Electrical Engineering Program

2020-2021 Undergraduate Student Handbook

Juan C. Balda, Department Head (jbalda@uark.edu)

Robert F. Saunders, Assistant Department Head (rsaunder@uark.edu)

Phone: (479)575-3008 or (479)575-3005

Fax: (479) 575-7967

Electronic copies available http://electrical-engineering.uark.edu
Welcome Note from the Department Head

The faculty and staff of the Department of Electrical Engineering (www.electrical-engineering.uark.edu) welcome you to the University of Arkansas. We strive to offer you a high-quality undergraduate educational program to enable you to have a very successful professional career. Qualified educators and staff will provide an excellent educational experience so you will be able to compete as a practicing engineer with electrical engineering (EE) graduates from any other university as well as become a leader in the society. Our graduates find employment in all disciplines of electrical engineering and are hired by a variety of small to large companies.

The Department of Electrical Engineering has been offering the Bachelor of Science in Electrical Engineering degree since its establishment in 1897 and has been continuously accredited by Accreditation Board for Engineering and Technology (ABET) since 1936. An important characteristic of our eight-semester EE degree plan is the hands-on opportunities provided through laboratories associated with most of our required EE courses. The labs culminate in the senior capstone design courses where students work on industry sponsored projects or multidisciplinary ones, bringing together students from several departments and/or colleges.

The main areas of specialization in the Department are (1) communications, radio-frequency/microwaves and terahertz, (2) control systems, (3) integrated circuit design, power electronics and power engineering, and (4) microelectronics, nanotechnology and optoelectronics.

The University of Arkansas, College of Engineering, and Department of Electrical Engineering offer a number of scholarships for qualified candidates. Outstanding students with excellent academic records could be considered for many prestigious fellowships, which offer competitive stipends and tuition.

For students seeking advanced degrees, the department also offers the master (M.S.E.E.) and Doctor of Philosophy (Ph.D.) degrees. Students continuing into graduate studies can apply for teaching or research assistantships. The M.S.E.E. degree has an online version for mainly those students who are working off campus.

Best wishes for success in achieving your academic and career goals. The faculty and staff are available to provide assistance during your stay in the department, and if we can be of help in any way, please do not hesitate to contact any of us.

Sincerest regards,

Juan Carlos Balda
Department Head
University Professor
Email: jbalda@uark.edu
Phone: 479-575-3008
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ELECTRICAL ENGINEERING AT THE UNIVERSITY OF ARKANSAS

What is Electrical Engineering?

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 components, integrated circuits, integrated chips, 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 and power.

The electrical engineering graduate is at the forefront of technologies leading to the dramatic increase in accelerated use of electric power, applications of real time embedded control systems for smart highways, the dominating influence of the computer on modern society, global communications, the miniaturization of electronics, smart vehicles and smart gadgets, the use of wireless chemical and biological nano-sensors for hazard detection, and a host of other developments. The increased use of electronic equipment for communication, control, measurement, and networking has spread into such diverse areas as agricultural production, automotives, computer networks and hardware, health care, information technology, manufacturing, marketing, recreation, renewable energy, transportation, underwater and space explorations, and many others. This widespread and expanding use of electrical and electronic equipment in virtually all fields has made electrical engineering the largest of all scientific disciplines and assures a continuing demand for electrical engineering graduates throughout business and government. Information regarding the average salary of an electrical engineer is available on the Electrical Engineering website (http://electrical-engineering.uark.edu).

Electrical Engineering Research Areas

Analog and Mixed-Signal Circuit Design/Test deals with modeling, designing, and testing integrated circuits and electronic systems that interface the digital world with the real world, including several forms of signal processing.

The Biomedical area applies electrical engineering to the field of medicine, including the design of medical equipment (e.g., MRI), implantable medical devices (e.g., pacemaker), neural interfaces (e.g., cochlear implants for the deaf), and electrical therapies (e.g., electrical brain stimulus to minimize shaking effects of Parkinson's).

