## ELECTRICAL ENGINEERING MAJOR

### First Semester

| | | | | |
|---|---|---|---|---|
| FRESHMAN YEAR | | | | |
| Composition and Literature | ENGL | 101 | 3 | (3,0)* |
| General Chemistry I | CHEM | 151 | 3 | (3,0) |
| General Chemistry I Laboratory | CHEM | 161 | 1 | (0,2) |
| Analytic Geometry and Calculus I | MATH | 131 | 4 | (4,0) |
| History of Western Civilization | HIST | 103 | 3 | (3,0) |
| Engineering Fundamentals I | ELEC | 104 | 1 | (1,1) |
| +1st Year Basic ROTC | | | | |
| Required Physical Education | RPED | 250 | 2 | (2,0) |
| SOPHOMORE YEAR | | | | |
| Introduction to Discrete Structures | MATH | 206 | 3 | (3,0) |
| Analytic Geometry and Calculus III | MATH | 231 | 4 | (4,0) |
| Physics with Calculus I | PHYS | 221 | 3 | (3,0) |
| Physics with Calculus I Laboratory | PHYS | 271 | 1 | (0,2) |
| Electric Circuit Analysis I | ELEC | 201 | 3 | (3,0) |
| Digital Logic and Circuit | ELEC | 311 | 3 | (3,0) |
| +2nd Year Basic ROTC | | | | |
| Required Physical Education | RPED | | 0 | (0,1) |
| JUNIOR YEAR | | | | |
| Major British Writers | ENGL | 201 | 3 | (3,0) |
| Applied Mathematics II | MATH | 335 | 3 | (3,0) |
| Linear Systems Analysis | ELEC | 309 | 3 | (3,0) |
| Engineering Administration | CIVL | 314 | 2 | (2,0) |
| Electronics I | ELEC | 306 | 3 | (3,0) |
| Electronics Laboratory | ELEC | 313 | 1 | (0,2) |
| +1st Year Advanced ROTC | | | | |
| SENIOR YEAR | | | | |
| Design I | ELEC | 421 | 3 | (1,4) |
| **Non-Departmental Elective | | | 3 | (3,0) |
| Applied Probability and Statistics for Engineers | ELEC | 412 | 3 | (3,0) |
| ***Approved Department Elective | ELEC | 4XX | 3 | (3,0) |
| ***Approved Department Elective | ELEC | 4XX | 3 | (3,0) |
| +2nd Year Advanced ROTC | | | | |

*Represents semester credit. Lecture, laboratory hours, in that order.
**Advanced humanitites or social science course.
***APPROVED DEPARTMENT ELECTIVES must be selected from among the following courses: ELEC 307, ELEC 401, ELEC 403, ELEC 405, ELEC 407, ELEC 413, ELEC 414, ELEC 415, ELEC 416, ELEC 418, ELEC 419, ELEC 423, ELEC 424, ELEC 425, ELEC 426, and CSCI 420.
+ROTC hours (credit, lecture, and/or lab) may vary each semester by military department; however, the total hours which may be applied toward graduation requirements may not exceed 16 semester hours.

