

# Electrical Engineering

## Electrical Engineering Major

The Electrical Engineering program at NDSU is accredited by the Engineering Accreditation Commission of ABET (<http://www.abet.org>).

### EE Specialization

The Electrical Engineering program is designed to reflect the broad nature of the field, and students may tailor their studies within broad parameters. Students are encouraged to develop an individual program of study in close consultation with their advisers. Examples are available to illustrate how specialization may be obtained in a number of different technical areas. Students may mix and match from the examples to suit their particular interests. Technical areas include the following:

- **Biomedical Engineering** is firmly based in engineering and the life sciences. The integration of medicine and engineering serves to provide appropriate products, tools, and techniques for research diagnosis and treatment by health care professionals. Some important products are artificial hearts, medical imaging (MRI, ultrasound, CT scans), prosthetic devices, and computer aids for diagnosis. Biomedical engineers help identify the problems and needs that can be solved using engineering technology and systems methodology to provide high-quality health care at reasonable cost.
- **Communication and Signal Processing** are closely related fields within electrical engineering. Communication is the process of transferring information from one point in time and space to another point. Signal processing involves signal representation, as well as signal design and filtering. Students with this specialization find challenging opportunities worldwide to meet the need for more convenient, inexpensive, and reliable communication and signal processing.
- **Computer Engineering** involves both hardware and software for small and large computers and for all products that include dedicated computers within, such as smart phones, game consoles, and automobiles.
- **Control Engineering** deals with the design and implementation of algorithms for controlling physical systems. Examples include active suspension for cars, auto pilots for aircraft, and robot motion control.
- **Electromagnetics** includes electromagnetic compatibility, fiber optics, antennas, microwave devices, radar, sonar, satellite systems, power and communication transmission lines, grounding, shielding, and propagation.
- **Electronics and Microelectronics** deal with integrated circuits, VLSI, transistors, lasers, consumer electronics, defense electronics, power electronics, and electronic materials.
- **Optical Engineering**, developed jointly with the Department of Physics (<https://www.ndsu.edu/physics>), prepares future engineers in such areas as quantum theory; coherent/incoherent polarized/non-polarized light; geometric, physical, and Fourier optics; holography; and image processing and acquisition.
- **Power Systems** deals with the generation, transmission, distribution, and utilization of electric energy subject to safety, environmental, and economic concerns.
- **Nanotechnology** deals with the study of electric materials at the nanoscale level for applications such as solar cells and sensors.

## Major Requirements

### Major: Electrical Engineering

Degree Type: B.S.E.E.

Required Degree Credits to Graduate: 128

### General Education Requirements for Baccalaureate Degree

- A list of approved general education courses is available here (<http://bulletin.ndsu.edu/past-bulletin-archive/2017-18/academic-policies/undergraduate-policies/general-education/#genedcoursestext>).
- General education courses may be used to satisfy requirements for both general education and the major, minor, and program emphases, where applicable. Students should carefully review the major, minor, and program emphases requirements for minimum grade restrictions, should they apply.

Code	Title	Credits
<b>Communication (C)</b>		12
ENGL 110	College Composition I	
ENGL 120	College Composition II	
COMM 110	Fundamentals of Public Speaking	
Upper Division Writing <sup>†</sup>		
<b>Quantitative Reasoning (R) <sup>†</sup></b>		3
<b>Science and Technology (S) <sup>†</sup></b>		10

Humanities and Fine Arts (A) <sup>†</sup>	6
Social and Behavioral Sciences (B) <sup>†</sup>	6
Wellness (W) <sup>†</sup>	2
Cultural Diversity (D) <sup>**†</sup>	
Global Perspectives (G) <sup>**†</sup>	
Total Credits	39

\* May be satisfied by completing courses in another General Education category.

† May be satisfied with courses required in the major. Review major requirements to determine if a specific upper division writing course is required.

## Major Requirements

Code	Title	Credits
<b>Electrical Engineering Core Requirements</b>		
ECE 111	Introduction to Electrical and Computer Engineering	3
ECE 173	Introduction to Computing <sup>*</sup>	4
ECE 275	Digital Design <sup>*</sup>	4
ECE 311	Circuit Analysis II	4
ECE 320	Electronics for Computer Engineers	3
ECE 321	Electronics for Electrical Engineers	2
ECE 331	Energy Conversion	4
ECE 341	Random Processes	3
ECE 343	Signals & Systems	4
ECE 351	Applied Electromagnetics	4
ECE 376	Embedded Systems	4
ECE 401	Design I (capstone)	1
ECE 403	Design II (capstone)	2
ECE 405	Design III (capstone)	3
<b>MATH Courses Required</b>		
MATH 129	Basic Linear Algebra <sup>*</sup>	3
MATH 165	Calculus I (May satisfy general education category R)	4
MATH 166	Calculus II <sup>*</sup>	4
MATH 265	Calculus III (w/ vectors) <sup>*</sup>	4
MATH 266	Introduction to Differential Equations <sup>*</sup>	3
<b>Other Courses Required</b>		
CHEM 121	General Chemistry I (May satisfy general education category S)	3
EE 206	Circuit Analysis I <sup>*</sup>	4
Select one of the following: (May satisfy general education category C)		3
ENGL 320	Business and Professional Writing	
ENGL 321	Writing in the Technical Professions	
ENGL 324	Writing in the Sciences	
ENGL 459	Researching and Writing Grants and Proposal	
ENGR 402	Engineering Ethics and Social Responsibility	1
PHYS 251	University Physics I (May satisfy general education category S)	4
PHYS 252	University Physics II (May satisfy general education category S)	4
Select one of the following lab courses (May satisfy general education category S):		1
CHEM 121L	General Chemistry I Laboratory	
PHYS 251L	University Physics I Laboratory	
PHYS 252L	University Physics II Laboratory	
<b>ECE Electives</b>	<b>Select 9 credits of ECE 400 level electives (excluding 494 and 496)</b>	9
Includes the cross listed courses of ECE 427/IME 427; ECE 429/IME 429; ECE 411/PHYS 411; & ECE 411L/PHYS 411L		
<b>Tech Electives: Select 12 credits from the following:</b>		12
ABEN 456	Biobased Energy	

