# ELECTRICAL ENGINEERING, B.S.

## UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the *Guide*.

| General Education | • Breadth–Humanities/Literature/Arts: 6 credits |
| | • Breadth–Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits |
| | • Breadth–Social Studies: 3 credits |
| | • Communication Part A & Part B * |
| | • Ethnic Studies * |
| | • Quantitative Reasoning Part A & Part B * |
| | * The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements. |

## SUMMARY OF REQUIREMENTS

The following curriculum applies to students who were admitted to the electrical engineering degree program (classification changed to EE) in Fall 2017 or later.

| Code | Title | Credits |
|---|---|---|
| Mathematics | | 16 |
| Science | | 17-18 |
| Electrical Engineering Core | | 33 |
| Electrical Engineering Advanced Electives | | 24 |
| Professional Electives | | 9 |
| Communication Skills | | 6 |
| Liberal Studies | | 15 |
| **Total Credits** | | **120-121** |

## MATHEMATICS [1]

| Code | Title | Credits |
|---|---|---|
| MATH 221 | Calculus and Analytic Geometry 1 | 5 |
| or MATH 217 | Calculus with Algebra and Trigonometry II | |
| or MATH 275 | Topics in Calculus I | |
| MATH 222 | Calculus and Analytic Geometry 2 | 4 |
| or MATH 276 | Topics in Calculus II | |
| MATH 234 | Calculus--Functions of Several Variables [2] | 4 |
| Probability and Statistics Elective | | 3 |
| STAT 311 | Introduction to Theory and Methods of Mathematical Statistics I | |
| STAT/M E 424 | Statistical Experimental Design | |
| MATH/STAT 431 | Introduction to the Theory of Probability | |
| E C E 331 | Introduction to Random Signal Analysis and Statistics | |
| **Total Credits** | | **16** |

[1]

In additional to the courses listed in the Mathematics Requirement at least one additional course must be completed for the advanced mathematics auxiliary condition. Choose: MATH 319 Techniques in Ordinary Differential Equations, MATH 320 Linear Algebra and Differential Equations, MATH 340 Elementary Matrix and Linear Algebra, MATH 341 Linear Algebra, E C E 334 State Space Systems Analysis, or E C E/COMP SCI/M E 532 Matrix Methods in Machine Learning to satisfy the advanced math auxiliary condition. These credits count toward either professional electives or advanced elective credit depending on the course.

[2]

MATH 375 and MATH 376 taken in sequence will fulfill the requirement for MATH 234, professional elective credit, and advanced math auxiliary condition.

## SCIENCE

| Code | Title | Credits |
|---|---|---|
| COMP SCI 300 | Programming II | 3 |
| PHYSICS 201 | General Physics [1] | 5 |
| or PHYSICS 207 | General Physics | |
| or PHYSICS 247 | A Modern Introduction to Physics | |
| PHYSICS 202 | General Physics | 5 |
| or PHYSICS 208 | General Physics | |
| or PHYSICS 248 | A Modern Introduction to Physics | |
| Select one of the following: | | 4-5 |
| CHEM 109 | Advanced General Chemistry | |
| CHEM 103 | General Chemistry I | |
| CHEM 104 | General Chemistry II | |
| **Total Credits** | | **17-18** |

[1]

Students may also fulfill this requirement by taking E M A 201 Statics and E M A 202 Dynamics or E M A 201 Statics and M E 240 Dynamics.

## ELECTRICAL ENGINEERING CORE

| Code | Title | Credits |
|---|---|---|
| E C E 203 | Signals, Information, and Computation | 3 |
| E C E 210 | Introductory Experience in Electrical Engineering | 2 |
| E C E 219 | Analytical Methods for Electromagnetics Engineering | 2 |

| | | |
|---|---|---|
| E C E 220 | Electrodynamics I | 3 |
| E C E 230 | Circuit Analysis | 4 |
| E C E/PHYSICS 235 | Introduction to Solid State Electronics | 3 |
| E C E/COMP SCI 252 | Introduction to Computer Engineering | 3 |
| E C E 270 | Circuits Laboratory I | 1 |
| E C E 271 | Circuits Laboratory II | 1 |
| E C E 330 | Signals and Systems | 3 |
| E C E 340 | Electronic Circuits I | 3 |
| E C E/COMP SCI 352 | Digital System Fundamentals | 3 |
| E C E 370 | Advanced Laboratory | 2 |
| **Total Credits** | | **33** |

## ELECTRICAL ENGINEERING ADVANCED ELECTIVES

Students must take 22 credits in at least three of six areas and at least 2 credits in two laboratory courses.