## ELECTRICAL ENGINEERING MAJOR
### Second Semester

| | | | | |
|---|---|---|---|---|
| FRESHMAN YEAR | | | | |
| General Chemistry II | CHEM | 152 | 3 | (3,0) |
| General Chemistry II Laboratory | CHEM | 162 | 1 | (0,2) |
| Analytic Geometry and Calculus II | MATH | 132 | 4 | (4,0) |
| Composition and Literature | ENGL | 102 | 3 | (3,0) |
| History of Western Civilization | HIST | 104 | 3 | (3,0) |
| Engineering Fundamentals II | ELEC | 105 | 2 | (2,0) |
| +1st Year Basic ROTC | | | | |
| Required Physical Education | RPED | 251 | 2 | (2,0) |
| SOPHOMORE YEAR | | | | |
| English, American or World Literature | ENGL | | 3 | (3,0) |
| Applied Mathematics I | MATH | 234 | 4 | (4,0) |
| Physics with Calculus II | PHYS | 222 | 3 | (3,0) |
| Physics with Calculus II Laboratory | PHYS | 272 | 1 | (0,2) |
| Electric Circuit Analysis II | ELEC | 202 | 3 | (3,0) |
| Electrical Laboratory | ELEC | 204 | 1 | (0,2) |
| Computer Applications for Electrical Engineering | ELEC | 206 | 3 | (3,0) |
| +2nd Year Basic ROTC | | | | |
| Required Physical Education | RPED | | 0 | (0,1) |
| JUNIOR YEAR | | | | |
| Systems I | ELEC | 312 | 3 | (3,0) |
| Electromechanical Energy Conversion | ELEC | 316 | 3 | (3,0) |
| Digital Systems Engineering | ELEC | 330 | 3 | (3,0) |
| Electrical Machinery Laboratory | ELEC | 302 | 1 | (0,2) |
| ++Technical Elective | | | 3 | (3,0) |
| Electromagnetic Fields | ELEC | 318 | 3 | (3,0) |
| Linear Systems Laboratory | ELEC | 301 | 1 | (0,2) |
| +1st Year Advanced ROTC | | | | |
| SENIOR YEAR | | | | |
| Design II | ELEC | 422 | 3 | (1,4) |
| Social Science Core Course | | | 3 | (3,0) |
| ***Approved Department Elective | ELEC | 4XX | 3 | (3,0) |
| ***Approved Department Elective | ELEC | 4XX | 3 | (3,0) |
| ***Approved Department Elective | ELEC | 4XX | 3 | (3,0) |
| +2nd Year Advanced ROTC | | | | |

++Technical Electives: *Optics* (PHYS 308), *Thermodynamics* (PHYS 410), *Statics and Mechanics of Materials For Non-Civil Engineers*, (CIVL 310); *Data Structures*, (CSCÎ 223); *Engineering Management*, (CIVL 411), Deterministic Methods of Operational Research, (MATH 381), Mathematical Models and Applications, (MATH 470).

Credit hours required for graduation: 128 plus the credit hours from successful completion of RPED 250, RPED 251, and all required ROTC courses.

# Department of Electrical and Computer Engineering

Department Head: Peeples
Professors: Peeples
Associate Professor: Barsanti, Jerse, McKinney
Assistant Professor: Hayne, Potisuk, Skinner

## General Information

In 1941 the Board of Visitors authorized the establishment of a Department of Electrical Engineering at The Citadel. Because World War II intervened, the first electrical engineering degrees were awarded to the class of 1948. The electrical engineering program is offered in two modes—day mode and the 2+2 evening mode. The day mode is open only to members of the South Carolina Corps of Cadets and enlisted active duty students assigned to one of The Citadel's ROTC Departments. Cadets must take sixteen hours of ROTC and four hours of Health and Physical Education in addition to two Required Physical Education non-credit courses. The 2+2 evening mode is open to transfer students and does not require ROTC or Health and Physical Education. Otherwise curricula, faculty, textbooks, laboratory equipment, course content, classrooms, and laboratory rooms are the same for both modes.

The Electrical and Computer Engineering Department is located on the third floor of Grimsley Hall, a first-tier engineering education facility that provides fully-equipped laboratories, classrooms and faculty offices. The related Departments of Mathematics and Computer Science, Physics, and Civil and Environmental Engineering are housed adjacent to the department, creating a "micro-campus" of science and technology.

The student branch of the Institute of Electrical and Electronics Engineers was established in 1962 and is an active component of the electrical engineering program. A Citadel chapter of Tau Beta Pi, the national engineering honor society, recognizes junior and senior students who meet the organization's high academic standards.

The electrical engineering program is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET).

## Mission

The mission of the Department of Electrical and Computer Engineering is to prepare the individual for professional work or for graduate study in the fields of electrical and computer engineering and to provide as many of the elements of a broad education as can be included in a program of professional study

leading to the degree of Bachelor of Science in Electrical Engineering.

In addressing its mission, the department strives, through small classes and hands-on experience in laboratories closely monitored by full-time faculty, to provide an environment highly conducive both to learning and to the development of close student-faculty relationships.

The electrical engineering curriculum places emphasis on a broad liberal education base, a strong background in mathematics and basic sciences, and a logical sequence of electrical and computer engineering courses that provide the breadth and depth necessary for continuous professional growth in today's technological society. In the junior year the electrical engineering student normally selects an area of professional emphasis such as computer engineering, control systems, communication systems, electronics, or power systems. An integral part of the program is the design component that develops the student's ability to address practical engineering problems. This is accomplished by the inclusion of engineering design problems and concepts throughout the curriculum and capped by a mandatory two-semester senior design course in which students undertake significant design projects.