BIOL 150 & 150L	General Biology I and General Biology I Laboratory
BIOL 220 & 220L	Human Anatomy and Physiology I and Human Anatomy and Physiology I Laboratory
BIOL 221 & 221L	Human Anatomy and Physiology II and Human Anatomy and Physiology II Laboratory
BIOL 315 & 315L	Genetics and Genetics Laboratory
CE 309 & CE 310	Fluid Mechanics and Fluid Mechanics Laboratory
CE/ME 486	Nanotechnology and Nanomaterials
CHEM 122 & 122L	General Chemistry II and General Chemistry II Laboratory
CHEM 341 & 341L	Organic Chemistry I and Organic Chemistry I Laboratory
CHEM 342 & 342L	Organic Chemistry II and Organic Chemistry II Laboratory
CHEM 364	Physical Chemistry I
CHEM 365 & CHEM 471	Physical Chemistry II and Physical Chemistry Laboratory
CHEM 425 & CHEM 429	Inorganic Chemistry I and Inorganic Chemistry Laboratory
CSCI 161	Computer Science II
CSCI 222	Discrete Mathematics
CSCI 336	Theoretical Computer Science
CSCI 366	Database Systems
CSCI 372	Comparative Programming Languages
CSCI 426	Introduction to Artificial Intelligence
CSCI 458	Microcomputer Graphics
CSCI 459	Foundations of Computer Networks
CSCI 467	Algorithm Analysis
CSCI 474	Operating Systems Concepts
CSCI 477	Object-Oriented Systems
ECE 374	Computer Organization
ECE 494	Individual Study (max. of 6 cr.)
ECE 4XX	Any ECE 400 level didactic course
ECE 496	Field Experience (max. of 3 cr.)
ENGR 310	Entrepreneurship for Engineers and Scientists
IME 440	Engineering Economy
IME 456	Program and Project Management
IME 461	Quality Assurance and Control
MATH 270	Introduction to Abstract Mathematics
MATH 420	Abstract Algebra I
MATH 421	Abstract Algebra II
MATH 429	Linear Algebra
MATH 450	Real Analysis I
MATH 451	Real Analysis II
MATH 452	Complex Analysis
MATH 480	Applied Differential Equations
MATH 481	Fourier Analysis
MATH 483	Partial Differential Equations
MATH 488	Numerical Analysis I
MATH 489	Numerical Analysis II
ME 221	Engineering Mechanics I

ME 222	Engineering Mechanics II
ME 223	Mechanics of Materials
ME 350	Thermodynamics and Heat Transfer
ME 470	Renewable Energy Technology
MICR 445	Animal Cell Culture Techniques
PHYS 350	Modern Physics
PHYS 360	Modern Physics II
PHYS 413	Lasers for Scientists and Engineers
PHYS 415	Elements of Photonics
PHYS 485	Quantum Mechanics I
STAT 450	Stochastic Processes
STAT 468	Probability and Mathematical Statistics II
ZOO 460	Animal Physiology

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Total Credits

104

\* No grade less than a C accepted in these courses and before enrolling in ECE 300 level courses, excluding ECE 311.

### Degree Requirements and Notes

- A student must complete at least 60 semester credits of professional level course work in his/her program while in residence and enrolled in the college. Students transferring into the college from programs with professional accreditation are exempt from this residency requirement but are subject to the residency requirement of NDSU.
- In order to graduate, an ECE student must have at least a 2.0 GPA in all required EE and ECE courses taken at NDSU. Elective ECE courses are not included in this GPA requirement.
- Transfer Students – Transfer courses with grades less than 'C' in Biology, Chemistry, Computer Science, Mathematics, Physics, and any type of engineering class will not be accepted as a major requirement.
- All Students – Students are required to attain a grade of 'C' or better in ECE 173 Introduction to Computing, ECE 275 Digital Design, EE 206 Circuit Analysis I, and all required MATH courses.

**Note:** For students interested in pursuing one of the areas of specialization, lists of recommendations for specific electives are available from the ECE Department (<https://www.ndsu.edu/ece>).