

# Electrical Engineering

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## 1. University Requirements: (23-24)

|   |     |
|---|-----|
| Writing, Rhetoric and American Cultures (WRA) | 4   |
| Integrative Studies in Humanities (IAH)       | 8   |
| IAH 201-210 and IAH 211 or >                  |     |
| Integrative Studies in Social Sciences (ISS)  | 8   |
| ISS 2XX and ISS 3XX                           |     |
| Bioscience (one of the following):            |     |
| BS 161, ENT 205, IBIO 150, MMG 141,           |     |
| MMG 201, PLB 105, PSL 250                     | 3-4 |

## 2. College Requirements: (31)

|                                       |                                       |   |
|---------------------------------------|---------------------------------------|---|
| *CEM 141                              | General Chemistry                     | 4 |
| *EGR 100                              | Introduction to Engineering Design    | 2 |
| *CSE 220                              | Programming in C                      | 3 |
| *MTH 132                              | Calculus I                            | 3 |
| *MTH 133                              | Calculus II                           | 4 |
| MTH 234                               | Multivariable Calculus                | 4 |
| MTH 235                               | Differential Equations                | 3 |
| *PHY 183                              | Physics for Scientists & Engineers I  | 4 |
| PHY 184                               | Physics for Scientists & Engineers II | 4 |
| <i>*College Admission Requirement</i> |                                       |   |

## 3. Major Requirements: (61)

### a. Complete one of the following courses: (1)

|         |                                     |   |
|---------|-------------------------------------|---|
| CEM 161 | Chemistry Laboratory I              | 1 |
| PHY 191 | Physics Laboratory for Scientists I | 1 |

### b. Complete all of the following courses: (38)

|         |   |   |
|---------|---|---|
| ECE 201 | Circuits and Systems I                          | 3 |
| ECE 202 | Circuits and Systems II                         | 3 |
| ECE 203 | Electronic Circuits and Systems Lab             | 1 |
| ECE 230 | Digital Logic Fundamentals                      | 3 |
| ECE 280 | Electrical Engineering Analysis                 | 3 |
| ECE 302 | Electronic Circuits                             | 3 |
| ECE 303 | Electronics Laboratory                          | 1 |
| ECE 305 | Electromagnetic Fields & Waves I                | 4 |
| ECE 313 | Control Systems                                 | 3 |
| ECE 320 | Energy Conversion & Pwr Electronics             | 3 |
| ECE 331 | Microprocessors & Digital Systems               | 4 |
| ECE 366 | Introduction to Signal Processing               | 3 |
| ECE 377 | Principles of Electronic Devices                | 3 |
| ECE 390 | Ethics, Professionalism and Contemporary Issues | 1 |

### c. Select one of the following courses: (4)

|         |                           |   |
|---------|---------------------------|---|
| ECE 480 | Senior Design (W)         | 4 |
| ECE 489 | Independent Senior Design | 4 |

## d. Major Electives: (18)

Complete a minimum of 18 credits including at least 12 credits from the ECE focus areas below. The 12 ECE focus credits must include at least one laboratory course ("L") and at least one 3 or 4 credit course from two different focus areas. Additional credits to meet the 18 credit requirement may be taken from MTH 314 or any 400-level engineering course or by completing an approved 3 or 4 credit experiential education experience obtained in a minimum of three out-of-classroom experiences through engineering cooperative education or independent study. Students interested in the experiential education experience must contact the department for approval. Note that 400-level courses outside of ECE may have restrictions or require additional prerequisites not included within this degree program.

