Bachelor of Electrical Engineering

College of Engineering and Advanced Computing, Alfaisal University

Effective: Fall 2024 with tracks

Revised: Sep,2024

Curriculum Structure and Study Plan

The Bachelor of Electrical Engineering curriculum is composed of **137** Credit Hours (CRHs) divided as follows:

I. General Education Requirements (50 CRHs)
1. Mathematics & Statistics (21 CRHs)
2. Basic Sciences (12 CRHs)
3. Humanities (17 CRHs)

II. Core Requirements (87 CRHs)
1. Electrical Engineering Courses (58 CRHs)
2. College of Engineering Courses (11 CRHs)
3. Technical Electives (18 CRHs)
4. Summer Internship (0 CRHs)

I. General Education Requirements (53 CRHs)

1. Mathematics & Statistics (21 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect.	Lab	Tut		
MAT 101	Calculus I	3	3	0	0		
MAT 112	Calculus II	3	3	0	0	MAT 101	
MAT 211	Calculus III	3	3	0	0	MAT 112	
MAT 212	Linear Algebra	3	3	0	0	MAT 112	
MAT 213	Differential Equations	3	3	0	0	MAT 112	MAT 212
MAT 224	Numerical Methods	3	3	0	0	MAT 212	
STA 212	Probability and Statistics for Engineers	3	3	0	0	MAT 112	

2. Basic Sciences (12 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
CHM 102	Introduction to Chemistry	3	3	0	1		
CHM 102 L	Introduction to Chemistry Lab	1	0	2	0		CHEM 102
PHU 103	Mechanics and Waves for Engineers	3	3	0	1		MAT 101
PHU 103 L	Mechanics and Waves for Engineers Lab	1	0	2	0		PHU 103
PHU 124	Electromagnetism and Optics for Engineers	3	3	0	1	PHU 103, MAT 101	
PHU 124 L	Electromagnetism and Optics for Engineers Lab	1	0	2	0	PHU 103, MAT 101	PHU 124

3. Humanities (17 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Pre-Requisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
ENG 101	University Writing	3	3	0	0		
_ _ _ _ _ _	General Education Elective I	2	2	0	0		
ENG 222	Technical Writing	3	3	0	0	ENG 101	
ISL 101	Islamic Studies I	2	2	0	0		
ARB 101	Arabic Language I	2	2	0	0		
_ _ _ _ _	General Education Elective	2	2	0	0	ARB 101	
ENG _ _ _	English Elective	3	3	0	0		

II. Core Requirements (87 CRHs)

1. Electrical Engineering Core Courses (58 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
EE 207	Foundations of Electrical Engineering	3	3	0	1	PHU 124	MAT 213
EE 207 L	Foundations of Electrical Engineering Lab	1	0	2	0		EE 207
EE 208	Electric Circuits	3	3	0	0	EE 207	
EE 209	Applied Electromagnetics	3	3	0	0	EE 207, MAT 211	
EE 210	Digital Logic Systems	3	3	0	0		
EE 210 L	Digital Logic Systems Lab	1	0	2	0		EE 210
EE 301	Signals and Systems	3	3	0	0	EE 208, MAT 224	
EE 302	Communications Theory	3	3	0	0	EE 301, STA 212	
EE 302 L	Communications Theory Lab	1	0	2	0		EE 302
EE 303	Introduction to Electronics	3	3	0	0	EE 208	
EE 303 L	Introduction to Electronics Lab	1	0	2	0		EE 303
EE 304	Microelectronics	3	3	0	0	EE 303	
EE 304 L	Microelectronics Lab	1	0	2	0		EE 304
EE 305	Computer Networks	3	3	0	0	SE 100, STA 212, EE 210 or SE 223	
EE 305 L	Computer Networks Lab	1	0	2	0		EE 305
EE 306	Control and Feedback System Design	3	3	0	0	EE 301	
EE 306 L	Control and Feedback System Design Lab	1	0	2	0		EE 306

EE 307	Computer Architecture	3	3	0	0	SE 100, EE 210 or SE 223	
EE 307 L	Computer Architecture Lab	1	0	2	0		EE 307
EE 308	Electrical Energy Conversion	3	3	0	0	EE 209	
EE 308 L	Electrical Energy Conversion Lab	1	0	2	0		EE 308
EE 405	Electric Power Systems	3	3	0	0	EE 308, MAT 224	
EE 413	Digital Communications	3	3	0	0	EE 302	
EE 413 L	Digital Communications Lab	1	0	2	0		EE 413
EE 495	Electrical Engineering Capstone Project I	3	0	6	0	EE 390	
EE 496	Electrical Engineering Capstone Project II	3	0	6	0	EE 495	

2. College of Engineering Courses (11 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
SE 100	Programming for Engineers	3	3	0	0		
SE 100 L	Programming for Engineers Lab	1	0	2	0		SE 100
ME 201	Materials Science and Engineering	3	3	0	0	CHM 102	
ME 201 L	Materials Science and Engineering Lab	1	0	2	0		ME 201
IE 315	Engineering Economy and Cost Analysis	3	3	0	0	STA 212	

3. Technical Electives (18 CRHs)

Select three courses with their labs and two courses without labs from the following list:

