



# Electrical & Computer Engineering Department

*School of Engineering & Applied Science*

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## **ELECTRICAL ENGINEERING**

**CATALOG YEAR 2011-2012 (201210)**

**MIAMI UNIVERSITY**

**BACCALAUREATE PROGRAM**

**Degree Awarded: Bachelor of Science in Engineering  
with a major in Electrical Engineering**

Electrical Engineering encompasses analysis, design, and synthesis of products and processes in a variety of areas. Such areas include electrical power, electromechanical devices, and electronic systems, computers and their associated components, as well as development of processes needed in such areas as audio, video, and image enhancement and recognition. The field of electrical engineering requires the ability to: understand and apply math, science, and engineering science; to research concepts and apply modeling methods; to simulate and test working conditions and their impact on the designed systems; and to synthesize different elements in order to obtain the optimum design of a specific product.

Graduates have the opportunity to work in a diverse spectrum of professional fields. These vary from research to design, from development to manufacturing, from technical sales to production. Many electrical engineers work in manufacturing-related areas such as in the analysis and design of varied products and computer-related fields such as computer hardware and chip design, as well as in non-technical sectors of the economy such as business, law, and management. Graduates will also be prepared to continue their education at the graduate level.

Students interested in a double major must choose an additional 18 elective hours of adviser approved courses and cannot use a required course in one major as an elective in the other major.

For information, contact the Electrical and Computer Engineering Office, 260 EGR Bldg. (513-529-0740) and visit our web site: <http://www.eas.muohio.edu/ece>.

# ELECTRICAL ENGINEERING MAJOR REQUIREMENTS

Total Degree Requirements is 129 Hours  
Catalog Year 2011-2012 (201210)

## General Education (27 hrs) 21%

### English (9 hrs)

Miami Plan English Composition Electives MPF I (3)  
ENG 313 Technical Writing (3)

### Fine Arts, Humanities, and Social Science (9 hrs)

ECO 201 Principles of Microeconomics (3)  
Miami Plan Foundation II A Fine Arts Elective (3)  
Miami Plan Foundation II B Humanities Elective (3)

**NOTE: CSE 262 can be used for (3) MPF IIB**

### Global Perspective (6-9 hrs)

- 6 hours of credit on any Miami-approved study abroad program or
- 9 hours of "G" courses specifically designed to have a global perspective or
- 9 hours of "G-cluster", 3 courses that focus on a global issue or theme.

## Thematic Sequence (built-in)

The MTH-3 thematic sequence is fulfilled by ECE requirements:

- **MTH3-Almost Linear Structures-Models for Physical Science: MTH 222, MTH 252, MTH 347**

## Mathematics & Science (37 hrs) 29%

MTH 151, 251 Calculus I, II (5,4)  
MTH 222 Linear Algebra (3)  
MTH 252 Calculus III (4)  
MTH 347 Differential Equations (3)  
PHY 181, 183 Physics I and Lab (4,1)  
PHY 182, 184 Physics II and Lab (4,1)  
CHM 141, 144 College Chemistry and Lab (3,2)  
Miami Plan Foundation IVA Biological Science (3)

## Computer Science & System Analysis (3 hrs) 2%

CSE 153 Introduction to C/C++ (3)  
CSE 262 Technology, Ethics, and Global Society (3)

## General Engineering (8 hrs) 6%

EAS 101 Computing, Engineering and Society (1)  
EAS 102 Problem Solving and Design (3)  
ECE 448 Senior Design Project I (2)  
ECE 449 Senior Design Project II (2)

## Electrical Engineering (35 hrs) 27%

ECE 205 Electric Circuit Analysis I (4)  
ECE 287 Digital Systems Design (4)  
ECE 304 Electronics (3)  
ECE 303 Computer-Aided Experimentation (3)  
ECE 306 Signals and Systems (3)  
ECE 325 Applied Electromagnetics (3)  
ECE 345 Random Signal Processing (3)  
ECE 387 Embedded Systems Design (4)  
ECE 425 Digital Signal Processing (3)  
ECE 436\* Control of Dynamic Systems (3)  
ECE 453 Communication Systems or ECE 461 Network Performance Analysis (3)

## Professional EE Electives (9 hrs) 7%

ECE 291 Renewable Energy Systems (3)  
ECE 414 Introduction to VLSI Circuit and System Design (3)  
ECE 426 Biomedical Signal Analysis (3)  
ECE 427 Radar Signal Processing (3)  
ECE 428 Real-Time Digital Signal Processing (3)  
ECE 429 Digital Image Processing (3)  
ECE 430 Electromagnetics in Wireless Sensing and Communications (3)  
ECE 453 Communication Systems (3)  
ECE 461 Network Performance Analysis (3)  
ECE 465 Introduction to GPS (3)  
ECE 475 Software Receiver Technologies (3)  
ECE 491 Power Systems Engineering (3)