Communications deals with developing algorithms, protocols, hardware, software, and performance evaluation techniques, for wireless and wired communications networks and systems.

Computer Hardware and Digital Circuit Design deals with designing digital integrated circuits (i.e., computer chips) that are pervasively integrated into today's technological society, including computers, cell phones, MP3 players, DVRs, video games, etc.

The Control Systems area deals with developing algorithms and associated hardware to regulate complex systems, including robotics, factory automation, flight control, automobile stability, camera focusing and image stability, etc.

Electronic Packaging deals with interfacing integrated circuit die to connectors such that they can be soldered on printed circuit boards. Packaging objectives include decreasing size, increasing performance, and decreasing electrical interference.

Embedded Systems Design combines digital and analog integrated circuit chips along with
software to develop complex systems, such as cell phones, MP3 players, digital cameras, etc.

**Microwave and Radar Engineering** exploits the relationship between electricity, magnetism, and waves for applications such as medical imaging, radar systems, wireless communications, antenna design, and defense applications.

**Nanophotonics** exploits the special properties of metals and dielectrics at THz, optical, UV, and IR frequencies for the development of plasmonic solar cells, plasmonic biosensors, and a variety of optical devices.

**Nanotechnology/Microelectronics/Optoelectronics** deals with the study of materials used to fabricate electronic devices as well as the actual fabrication of miniaturized electronic devices, including sensors, MEMs (Micro Electro Mechanical devices), and optical devices, such as LAZERs.

**Power Electronics** design deals with the modeling, design and test of discrete higher power circuitry from fractional horsepower to very large systems.

**Renewable Energy and Power** deals with designing motors, generators, and the circuitry to control high-power devices, as well as designing power generation and distribution systems, which include green technology, such as solar energy, wind turbines, and hydroelectric power.

**Mission of the Electrical Engineering Department**

The University of Arkansas, the state land grant university, is a nationally competitive, student-centered, teaching and research university serving Arkansas and the world. As part of the University of Arkansas. The Electrical Engineering Department will provide the education necessary to establish the best foundation for electrical engineers at all degree levels, and prepare them to be nationally competitive leaders, skillful at undertaking the current and future challenges facing our world. (www.uark.edu).

**Undergraduate Commitment**

The electrical engineering department is committed to producing graduates with a Bachelor of Science in Electrical Engineering who:

1. Are valued as reliable and competent employees by a wide variety of industries, in particular electrical engineering industries;
2. Succeed, if pursued, in graduate studies such as, engineering, science, law, medicine, business, and other professions;
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.

In addition to the above program educational objectives, the department is also committed to challenging gifted undergraduate students to participate in the honors program (http://honorscollege.uark.edu). The honors program gives a structure for a student to work closely with faculty members and other students in a team environment. As a result, the honors student gains a more in-depth academic insight along with a quality research experience.

**Research Commitment**

The Electrical Engineering Department’s research commitment 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 that keep our faculty at the cutting edge of electrical
engineering; Advance quickly to management positions in research and development;
3. Provide financial support for graduate students and gifted undergraduate students; and
4. Improve the quality of life for the citizens of Arkansas and the world.

Faculty, students, administrators, and staff conduct the service mission of the department. The electrical engineering program, including faculty, students, staff, and facilities, is a major resource of the state, region, and nation. Faculty members are encouraged to provide services to both the community and the profession. Thus, our faculty members are active in local, state, national, and international professional and service organizations, as well as public and private schools involving grades K-12. A full listing of the faculty, their areas of interest, and email addresses are shown in the Appendix (which is in the website).

In summary, the Electrical Engineering program is designed to offer a high-quality path of instruction involving classroom, laboratory, and extracurricular activities that results in graduates who will be nationally competitive leaders, skillful at undertaking the current and future challenges facing our world.