### Computing and Electronics

|         |  |   |
|---------|--|---|
| ECE 410 | VLSI Design (L)                            | 4 |
| ECE 430 | Embedded Cyber Physical Systems (L)        | 4 |
| ECE 431 | Smart Sensor Systems (L)                   | 3 |
| ECE 434 | Autonomous Vehicles (L)                    | 3 |
| ECE 442 | Introduction to Communication Networks     | 3 |
| ECE 445 | Biomedical Instrumentation (L)             | 3 |
| ECE 456 | Intro to Communication & Networks Security | 3 |

### Electrosciences

|         |   |   |
|---------|---|---|
| ECE 404 | Radio Frequency Electronic Circuits (L) | 4 |
| ECE 405 | Electromagnetic Fields & Waves II (L)   | 4 |
| ECE 407 | Electromagnetic Compatibility (L)       | 4 |
| ECE 447 | Introduction to Biomedical Imaging      | 3 |
| ECE 449 | Fundamentals of Acoustics               | 3 |
| ECE 476 | Electro-Optics (L)                      | 4 |
| ECE 477 | Microelectronic Fabrication (L)         | 3 |

### Systems

|         |  |   |
|---------|--|---|
| ECE 415 | Computer Aided Manufacturing (L)             | 3 |
| ECE 416 | Digital Control (L)                          | 3 |
| ECE 417 | Robotics (L)                                 | 4 |
| ECE 420 | Machines and Power Laboratory (L)            | 1 |
| ECE 423 | Power System Analysis                        | 3 |
| ECE 424 | Electrical Drives                            | 3 |
| ECE 425 | Solid State Power Conversion                 | 3 |
| ECE 446 | Biomedical Signal Processing                 | 3 |
| ECE 448 | Modeling & Analysis of Bioelectrical Systems | 3 |
| ECE 457 | Communication Systems                        | 3 |
| ECE 458 | Communication Systems Laboratory (L)         | 1 |
| ECE 466 | Digital Signal Processing                    | 3 |

### Other Electives (Variable)

**Total Credits Required for Degree**

**128**

The requirements listed above apply to students admitted to the major of Electrical Engineering beginning Fall 2021. The Department of Electrical and Computer Engineering (ECE) constantly reviews program requirements and reserves the right to make changes as necessary. Students are encouraged to consult with their advisor to obtain assistance in planning an appropriate schedule. Students who have questions about Computer Engineering should contact the Electrical and Computer Engineering Department Advising Office, 2212 Engineering Building, phone (517) 355-5242.

**Concentrations**

The department offers the following concentrations to student wishing an area of specialization in their degree. Concentrations are available to, but not required of, any student enrolled in the Bachelor of Science degree in Computer Engineering. Courses completed to satisfy Requirement 3c. above may also be used to satisfy the requirements of a concentrations. NOTE: Completing the Bachelor of Science degree in Computer Engineering with a concentration may require more than 128 credits. Upon completion of the required courses for a concentration, certification will appear on the student's official transcript.

**Biomedical Engineering (15-17)**

This concentration for students who plan to pursue graduate work in biomedical areas or seek employment in selected medical-related areas. To earn a Bachelor of Science degree in Electrical Engineering with a biomedical engineering concentration, students must complete requirements 1., 2., and 3. above and the following:

**1. Complete 2 courses from the following:**

|          |   |   |
|----------|---|---|
| ANTR 350 | Human Gross Anatomy for Pre-Health Prof | 3 |
| BS 161   | Cells and Molecular Biology             | 3 |
| PSL 250  | Introductory Physiology                 | 4 |
| PSL 310  | Physiology for Pre-Health Professionals | 4 |

**2. Complete 3 courses from the following:**

|         |  |   |
|---------|--|---|
| BE 444  | Biosensors for Medical Diagnostics         | 3 |
| ECE 445 | Biomedical Instrumentation (L)             | 3 |
| ECE 446 | Biomedical Signal Processing               | 3 |
| ECE 447 | Intro to Biomedical Imaging                | 3 |
| ECE 448 | Modeling & Analys of Bioelectrical Systems | 3 |
| ECE 449 | Fundamentals of Acoustics                  | 3 |

*Note: Students may enroll in 3 or 4 credits of ECE 490 or 491 with biomedical engineering content as approved by the student's advisor for partial fulfillment of this requirement.*

