Electrical and Computer Engineering

Interim Chair: Leon Jololian, PhD

Degree Offered	Bachelor of Science in Electrical and Computer Engineering
Accreditation	The Bachelor of Science in Electrical and Computer Engineering degree program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission's General Criteria and Program Criteria for Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Programs.
Website	https://www.uab.edu/engineering/ece/undergrad
Program Director	Leon Jololian, PhD
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The Department of Electrical and Computer Engineering offers a bachelor's degree in electrical and computer engineering (BSECE), which provides the foundation for students to succeed in any of the areas of electrical or computer engineering, including electronics, biomedical instrumentation, digital computer systems, software systems, power systems, digital control, signal processing, and data analysis.

In addition to the Blazer Core, the program includes a strong foundation in mathematics and physical sciences including calculus-based physics, a core of courses in the breadth of electrical and computer engineering, electrical and computer engineering electives, and courses from other engineering disciplines.

Each student must complete a senior design team project that comprises six semester hours of coursework (EE 498 Team Design Project I and EE 499 Team Design Project II).

Vision

To be a nationally recognized Department of Electrical and Computer Engineering: the first choice for undergraduate and graduate education

Mission

To prepare graduates to be immediately productive and able to adapt to a rapidly changing environment while also creating and applying knowledge for the benefit of Birmingham, the state, and beyond

Program Educational Objectives

The Electrical and Computer Engineering undergraduate program prepares graduates to:

- Succeed in a career or graduate studies in electrical and computer engineering
- Approach problem solving with an engineering mindset
- Grow professionally

Student Outcomes

Upon completion of the BSECE degree program, our graduates will have:

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 judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Bachelor of Science in Electrical and Computer Engineering

Requirements		Hours
Blazer Core Requirements		**43**
CH 115 & 115R & CH 116	General Chemistry I and General Chemistry I Recitation and General Chemistry I Laboratory	
EH 101	English Composition I	
EH 102	English Composition II	
EGR 103	Computer Aided Graphics and Design	
EGR 200	Introduction to Engineering [1]	
MA 125 & 125L	Calculus I and Calculus I Lab	
PH 221 & 221L & 221R	General Physics I and General Physics Laboratory I and General Physics I Recitation	
PH 222 & 222L & 222R	General Physics II and General Physics Laboratory II and General Physics II - Recitation	
Academic Foundations: Reasoning		
Thinking Broadly: History & Meaning		
Thinking Broadly: Creative Arts		
Thinking Broadly: Humans & Their Societies		
City as a Classroom [2]		
Other Required Courses		**73**
CE 210	Statics	
EE 210	Digital Logic	
EE 233	Engineering Programming Methods	
EE 254	Applied Numerical Methods [3]	
EE 300	Engineering Problem Solving II	

EE 314 & 314R	Electrical Circuits and Electrical Circuits Recitation	
EE 316 & 316L	Electrical Networks and Electrical Networks Laboratory	
EE 318	Signals and Systems	
EE 333	Engineering Programming Using Objects	
EE 337 & 337L	Introduction to Microprocessors and Introduction to Microprocessors Laboratory	
EE 341	Electromagnetics	
EE 351 & 351L	Electronics and Electronics Laboratory	
EE 361 & 361L	Machinery I and Machinery I Laboratory	
EE 421	Communication Systems	
EE 426	Control Systems	
EE 431	Analog Integrated Electronics	
EE 485	Engineering Operations	
EE 498	Team Design Project I	
EE 499	Team Design Project II	
EGR 150	Computer Methods in Engineering	
EGR 194	Engineering Explorations	
EGR 265	Math Tools for Engineering Problem Solving [3]	
MA 126	Calculus II	
ME 251	Introduction to Thermal Sciences	
Engineering Electives		**12**
Select four courses from the following:		
EE 412	Practical Computer Vision	
EE 418	Wireless Communications	
EE 423	Digital Signal Processing	
EE 427	Industrial Control	
EE 432	Introduction to Computer Networking	
EE 433	Engineering Software Solutions	
EE 434	Power Semiconductor Electronics	
EE 437	Introduction to Embedded Systems	
EE 438	Computer Architecture	
EE 444	Real-Time Process & Protocols	
EE 447	Internet/Intranet Application Development	
EE 448	Software Engineering Projects	
EE 452	Digital Systems Design	
EE 458	Medical Instrumentation	
EE 461	Machinery II	
EE 463	Medical Image Analysis	
EE 467	Brain Machine Interface	
EE 471	Power Systems I	
EE 472	Power Systems II	
EE 473	Protective Relaying of Power Systems	
EE 489	Undergraduate Engineering Research	
Total Hours		**128**