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
EE 401	Special Topics in Electrical Engineering	3	3	0	0	EE 390	
EE 401 L	Special Topics in Electrical Eng. Lab	3	0	2	0		EE 401
EE 402	Introduction to Wireless Networks	3	3	0	0	EE 305	
EE 403	Wireless Communications	3	3	0	0	EE 413	
EE 403 L	Wireless Communications Lab	1	0	2	0		EE 403
EE 404	Data Engineering in Electrical Systems	3	3	0	0	EE 301	
EE 404 L	Data Engineering in Electrical Systems Lab	1	0	2	0		EE 404
EE 406	Digital Electronics	3	3	0	0	EE 304	
EE 406 L	Digital Electronics Lab	1	0	2	0		EE 406
EE 408	Communication Electronics	3	3	0	0	EE 304	
EE 410	Cyber Physical Systems	3	3	0	0	EE 306	
EE 410 L	Cyber Physical Systems Lab	1	0	2	0		EE 410
EE 411	Internet of Things	3	3	0	0	EE 390	
EE 412	Nanoelectronics	3	3	0	0	EE 304	
EE 412 L	Nanoelectronics Lab	1	0	2	0		EE 412
EE 417	Digital Signal Processing	3	3	0	0	EE 301	
EE 417 L	Digital Signal Processing Lab	1	0	2	0		EE 417
EE 418	Digital Image Processing	3	3	0	0	EE 301	
EE 418 L	Digital Image Processing Lab	1	0	2	0		EE 418
EE 420	Power Electronics	3	3	0	0	EE 304	
EE 420 L	Power Electronics Lab	1	0	2	0		EE 420

EE 422	Antennas and Wave Propagation	3	3	0	0	EE 209	
EE 423	Optical Fiber Communication Systems	3	3	0	0	EE 422	
EE 424	Optoelectronics	3	3	0	0	EE 304	
EE 424 L	Optoelectronics Lab	1	0	2	0		EE 424
EE 425	Microwave Engineering	3	0	0	0	EE 422	
EE 426	Renewable Energy	3	3	0	0	EE 405	
EE 426 L	Renewable Energy Lab	1	0	2	0		EE 426
EE 427	Digital Control	3	3	0	0	EE 306	
EE 428	Modern Control Theory	3	3	0	0	EE 306	
EE 435	Undergraduate Research in Electrical Engineering	3	0	6	0	Department Chair approval, a min. 3.0 GPA, & a signed research contract.	
EE 440	Machine Learning	3	3	0	0	EE 390	
EE 440 L	Machine Learning Lab	1	0	2	0		EE 440
EE 444	Artificial Intelligence	3	3	0	0	EE 390	
EE 481	Innovations and Entrepreneurship in Engineering	3	3	0	0	EE 390	

4. Summer Internship (0 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
EE 390	Electrical Engineering Summer Internship	0	0	0	0	EE 302, EE 304, EE 306, EE 308	

Typical Study Plan-Electrical Engineering Program

4-Year Curriculum: ***137 Credit Hours Total***

Each course below follows the following format:
Course Code, Course Title, and Course Credit Hours (Lecture contact hours – Lab contact hours – Tutorial contact hours)

1st Year			
Fall	**Course Code**	**Course-Title**	**CRHs**
	SE 100	**Programming for Engineers**	**3 (3-0-0)**
	SE 100 L	**Programming for Engineers Lab**	**1 (0-2-0)**
	CHM 102	**Introduction to Chemistry**	**3 (3-0-1)**
	CHM 102 L	**Introduction to Chemistry Lab**	**1 (0-2-0)**
	MAT 101	**Calculus I**	**3 (3-0-0)**
	PHU 103	**Mechanics and Waves for Engineers**	**3 (3-0-1)**
	PHU 103 L	**Mechanics and Waves for Engineers Lab**	**1 (0-2-0)**
	ENG 101	**University Writing**	**3 (3-0-0)**
		Total	**18**
Spring	**Course Code**	**Course-Title**	**CRHs**
	ME 201	**Materials Science and Engineering**	**3 (3-0-0)**
	ME 201 L	**Materials Science and Engineering Lab**	**1 (0-2-0)**
	MAT 112	**Calculus II**	**3 (3-0-0)**
	PHU 124	**Electromagnetism and Optics for Engineers**	**3 (3-0-1)**
	PHU 124 L	**Electromagnetism and Optics for Engineers Lab**	**1 (0-2-0)**
	ARB 101	**Arabic Language I**	**2 (2-0-0)**
	ENG ___	**English Elective**	**3 (3-0-0)**
		Total	**16**

2nd Year			
Fall	Course Code	Course-Title	CRHs
	EE 207	Foundations of Electrical Engineering	3 (3-0-1)
	EE 207 L	Foundations of Electrical Engineering Lab	1 (0-2-0)
	MAT 211	Calculus III	3 (3-0-0)
	MAT 212	Linear Algebra	3 (3-0-0)
	MAT 213	Differential Equations	3 (3-0-0)
	ISL 101	Islamic Studies I	2 (2-0-0)
	ENG 222	Technical Writing	3 (3-0-0)
		Total	**18**
Spring	**Course Code**	**Course-Title**	**CRHs**
	EE 208	Electric Circuits	3 (3-0-0)
	EE 209	Applied Electromagnetics	3 (3-0-0)
	EE 210	Digital Logic Systems	3 (3-0-0)
	EE 210 L	Digital Logic Systems Lab	1 (0-2-0)
	MAT 224	Numerical Methods	3 (3-0-0)
	STA 212	Probability and Statistics for Engineers	3 (3-0-0)
	_____	General Elective I	2 (2-2-0)
		Total	**18**