Convinced of the great value of practical experience, the department encourages its majors to obtain gainful employment in electrical engineering or a related field for at least one summer, preferably between the junior and senior years.

## Program Objectives

The Citadel Department of Electrical and Computer Engineering program prepares graduates to:

- Succeed in the practice of electrical engineering, by ethically and judiciously applying knowledge of science, mathematics and engineering methods to solve problems facing a technologically complex society.
- Apply and operate current hardware and software tools, equipment, and development environments to conduct and/or lead engineering analysis, design and research.
- Value and pursue lifelong learning, not only to keep current in electrical and computer engineering fields, but also to sustain awareness of engineering-related issues facing contemporary society.
- Pursue graduate education and/or professional registration as desired or required.
- Be principled leaders with strong communications and team-building skills.

Methods used to evaluate the program's success in meeting these objectives include:

1. Periodic surveys of graduates and employers to gauge our graduates' success, advancement and technical contributions in the workplace, and to identify potential gaps or areas requiring improvement in the curriculum.
2. Annual evaluation by an ECE Advisory Board sub-committee of hardware

and software tools, equipment, development environments and laboratory plans, to ensure currency and/or identify requirements gaps.
3. Periodic evaluation of our graduates' membership and roles in professional organizations, participation in formal continuing education opportunities, and other activities relating to lifelong learning.
4. Monitoring of our graduates' involvement and success in graduate study of engineering and related disciplines.
5. Annual review of our graduates' success in efforts to become professionally licensed.

## Electrical Engineering Curriculum

The electrical engineering educational experience begins in the freshman engineering fundamentals courses, ELEC 104 and ELEC 105. These freshman courses develop basic skills and good teamwork habits through team case studies requiring the communication of creative ideas. The study of electrical engineering topics in the sophomore year includes 6 credit hours of electric circuit analysis, 3 credit hours of digital logic and circuits, 1 credit hour of electrical laboratory, and 3 credit hours of computer applications for electrical engineers. Theory is combined with application, demonstration, and experimental verification. In addition the first two years include 19 credit hours of mathematics, 8 credit hours of chemistry, 8 credit hours of physics, and 18 credit hours of English and history to provide the foundation necessary for an engineering education.

The junior year requires a total 21 credit hours of electrical engineering course work. Breadth of coverage is provided by courses in linear circuit analysis, electronics, systems (automatic controls), digital circuits and systems, electromagnetics, and electromechanical energy conversion. Many of these courses include engineering design problems drawn from the experience of the faculty. First semester juniors complete their sixth mathematics course, MATH 335 (Applied Mathematics II), which provides coverage of mathematical topics required in upper division electrical engineering courses. There is a single junior year elective course that must be technical in nature and outside the mainstream of electrical engineering.

The senior year provides depth in electrical and computer engineering by requiring five out of an available thirteen 400-level electrical engineering elective courses taught and at least one approved Computer Science elective. The elective courses are ELEC 307 (Nuclear Engineering), ELEC 401 (Electronics II), ELEC 403 (Electric Power Systems), ELEC 405 (Electrical Measurements) and ELEC 415 (Electrical Measurements Laboratory), ELEC 407 (Systems II), ELEC 413 (Advanced Topics in Electrical Engineering), ELEC 414 (System Simulation), ELEC 416 (Communications Engineering), ELEC 418 (Advanced Digital Systems), ELEC 419 (Computer Network Architecture), ELEC 423 (Digital Signal Processing), ELEC 424 (Solid-State Devices), ELEC 425 (Interference Control in Electronics), ELEC 426 (Antennas and Propagation) and

CSCI 420 (Software Engineering). These electives provide the student the opportunity to pursue an area of interest. While narrow specialization is neither possible nor desirable at the undergraduate level, these three-credit electives provide depth in both design and theory in their specialized areas. Below are several examples of possible areas of concentration available to the student.