1 EGR 200 preferred; other FYE courses accepted
2 CE 280 preferred; other CAC courses accepted
3 May substitute MA 227 and MA 252 for EGR 265 and EE 254

Residency Requirement

In addition to UAB's residency requirement, to earn a bachelor of science in electrical and computer engineering from UAB, the ECE department requires that students complete the following courses at UAB:

Requirements		Hours
EE 421	Communication Systems	3
EE 426	Control Systems	3
EE 431	Analog Integrated Electronics	4
EE 498	Team Design Project I	3
EE 499	Team Design Project II	3
Nine hours of EE 400-level electives		9
Total Hours		**25**

Please refer to the School of Engineering overview for policies regarding admission; change of major; transfer credit; transient status; dual degree programs; reasonable progress; academic warning, probation, and suspension; reinstatement appeals; and graduation requirements.

Curriculum for the Bachelor of Science in Electrical and Computer Engineering (BSECE)

Freshman

First Term	Hours	Second Term	Hours
CH 115 & 115R & CH 116^	4	EE 210	3
EGR 200[1]	3	EGR 103#	3
EH 101%	3	EGR 150	3
MA 125 & 125L*	4	EGR 194	1
		MA 126	4
		PH 221 & 221L & 221R^	4
	14		**18**

Sophomore

First Term	Hours	Second Term	Hours
CE 210	3	EE 233	3
EE 314 & 314R	3	EE 316 & 316L	4
EGR 265[2]	4	EE 300	3
EH 102%	3	ME 251	2
PH 222 & 222L & 222R^	4	Blazer Core: Reasoning[3]	3
	17		**15**

Junior

First Term	Hours	Second Term	Hours
EE 318	3	EE 254[2]	3
EE 333	3	EE 337 & 337L	4
EE 351 & 351L	4	EE 341	3

EE 485	3	EE 361 & 361L	4
Blazer Core: City as a Classroom[$]	3	Blazer Core: Creative Arts[3]	3
	16		**17**

Senior

First Term	Hours	Second Term	Hours
EE 426	3	EE 421	3
EE 498	3	EE 431	4
Electrical Engineering Elective[4]	3	EE 499	3
Electrical Engineering Elective[4]	3	Electrical Engineering Elective[4]	3
Blazer Core: Humans & Their Societies[3]	3	Blazer Core: History & Meaning[3]	3
	15		**16**

Total credit hours: 128

[1] EGR 200 preferred; other FYE courses accepted
[2] May substitute MA 227 and MA 252 for EGR 265 and EE 254
[3] Refer to the Blazer Core as specified for engineering majors
[4] Must be chosen from the approved list of electives
^ Satisfies Blazer Core: Scientific Inquiry
% Satisfies Blazer Core: Writing
# Satisfies Blazer Core: Communicating in the Modern World
* Satisfies Blazer Core: Quantitative Literacy
$ CE 280 preferred; other CAC courses accepted

Courses

EE 011. Undergraduate Internship in EE. 0 Hours.
Engineering internship experience in preparation for the student's intended career. Students in a university recognized cooperative education experience should register for COP 011 or COP 012.

EE 210. Digital Logic. 3 Hours.
This course introduces the basic principles of how computers do computations using digital components. Topics include: the number systems, Boolean algebra, circuit minimization of multi-level logic, K-Maps, combinational and sequential logic circuit design, clocked latches, flip-flops, registers, and finite state machines. In class lab.