The Electrical Engineering Undergraduate Curriculum

The electrical engineering undergraduate 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, manufacturing and processing, research and development, and/or management. The outcomes of the electrical engineering undergraduate curriculum are the following:

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 2019-2020 Criteria for Accrediting Engineering Programs – Proposed Changes 40 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 judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The electrical engineering undergraduate curriculum is divided into three phases: the first year, the second and third years, and the senior year. The first-year concentrates on developing a sound understanding of basic sciences and mathematics and introduces general engineering concepts. The College of Engineering has adopted a common first year for all new first-year students. For more information about the first year, please refer to the electrical engineering undergraduate curriculum in this handbook and also http://first-year-engineering.uark.edu/.

Following the first year, students enter the heart of the EE undergraduate curriculum. The sophomore year provides a transition into electric circuits and digital systems, and largely
completes the required mathematics. This leads to the junior year containing the majority of the required technical courses within electrical engineering. The senior year is composed primarily of technical electives, both within and outside electrical engineering, where students can explore several areas of interest. At this time, the student in conjunction with their adviser may select technical electives to concentrate in one or more of the technical specializations within electrical engineering, namely, 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 his or her individual career objectives. Students progressively build their design experience throughout the curriculum and demonstrate this ability in Electrical Engineering Design I and II, where they conceptualize a project, design the system, and build a working prototype, over the course of two semesters.

For those students enrolled in the Honors program, their design experience culminates in the Honors Electrical Engineering Design I and II, and the senior honors thesis. In addition, Honors sections of several electrical engineering courses provide further information on special issues in the electrical engineering discipline.

Lastly, the curriculum also introduces students to subjects in the humanities, social sciences, and professional success and ethics so they may better understand the interaction of technology and society.

The graduation requirement in electrical engineering is 125 semester hours. A full listing, flowchart, and specific details of the present curriculum are given below.

Though faculty advisors are quite knowledgeable about the technical aspects of an engineering education, other students are a good resource when it comes to charting a path through the curriculum. Students are advised to inquire in order to be well informed about various curriculum issues.

Please be aware that, in all cases, the curriculum requirements set forth in the University Catalog of Studies supersedes the requirements set forth in this Handbook.
## ELECTRICAL ENGINEERING CURRICULUM 2020 – 2021

### Freshman Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>GNEG 1111</td>
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<td>MATH 2554</td>
<td>Calculus I</td>
<td>4</td>
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<td>CHEM 1103</td>
<td>University Chemistry I</td>
<td>3</td>
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<td>PHYS 2054</td>
<td>University Physics I</td>
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<td>Composition I</td>
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<td>ELEG 2904</td>
<td>Digital Design w/ Lab</td>
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<td>MATH 2584</td>
<td>Differential Equations</td>
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<td>ELEG 3124</td>
<td>Systems &amp; Signals Analysis w/Lab</td>
<td>3</td>
</tr>
<tr>
<td>ELEG 3214</td>
<td>Electronics I w/ Lab</td>
<td>4</td>
</tr>
<tr>
<td>ELEG 3704</td>
<td>Applied Electromagnetics w/ Lab</td>
<td>4</td>
</tr>
<tr>
<td>ELEG 3924</td>
<td>Microprocessor System Design w/ Lab</td>
<td>4</td>
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### Senior Year

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<td>ELEG 4063</td>
<td>Electrical Engineering Design I</td>
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<tr>
<td>ELEG Technical Elective&lt;sup&gt;e&lt;/sup&gt;</td>
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<tr>
<td>ELEG Technical Elective&lt;sup&gt;e&lt;/sup&gt;</td>
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<td>Engineering Science/Technical Elective&lt;sup&gt;d&lt;/sup&gt;</td>
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</table>

### TOTAL: 125 semester hours

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<sup>a</sup> Sophomore Science Elective – CHEM 1123/1121L University Chemistry II, BIOL 1543/1541L Principles of Biology, BIOL 2213/2211L Human Physiology, PHYS 2094 University Physics III