3rd Year			
Fall	Course Code	Course-Title	CRHs
	EE 301	Signals and Systems	3 (3-0-0)
	EE 303	Introduction to Electronics	3 (3-0-0)
	EE 303 L	Introduction to Electronics Lab	1 (0-2-0)
	EE 305	Computer Networks	3 (3-0-0)
	EE 305 L	Computer Networks Lab	1 (0-2-0)
	EE 307	Computer Architecture	3 (3-0-0)
	EE 307 L	Computer Architecture Lab	1 (0-2-0)
	_____	General Education Elective II	2 (2-0-0)
		Total	17
Spring	Course Code	Course-Title	CRHs
	EE 302	Communications Theory	3 (3-0-0)
	EE 302 L	Communications Theory Lab	1 (0-2-0)
	EE 304	Microelectronics	3 (3-0-0)
	EE 304 L	Microelectronics Lab	1 (0-2-0)
	EE 306	Control and Feedback System Design	3 (3-0-0)
	EE 306 L	Control and Feedback System Design Lab	1 (0-2-0)
	EE 308	Electrical Energy Conversion	3 (3-0-0)
	EE 308 L	Electrical Energy Conversion Lab	1 (0-2-0)
	IE 315	Engineering Economy and Cost Analysis	3 (3-0-0)
		Total	19

Summer	Course Code	Course-Title	CRHs
	EE 390	Electrical Engineering Summer Internship	0 (0-0-0)
		Total	0

4th Year			
Fall	Course Code	Course-Title	CRHs
	EE 405	Electric Power Systems	3 (3-0-0)
	EE 413	Digital Communications	3 (3-0-0)
	EE 413 L	Digital Communications Lab	1 (0-2-0)
	EE 495	Electrical Engineering Capstone Project I	3 (0-6-0)
	EE 4**	Technical Elective	3 (3-0-0)
	EE 4**	Technical Elective	3 (3-0-0)
		Total	17
Spring	Course Code	Course-Title	CRHs
	EE 496	Electrical Engineering Capstone Project II	3 (0-6-0)
	EE 4**	Technical Elective	3 (3-0-0)
	EE 4** L	Technical Elective Lab	1 (0-2-0)
	EE 4**	Technical Elective	3 (3-0-0)
	EE 4** L	Technical Elective Lab	1 (0-2-0)
	EE 4**	Technical Elective	3 (3-0-0)
	EE 4** L	Technical Elective Lab	1 (0-2-0)
		Total	14

Electrical Engineering Tracks:

All EE students have the opportunity of selecting their electives in the fourth year according to their desired academic objective in consultation with their academic advisor. Regular, non-track students select any of the offered EE electives in the fourth year, specifically, three electives with a lab and two electives without a lab. Students also have the option to follow one of the three tracks in the program, namely, Robotics & AI, Renewable Energy, or Innovation & Entrepreneurial tracks.
Whether selecting the regular program or one of the three tracks, the total credits of these electives is 18 CRHs. All offered technical electives are available for regular non-track students, whether or not they are associated with a given track. In summary, all EE students follow the same curriculum and take the same required courses, with the difference being the designation of the electives in the fourth year. A regular non-track student would have the following electives distribution in the fourth year.

4th Year			
Fall	**Course Code**	**Course-Title**	**CRHs**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
		Total	**6**
Spring	**Course Code**	**Course-Title**	**CRHs**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
	EE 4 L**	**Technical Elective Lab**	**1 (0-2-0)**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
	EE 4 L**	**Technical Elective Lab**	**1 (0-2-0)**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
	EE 4 L**	**Technical Elective Lab**	**1 (0-2-0)**
		Total	**12**

Per standing policy, and with the approval of the department chair, a student may opt to take one of the 3 CRH technical electives from another engineering program.

- **Bachelor of Electrical Engineering – Robotics & AI Track**

Robots are automated machines that can assist humans in a variety of settings, from manufacturing processes, to working in critical conditions, unsuitable for human life. Robotics specialists aim to achieve diverse tasks by designing mechanical devices, able to complete them intelligently. Studying robotics, students will acquire information related to computer gadgetry, mobile robot programming, robotic motion methods, mathematical algorithms, social implications of technology, and more. Apart from learning specific scientific methods, graduates will gain skills that involve mathematical thinking but also artistic vision. Robotics will prepare specialists in competencies such as technology design, programming, repairing and installing equipment for machines, etc. Career paths in robotics cover a large subject palette, from medicine to engineering and IT. Robotics graduates usually engage in jobs as laboratory assistants, testing technicians, quality assurance staff, programmers, systems controllers, or researchers.

Track Course Requirements:

In addition to completing the core course: **EE 306 + L – Control and Feedback System Design,** students should complete the following four courses.

- EE 410 + L Cyber Physical Systems (Prerequisite: EE 306)
- EE 411 Internet of Things
- EE 440 + L Machine Learning (Prerequisite: EE 390)
- EE 444 Artificial Intelligence (or SE 444 Artificial Intelligence)

The student will need to further complete the program's elective requirements and have a capstone project themed according to the track.