## General Technical Electives (9 hrs) 7%

- Additional courses from the Professional EE Elective List
- CSE 174, 271, 274, 283
- MTH 331, 432, 438, 441, 451, 453
- PHY 286, 291/293, 341, 421, 423, 441
- MME 211 or PCE 219 (but not both), MME/PCE 314,

General Technical Electives are subject to the following rules:

1. At least 3 credits of General Technical Electives must be 300-level or above.
2. Courses cannot be double-counted as both Professional EE Electives and General Technical Electives.
3. Other courses such as ECE 470 may be approved by petition.

All ECE majors must take the following for a grade (credit/no-credit **not allowed**): All engineering, chemistry, physics, mathematics, statistics, computer science, and English courses that are used to satisfy degree requirements.

\* Cross-listed with MME 436

# ELECTRICAL ENGINEERING MAJOR (SAMPLE) FOUR-YEAR PLAN

Catalog Year 2011-2012 (201210)

## Freshman Year

### First Semester

EAS 101	Computing, Engineering and Society	1
Miami Plan	English Composition Elective (MPF I)	3
MTH 151	Calculus I	5
PHY 181	Physics I	4
PHY 183	Physics I Lab	1
CSE 153	Introduction to C/C++ Programming	<u>3</u>
		17

### Second Semester

EAS 102	Problem Solving and Design	3
Miami Plan	English Composition Elective (MPF I)	3
MTH 251	Calculus II	4
PHY 182	Physics II	4
PHY 184	Physics II Lab	1
MPF III	Global Perspectives	<u>3</u>
		18

## Sophomore Year

### First Semester

ECE 205	Electric Circuit Analysis I	4
ECE 287	Digital Systems Design	4
MTH 222	Linear Algebra	3
MTH 252	Calculus III	4
CSE 262	Tech., Ethics, and Global Society-MPF II B	<u>3</u>
		18

### Second Semester

CHM 141	College Chemistry	3
CHM 144	Chemistry Lab	2
ECE 303	Computer-Aided Experimentation	3
MTH 347	Differential Equations	3
MPF IV A	Biological Science	3
MPF III	Global Perspectives	<u>3</u>
		17

## Junior Year

### First Semester

ECE 304	Electronics	3
ECE 306	Signals and Systems	3
ECE 325	Applied Electromagnetics	3
ECE 345	Random Signal Processing	3
ENG 313	Technical Writing	<u>3</u>
		15

### Second Semester

ECE 387	Embedded Systems Design	4
ECE 425	Digital Signal Processing	3
ECE ____	Professional EE Elective	3
XXX ____	General Technical Elective	3
ECO 201	Microeconomics	<u>3</u>
		16

## Senior Year

### First Semester

ECE 448	Senior Design Project I	2
ECE 436*	Control of Dynamics Systems	3
ECE 453	Communication Systems or ECE 461	3
ECE ____	Professional EE Elective	3
XXX ____	General Technical Elective	<u>3</u>
		14

### Second Semester

ECE 449	Senior Design Project II	2
ECE ____	Professional EE Elective	3
XXX ____	General Technical Elective	3
MPF II A	Fine Arts Elective	3
MPF III	Global Perspectives	<u>3</u>
		14

The above curriculum is a POSSIBLE four-year plan, and your specific plan may be different. Please note that Miami University has multiple liberal education plans; please refer to <http://www.miami.muohio.edu/academics/core-curriculum/index.html> for Global Miami Plan information and <http://www.honors.muohio.edu/> for the Honors academic plan. Also note that certain major and divisional requirements may be used to fulfill liberal education requirements and could affect total hours required to graduate; this should be discussed with your faculty advisor.

### **129 total hours required for the degree.**

*The thematic sequence MTH3-Almost Linear Structures-Models for Physical Science is fulfilled by ECE requirements. The form to "declare" a thematic sequence must be submitted through the department offering the sequence.*

\* Cross-listed with MME 436

## ELECTRICAL & COMPUTER ENGINEERING - COURSE DESCRIPTIONS 2011-2012 (201210)

**ECE 205 Electric Circuit Analysis I (4)** Study of electric circuits and networks. Includes resistive circuits, first-order transients, sinusoidal steady-state analysis, and frequency response. Emphasis on basic principles and their application to circuit analysis using linear algebra and calculus. Laboratory component included. (*Prerequisite: PHY 182/184; Co-requisite: MTH 249 or MTH 251 or MTH 257H*)