**Digital Systems and IoT: (12-15)**

This concentration is for students interested in graduate work or employment in the world of digital hardware, software and systems within the internet of things (IoT) industry. To earn a Bachelor of Science degree in Electrical Engineering with a digital systems and IoT concentration, students must complete requirements 1., 2., and 3. above and the following:

**Complete 4 courses from the following:**

|         |  |   |
|---------|--|---|
| CSE 231 | Introduction to Programming I          | 4 |
| ECE 411 | Electronic Design Automation (L)       | 4 |
| ECE 430 | Embedded Cyber-Physical Systems (L)    | 4 |
| ECE 431 | Smart Sensors Systems (L)              | 3 |
| ECE 442 | Intro Communication Networks           | 3 |
| ECE 456 | Intro Communication & Network Security | 3 |
| ECE 466 | Digital Signal Processing              | 3 |

**EM, Acoustics and Optics: (14-15)**

This concentration is for students interested in graduate work or employment in areas related to electromagnetics, acoustics and optics. To earn a Bachelor of Science degree in Electrical Engineering with an EM, acoustics and optics concentration, students must complete requirements 1., 2., and 3. above and the following:

**Complete 4 courses from the following:**

|         |   |   |
|---------|---|---|
| ECE 405 | Electromagnetic Fields and Waves II (L) | 4 |
| ECE 407 | Electromagnetic Compatibility (L)       | 4 |
| ECE 447 | Intro Biomedical Imaging                | 3 |
| ECE 449 | Fundamentals of Acoustics               | 3 |
| ECE 476 | Electro-Optics (L)                      | 4 |

**Microelectronics: (14-15)**

This concentration is for students interested in graduate work in electronic materials, devices or circuits or employment in the semiconductor industry. To earn a Bachelor of Science degree in Electrical Engineering with a microelectronics concentration, students must complete requirements 1., 2., and 3. above and the following:

**Complete 4 courses from the following:**

|         |   |   |
|---------|---|---|
| ECE 404 | Radio Frequency Electronic Circuits (L) | 4 |
| ECE 410 | VLSI Design (L)                         | 4 |
| ECE 425 | Solid State Power Conversion            | 3 |
| ECE 476 | Electro-Optics (L)                      | 4 |
| ECE 477 | Microelectronic Fabrication Lab (L)     | 3 |

**RF and Wireless: (14-15)**

This concentration is for students interested in radio frequency technologies and the theories and principles of electronic communication and networking for graduate work or employment in areas related to wireless communication. To earn a Bachelor of Science degree in Electrical Engineering with an RF and wireless concentration, students must complete requirements 1., 2., and 3. above and the following:

**Complete 4 courses from the following:**

|         |   |   |
|---------|---|---|
| ECE 404 | Radio Frequency Electronic Circuits (L) | 4 |
| ECE 405 | Electromagnetic Fields and Waves II (L) | 4 |
| ECE 407 | Electromagnetic Compatibility (L)       | 4 |
| ECE 442 | Intro Communication Networks            | 3 |
| ECE 457 | Communication Systems                   | 3 |

**Robotics and Automation: (13-14)**

This concentration is for students interested in graduate work or employment in robotics or automation areas. To earn a Bachelor of Science degree in Electrical Engineering with a robotics and automation concentration, students must complete requirements 1., 2., and 3. above and the following:

**1. Complete the following course:**

|         |              |   |
|---------|--------------|---|
| ECE 417 | Robotics (L) | 4 |
|---------|--------------|---|

**2. Complete 3 courses from the following:**

|         |                                     |   |
|---------|-------------------------------------|---|
| ECE 415 | Computer Aided Manufacturing (L)    | 3 |
| ECE 416 | Digital Control (L)                 | 3 |
| ECE 430 | Embedded Cyber-Physical Systems (L) | 4 |
| ECE 431 | Smart Sensors Systems (L)           | 3 |
| ECE 434 | Autonomous Vehicles (L)             | 3 |
| ECE 466 | Digital Signal Processing           | 3 |