Track Plan (course offerings may change from year to year):

4th Year Electives			
Fall	**Course Code**	**Course-Title**	**CRHs**
	EE 410	**Cyber Physical Systems**	**3 (3-0-0)**
	EE 410 L	**Cyber Physical Systems Lab**	**1 (0-2-0)**
	EE 444 (or SE 444)	**Artificial Intelligence**	**3 (3-0-0)**
		Total	**7**
Spring	**Course Code**	**Course-Title**	**CRHs**
	EE 440	**Machine Learning**	**3 (3-0-0)**
	EE 440 L	**Machine Learning Lab**	**1 (0-2-0)**
	EE 411	**Internet of Things**	**3 (3-0-0)**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
	EE 4 L**	**Technical Elective Lab**	**1 (0-2-0)**
		Total	**11**

- **Bachelor of Electrical Engineering – Renewable Energy Track**

The Renewable Energy track offered at Alfaisal University is a specialization within electrical engineering concerning the generation of electrical power from a wide range of renewables. The track addresses the major topics related to power plant planning, theory and practical design of renewable and non-renewable sources, integration with the power grid, and engineering economy factors of design and deployment. Renewable energy resources covered include a wide array of established and experimental phase plants including solar, wind, hydro, tidal, wave, biomass and geothermal. This is in addition to energy storage technologies such as fuel cells and pumped hydro. The integration of these energy sources into the power grid with the power electronics theory and practice is also emphasized.

As well as having multiple technical and transferable skill competencies, graduates will gain strong analytical skills, and have the ability to lead complex design projects. Electrical renewable energy engineers have a wide range of employment opportunities across the power generation, conversion, distribution, and management sectors, including power utilities, factories, consultancy firms as well as the domestic markets where renewable energy systems are now commonly sought and deployed.

Track Course Requirements:

In addition to completing the core course: **EE 308 + L – Electrical Energy Conversion and EE 405 Electric Power Systems,** students should complete the following four courses as technical electives:

- EE 410 + L Cyber-Physical Systems (Prerequisite: EE 306)
- EE 420 + L Power Electronics (Prerequisite: EE 304)
- EE 426 + L Renewable Energy (Prerequisite: EE 405)
- IE 450 Management for Engineering (Prerequisite: IE 305)

The student will need to further complete the program's elective requirements, and have a capstone project themed according to the track.

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Track Plan (course offerings may change from year to year):

4th Year Electives			
Fall	**Course Code**	**Course-Title**	**CRHs**
	EE 410	**Cyber Physical Systems**	**3 (3-0-0)**
	EE 410 L	**Cyber Physical Systems Lab**	**1 (0-2-0)**
	EE 420	**Power Electronics**	**3 (3-0-0)**
	EE 420 L	**Power Electronics Lab**	**1 (0-2-0)**
		Total	**8**
Spring	**Course Code**	**Course-Title**	**CRHs**
	EE 426	**Renewable Energy**	**3 (3-0-0)**
	EE 426 L	**Renewable Energy Lab**	**1 (0-2-0)**
	IE 450	**Management for Engineering**	**3 (3-0-0)**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
		Total	**10**

- **Bachelor of Electrical Engineering – Innovation & Entrepreneurial Track**

When it comes to pursuing a career in engineering, whether it is resources engineering, sustainable materials or even innovative recycling, specialist skills and knowledge are vital if you want to stand out compared to other job candidates. Much like every other industry in the world, the electrical engineering landscape is evolving at a rapid rate, and so the demand for engineers with an innovative and entrepreneurial mindset has never been greater. Innovation and entrepreneurship are key drivers in today's engineering world, and the push for sustainable products, services and technologies is needed now more than ever.

Electrical Engineers work to improve society, and not just for the benefit of the local community, but the planet as a whole. Over the last few years, there has been a rise in developing sustainable innovative solutions, from e-mobility and new battery technologies for greener, more sustainable cities, to communications and robotics for a digital industry 4.0. Without innovation in these areas, modern life would not be possible. With this track, you will develop your expertise in Innovation and entrepreneurship; adding to this your in-depth engineering know-how and you will be well on your way to a career in research, industrial innovation, or even starting up your own business.

Track Course Requirements:

In addition to completing the core course: **IE 315 – Engineering Economy and Cost Analysis,** students should complete the following four courses as technical electives:

- EE 410 + L Cyber-Physical Systems (Prerequisite: EE 306)
- EE 440 + L Machine Learning (Prerequisite: EE 390)
- EE 481 Innovations and Entrepreneurship in Engineering (Prerequisite: EE 390)
- IE 450 Management for Engineering (Prerequisite: IE 305)

The student will need to further complete the program's elective requirements and have a capstone project themed according to the track.

Track Plan:

4th Year Electives			
Fall	**Course Code**	**Course-Title**	**CRHs**
	EE 410	**Cyber Physical Systems**	**3 (3-0-0)**
	EE 410 L	**Cyber Physical Systems Lab**	**1 (0-2-0)**
	EE 481	**Innovation and Entrepreneurship for Engineers**	**3 (3-0-0)**
		Total	**7**
Spring	**Course Code**	**Course-Title**	**CRHs**
	IE 450	**Management for Engineering**	**3 (3-0-0)**
	EE 440	**Machine Learning**	**3 (3-0-0)**
	EE 440 L	**Machine Learning Lab**	**1 (0-2-0)**
	EE 4**	**Technical Elective**	**3 (3-0-0)**
	EE 4 L**	**Technical Elective Lab**	**1 (0-2-0)**
		Total	**11**

• Course Descriptions

In this section we give the course descriptions of Electrical Engineering courses of the program. All specifications for all courses of the program are listed in Appendix C.