<sup>b</sup> Humanities course should be chosen from the following list: CLST 1003 Introduction to Classical Studies: Greece, CLST 1013 Introduction to Classical Studies: Rome, HUMN 1124H Honors Equilibrium of Cultures 500-1600, PHIL 2003/2003C/2003H Introduction to Philosophy, PHIL 2103/2103C Introduction to Ethics

<sup>c</sup> Social Science Elective should be chosen from one of the following: ANTH 1023 Intro to Cultural Anthropology, COMM 1023 Communication in a Diverse World, HDFS 1403 Life Span Development, HDFS 2413 Family Relations, HIST 1113/1113H Institutions and Ideas of World Civilization I, HIST 1123/11523H Institutions and Ideas of World Civilization II, HUMN 1114H Honors Root to Culture to 500 C.E., PLSC 2013 Introduction to Comparative Politics, RESM 2853 Leisure and Society


<sup>e</sup> CSCE 4114, CSCE 4613, CSCE 4233 are approved ELEG Technical Electives for students pursuing a dual ELEG-CSCE dual undergraduate degrees

<sup>f</sup> Fine Arts Elective should be selected from one of the following: ARHS 1003 Basic Course in the Arts: Art Lecture, COMM 1003 Basic Course in Arts: Film Lecture, DANC 1003 Basic Course in the Arts: Movement and Dance, MLIT 1003/1003H Experiencing Music, MLIT 1013/1013H Music and Society, MLIT 1333 Popular Music, THTR 1003 Basic Course in the Arts: Theatre Appreciation, THTR 1013 Musical Theatre Appreciation
### 2020-2021 Curriculum: List of Required Courses with Pre- and Co-Requisites for ELEG

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<tr>
<th>Year/Semester</th>
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<th>Course Title</th>
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<th>Co-Requisites</th>
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<td>QNEG 1111</td>
<td>Introduction to Engineering I</td>
<td>First Year Engineering</td>
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<td>University Chemistry I</td>
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<td>MATH 2554</td>
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<td>Freshman 1</td>
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<td>ELEG 3143</td>
<td>Probability and Stochastic Processes</td>
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<td>XXXX XXXX</td>
<td>Fine Arts Elective</td>
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**Notes:**

- a Sophomore Science Elective – CHEM 1123/1121L University Chemistry II, BIOL 1543/1541L Principles of Biology, BIOL 2213/2211L Human Physiology, PHYS 2094 University Physics III
- b Humanities course should be chosen from the following list: CLST 1003 Introduction to Classical Studies: Greece, CLST 1013 Introduction to Classical Studies: Rome, HUMAN 1124H Honors Equilibrium of Cultures 500-1600, MUSY 2003/2003H Music in World Cultures, WLIT 1113 World Literature I, WLIT 1123 World Literature II, Intermediate-level world language (usually 2003-level)
- c Social Science Elective should be chosen from one of the following: HDFS 1403 Life Span Development, HDFS 2603 rural Families and Communities, HST 2093 Animals in World History, HUMAN 1114H Honors Root to Culture to 500 C.E., HUMAN 2114H Honor Birth of Modern Culture 1600-1900, INST 2013 Introduction to International and Global Studies
- e CSCE 4114, CSCE 4613, CSCE 4233 are approved ELEG Technical Electives for students pursuing a dual ELEG-CSCE dual undergraduate degrees
- f Fine Arts Elective should be selected from one of the following: ARHS 1003 Basic Couse in the Arts: Art Lecture, COMM 1003 Basic Course in Arts: Film Lecture, DANC 1003 Basic Course in the Arts: Movement and Dance, MLIT 1003/1003H Experiencing Music, MLIT 1013/1013H Music and Society, MLIT 1333 Popular Music, THTR 1003 Basic Course in the Arts: Theatre Appreciation, THTR 1013 Musical Theatre Appreciation
- g Co-requisites may be taken prior to the class listed or with the class listed.
### Advising Form for 2020-2021 EE Plan of Study