**Computer Engineering**

| | |
|---|---|
| CSCI 223 | Data Structures |
| CSCI 420 | Software Engineering |
| ELEC 418 | Advanced Digital Systems |
| ELEC 419 | Computer Network Architecture |
| ELEC 423 | Digital Signal Processing |
| ELEC 416 | Communications Engineering |

**Power Engineering**

| | |
|---|---|
| CIVL 310 | Statics and Mechanics of Materials for Non-Civil Engineers |
| ELEC 307 | Nuclear Engineering |
| ELEC 403 | Electric Power Systems |
| ELEC 407 | Systems II |
| ELEC 405 | Electrical Measurements |
| ELEC 415 | Electrical Measurements Laboratory |
| ELEC 426 | Antennas and Propagation |

**Communications**

| | |
|---|---|
| PHYS 308 | Optics |
| ELEC 401 | Electronics II |
| ELEC 416 | Communication Engineering |
| ELEC 419 | Computer Network Architecture |
| ELEC 423 | Digital Signal Processing |
| ELEC 426 | Antennas and Propagation |

**Electronics**

| | |
|---|---|
| PHYS 410 | Thermodynamics |
| ELEC 401 | Electronics II |
| ELEC 418 | Advanced Digital Systems |
| ELEC 423 | Digital Signal Processing |
| ELEC 424 | Solid State Devices |
| ELEC 405 | Electrical Measurements |
| ELEC 415 | Electrical Measurements Laboratory |

## Electrical Engineering Design Experience

Engineering design is distributed throughout the electrical engineering curriculum. Introduction to the design process and the initial design experience occurs in the freshman courses, ELEC 104 and ELEC 105. The engineering profession and the ethical responsibilities of professional engineers are discussed. Design problems are posed that require little or no in-depth engineering knowledge. For example, a first problem might ask the student to design a dormitory room workplace. Functionality, aesthetics, and cost of implementation are a few of the issues to be considered. Case studies are assigned that provide an

opportunity for the students to work in teams. The emphasis is on the synthesis of a product that meets broad requirements. The students are introduced to the concept of design in which there is no single right answer and relatively few limits placed on the creative process.

Techniques of analysis, synthesis, iteration, and approximations are studied in the sophomore and junior electrical engineering courses. Specialized design exercises illustrate the use of these techniques in the areas of circuits, systems, electronics, and digital circuits and systems.

The senior year provides the opportunity for the student to begin to focus on design techniques in a particular area of interest through the choice of at least five senior electrical engineering elective courses. Examples range from the use of a load flow program to determine operational conditions of a small power system in a contingency situation (ELEC 403), to the design of a state estimator (ELEC 407), to the design and implementation of digital filters (ELEC 423).

The design experience culminates in the required senior design courses, ELEC 421 and ELEC 422. This two-semester design sequence provides students the opportunity to work on a project of interest and provides the faculty the opportunity to guide students in their first major design experiences and emphasize once more the various constraints that may come into play in a design. The students are taught several different structured design approaches. Project definition and documentation are stressed. Design teams of three to four students are formed at the beginning of the first semester. Students are instructed on various practical aspects of design, such as layout considerations, safety, functionality, and documentation of design. The student design teams select or propose a major design project to be completed by the end of second semester. They must enlist a faculty advisor to guide their project. At the end of the first semester the design teams present their design proposals (written and oral) that include their preliminary design (block diagram level), a schedule for the following semester, and a cost estimate. In the second semester, the teams do the detailed design and build, test, refine, demonstrate, and document their design projects. In addition to the technical aspects, project management and presentation techniques are taught and applied. A detailed project specification is developed and placed under tight change control. Financial and scheduling aspects of the project are tracked. A final presentation in both written and oral form is required at the end of the semester, along with a working demonstration.

## Minor in Electrical Engineering

**Objectives:** The minor in electrical engineering is designed to allow the student with quantitative and scientific aptitudes and interests to acquire a basic level of competence in one of two fields of electrical engineering.

**Structure of the Minor:**

1. ***Required Courses: (7 credit hours)***

| | |
|---|---|
| ELEC 201 & 202 | Electric Circuit Analysis I & II |
| ELEC 204 | Electrical Laboratory |

***2. Elective Fields of Emphasis:***

***a. Digital Electronics: (10 credit hours)***

| | |
|---|---|
| ELEC 306 | Electronics I |
| ELEC 313 | Electronics Laboratory |
| ELEC 311 | Digital Logic and Circuits |
| ELEC 330 | Digital Systems Engineering |

**OR**

***b. Control Systems: (13 credit hours)***

| | |
|---|---|
| ELEC 206 | Computer Applications for Electrical Engineers |
| ELEC 309 | Signals and Systems |
| ELEC 301 | Linear Circuits Laboratory |
| ELEC 312 | Systems I |
| ELEC 407 | Systems II |

***3. Plan of Study:***

Prerequisites and corequisites for each of the above courses are as presented in the course descriptions below. (Exception: ELEC 104 and ELEC 105 are waived as course prerequisites for the student pursuing a minor in electrical engineering.)