EE 233. Engineering Programming Methods. 3 Hours.
This course covers fundamentals of computer programming including coding and design elements. Topics include: the software development method, logic and algorithm development, C language coding, debugging, documentation, file input and output, an introduction to data structures, development environments, and command line tools.
Prerequisites: EGR 150 [Min Grade: C]

EE 250. Engineering Problem Solving I. 3 Hours.
This course covers a broad spectrum of engineering applications using engineering algebra. The applications to data reduction, data fitting, circuit, signal, and image analysis are shown.

EE 254. Applied Numerical Methods. 3 Hours.
This course covers applications of numerical mathematical techniques and theories laid out in prior courses. Topics include: Euler's Method, numerical integration and differentiation methods, root finding methods, accuracy versus precision and its relationship to data storage and algorithm efficiency.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and EGR 150 [Min Grade: C]

EE 300. Engineering Problem Solving II. 3 Hours.
This course covers fundamental mathematical background on complex functions, linear algebra, and the theory of probability and statistics which are indispensable in many electrical and computer engineering sub-fields such as signal and image processing, circuit design, and control systems.

Prerequisites: (MA 126 [Min Grade: C] or MA 226 [Min Grade: C])

EE 305. Fundamentals of Electrical Engineering. 3 Hours.
This course provides a survey of topics fundamental to field of electrical engineering. For non-engineering majors. Not available for credit toward engineering major.
Prerequisites: MA 109 [Min Grade: C]

EE 312. Electrical Systems. 3 Hours.
This course introduces how electrical circuits work and how to analyze them. Topics include: introduction to DC circuit analysis, AC steady-state analysis, first-order transient analysis, ideal transformers, and electrical safety. For non-EE majors.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

EE 314. Electrical Circuits. 3 Hours.
This course covers electrical circuits and their analysis. Topics include: DC circuit analysis, AC steady-state analysis, first-order transient analysis, and electrical safety. For EE Majors.
Prerequisites: (MA 126 [Min Grade: C] or MA 226 [Min Grade: C])

EE 314R. Electrical Circuits Recitation. 0 Hours.
A problem-solving course designed to reinforce concepts in EE 314.

EE 316. Electrical Networks. 4 Hours.
This course expands the Electrical Circuits course with advanced circuits and teaches how to report the results of experiments (emphasis on quantitative literacy). Topics include: Analysis of circuits using classical differential/integral techniques; Laplace transforms; Two-port network parameters; Ideal operational amplifiers; Circuit solution using simulation.

Prerequisites: EE 314 [Min Grade: D] and EH 101 [Min Grade: C] and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C])

EE 316L. Electrical Networks Laboratory. 0 Hours.
Electrical Networks laboratory component.

EE 318. Signals and Systems. 3 Hours.
This course provides fundamental mathematical background for extraction of useful information from signals and for modeling dynamic systems in the frequency domain. Topics include: time-domain and frequency-domain methods for modeling and analyzing continuous-time and discrete-time signals and systems, Fourier, Laplace, and Z transform methods.
Prerequisites: EE 300 [Min Grade: D] and EE 314 [Min Grade: D]

EE 333. Engineering Programming Using Objects. 3 Hours.
This course covers object-oriented thinking and applies it to creating software for engineering applications. Topics include: objected-oriented design and programming in an object-oriented language, graphical user interface framework, project management skills, written and oral communication, Team work, introduction to ethics and intellectual property issues.
Prerequisites: EE 233 [Min Grade: D]

EE 337. Introduction to Microprocessors. 4 Hours.
This course covers computer hardware, interfaces, and programming in assembly and C languages with applications of microcomputers to engineering problems, such as data acquisition and control. Topics include: CPU architecture, assembly language, Input/output interfacing.
Prerequisites: EE 210 [Min Grade: C] and EE 233 [Min Grade: D]

EE 337L. Introduction to Microprocessors Laboratory. 0 Hours.
Introduction to Microprocessors laboratory component.