#### Pre-Req Co-Req Fall Semester $\#$ Sem GR Pre-Req Co-Req Spring Semester $\#$ Sem GR
- MATH 2544 Calculus I 1
- MATH 2554 Calculus II 1
- PHYS 2054 University Physics I 4
- ENGL 1013 Composition I 1
- History/Political Science Elective 1

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<th>Pre-Req Co-Req Fall Semester</th>
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<th>Sem</th>
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- MATH 2544 Calculus I        |     |     |    | MATH 2564 Calculus II          |     |     |    |
- PHYS 2054 University Physics I | 4   |     |    | ENGL 1013 Technical Composition I | 1   |     |    |
- History/Political Science Elective | 1   |     |    | ENGL 1013 Technical Composition II | 1   |     |    |

### Year-by-Year EE Plan of Study

#### Freshman Year

- ELEG 2104 Intro to Engineering I 1
- MATH 1113 Intro to Engineering II 1
- MATH 2544 Calculus I 1
- CHEM 103 University Chemistry I 1
- MATH 2544 Calculus II 1
- MATH 2544 Calculus III 1
- ENGL 1013 Composition I 1
- ENGL 103 Technical Composition II 1

#### Sophomore Year

- MATH 2564 Calculus I 4
- ELEG 2104 Electric Circuits (With Lab) 4
- ELEG 2904 University Physics I 4
- ENGL 1013 Composition I 4
- History/Political Science Elective 3
- MATH 2564 Calculus II 4

#### Junior Year

- ELEG 3004 Electrical Engineering Design I 4
- ELEG 3214 Electronics I (With Lab) 4
- MATH 2574 Calculus IV 4
- ELEG 3124 System & Signal Analysis (With Lab) 4
- ELEG 3904 University Physics II 4
- MATH 2574 Calculus III 4
- ENGL 1013 Technical Composition I 4
- ENGL 103 Technical Composition II 4

#### Senior Year

- ELEG 3124 Electrical Engineering Design I 4
- ELEG 3214 Electronics II (With Lab) 4
- MATH 2574 Calculus IV 4
- ELEG 3904 University Physics II 4
- MATH 2574 Calculus III 4
- ELEG 3124 Electrical Engineering Design II 4
- ENGL 1013 Technical Composition I 4
- ENGL 103 Technical Composition II 4

### Notes

- Did you enroll before Fall 2014?  
  - TOTAL TRANSFER AND CREDIT HOURS 5
  - TOTAL UNIVERSITY CREDIT HOURS 5
  - ONLY 4 HOURS OF D' 5

#### Faculty Signature: Date

#### Student Signature: Date

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*Students who have (1) Talked to the departmental co-op coordinator, Robert Saunders, about the intention of taking three GNEG 3811 courses for 3 hours of non-ELEG technical electives, and (2) The grades in these courses were A or B may get credit for three hours of non-ELEG technical electives. Please consult the department regarding this if you have any further questions. GNEG 3801 cannot be used for technical elective credit.

*Students cannot use ELEG 3903, ELEG 3913, or ELEG 3933 to meet this requirement.*
The above form is designed so that students and advisors can keep record of the courses they have taken, the grades received, and whether the pre- and co-requisites have been met. An interactive version is available at https://electrical-engineering.uark.edu/academics/undergraduate-students/index.php.
NOTES FOR 2020-2021

Electrical Engineering Undergraduate Curriculum

GPA REQUIREMENTS

All students must have at least a 2.0 grade-point average on: (i) all courses in Electrical Engineering, (ii) all engineering courses and (iii) all work presented for the degree. No more than 8 hours of coursework taken at UA-Fayetteville and presented for the degree can be “D” grades.

RESIDENCY REQUIREMENTS

All students must complete 30 hours in residence, 20 of which must be ELEG courses 3000 level and above.

COMMON FIRST YEAR

Please refer to http://first-year-engineering.uark.edu/ for a description of the common first year.

