequency domain design, audio and video compression. Prerequisite: ELEG 31204. (Typically offered: Irregular)

ELEG 46203. Communication Systems. 3 Hours.
Various modulation systems used in communications. AM and FM fundamentals, pulse modulation, signal to noise ratio, threshold in FM, the phase locked loop, matched filter detection, probability of error in PSK, FKS, and DPSK. The effects of quantization and thermal noise in digital systems. Information theory and coding. Students may not receive credit for both ELEG 46203 and ELEG 56603. Pre- or Corequisite: ELEG 31403. (Typically offered: Irregular)

ELEG 47003. Introduction to RF and Microwave Design. 3 Hours.
An introduction to microwave design principles. Transmission lines, passive devices, networks, impedance matching, filters, dividers, and hybrids will be discussed in detail. Active microwave devices will also be introduced. In addition, the applications of this technology as it relates to radar and communications systems will be reviewed. Prerequisite: ELEG 37004. (Typically offered: Irregular)

ELEG 47803. Introduction to Antennas. 3 Hours.
Basic antenna types: small dipoles, half wave dipoles, image theory, monopoles, small loop antennas. Antenna arrays: array factor, uniformly excited equally spaced arrays, pattern multiplication principles, nonuniformly excited arrays, phased arrays. Use of MATLAB programming and mathematical techniques for antenna analysis and design. Emphasis will be on using simulation to visualize variety of antenna radiation patterns. Corequisite: Drill component. Prerequisite: ELEG 37004. (Typically offered: Irregular)

ELEG 478H3. Honors Introduction to Antennas. 3 Hours.
Basic antenna types: small dipoles, half wave dipoles, image theory, monopoles, small loop antennas. Antenna arrays: array factor, uniformly excited equally spaced arrays, pattern multiplication principles, nonuniformly excited arrays, phased arrays. Use of MATLAB programming and mathematical techniques for antenna analysis and design. Emphasis will be on using simulation to visualize variety of antenna radiation patterns. Corequisite: Drill component. Prerequisite: ELEG 37004. (Typically offered: Irregular)
This course is equivalent to ELEG 47803.

ELEG 4870V. Special Topics in Electrical Engineering. 1-3 Hour.
Consideration of current electrical engineering topics not covered in other courses. Prerequisite: Senior standing. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

ELEG 4880V. Special Problems. 1-3 Hour.
Individual study and research on a topic mutually agreeable to the student and a faculty member. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

ELEG 49603. CPLD/FPGA Based System Design. 3 Hours.
Field Programmable logic devices (FPGAs/CPLDs) have become extremely popular as basic building blocks for digital systems. They offer a general architecture that users can customize by inducing permanent or reversible physical changes. This course will deal with the implementation of logic options using these devices. Corequisite: Lab component. Prerequisite: CSCE 21104 with "C" grade or higher. (Typically offered: Irregular)
This course is cross-listed with CSCE 43503.

ELEG 49803. Computer Architecture. 3 Hours.
Design of a single board computer including basic computer organization, memory subsystem design, peripheral interfacing, DMA control, interrupt control, and bus organization. Prerequisite: ELEG 39204. (Typically offered: Irregular)
This course is cross-listed with CSCE 42103.