EE 341. Electromagnetics. 3 Hours.
This course introduces mathematical techniques used to solve problems in antenna design, high-frequency circuit design, and communications. Topics include: Maxwell equations, dynamic and static problems, electromagnetic wave propagation.
Prerequisites: EGR 265 [Min Grade: C](Can be taken Concurrently) or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C])

EE 351. Electronics. 4 Hours.
This course covers fundamentals of solid-state electronics, PN junction diode and diode circuits, bipolar junction transistor (BJT) and field-effect transistor (FET) properties, biasing, frequency response, amplifier configurations, single and multistage amplifier circuits. Students will work on projects in areas such as Internet-of-Things (IoT), and sensor instrumentation.
Prerequisites: EE 316 [Min Grade: C]

EE 351L. Electronics Laboratory. 0 Hours.
Electronics laboratory component.

EE 361. Machinery I. 4 Hours.
This course covers single and multi-phase electrical machines with an introduction to industrial applications. Topics include: fundamentals and applications of polyphase circuits; magnetic circuits; transformers; polyphase synchronous and asynchronous machines.
Prerequisites: EE 316 [Min Grade: C]

EE 361L. Machinery I Laboratory. 0 Hours.
Machinery I laboratory component.

EE 412. Practical Computer Vision. 3 Hours.
This course covers the fundamentals and applications of image analysis. Topics include: image preprocessing, detection, segmentation, classification and recognition, visual tracking, and deep learning.
Prerequisites: EE 318 [Min Grade: C]

EE 418. Wireless Communications. 3 Hours.
This course covers the principles and current applications of wireless technology. Topics include propagation models, modulation, multiple access, and channel and signal coding. Applications of wireless for cellular and Internet of Things (IoT) will also be covered.
Prerequisites: EE 316 [Min Grade: C]

EE 421. Communication Systems. 3 Hours.
This course covers the mathematics of modulation and demodulation of radio signals to transmit and receive information. It focuses on various forms of amplitude modulation (AM), phase and frequency modulation (FM). This course builds on the mathematics from signals and systems course to study how to represent and manipulate these signals in both time and frequency domain. It also studies the effects of sampling, and how these systems operate in the presence of noise.
Prerequisites: EE 318 [Min Grade: C]

EE 423. Digital Signal Processing. 3 Hours.
This course covers the theory and practice of using computers to process and analyze signals. The topics include digital filter analysis and design; Fast Fourier Transform (FFT) algorithms; applications of digital signal processing in engineering problems such as data acquisition and control.
Prerequisites: EE 318 [Min Grade: C]

EE 426. Control Systems. 3 Hours.
This course covers modeling and control of mechanisms or circuits to satisfy stability and performance criteria. Topics include: the theory of linear feedback control systems using complex frequency techniques, block diagram manipulation, performance measures, stability, analysis and design using root locus, and Z-transform methods.
Prerequisites: EE 318 [Min Grade: C]

EE 427. Industrial Control. 3 Hours.
This course covers power control devices and applications, relay logic and translation to other forms, programmable logic controllers (PLCs), proportional-integral-derivative (PID) and other methods for process control, modern laboratory instrumentation, and human-machine interface (HMI) software.
Prerequisites: EE 233 [Min Grade: C] and EE 318 [Min Grade: C] and EE 351 [Min Grade: C]

EE 431. Analog Integrated Electronics. 4 Hours.
This course covers advanced analysis and design using op-amps, differential amplifier, half-circuit analysis, error analysis and compensation. Applications include signal conditioning for instrumentation, instrumentation amplifiers, nonlinear and computational circuits, analog filter design, voltage regulator design, oscillators, and circuit configurations for A-to-D and D-to-A conversion methods. Laboratory exercises emphasize design techniques for projects in areas such as Internet-of-Things (IoT).
Prerequisites: EE 318 [Min Grade: C] and EE 351 [Min Grade: C]