SOPHOMORE SCIENCE ELECTIVE

CHEM 1123 and CHEM 1121L – University Chemistry II; BIOL 1543 and 1541L – Principles of Biology; BIOL 2213 and 2211 – Human Physiology; PHYS 2094 – University Physics III

ELEG TECHNICAL ELECTIVES

- ELEG 4000 or ELEG 5000 level courses
- For students pursuing a dual degree in CSCE and ELEG: CSCE 4114, CSCE 4613, CSCE 4233.
- Not more than 6 hours may be ELEG 488V or ELEG 489V courses are approved ELEG Technical Electives.

TECHNICAL ELECTIVES

*3000 or above level courses in Math, Engineering, or the sciences after the approval ELEG advisor. History courses in the Math and the sciences (e.g., MATH 3133) are not eligible technical elective credit. **CSCE 2014, Programming 2, and CSCE 2214, Computer Organization, are allowable non-ELEG technical electives.

*Students have (1) talked to the departmental co-op coordinator, Mr. Robert Saunders, about the intention of taking three GNEG 3811 courses for 3 hours of non-ELEG technical electives, and (2) the grades in these courses were A or B, may get credit for three hours of non-ELEG technical electives. Please consult the department regarding this if you have any further questions. GNEG 3801 cannot be used for technical elective credit.

**Students cannot use ELEG 3903 or ELEG 3933 to meet this requirement.
MATH/SCIENCE/TECHNICAL ELECTIVES
BIOL 1543 & 1541L Principles of Biology
CHEM 1123 & 1121L University Chemistry II
CHEM 3504 Physical Chemistry I
CHEM 3603 Organic Chemistry I
MATH 3083 Linear Algebra
MATH 3423 Advanced Applied Math
MATH 4443 Complex Variables
PHYS 3133 Analytical Mechanics
PHYS 2544 Optics
PHYS 3614 Modern Physics
MEEG 2703 Computer Methods in ME
STAT 4003 Statistical Methods
Or any other Technical Elective

ENGINEERING SCIENCE/TECHNICAL ELECTIVES
MEEG 2013 Introduction to Machine Analysis
MEEG 2303 Introduction to Materials
MEEG 2403 Thermodynamics
CHEG 2313 Thermodynamics of Single-Component Systems
INEG 2413 Engineering Economics Analysis
Or another Technical Elective

ELEG HUMANITIES / SOCIAL SCIENCE ELECTIVES
Select one course from U.S. History, fine arts, humanities, and economics for a total of 12 credit hours. Select two courses from the social sciences for a total of 6 credit hours. You must select from two different fields of study.

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Study Abroad for Electrical Engineering Students

A growing number of electrical engineering students are participating in Study Abroad. Though this is a worthwhile experience for students, it does cause problems in completing coursework and could delay graduation. However, it is possible for a student to take the lecture part of the course online and receive a grade of “Incomplete” for the course. Upon returning from the study abroad program, the student can then complete the lab section of the course and receive a grade.

Electrical Engineering Academic Emphasis Areas

Integrated Circuit Design

ELEG 4233. 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 4233 and ELEG 5923. Prerequisite: ELEG 3214 or ELEG 3933 and ELEG 2904 or equivalent.

ELEG 4233H. Honors Introduction to Integrated Circuit Design. 3 Hours.
Design and layout of large scale digital integrated circuits using NMOS and CMOS technology. Topics include MOS devices and basic circuits, integrated circuit layout and fabrication, dynamic logic, circuit design, and layout strategies for large scale NMOS and CMOS circuits. Prerequisite: ELEG 3214 or ELEG 3933 and ELEG 2904 or equivalent. This course is equivalent to ELEG 4233.

ELEG 4243. 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 3224.

ELEG 4293. Mixed-Signal Modeling & Simulation. 3 Hours.
Study of basic analog, digital & mixed signal simulation solution methods. Modeling with hardware description languages. Use of state-of-the-art simulators and HDLs. Students may not receive credit for both ELEG 4293 and ELEG 5993. Prerequisite: ELEG 3224.