Each course below follows the following format:
Course Code: Course Title Course Credit Hours (Lecture contact hours-Lab contact hours-Tutorial **Course Code Course Title Course Credit Hours (Lecture contact hours – Lab contact hours – Tutorial contact hours)**
Course Description
Prerequisites
Co-requisites

Core Courses

EE 207: Foundation of Electrical Engineering **3 (3-0-1)**
The course teaches fundamental concepts of electrical circuits, students will be familiarized with the essential principles of electrical circuit analysis composition of components into systems and networks, and understanding the trade-offs and limits imposed by energy and noise. Students learn to apply the concepts during laboratory design.
Prerequisites: PHU 124
Co-requisites: MAT 213

EE 207 L: Foundation of Electrical Engineering Lab **1 (0-2-0)**
Laboratory experiments dealing with Foundation of Electrical Engineering.
Prerequisites: None
Co-requisites: EE 207

EE 208: Electric Circuits **3 (3-0-0)**
The course teaches the design and analysis of interconnected networks of lumped circuit elements.
Prerequisites: EE 207
Co-requisites: None

EE 209: Applied Electromagnetics **3 (3-0-0)**
The course teaches the application of electromagnetic principles to classical and modern devices. The concepts of work and energy and electromagnetic fields are addressed.
Prerequisites: EE 207, MAT 211
Co-requisites: None

EE 210: Digital Logic Systems **3 (3-0-0)**
The course teaches theoretical foundations and concepts of digital systems and applies these concepts with design problems and projects. Students are exposed to the design and engineering of digital computers and subsystems.
Prerequisites: None
Co-requisites: None

EE 210 L: Digital Logic Systems Lab **1 (0-2-0)**
Laboratory experiments dealing with Digital Logic Systems.
Prerequisites: None
Co-requisites: EE 210

EE 301: Signals and Systems **3 (3-0-0)**
The course teaches fundamental concepts of signals and systems analysis, with applications drawn from filtering, audio and image processing, communications, and automatic control. The objective of the course is to allow students to develop a thorough understanding of time-domain and frequency domain approaches to the analysis of continuous and discrete systems. To provide students with necessary tools and techniques to analyze electrical networks and systems.
Prerequisites: EE 208, MAT 224
Co-requisites: None

EE 302: Communications Theory **3 (3-0-0)**
The course teaches communication systems and information theory. Topics covered include the classification of signals and systems, Fourier series and transform applications, power spectra and spectral density, band-limited signals and noise, sampling theory and digital transmission, modulation techniques and pulse code modulation.
Prerequisites: EE 301, STA 212
Co-requisites: None

EE 302 L: Communications Theory Lab **1 (0-2-0)**
Laboratory experiments dealing with Communications Theory.
Prerequisites: None
Co-requisites: EE 302

EE 303: Introduction to Electronics **3 (3-0-0)**
The course teaches the fundamentals of electronic circuits, including diode characteristics and diode circuits, transistors and applications, switches and MOS transistors, amplifiers, energy storage elements, digital circuits and applications. Design and laboratory exercises are also significant components of the course.
Prerequisites: EE 208
Co-requisites: None

EE 303 L: Introduction to Electronics Lab **1 (0-2-0)**
Laboratory experiments dealing with Introduction to Electronics.
Prerequisites: None
Co-requisites: EE 303

EE 304: Microelectronics **3 (3-0-0)**
This course teaches analog circuit analysis and design, including an introduction to the tools and methods necessary for the creative design of practical circuits using active devices.
Prerequisites: EE 303
Co-requisites: None

EE 304 L: Microelectronics Lab **1 (0-2-0)**
Laboratory experiments dealing with Microelectronics.
Prerequisites: None
Co-requisites: EE 304

EE 305: Computer Networks **3 (3-0-0)**
The course teaches the fundamental concepts of communication networks, and is concerned specifically with network architectures and protocols. The objective of the course is to allow students to develop a thorough understanding of the architectures of networks and the basic principles that allow the transmission of data over networks.
Prerequisites: SE 100, STA 212, EE 210 (or SE 223)
Co-requisites: None

EE 305 L: Computer Networks Lab **1 (0-2-0)**
Laboratory experiments dealing with Computer Networks.
Prerequisites: None
Co-requisites: EE 305

EE 306: Control and Feedback System Design **3 (3-0-0)**
The course teaches the analysis and synthesis of continuous and sampled-data linear feedback control systems, and its application to a variety of physical systems
Prerequisites: EE 301
Co-requisites: None

EE 306 L: Control and Feedback System Design Lab **1 (0-2-0)**
Laboratory experiments dealing with Control and Feedback System Design.
Prerequisites: None
Co-requisites: EE 306

EE 307: Computer Architecture **3 (3-0-0)**
The course introduces the architecture of digital systems, with an emphasis on the structural principles common to a wide range of computer technologies. Multilevel implementation strategies, the definition of new primitives (e.g., gates, instructions, procedures, and processes) and their mechanization using lower-level elements, the organization and operation of digital computers and the hardware/software interface are addressed.
Prerequisites: SE 100, EE 210 (or SE 223)
Co-requisites: None

EE 307 L: Computer Architecture Lab **1 (0-2-0)**
Laboratory experiments dealing with Computer Architecture.
Prerequisites: None
Co-requisites: EE 307

EE 308: Electrical Energy Conversion **4 (3-2-0)**
The course teaches the basic concepts of electrical machines and power semiconductor converters and their application within modern power systems.
Prerequisites: EE 209
Co-requisites: None

EE 308 L: Electrical Energy Conversion Lab **1 (0-2-0)**
Laboratory experiments dealing with Electrical Energy Conversion.
Prerequisites: None
Co-requisites: EE 308

EE405: Electric Power Systems **3 (3-0-0)**

The course teaches the components, analysis, and modeling of large-scale electric power systems. This includes the review of single and three phase circuit variables and parameters and the per unit system. The components of the system are studied including the transformers and the transmission line parameters. In addition, the operation in terms of modeling and analysis of electric power systems is studied in steady state and transient state, with a particular focus on power flow solution methods. Case studies are introduced to prepare for more advanced topics. A project accompanies the course to introduce practical aspects of measurements and operation, with simulations addressing large scale problems.