- At least 9 credits must be in E C E courses numbered 400 and above.
- At least one course must be a capstone design course.
- At least one course must be MATH 319 Techniques in Ordinary Differential Equations, MATH 320 Linear Algebra and Differential Equations, MATH 340 Elementary Matrix and Linear Algebra, MATH 341 Linear Algebra, E C E 334 State Space Systems Analysis, or E C E/COMP SCI/M E 532 Matrix Methods in Machine Learning to satisfy the advanced math auxiliary condition. MATH 319 Techniques in Ordinary Differential Equations, MATH 320 Linear Algebra and Differential Equations, MATH 340 Elementary Matrix and Linear Algebra, and MATH 341 Linear Algebra count toward professional electives. E C E 334 State Space Systems Analysis and E C E/COMP SCI/M E 532 Matrix Methods in Machine Learning count as advanced electives.
- Students can count 1 credit of E C E 1 Cooperative Education Program toward advanced electives.
- Students can count up to 6 credits of E C E 399 Independent Study , E C E 489 Honors in Research or E C E 699 Advanced Independent Study towards advanced electives.
- Students can take E C E 379 Special Topics in Electrical and Computer Engineering and E C E 601 Special Topics in Electrical and Computer Engineering as advanced electives.
- Students can count up to 5 credits of COMP SCI courses numbered 500 and above (not including independent study)
- E C E courses numbered 300 and above that are not specified in an area can count toward the total number of advanced elective credits required.

### Laboratory

| Code | Title | Credits |
|---|---|---|
| *Select at least one course from E C E 301 to E C E 317* | | |
| *An additional laboratory course must be taken from the following list:* | | |
| E C E 303 | Introduction to Real-Time Digital Signal Processing | |
| E C E 304 | Electric Machines Laboratory | |
| E C E 305 | Semiconductor Properties Laboratory | |
| E C E 306 | Linear Active Circuits Laboratory | |
| E C E 308 | Nonlinear Electronic Circuits Laboratory | |
| E C E 313 | Optoelectronics Lab | |
| E C E 315 | Introductory Microprocessor Laboratory | |
| E C E 317 | Sensors Laboratory | |
| E C E 432 | Digital Signal Processing Laboratory | |
| E C E 453 | Embedded Microprocessor System Design | |
| E C E/B M E 462 | Medical Instrumentation [1] | |
| E C E 504 | Electric Machine & Drive System Laboratory | |
| E C E 512 | Power Electronics Laboratory | |
| E C E 545 | Advanced Microwave Measurements for Communications | |
| E C E 549 | Integrated Circuit Fabrication Laboratory | |
| E C E 554 | Digital Engineering Laboratory | |
| E C E/M E 577 | Automatic Controls Laboratory | |

[1]

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

### Fields & Waves

| Code | Title | Credits |
|---|---|---|
| E C E 320 | Electrodynamics II | 3 |
| E C E 420 | Electromagnetic Wave Transmission | 3 |
| E C E 434 | Photonics | 3 |
| E C E/N E/PHYSICS 525 | Introduction to Plasmas | 3 |
| E C E/N E/PHYSICS 527 | Plasma Confinement and Heating | 3 |
| E C E/N E 528 | Plasma Processing and Technology | 3 |
| E C E 536 | Integrated Optics and Optoelectronics | 3 |
| E C E/PHYSICS 546 | Lasers | 2-3 |
| E C E 547 | Advanced Communications Circuit Design [1] | 3 |

[1]