Power Electronics

ELEG 4533. 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 4533 and ELEG 5533. Prerequisite: ELEG 3304 and ELEG 3224.

ELEG 4543. 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 5543 and ELEG 4543. Prerequisite: ELEG 2114 and ELEG 3214.

ELEG 4553. 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 3224 and ELEG 3124.

ELEG 487V. Special Topics in Electrical Engineering. 1-3 Hour.

Consideration of current electrical engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 6 hours of degree credit.

ELEG 487VH. Honors Special Topics in Electrical Engineering. 1-3 Hour.

Consideration of current electrical engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 6 hours of degree credit. This course is equivalent to ELEG 487V.

Power Systems

ELEG 4403. 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 4403 and ELEG 5403. Prerequisite: ELEG 3124.

ELEG 4403H. 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 4403 and ELEG 5403. Prerequisite: ELEG 3124.

ELEG 4413. 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 4413 and ELEG 5413. Prerequisite: ELEG 4403 or equivalent course.

ELEG 4423. 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 4403.

**ELEG 4463L. 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 3924 and ELEG 3124.

**ELEG 4473. Power System Operation and Control. 3 Hours.**

Study of the control and operation of electric power systems: Modeling, dynamics, and stability of three-phase power systems. Design and implementation of control systems related to generation and transmission. Overview of the related industry and government regulations for power system protection and reliability. Students may not receive credit for both ELEG 4473 and ELEG 5473. Prerequisite: ELEG 3124 and ELEG 3304.

**ELEG 4503. 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. Prerequisite: ELEG 3304.

**ELEG 4503H. Honors 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 4503H and ELEG 5503. Prerequisite: ELEG 3304. This course is equivalent to ELEG 4503.

**ELEG 4513. 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 4513 and ELEG 5513. Prerequisite: ELEG 2114.

**ELEG 4523. Quality of Electric Power. 3 Hours.**

This course addresses concepts related to the quality of electric power (in particular wiring and grounding, voltage sags and interruptions, harmonics, and transients), distributed generation and power electronic systems, power quality benchmarking, as well as instrumentation and PQ analyzers. Students may not receive credit for both ELEG 4523 and ELEG 5523. Prerequisite: ELEG 3304.

**ELEG 487V. Special Topics in Electrical Engineering. 1-3 Hour.**

Consideration of current electrical engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 6 hours of degree credit.

**ELEG 487VH. Honors Special Topics in Electrical Engineering. 1-3 Hour.**

Consideration of current electrical engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 6 hours of degree credit. This course is equivalent to ELEG 487V.
RF and Antenna Engineering

**ELEG 4623. 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. Pre- or Corequisite: ELEG 3143.

**ELEG 4703. 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 3704.

**ELEG 4703H. Honors 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 3704.
This course is equivalent to ELEG 4703.

**ELEG 4783. 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 3704.

**ELEG 4783H. 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 3704. This course is equivalent to ELEG 4783.

**ELEG 487V. Special Topics in Electrical Engineering. 1-3 Hour.**
Consideration of current electrical engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 6 hours of degree credit.

**ELEG 487VH. Honors Special Topics in Electrical Engineering. 1-3 Hour.**
Consideration of current electrical engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 6 hours of degree credit.
This course is equivalent to ELEG 487V.
Electrical Engineering Honors Program

To graduate with Honors in Electrical Engineering, a student 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 at least 6 hours must be Electrical Engineering courses which include the following courses:

ELEG 4063H – Honors Electrical Engineering Design I
ELEG 4071H – Honors Electrical Engineering Design II
ELEG 400VH – Senior Thesis

Electrical Engineering Honors Courses

ELEG 3XX3H: Honors section of ELEG required junior courses.
ELEG 4063H: Electrical Engineering Design I
Design and application in electrical engineering.