**ECE/CSE 278 Computer Architecture (3)** Principles of Von Neumann computer architecture. Data representation and computer arithmetic. Memory hierarchy. CPU structure and instruction sets. Assembly language programming to better understand and illustrate computer architecture concepts. Performance considerations and alternative computer architectures. (*Prerequisite: CSE 271 or equivalent*)

**ECE 287 Digital Systems Design (4)** Design of digital systems. Topics include switching algebra and switching functions, logic design of combinational and sequential circuits using TTL, combinational logic design with MSI and LSI, busing, flip-flops, registers, counters, programmable logic devices, memory devices, register-level design, and microcomputer system organization. Students must show competency in computer-aided design (CAD) and laboratory implementation of digital systems. (*Prerequisite: none*)

**ECE 291 Renewable Energy Systems (3)** Analysis of various renewable energy sources, including hydroelectric, solar, wind, biomass, geothermal, nuclear and hydrogen. Sustainability of energy sources and environmental impact of energy consumption are addressed. (*Prerequisite: PHY 172*)

**ECE/MME 303 Computer-Aided Experimentation (4)** Study of theory and application of instrumentation and experimentation including: components and concepts of computer-machine interface systems; design of computer-controlled experimentation for real-time industrial measurement, monitoring, and control; AC power analysis; applications of the Laplace Transform. Laboratory component included. (*Prerequisite: ECE 205; Co-requisite: MTH 347 or MTH 245 for MME majors only*)

**ECE 304 Electronics (3)** Analysis and design of electronic circuits and subsystems. Frequency response and circuit models for amplifiers; non-ideal operational amplifier circuits; transistors; transistor amplifiers; small signal operation and models. Laboratory component included. (*Prerequisite: ECE 305 or ECE/MME 303*)

**ECE 306 Signals and Systems (3)** Study of the basic principles of signals and systems. Theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing. Lectures, simulation exercises, and design projects. (*Prerequisite: ECE 205 or PHY 292/294 and Concurrent: ECE 305 or ECE/MME 303 and*

*MTH 245 or MTH 347*) It is recommended that students enroll in **MTH 245 or MTH 347** PRIOR to enrolling in **ECE 306**.

**ECE 320 Professional Practice (0)** Students participating in the ECE co-op program register for this course during semesters when they are away from Oxford on work assignment. This enables students to remain in good standing with the University Registrar.

**ECE 325 Applied Electromagnetics (3)** Study of theories and applications of electromagnetic fields and waves; including electrostatics, magnetostatics, Maxwell equations, plane wave propagation and reflection, transmission lines, and antennas. Laboratory component included. (*Prerequisites: ECE 305 or ECE/MME 303 and MTH 245 or MTH 347*)

**ECE 345 Random Signal Processing (3)** Introduction to probability and statistics, including applications relevant to electrical and computer engineering. Includes extensive coverage of random variables. Introduces random processes and illustrates their importance in communications, signal processing and networking. (*Prerequisites: MTH 249 or MTH 251 and MTH 222 or MTH 231*)

**ECE 387 Embedded Systems Design (4)** Fundamentals of computer systems design, interfacing and basics of embedded computers (microprocessors). Laboratory projects require students to successfully design, implement, debug, and document computer solutions requiring a mix of hardware and software. Intro of models and methodologies for designing systems containing both hardware and software components, or co-design. Substantial design projects required of each student. (*Prerequisites: ECE 287 and CSE 153 or CSE 274*)

**ECE 414/514 Introduction to VLSI Circuit and System Design (3)** Study of fundamentals of modern VLSI IC design. Introduction of three main aspects of CMOS IC engineering: device operation, circuit design, and circuit layout. Also, introduction of three main aspects of VLSI system engineering: system-level simulation, interconnect analysis, and basics of high-volume manufacturability. Hands-on experience with modern IC design software. (*Prerequisites: ECE 287 and ECE 304*)

**ECE 425/525 Digital Signal Processing (3)** Study of the relation between continuous-time and discrete-time signals. Time-sampling, signal representation, transformation and manipulation of digital signal, digital filter structure and design. (*Prerequisite: ECE 306; Co-requisites: ECE 345 or STA 301 or STA 368*)

**ECE 426/526 Biomedical Signal Analysis (3)** Physiological origin, characterization, modeling, and analysis of biomedical signals, including EEG, MEG and ECG signals. Noise and artifact reduction; nonparametric and model-based spectral estimation; joint time-frequency analysis. (*Prerequisites: ECE 306, and STA 301 or STA 368, or ECE 345, or permission of instructor.*)