Prerequisites: EE 308, MAT 224

Co-requisites: None

EE 413: Digital Communications **3 (3-0-0)**

The course teaches the principles of digital communication systems. Topics include sampling, quantization and encoding of analog signals, pulse code modulation (PCM), delta modulation (DM), noise analysis in PCM and DM systems, base-band digital systems (matched filter, probability of error, inter-symbol interference, equalization, distortionless transmission, and M-ary transmission), line codes and their power spectra, pass-band digital systems (ASK, FSK PSK, DPSK, and M-ary), bandwidth and power requirements of modulation schemes, coherent and non-coherent detection, error rate analysis, and introduction to information theory.

Prerequisites: EE 302

Co-requisites: None

EE 413 L: Digital Communications Lab **1 (0-2-0)**

Laboratory experiments dealing with Digital Communications.

Prerequisites: None

Co-requisites: EE 413

EE 495: Electrical Engineering Capstone Project I **3 (0-6-0)**

Students work in teams as professional engineering consultants on an independent engineering project under the supervision of a project advisor. The design process is emphasized, encompassing project definition, feasibility analysis, evaluation of alternative designs, and design computations. For each project, the scope of work is developed and negotiated between client and student consultants. The scope of work may also include fabrication, device testing, and field-testing. Projects are arranged by the students with approval of the instructor. The design and methodology are emphasized in part 1. Progress reports and an end of term report are submitted to the project advisor with an oral presentation of the design and methodology of the project.

Prerequisites: EE 390

Co-requisites: None

EE 496: Electrical Engineering Capstone Project II **3 (0-6-0)**

The students work on the implementation and validation of the designs developed in part 1. A demonstration is presented, and a final written report is submitted to the project advisor. Oral presentations of reports are made before the faculty and students. A student who selects a project suggested by the industry has the opportunity of working with an industry sponsor.

Prerequisites: EE 495

Co-requisites: None

Elective Courses

EE 401 Special Topics in Electrical Engineering **3 (3-0-0)**
This course provides instruction and experience in timely topics related to Electrical Engineering major.
Prerequisites: EE 390
Co-requisites: None

EE 401 Special Topics in Electrical Engineering Lab **1 (0-2-0)**
Laboratory experiments dealing with the special topics course. This will be offered if the special topics course has an applied side and is scheduled to be offered with a lab.
Prerequisites: None
Co-requisites: EE 401

EE 402: Introduction to Wireless Networks **3 (3-0-0)**
The course surveys the various types of wireless communications, the protocols involved and the design issues that nature and engineering impose upon the telecommunications engineer. Specifically, the course covers wireless network architectures including cellular networks, local area networks, multi-hop wireless networks such as ad hoc networks, mesh networks, and sensor networks; capacity of wireless networks; medium access control, routing protocols, and transport protocols for wireless networks; mechanisms to improve performance and security in wireless networks; energy-efficient protocols for sensor networks.
Prerequisites: EE 305
Co-requisites: None

EE 403: Wireless Communications **3 (3-0-0)**
The course teaches wireless communications for voice, data, and multimedia. Topics include wireless systems and standards, characteristics of the wireless channel, including path loss for different environments, random log-normal shadowing due to signal attenuation, and the flat and frequency-selective properties of multipath fading.
Prerequisites: EE 413
Co-requisites: None

EE 403 L: Wireless Communications Lab **1 (0-2-0)**
Laboratory experiments dealing with Wireless Communications.
Prerequisites: None
Co-requisites: EE 403

EE 404: Data Engineering in Electrical Systems **3 (3-0-0)**
The course introduces students to data engineering and science (DES) techniques, with a focus on application to substantive (i.e. "applied") engineering problems. Students will gain experience in identifying which problems can be tackled by DES methods, and learn to identify which specific DES methods are applicable to a problem at hand.
Prerequisites: EE 301
Co-requisites: None

EE 404 L: Data Engineering in Electrical Systems Lab **1 (0-2-0)**
Laboratory experiments dealing with Data Engineering in Electrical Systems.
Prerequisites: None
Co-requisites: EE 404

EE 406: Digital Electronics **3 (3-0-0)**

This course aims to familiarize students with the basic concepts and mechanisms of operation and design of digital electronic circuits, both discrete and integrated. Topics covered include an overview of MOS and BJT types, structures and operation, digital logic inverters (voltage transfer characteristic, digital integrated circuit technologies and logic-circuit families), CMOS inverters (dynamic operation of the CMOS inverter, inverter sizing, power dissipation), logic-gate circuits (NOR, NAND, XOR), propagation delay analysis, pseudo-NMOS logic circuits, gate circuits, pass-transistor logic circuits (NMOS transistors as switches, CMOS transmission gates as switches), dynamic MOS logic circuits (Emitter-coupled logic (ECL) and families), BiCMOS inverters and logic gates, latches, flip-flop circuits, multivibrators, and an overview of memory circuits types and architectures, and A/D and D/A converters.