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

### Systems & Control

| Code | Title | Credits |
|---|---|---|
| E C E 332 | Feedback Control Systems | 3 |
| E C E 334 | State Space Systems Analysis | 3 |
| E C E/M E 439 | Introduction to Robotics [1] | 3 |
| E C E/M E 577 | Automatic Controls Laboratory [1] | 4 |

[1]

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

## Power & Machines

| Code | Title | Credits |
| --- | --- | --- |
| E C E 355 | Electromechanical Energy Conversion | 3 |
| E C E 356 | Electric Power Processing for Alternative Energy Systems | 3 |
| E C E 411 | Introduction to Electric Drive Systems | 3 |
| E C E 412 | Power Electronic Circuits [1] | 3 |
| E C E 427 | Electric Power Systems [1] | 3 |
| E C E 504 | Electric Machine & Drive System Laboratory | 2-3 |
| E C E 511 | Theory and Control of Synchronous Machines | 3 |
| E C E 512 | Power Electronics Laboratory [1] | 3 |

[1]

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

## Communications & Signal Processing

| Code | Title | Credits |
| --- | --- | --- |
| E C E 331 | Introduction to Random Signal Analysis and Statistics | 3 |
| E C E 401 | Electro-Acoustical Engineering | 3 |
| E C E 431 | Digital Signal Processing [1] | 3 |
| E C E 432 | Digital Signal Processing Laboratory [1] | 3 |
| E C E/COMP SCI/ MATH 435 | Introduction to Cryptography | 3 |
| E C E 436 | Communication Systems I [1] | 3 |
| E C E 437 | Communication Systems II [1] | 3 |
| E C E 447 | Applied Communications Systems [1] | 3 |
| E C E/COMP SCI/ M E 532 | Matrix Methods in Machine Learning [1] | 3 |
| E C E/ COMP SCI 533 | Image Processing [1] | 3 |
| E C E 537 | Communication Networks [1] | 3 |
| E C E/COMP SCI/ M E 539 | Introduction to Artificial Neural Networks [1] | 3 |
| E C E/MATH 641 | Introduction to Error-Correcting Codes | 3 |

[1]

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## Circuits & Devices

| Code | Title | Credits |
| --- | --- | --- |
| E C E 335 | Microelectronic Devices | 3 |
| E C E 342 | Electronic Circuits II | 3 |
| E C E 445 | Semiconductor Physics and Devices | 3 |
| E C E/B M E 462 | Medical Instrumentation [1] | 3 |
| E C E 466 | Electronics of Solids | 3 |
| E C E 541 | Analog MOS Integrated Circuit Design [1] | 3 |

| Code | Title | Credits |
| --- | --- | --- |
| E C E 542 | Introduction to Microelectromechanical Systems [1] | 3 |
| E C E 545 | Advanced Microwave Measurements for Communications [1] | 3 |
| E C E 548 | Integrated Circuit Design [1] | 3 |
| E C E 549 | Integrated Circuit Fabrication Laboratory [1] | 3 |
| E C E 555 | Digital Circuits and Components [1] | 3 |

[1]

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

## Computers & Computing

| Code | Title | Credits |
| --- | --- | --- |
| E C E 353 | Introduction to Microprocessor Systems | 3 |
| E C E/ COMP SCI 354 | Machine Organization and Programming | 3 |
| E C E 453 | Embedded Microprocessor System Design [1] | 4 |
| E C E 454 | Mobile Computing Laboratory [1] | 4 |
| E C E/B M E 463 | Computers in Medicine | 3 |
| E C E/ COMP SCI 506 | Software Engineering | 3 |
| E C E 551 | Digital System Design and Synthesis [1] | 3 |
| E C E/ COMP SCI 552 | Introduction to Computer Architecture | 3 |
| E C E 553 | Testing and Testable Design of Digital Systems [1] | 3 |
| E C E 554 | Digital Engineering Laboratory [1] | 4 |
| E C E 556 | Design Automation of Digital Systems [1] | 3 |

[1]