Total Credit Hours Required — 17 (Digita Electronics Track)
20 (Control Systems Track)

## Electrical Engineering Course Descriptions

ELEC 104 *Engineering Fundamentals I* One Credit Hour

Required of electrical engineering freshmen. Meets the first year seminar requirement.

An introduction to the engineering profession, branches and functions of engineering, professional ethics, and the role of engineers in society. Fundamentals of engineering problem solving and the use of calculators and computers as tools to aid in problem solving. This course also covers first year seminar topics including academic skills and lifestyle issues related to success in college.

Lecture: one hour. Laboratory: one hour.

ELEC 105 *Engineering Fundamentals II* Two Credit Hours

Required of electrical engineering freshmen.

A continuation of Engineering Fundamentals I to include subject areas common to most engineering disciplines, such as the introduction to the engineering design process and teamwork through a design project, engineering laboratory skills, report writing, engineering economics, material balance, and drafting.

Lecture: two hours.

ELEC 201 and ELEC 202 *Electric Circuit Analysis I and II* Three Credit Hours

Prerequisites for ELEC 201: MATH 131 or permission of the department head to allow it as a corequisite; prerequisite or corequisites: ELEC 104, PHYS 221/271.

Prerequisites for ELEC 202: MATH 132 or permission of the department head to allow it as a corequisite, a grade of "C" or better in ELEC 201; prerequisite or corequisites: ELEC 105, ELEC 204, ELEC 206.

Required of electrical engineering sophomores.

Basic electrical elements and sources, Ohm's and Kirchoff's Laws, techniques of circuit analysis, sinusoidal analysis and phasors, power, three-phase circuits, and transient response of simple circuits, uses SPICE to aid circuit analysis.

Lecture: three hours, two semesters.

**Students must earn at least a "C" in ELEC 202 before enrolling in any courses for which ELEC 202 is a prerequisite.**

ELEC 204 *Electrical Laboratory* One Credit Hour

Prerequisites or corequisites: ELEC 202 or ELEC 308, ELEC 206

Required of electrical engineering sophomores.

An introduction to the experimental method. Laboratory exercises are designed to supplement the material presented in ELEC 201 and ELEC 202.

Laboratory: two hours.

ELEC 206 *Computer Applications for Electrical Engineers* Three Credit Hours

Prerequisite or corequisite: ELEC 202 or ELEC 308

Required of electrical engineering sophomores.

The computer is presented as a tool for the solution of electrical engineering problems. High level language programming of computers; the use of application programs for the study of electrical circuits in the time and frequency domains; data manipulation, data plotting, and equation solving using application programs such as MATLAB.

Lecture: three hours

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ELEC 301 *Linear Systems Laboratory* One Credit Hour

Prerequisite: ELEC 204, ELEC 309

Corequisite: ELEC 312

Required of electrical engineering juniors.

A laboratory course to accompany ELEC 312.

Laboratory: two hours.

ELEC 302 *Electrical Machinery Laboratory* One Credit Hour
Prerequisite or corequisite: ELEC 316
Required of electrical engineering juniors.
A laboratory course to accompany ELEC 316.
Laboratory: two hours.

ELEC 306 *Electronics I* Three Credit Hours
Prerequisites: ELEC 202, ELEC 204, ELEC 206; prerequisite or corequisite: ELEC 313
Required of electrical engineering juniors.
Characteristics of solid-state devices; theory and design of low-frequency amplifiers; transistor biasing and stabilization; design of multistage amplifiers, utilizing bipolar and MOS devices.
Lecture: three hours.

ELEC 307 *Nuclear Engineering* Three Credit Hours
Prerequisite: PHYS 222/272
An introduction to the theory and application of nuclear energy. Topics include fission and the chain reaction; nuclear fuels; nuclear reactor principles, concepts, examples, construction, operation, and ecological impact; radiation hazards and shielding; nuclear propulsion; and controlled fusion.
Lecture: three hours.