Prerequisites: EE 304
Co-requisites: None

EE 406 L: Digital Electronics Lab **1 (0-2-0)**

Laboratory experiments dealing with Digital Electronics.
Prerequisites: None
Co-requisites: EE 406

EE 408: Communication Electronics **3 (3-0-0)**

This course is designed for senior-level undergraduate students in Electrical Engineering. It builds upon perquisite courses on signal and systems, communications, control systems, and electronics to further enhance the understanding of communication circuits operation and physical implementation. The course focuses on the field of communication electronics at levels from block diagram to circuit analysis for physical implementation. It aims to cover topics as radio frequency amplifiers, oscillators, signal spectra, noise, modulation and AM systems, transmitter and receiver circuits, sideband systems, frequency and phase modulation, phase-locked loops, and pulse and digital modulation.

Prerequisites: EE 304
Co-requisites: None

EE 410: Cyber Physical Systems **3 (3-0-0)**

This course takes on an updated view of electrical engineering systems, especially in light of their increasing predominant cyber-physical nature. It offers a review of modeling physical systems, including electrical, mechanical, thermal and fluid. It also covers notions such as hybrid (continuous-discrete) and applied control theory. Modeling computational (cyber) aspects of modern systems is then discussed, along with relevant considerations including communications, aggregate control, and connected sensing and actuation.

Prerequisites: EE 306
Co-requisites: None

EE 410 L: Cyber Physical Systems Lab **1 (0-2-0)**

Laboratory experiments dealing with Cyber Physical Systems.
Prerequisites: None
Co-requisites: EE 410

EE 411: Internet of Things **3 (3-0-0)**

This course introduces the principles, technologies, challenges, and required expertise needed for building the Internet of Things (IoT) solutions. It provides a big picture of what is involved in IoT. Topics covered in this course include analog and digital sensing, interfacing sensors with microcontrollers, digital communication protocols, microcontroller choices and capabilities, gateways, fog computing, networking, cloud computing, need and challenges for cryptography and compression, security issues, and low power/energy challenges. The course involves a hands-on-experience that culminates in an implementation project.

Prerequisites: EE 390
Co-requisites: None

EE 412: Nanoelectronics **3 (3-0-0)**
The course teaches an introduction to the electronic properties of molecules, carbon nanotubes, crystals and other nanodevices.
Prerequisites: EE 304
Co-requisites: None

EE 412 L: Nanoelectronics Lab **1 (0-2-0)**
Laboratory experiments dealing with Nanoelectronics.
Prerequisites: None
Co-requisites: EE 412

EE 417: Digital Signal Processing **3 (3-0-0)**
This course presents an introduction to the techniques and algorithms of digital processing for signals and information data. It is designed for senior-level undergraduate students in electrical and computer engineering. The theory and practice covered in this course can be applied in wide range of science fields, such as image processing, communications, satellite systems, biomedical, power and electronic devices, and programmable units. The proposed content covers a review of discrete-time sequences and systems, sampling of continuous-time signals and aliasing effect, discrete Fourier transform: properties and applications; fast Fourier transform (FFT): implementation and computations, finite impulse response (FIR) filters design and analysis: low-pass, band pass, high pass, phase response etc., and infinite impulse response (IIR) filters design methods and cascaded structures. The course involves extensive software and programming experience to enrich the understanding of the covered material.
Prerequisites: EE 301
Co-requisites: None

EE 417 L: Digital Signal Processing Lab **1 (0-2-0)**
Laboratory experiments dealing with Digital Signal Processing.
Prerequisites: None
Co-requisites: EE 417

EE 418: Digital Image Processing **3 (3-0-0)**
The course teaches an introduction to image processing and its applications, including the fundamental concepts of visual perception and image acquisition, the basic techniques of image manipulation, segmentation and coding, and a preliminary understanding of pattern recognition and computer vision.
Prerequisites: EE 301
Co-requisites: None

EE 418 L: Digital Image Processing Lab **1 (0-2-0)**
Laboratory experiments dealing with Digital Image Processing.
Prerequisites: None
Co-requisites: EE 418

EE 420: Power Electronics **3 (3-0-0)**

The course teaches the principles of designing power electronic circuits. Power electronics design has applications in several fields from motor drives to consumer electronics to electric power transmission over HVDC lines. Therefore, the course reviews the fundamentals before covering generic power electronic circuit topologies. This entails a review of the switching devices, e.g., diodes, thyristors, BJTs, and the review of the fundamentals of electric circuit design and magnetism. Building on the fundamentals, the course covers AC to DC, DC to DC, DC to AC, and AC to AC electric power conversion topologies. The lab component is simultaneously administered to offer a practical perspective including the selection of components vis-à-vis the application, the instrumentation. In addition, the lab goes over the prototyping and testing aspects of power electronic circuit design.

Prerequisites: EE 304

Co-requisites: None

EE 420 L: Power Electronics Lab **1 (0-2-0)**

Laboratory experiments dealing with Power Electronics.

Prerequisites: None

Co-requisites: EE 420

EE 422: Antennas and Wave Propagation **3 (3-0-0)**

This course introduces the characteristics of electromagnetic waves and their behavior during the propagation through different media. The wave equation is derived using the Maxwell's equations for time varying fields. The electromagnetic wave propagation in different media as well as their reflection at normal and oblique angle of incidence is discussed. The concept of transmission line theory and its parameters, smith chart and its application are introduced. Waveguide and TM & TE modes are discussed. In addition, the course includes Antenna characteristics, antenna types such as dipole, loop and antenna array.

Prerequisites: EE 209

Co-requisites: None

EE 423: Optical Fiber Communication Systems **3 (3-0-0)**

The course teaches the introduction to the optical fiber communications. Topics discusses dielectric slab waveguide, step-index and graded-index optical fibers, single mode and multimode fiber, attenuation and dispersion, light sources (LED and Laser diode), optical modulation and detection, noise modeling in optical receivers, and error rate analysis.