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

# PROFESSIONAL ELECTIVES

| Code | Title | Credits |
| --- | --- | --- |
| *Classes to be taken in an area of professional interest. The following courses are acceptable as professional electives if the courses are not used to meet any other degree requirements.* | | 9 |
| MATH/ COMP SCI 240 | Introduction to Discrete Mathematics | |
| E C E 204 | Data Science & Engineering | |
| E C E 320 | Electrodynamics II | |
| E C E 331 | Introduction to Random Signal Analysis and Statistics | |
| E C E 332 | Feedback Control Systems | |
| E C E 334 | State Space Systems Analysis | |
| E C E 335 | Microelectronic Devices | |
| E C E 342 | Electronic Circuits II | |
| E C E 353 | Introduction to Microprocessor Systems | |

| | | |
|---|---|---|
| E C E/ COMP SCI  354 | Machine Organization and Programming | |
| E C E 355 | Electromechanical Energy Conversion | |
| E C E 356 | Electric Power Processing for Alternative Energy Systems | |
| E C E courses numbered 399 and higher | | |
| COMP SCI courses numbered 400 and higher | | |
| MATH 319 | Techniques in Ordinary Differential Equations | |
| MATH 320 | Linear Algebra and Differential Equations [1] | |
| MATH 321 | Applied Mathematical Analysis | |
| MATH 322 | Applied Mathematical Analysis | |
| MATH 340 | Elementary Matrix and Linear Algebra [1] | |
| MATH 341 | Linear Algebra | |
| MATH courses numbered 400 and higher | | |
| STATS courses numbered 400 and higher | | |
| Any biological science course that is designated as intermediate or advanced | | |
| Any physical science course that is designated as intermediate or advanced (except PHYSICS 241) | | |
| Any natural science course that is designated as advanced except that Math, Computer Sciences, and Statistics courses must follow the above criteria | | |
| Engineering courses numbered 300 and higher that are not E C E or cross-listed with E C E | | |
| Up to six credits of Professional Electives can be taken from School of Business classes numbered 300 and higher. | | |
| DS 501 | Special Topics (Wearable Technologies) | |
| DANCE 560 | Current Topics in Dance: Workshop (Making Digital Lighting Controls) | |

[1]
 Students may only earn degree credit for MATH 320 Linear Algebra and Differential Equations or MATH 340 Elementary Matrix and Linear Algebra, not both.

## COMMUNICATION SKILLS

| Code | Title | Credits |
|---|---|---|
| ENGL 100 | Introduction to College Composition | 3 |
| or LSC 100 | Science and Storytelling | |
| or COM ARTS 100 | Introduction to Speech Composition | |
| or COM ARTS 181 | Elements of Speech-Honors Course | |
| or ESL 118 | Academic Writing II | |
| INTEREGR 397 | Engineering Communication | 3 |
| **Total Credits** | | **6** |

## LIBERAL STUDIES ELECTIVES

| Code | Title | Credits |
|---|---|---|
| **College of Engineering Liberal Studies Requirements** | | |
| Complete requirements (http://guide.wisc.edu/ undergraduate/engineering/#requirementstext) [1] | | 15 |
| **Total Credits** | | **15** |

[1]

All liberal studies credits must be identified with the letter H, S, L, or Z. Language courses are acceptable without the letter and are considered humanities. **Note**: See an E C E advisor and/or the EE Curriculum Guide for additional information.

## HONORS IN UNDERGRADUATE RESEARCH PROGRAM

Qualified undergraduates may earn an Honors in Research designation on their transcript and diploma by completing 8 credits of undergraduate honors research, including a senior thesis. Further information is available in the department office.

## NAMED OPTION

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- ELECTRICAL ENGINEERING: MACHINE LEARNING AND DATA SCIENCE, B.S. **(**HTTP:// GUIDE.WISC.EDU/UNDERGRADUATE/ ENGINEERING/ELECTRICAL-COMPUTER- ENGINEERING/ELECTRICAL-ENGINEERING- BS/ELECTRICAL-ENGINEERING-MACHINE- LEARNING-DATA-SCIENCE-BS/**)**

## TOTAL DEGREE CREDITS: 120

## UNIVERSITY DEGREE REQUIREMENTS

| | |
|---|---|
| Total Degree | To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements. |
| Residency | Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs. |
| Quality of Work | Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation. |