ELEC 308 *Elements of Electrical Engineering* Three Credit Hours
Prerequisite: MATH 132
Required of civil engineering juniors.
Fundamental electrical concepts and units; basic laws of electrical circuits; equivalent circuits; DC and steady-state AC circuit analysis; and effective current, average power, and three-phase power.
Lecture: three hours.

ELEC 309 *Signals and Systems* Three Credit Hours
Prerequisites: ELEC 202, ELEC 204, ELEC 206, MATH 234; prerequisite or corequisite: MATH 335
Required of electrical engineering juniors.
The study of continuous and discrete systems utilizing Laplace and z-transform theory.
Lecture: three hours.

ELEC 311 *Digital Logic and Circuits* Three Credit Hours
Prerequisite or corequisite: MATH 206 or consent of department head.
Required of electrical engineering sophomores.
Introduction to Boolean algebra; digital data coding; digital arithmetic; design of combinational and sequential circuits; design, construction and evalua-

tion of digital circuits using industry-standard digital integrated circuits. Employs VHDL and other S/W design tools.

Lecture: three hours.

ELEC 312 *Systems I* Three Credit Hours

Prerequisite: ELEC 309

Corequisite: ELEC 301

Required of electrical engineering juniors.

An introduction to feedback control systems, system representation, stability, root-locus and frequency response, and compensation.

Lecture: three hours.

ELEC 313 *Electronics Laboratory* One Credit Hour

Prerequisites: ELEC 202, ELEC 204, ELEC 206

Corequisite: ELEC 306

Required of electrical engineering juniors.

Experimental studies coordinated with the subjects introduced in ELEC 306.

Laboratory: two hours.

ELEC 316 *Electromechanical Energy Conversion* Three Credit Hours

Prerequisite: ELEC 309 or consent of the department head; prerequisite or corequisite: ELEC 302

Required of electrical engineering juniors.

Analysis of transformers; fundamentals of electromechanical energy conversion; and study of DC, induction, and synchronous machines.

Lecture: three hours.

ELEC 318 *Electromagnetic Fields* Three Credit Hours

Prerequisites: ELEC 202, ELEC 204, ELEC 206, PHYS 222/272, MATH 234, MATH 335.

Required of electrical engineering juniors.

Static and magnetic fields; experimental laws and their relation to Maxwell's equations; Laplace and Poisson's equations; boundary value problems; time varying fields and plane waves.

Lecture: three hours.

ELEC 330 *Digital Systems Engineering* Three Credit Hours

Prerequisite: ELEC 311

Required of electrical engineering juniors.

Characteristics, specifications, and design of digital systems; analysis and synthesis of sequential circuits; microcontroller interfacing.

Lecture: three hours.

ELEC 401 *Electronics II* Three Credit Hours

Prerequisites: ELEC 306 and ELEC 313

Characteristics and applications of analog and digital integrated circuits. Topics to include CMOS digital logic, differential amplifiers, power amplifiers, feedback amplifiers, oscillators and filter circuits.

Lecture: three hours.

ELEC 403 *Electric Power Systems* Three Credit Hours

Prerequisites: ELEC 206, ELEC 316, and ELEC 318

A study of electrical power generation, transmission, and distribution; load flow, faults, and system stability; and system economics.

Lecture: three hours.

ELEC 405 *Electrical Measurements* Two Credit Hours

Prerequisite: Any two 300-level electrical engineering laboratory courses; prerequisite or corequisite: ELEC 415.

An introduction to modern electrical instrumentation and measurements. Topics include measurement theory, analog and digital signal conditioning, noise, transducers, instrumentation system design, digital interfaces, and computer-based instrumentation and measurement.

Lecture: two hours.

ELEC 407 *Systems II* Three Credit Hours

Prerequisite: ELEC 312

A continuation of Systems I with primary emphasis on digital control systems. Topics include state-variable analysis, simulation techniques, controllability, state-variable feedback, observability, and state estimator design.

Lecture: three hours.

ELEC 412 *Applied Probability and Statistics for Engineers* Three Credit Hours

Prerequisites: MATH 231, ELEC 206.

Required of all electrical engineering majors.

Application of the theory of probability and statistics in modeling random phenomena and signals; in the calculation of system responses; and in making estimates, inferences and decisions in the presence of chance and uncertainty. Applications will be studied in areas such as communications, power systems, device modeling, measurements, reliability and quality control.