EE 432. Introduction to Computer Networking. 3 Hours.
This course covers the fundamentals of modern computer networks including current applications such as the Internet of Things (IoT). Topics Include: hardware and software level network protocols, network architecture and topology including WANs and LANs, client-server relationships, distributed computing, data transfer, security, virtualization of hardware, multi-tier network configuration examples, and certifications will be addressed.
Prerequisites: EE 233 [Min Grade: C]

EE 433. Engineering Software Solutions. 3 Hours.
This course covers the fundamentals of software design, architecture, and implementation for future software engineers. Topics include customer-focused requirements gathering, project planning, team tools, architectural patterns, environment and component selection, quality assurance, sustainability, versioning. Various development methodologies are discussed with a project demonstrating at least one release cycle.
Prerequisites: EE 333 [Min Grade: C]

EE 434. Power Semiconductor Electronics. 3 Hours.
This course covers the fundamentals of power electronics such as principles of static power conversions, basic power converter architectures, power semiconductor switches, steady-state equivalent circuit modeling, DC transformer model, basic AC equivalent circuit modeling, linearization, and perturbation. Pulse width modulation and controller design, circuit design considerations, and applications of power electronics. The course project emphasizes computer-aided analysis and design of power electronic circuits.
Prerequisites: EE 316 [Min Grade: C] and EE 318 [Min Grade: D] and EE 351 [Min Grade: D]

EE 437. Introduction to Embedded Systems. 3 Hours.
This course provides an applied introduction to the design of embedded systems, including hardware and software aspects. Topics include: various embedded hardware platforms, interfacing industrial bus systems, sensors, actuators, low-power wireless communication, and the application of the Internet-of-Things (IoT).
Prerequisites: EE 314 [Min Grade: D] and EE 337 [Min Grade: D]

EE 438. Computer Architecture. 3 Hours.
Advanced microprocessor topics which include a comparison of advanced contemporary microprocessors, cache design, pipelining, superscalar architecture, design of control units, microcoding, and parallel processors. Basic knowledge of microprocessors is recommended.
Prerequisites: EE 210 [Min Grade: C] and EE 233 [Min Grade: D] and EE 337 [Min Grade: D]

EE 444. Real-Time Process & Protocols. 3 Hours.
Hands-on laboratory course covering topics in real-time computer systems such as algorithms, state-machine implementations, communication protocols, instrumentation, and hardware interfaces.
Prerequisites: EE 233 [Min Grade: D] and EE 337 [Min Grade: D]

EE 447. Internet/Intranet Application Development. 3 Hours.
This course covers the development of software models and applications using Internet/Intranet technologies. Topics include web client-server relationships, multi-tier design models, scripting and validation, basic TCP/IP networking, separation of concerns, markup and data description languages. Projects will allow the opportunity for the use of a range of tools and development platforms.
Prerequisites: EE 233 [Min Grade: C]

EE 448. Software Engineering Projects. 3 Hours.
This course covers practical applications of software engineering including the development of applications for the Internet of Things (IoT). Topics include requirements gathering, design matrices, environment selection, relevant architectural patterns, networking basics, databases, service endpoints, embedded systems selections and security. Projects with a software emphasis will be utilized to demonstrate the principles of IoT applications.
Prerequisites: EE 333 [Min Grade: C]

EE 452. Digital Systems Design. 3 Hours.
This course covers the design of customized complex digital systems using Field Programmable Gate Array (FPGA) based platforms, using modern design tools for simulation, synthesis, and implementation. Topics include hardware design and development languages such as Verilog or VHDL.
Prerequisites: EE 337 [Min Grade: C] and EE 351 [Min Grade: C]

EE 458. Medical Instrumentation. 3 Hours.
This course covers the fundamental operating principles, applications, safety, and design of electronic instrumentation used in the measurement of physiological parameters.
Prerequisites: EE 351 [Min Grade: C]