Prerequisites: EE 422

Co-requisites: None

EE 424: Optoelectronics **3 (3-0-0)**

The course teaches semiconductor light sources, such as different types of LEDs, Lasers (both gas and solid states), modulation techniques, photodetectors, PIN diode, avalanche Photo Diode (APD), the basics of optical waveguides and the principles of fiber optics

Prerequisites: EE 304

Co-requisites: None

EE 424 L: Optoelectronics Lab **1 (0-2-0)**

Laboratory experiments dealing with Optoelectronics.

Prerequisites: None

Co-requisites: EE 424

EE 425: Microwave Engineering **3 (3-0-0)**

The course teaches the fundamentals of Microwave Engineering. Topics include a review of electromagnetics theory, and discuss transmission lines and waveguides, microwave network analysis, impedance matching, passive microwave devices (power dividers and directional couplers), strip-line and micro-strip line circuits, microwave filters, and introduction to ferrimagnetic materials and components.

Prerequisites: EE 422

Co-requisites: None

EE 426: Renewable Energy **3 (3-0-0)**

This course covers fundamentals of renewable energy systems, Solar energy, Bio-energy, Wind energy, Hydro-power, Tidal power, Wave energy and Geothermal energy. Also, integration of renewable energy systems will be covered in the course. The students will be exposed to technical aspects of mentioned topics; How to utilize renewable energy for domestic and industrial applications; requirements and obstacles of applications; how to integrate renewable energy systems.

Prerequisites: EE 405

Co-requisites: None

EE 426 L: Renewable Energy Lab **1 (0-2-0)**

Laboratory experiments dealing with Renewable Energy.

Prerequisites: None

Co-requisites: EE 426

EE 427: Digital Control **3 (3-0-0)**

The course discusses digital control designs and methodologies for dynamic systems. It describes classical and state-space control methods, and applies them to selected applications. The course explores the advantages and limitations of each method, offers an overview of feedback control systems, and proposes to cover selected topics on multivariable and optimal control methods. The course involves Matlab experience to improve the understanding of the covered design methods. The topics include a review of continuous control (feedback, root locus, frequency response design, compensation, state-space design), basic digital control (digitization, sampling, PID), discrete systems (linear difference equations, z-transform, spectrum, block diagrams), discrete equivalents (design via numerical integration, zero-pole matching), transform techniques (root locus in z-plane, frequency response), state-space approaches (regulator design, integral control and disturbance estimation, controllability and observability), and an introduction to multivariable and optimal control (time-varying and LQR steady-state optimal control, multivariable design)

Prerequisites: EE 306

Co-requisites: None

EE 428: Modern Control Theory **3 (3-0-0)**

The course covers the fundamentals of Matrix Theory including eigenvalues and eigenvectors, and the matrix representations of the Diagonal, Jordan, Controllable, and Observable forms. The student learns to represent systems in terms of their state variables and state diagrams, and then solve for their response in the time domain. The focus of the course is on linear time invariant or LTI systems. Furthermore, the controllability and observability of the LTI system is studied, before covering the design of state feedback and output feedback control techniques. In addition, observer design is covered, with the separation principle, to construct observer-based control systems.

Prerequisites: EE 306

Co-requisites: None

EE 435: Undergraduate Research in Electrical Engineering 3 (0-6-0)

Students participate in supervised research with a faculty member. Supervised research can be: 1) independent research undertaken by the student (thesis, independent study), or 2) assistance on a faculty member's research project. Students must find a faculty member who is willing to supervise him/her as an assistant on an existing project or as the author of an individual project. The student and the faculty supervisor will complete and sign a research contract which will be turned in to the chair of the Electrical Engineering Department. Drafting the contract will allow the student to develop ideas about what should be accomplished and what the faculty supervisor's expectations are. All academic requirements are at the discretion of the supervising faculty member. Students should agree on a plan for the semester with the faculty mentor before the research begins. The plan should include academic requirements, the basis for grading the experience, and a plan for student/professor meetings for the semester. It is the student's responsibility to report progress and seek guidance when needed. Students are expected to be active and reliable participants in the research experience.
Prerequisites: Department Chair approval, a GPA of at least 3.0/4.0, and a signed research contract.

EE 440: Machine Learning 3 (3-0-0)

This course introduces machine learning and its applications in electrical engineering systems. It offers a review of relevant background in probability and background, and introduces general machine learning methods including supervised learning, unsupervised learning, and reinforcement learning. Applications instances in electrical engineering systems are discussed.
Prerequisites: EE 390
Co-requisites: None

EE 440 L: Machine Learning Lab 1 (0-2-0)

Laboratory experiments dealing with Machine Learning.
Prerequisites: None
Co-requisites: EE 440

EE 444: Artificial Intelligence 3 (3-0-0)

The course teaches the theory and implementation of Artificial Intelligence through several state-of-the-art methods.
It is also cross listed with SE 444 Artificial Intelligence
Prerequisites: EE 390
Co-requisites: None

EE 481: Innovations and Entrepreneurship in Engineering 3 (3-0-0)

This course guides engineers and scientists who want to create new products that that could become income-producing businesses for themselves and for investors. Students will learn to sharpen an idea and turn it into a product, conduct patent searches, complete a provisional patent application, and prepare a business plan from a business model.
Prerequisites: EE 390
Co-requisites: None