**Smart Devices: (12-14)**

This concentration is for students interested in the design and implementation of smart devices and systems for graduate work or employment in consumer electronics and wearables fields. To earn a Bachelor of Science degree in Electrical Engineering with a smart devices concentration, students must complete requirements 1., 2., and 3. above and the following:

**Complete 4 courses from the following:**

|         |                                     |   |
|---------|-------------------------------------|---|
| ECE 410 | VLSI Design (L)                     | 4 |
| ECE 411 | Electronic Design Automation (L)    | 4 |
| ECE 416 | Digital Control (L)                 | 3 |
| ECE 431 | Smart Sensors Systems (L)           | 3 |
| ECE 445 | Biomedical Instrumentation (L)      | 3 |
| ECE 477 | Microelectronic Fabrication Lab (L) | 3 |

# Electrical Engineering

## Sample Program

| Freshman Year |              |              |           | Sophomore Year |           |               |              |
|---------------|--------------|--------------|-----------|----------------|-----------|---------------|--------------|
| Fall          | Credits      | Spring       | Credits   | Fall           | Credits   | Spring        | Credits      |
| Bioscience    | 3/4          | Elective     | 4         | CEM 161        | 1         | Elective      | 3/4          |
| CEM 141       | 4            | CSE 220      | 3         | ECE 201        | 3         | ECE 202 & 203 | 4            |
| EGR 100       | 2            | MTH 133      | 4         | MTH 234        | 4         | ECE 280       | 3            |
| MTH 132       | 3            | PHY 183      | 4         | PHY 184        | 4         | MTH 235       | 3            |
| WRA 101       | 4            | IAH 201-210  | 4         | ISS 2XX        | 4         | ECE 230       | 3            |
| <b>Total</b>  | <b>16/17</b> | <b>Total</b> | <b>19</b> | <b>Total</b>   | <b>16</b> | <b>Total</b>  | <b>16/17</b> |

  

| Junior Year   |           |              |              | Senior Year       |              |                   |              |
|---------------|-----------|--------------|--------------|-------------------|--------------|-------------------|--------------|
| Fall          | Credits   | Spring       | Credits      | Fall              | Credits      | Spring            | Credits      |
| ECE 377       | 3         | ECE 366      | 3            | Major Elective #1 | 3/4          | Elective          | 3/4          |
| ECE 313       | 3         | ECE 320      | 3            | Major Elective #2 | 3/4          | ECE 480 or 489    | 4            |
| ECE 302 & 303 | 4         | ECE 331      | 4            | Major Elective #3 | 3/4          | Major Elective #5 | 3/4          |
| ECE 305       | 4         | Elective     | 3/4          | Major Elective #4 | 3/4          | Major Elective #6 | 3/4          |
| ISS 3XX       | 4         | IAH 211 or > | 4            | ECE 390           | 1            |                   |              |
| <b>Total</b>  | <b>18</b> | <b>Total</b> | <b>17/18</b> | <b>Total</b>      | <b>13/17</b> | <b>Total</b>      | <b>13/16</b> |

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## Program Educational Objectives

The bachelor's degree in electrical/computer engineering provides its graduates with a solid foundation on which they can build successful and sustainable careers in the ever-changing global work environment. The program prepares its graduates for a variety of career paths including engineering positions directly after program completion, entry to engineering graduate school, and entry to other professional graduate-level schools, and eventual leadership in scientific, technical, organizational, and entrepreneurial arenas.

Specifically, the electrical/computer engineering program graduates will:

- be independent and critical thinkers who identify problems and develop effective solutions;
- be competent and ethical engineers practicing in a diverse range of fields;
- maintain and increase their technical expertise through lifelong learning;
- use their expertise to the benefit of the larger community.