EE 461. Machinery II. 3 Hours.
Physical principles of DC machines. Mathematical analysis of generator designs using equivalent circuits and magnetization curves. Calculation of motor speed, torque, power, efficiency, and starting requirements. Solid-state speed control systems.
Prerequisites: EE 361 [Min Grade: D]

EE 463. Medical Image Analysis. 3 Hours.
A lab-based introduction to processing, analysis, and display techniques for medical imaging.
Prerequisites: EE 318 [Min Grade: D]

EE 467. Brain Machine Interface. 3 Hours.
This course explores the brain-machine interfaces, particularly the technologies that directly stimulate and/or record neural activity. This course is divided into three major components: 1) neuroscience and electrode interfaces, 2) brain recording and stimulating front-end circuits, and 3) circuit modeling, simulation, and optimization.
Prerequisites: EE 233 [Min Grade: C] and EE 351 [Min Grade: C]

EE 471. Power Systems I. 3 Hours.
Components of power systems. Performance of modern interconnected power systems under normal and abnormal conditions. Calculation of inductive and capacitive reactances of three-phase transmission lines in a steady state.
Prerequisites: EE 361 [Min Grade: D]

EE 472. Power Systems II. 3 Hours.
Modeling of generators, transformers, and transmission lines for system studies. Introduction to symmetrical components. Calculation of short-circuit currents due to balanced and unbalanced faults. Determination of interrupting ratings of circuit breakers. Transient stability of power systems. Derivation of swing equation and solution by numerical method. Equal area criterion.
Prerequisites: EE 471 [Min Grade: D]

EE 473. Protective Relaying of Power Systems. 3 Hours.
Operating principles of protective relays. Protection of transmission lines, generators, motors, transformers, and buses.
Prerequisites: EE 361 [Min Grade: D]

EE 485. Engineering Operations. 3 Hours.
This course covers the principles and standards of engineering design from ideation to final design. Topics include product development process, problem definition and need identification, embodiment and detail design, design for specific criterion, modeling and cost evaluation. Emphasis is placed on ethics and civil responsibilities in design including environmental, and social issues, liability, sustainability, and reliability through the lens of engineering design.
Prerequisites: EE 312 [Min Grade: D] or EE 314 [Min Grade: D]

EE 489. Undergraduate Engineering Research. 1-3 Hour.
Undergraduate research experiences in electrical and computer engineering under faculty guidance.
Prerequisites: EGR 194 [Min Grade: D] or EGR 111 [Min Grade: D] or EGR 200 [Min Grade: D]

EE 490. Special Topics in Electrical Engineering. 1-3 Hour.
This course covers contemporary topics in Electrical Engineering selected by faculty.

EE 491. Individual Study in Electrical Engineering. 1-6 Hour.
Faculty-guided self-study of special topic in electrical and computer engineering.

EE 492. Honors Research I. 4 Hours.
Departmental honors students work closely with faculty to develop research skills.
Prerequisites: EGR 301 [Min Grade: C](Can be taken Concurrently)

EE 493. Honors Research II. 4 Hours.
Departmental honors students work closely with faculty to develop research skills.
Prerequisites: EGR 492 [Min Grade: C]

EE 498. Team Design Project I. 3 Hours.
This course is the first part of a two-semester team design project. The deliverables include detailed design, documentation, and project plan for completion in EE 499. Design projects are chosen from analog/digital systems, machine learning, embedded systems, signal processing, Internet of Things (IoT), and others. Course taken during the student's final year of the program.
Prerequisites: EE 333 [Min Grade: D] and EE 337 [Min Grade: D] and EE 351 [Min Grade: D](Can be taken Concurrently) and EE 485 [Min Grade: D](Can be taken Concurrently)

EE 499. Team Design Project II. 3 Hours.
This course is the second part of a two-semester team design project focusing on project implementation. Teams are required to complete a written design report and a final oral and poster presentation. Course is taken the during the student's final year of the program, in the term immediately after successfully completing EE 498.
Prerequisites: EE 498 [Min Grade: C]