Lecture: three hours.

ELEC 413 *Advanced Topics in Electrical Engineering* Three Credit Hours

Advanced topics in electrical engineering. Offered occasionally when the special interests of students and faculty coincide. The syllabus must be approved

by the Electrical Engineering Faculty. This course may be taken only once for credit.

Lecture: three hours.

ELEC 414 *System Simulation* Three Credit Hours

Prerequisite: ELEC 312

An introduction to system concepts, mathematical models of systems, and simulation methods applied to a broad range of systems. Design project required.

Lecture: three hours.

ELEC 415 *Electrical Measurements Laboratory* One Credit Hour

Prerequisite or corequisite: ELEC 405

A laboratory course to complement ELEC 405.

Laboratory: two hours.

ELEC 416 *Communications Engineering* Three Credit Hours

Prerequisites: ELEC 306, ELEC 312, ELEC 318, and ELEC 330

Principles of amplitude, frequency, phase, and pulse modulation; processing in communications systems; and analog and digital communication systems.

Lecture: three hours.

ELEC 418 *Advanced Digital Systems* Three Credit Hours

Prerequisites: ELEC 311, ELEC 330

Experience in advanced digital design techniques and exposure to the development tools used in the design of advanced digital systems. Topics include the design of digital systems using VHDL, industry standard FPGA devices and software, and microprocessor hardware components.

Lecture: three hours.

ELEC 419 *Computer Network Architecture* Three Credit Hours

Prerequisite: ELEC 311

This course will cover network architectures and protocols. Included are transmission technologies, encoding/decoding schemes, packet switching, frame relay, ISDN, ATM and performance modeling techniques.

Lecture: three hours.

ELEC 421 *Design I* Three Credit Hours

Prerequisites: ELEC 302, ELEC 306, ELEC 312, ELEC 316, ELEC 330, and ELEC 318, or consent of the department head.

Required of electrical engineering seniors.

Initiation, design, scheduling, documentation and reporting on a major design project. Normally accomplished by students working in small groups. All students will make written and oral presentations on their contributions to the

project. Financial, legal, ethical, societal, regulatory, environmental, manufacturability, and quality issues will be discussed and will constrain the designs as appropriate.

Lecture: one hour; laboratory: four hours.

ELEC 422 *Design II* Three Credit Hours

Prerequisite: ELEC 421 taken the preceding semester.

Required of all electrical engineering seniors.

Continuation of the major design project begun in Elec 421. Project implementation, documentation, and reporting. Normally to be accomplished by students working in the small groups formed in ELEC 421. The impact of the practical, societal, and governmental issues raised in ELEC 421 will be assessed. Each student will make written and oral presentations on their contributions to the project. A prototype demonstration and presentation of final results in a symposium format is required.

Lecture: one hour; laboratory: four hours.

ELEC 423 *Digital Signal Processing* Three Credit Hours

Prerequisite: ELEC 312 and ELEC 330

Introduction to the characteristics, design, and applications of discrete time systems including discrete time Fourier Transforms, FIR, and IIR Systems. Design of FIR and IIR filters. Design of Chebyshev and Butterworth filters. Introduction to DSP architecture.

Lecture: three hours.

ELEC 424 *Solid-State Devices* Three Credit Hours

Prerequisites: PHYS 222/272, MATH 234, and ELEC 306

Basic principles governing the operation of solid-state devices are developed from fundamental concepts. P-N junction theory is developed and applied to the analysis of devices such as bipolar transistors, solar cells, detectors, and photo devices. The theory of field-effect devices is developed.

Lecture: three hours.

ELEC 425 *Interference Control in Electronics* Three Credit Hours

Prerequisites: ELEC 309, ELEC 318, and ELEC 330

An introduction to the control and measurement of interference between electronic devices. Analysis methods and practical design techniques to minimize both radiated and conducted emissions and susceptibility will be taught. The course will also cover ways of enhancing signal integrity in high-speed circuits and reducing crosstalk. Laboratory exercises and demonstrations will be used to reinforce the material.

Lecture: three hours.

ELEC 426 *Antennas and Propagation* Three Credit Hours

Prerequisites: ELEC 318

Transmission, radiation, and propagation of electromagnetic waves by means of transmission lines, waveguides, optical fibers, and antennas.

Lecture: three hours.