ELEG 4071H: Electrical Engineering Design II
Design and application in electrical engineering.

ELEG 400VH: Honors Senior Thesis
ELEG 488VH: Honors Special Problem
This is a special investigation where the student performs an individual study/research on a topic mutually agreeable to the student and a faculty member.

ELEG 4XX3H: ELEG technical elective (Honors section)
Several ELEG technical electives have an Honors section. Please check the offering of these Honors Sections for a particular semester.

ELEG 5XXX: Any graduate level course

ELEG 3083H: Honors Colloquium
Special topics and issues in Electrical Engineering

ELEG 388VH: Special Problems
Individual study and research on a topic mutually agreeable to the student and faculty member.

See http://electrical-engineering.uark.edu/academics/undergraduate-students/honors-college.php for more information.
The EE Curriculum and Medical School

This section provides some general guidelines for those students interested in continuing into Medical School.

Different medical schools have different requirements. Most of UA CoE graduates apply to UAMS in Little Rock whose catalog is found at:

http://www.uams.edu/com/comcat/COM_Admissions_Guide_Web_2013.pdf  In general, it is required to have:

- 2 semesters of Calculus: EE curriculum has 4 semesters of MATH courses
- 2 semesters of Physics: EE curriculum has 2 semesters of PHYS courses
- 2 semesters of Chemistry: EE curriculum requires CHEM 1103/1101L plus CHEM 1123/1121L can be taken as a Sophomore Science Elective or Math/Science Elective
- 2 semesters of Organic Chemistry: CHEM 3603 and CHEM 3613 can be taken as non-EE Technical Electives
- 2 semesters of Biological Sciences: BIOL 1543/1541L taken as a Sophomore Science Elective or Math/Science Elective plus BIOL 3xxx taken as Engineering Science/Technical Elective
- 2 semesters of English: EE requires 3 semesters; however, note that UAMS will accept regular credit (taking the class on campus) or AP-- but not CLEP, exemptions, correspondence courses, etc. This restriction can cause trouble with students who exempt ENGL comp due to high ACT. They will need to make sure to have 2 courses from ENGL on their transcript.

Additional (advanced) courses are suggested but not required. Additional biology often helps the student with their MCAT tests which weigh heavily on med school admissions decisions. Students should try to take 1 or 2 of these courses when they can (maybe summer), hopefully prior to the last part of their junior year when the MCAT is taken. Recommended courses include anatomy, physiology, microbiology, and/or cell biology, which are basic biology courses that would help students prepare.
FERPA Hold
The purpose of this section is to make you aware of an unwanted effect of the FERPA (Family Educational Rights and Privacy Act of 1974) hold. FERPA relates to privacy and some of you have “clicked” on the FERPA box in ISIS so we cannot release information about you. By doing this, you get the following unwanted effects:

- Your name cannot be listed in the Dean’s list. You get a letter stating that you are part of the Dean’s list, but your name is now shown in any publication of the list.
- Upon graduation, your name cannot be included in the “Senior Walk.” So if you come back to campus and your name is not there, one potential reason is that you have a FERPA hold.
- Your name cannot be listed in the Commencement Programs.
- Other unwanted effects that we may not have yet identified.

Therefore, if you want your name in the Senior Walk and printed in the Commencement programs, please, remove your FERPA hold during your last semester.

We want to let you know independently of whether you have a FERPA hold or not, the department does not release any information to third parties without your consent. This is normally done when we have an employer seeking graduates.
NOTE: The hardcopy of the Undergraduate Handbook finishes here. Please, refer to the website http://electrical-engineering.uark.edu/, and click on “Current Students” and “Research” for additional information on:

- Humanities/Social Science/Economics/Fine Arts Electives
- Departmental Facilities
- Advising
- Registration
- Tutoring Services
- Activities and Organizations
- Career Services
- Electrical Engineering Faculty Research Specialty Areas
- Scholarships