**ECE 427/527 Radar Signal Processing (3)** Principles, theories and techniques of radar signal processing. Including: elements of radar systems; radar equation; sampling and quantization of pulse radar signals; radar waveforms; Doppler processing; target detection; and concepts of synthetic aperture imaging and beamforming. *(Prerequisites: ECE 306, and STA 301 or STA 368, or ECE 345, or permission of instructor.)*

**ECE 428/528 Real-Time Digital Signal Processing (3)** Study of real-time digital signal processing techniques. Design and implementation of real time digital signal processing algorithms with an industry-standard DSP microprocessor. Several structured laboratory exercises, such as spectrum analysis and digital filtering, followed by an extensive final project. *(Prerequisites: ECE 425)*

**ECE 429/529 Digital Image Processing (3)** Study of digital image processing techniques. Included: digital image fundamentals, digital image spatial filtering, digital image frequency filtering, image restoration, inverse filtering, Wiener filtering, and color image processing fundamentals. *(Prerequisite: ECE 425)*

**ECE 430/530 Electromagnetics in Wireless Sensing and Communications (3)** Electromagnetic aspects of modern wireless sensing and communications. Fundamentals of EM wave propagation in various media, antenna design and wireless system analysis. Hands-on experience with computational modeling and contemporary EM software. *(Prerequisite: ECE 325; Co-requisites: ECE 345 or STA 301 or STA 368)*

**ECE/MME 436 Control of Dynamic Systems (3)** In-depth study of the theory, design, and analysis of feedback control of dynamic systems. Integration of problem-solving techniques and concepts of electric circuits and computer-aided experimentation into the design and construction of programmable-logic based control systems and application to modern manufacturing systems. Design methodologies applied in laboratory exercises and short-term design projects. *(Prerequisite: ECE/MME 303 or ECE 305)*

**ECE 448 Senior Design Project I (2) and ECE 449 Senior Design Project II (2)** Student teams, with varied academic backgrounds, conduct major open-ended research/design projects. Elements of the design process are considered as well as real-world constraints, such as economic and societal factors, marketability, ergonomics, safety, aesthetics, and ethics. 448: feasibility studies performed; 449: implementation, testing, and production of design. Nonmajors can register for 3-4 credits. *(Prerequisite: senior standing in student's major.)*

**ECE 453/553 Communication Systems (3)** Introduction to basic communication systems and their principles and practices including modulation and demodulation, multiplexing techniques, system design, and performance analysis. *(Prerequisites: ECE 306 and ECE 345 or STA 301 or STA 368 and Co-requisite: ECE 304)*

**ECE 461/561 Network Modeling and Performance Analysis (3)** Modeling and performance analysis of computer and communication networks including delay and occupancy models, architectures, transmission media, multiple access, switching, and protocols. Emphasis on lower layer network performance. *(Prerequisites: ECE 345 or STA 301 or STA 368)*

**ECE 465/565 Introduction to GPS (3)** Study of basic Global Positioning Systems (GPS), including GPS satellite constellation, satellite orbits, ground monitoring stations' functions, GPS receiver working principles, GPS measurement errors and correction techniques, recent advancements in GPS, and applications of GPS. Students will learn to use a variety of GPS receivers and analyze GPS data. *(Prerequisites: PHY 182 and MTH 25; Co-requisites: MTH 222, STA 302 or STA 368 or ECE 345)*

**ECE 475/575 Software Receiver Technologies (3)** Study of important aspects of software-based Global Positioning System (GPS) receivers, including GPS signal structure, radio frequency front end design, GPS signal acquisition and tracking methods and algorithms, and navigation data extraction using software digital signal processing implementations. *(Prerequisites: ECE 306, STA 301 or STA 368 or ECE 345; Recommended: ECE 325)*

**ECE 470/570 Special Topics (3)** Advanced special topics in electrical and computer engineering. *(Prerequisite: Permission of instructor.)*

- **470.N Introduction to Navigation:** Study of basic theories, techniques (including animal navigation), components, and systems required in determining a user's position, velocity, and attitude for navigation purposes. Discussion of recent developments in navigation techniques and methods. Hands-on experience with navigation models.

**ECE 491 Power Systems Engineering (3)** Study of electric power generation, utility load flow, fault analysis, system stability, surge protection, and the interconnection of the electrical grid system. *(Prerequisite: ECE 303 or ECE 305)*

**ECE 610 Graduate Seminars (1)** Weekly presentations on current research topics in multi-disciplinary areas of electrical and computer engineering, computational science and engineering, and their applications in other disciplines by graduate students, faculty, and visiting scientists and researchers. Research methods, processes, and presentation skills are emphasized. Approved for credit/no-credit grading only. May be repeated. *(Prerequisite: Graduate standing or consent of instructor.)*

**ECE 700 Independent Studies**