# ELECTRICAL AND COMPUTER ENGINEERING

Majors:

- Bachelor of Electrical Engineering (p. 2)
- Bachelor of Science in Computer Engineering (p. 3)

Concentrations:

- Electrical Energy Systems (p. 4)
- Electro-Optics (p. 4)
- Robotics (p. 5)

Minors:

- Computer Systems (p. 5)
- Signals and Systems (p. 5)

The Department of Electrical and Computer Engineering offers two ABET accredited undergraduate programs leading to the Bachelor of Electrical Engineering and the Bachelor of Science in Computer Engineering. The department offers masters and doctoral degrees in electrical and computer engineering and is closely coupled to the graduate program in electro-optics where both master's and doctoral degrees are offered. The electrical and computer engineering department offers an accelerated 5 year B.S.-M.S. program, where students completing their baccalaureate degree can attain their Master of Science in Electrical Engineering or Computer Engineering within one additional year. The department also offers an undergraduate concentration in electro-optics, in collaboration with the Physics Department and the Department of Electro-Optics and Photonics, as well as a concentration in Robotics, and a concentration in Electrical Energy Systems.

The mission of the Department of Electrical and Computer Engineering is to provide an educational experience of the highest quality to produce the discipline's most valued graduates, with the skills and knowledge to learn, lead, and serve in electrical and computer engineering related professions and in their communities.

Our electrical engineering and computer engineering graduates will be prepared to:

1. find rewarding careers as engineering professionals. As electrical engineers they will be prepared to design and develop new products, technologies, and processes that incorporate one or more of the following elements: analog and digital circuits, signals and systems, propagation and processing of signals, and control systems. As computer engineers they will be prepared to design and develop new products, technologies, and processes that incorporate one or more of the following elements: analog and digital circuits, signals and systems, computer design, software development, and hardware/software integration.
2. continue their professional education either formally, in graduate school, professional schools, or through industrial training programs; or informally, through activities such as continuing education, attendance in short courses, professional workshops, and conferences.
3. exercise and further develop their skills in professional communication through activities such as project briefings, conference presentations, technical reports and manuals, and journal publications.
4. participate in activities for the betterment of society, and carry on the traditions of the University of Dayton by maintaining high ethical standards in their professional activities, and by serving their country and community through service, leadership and mentoring.

Electrical engineering is an exciting field within the engineering discipline. It offers the opportunity to enter some of the most rewarding and challenging careers available. The latest developments in the computer, communication, automotive, medical, entertainment, and aerospace industries, as well as homeland security have resulted from advances in the electronics field. Electrical engineers are equipped to enter this dynamic arena as well as equally challenging and rewarding careers in the fields of electro-optics, communication, radar, signal and image processing, biomedicine, controls, robotics and instrumentation, and many more. Electrical engineers work in all phases of technological programs. They are involved from the conception of the basic ideas through design, fabrication, verification, manufacturing, and marketing of the final product.

Computer engineering represents perhaps the most sought-after professional component of an engineering team which develops the technological possibilities inherent in the design, construction, and operation of computer systems. The computer engineer performs a wide variety of tasks involving hardware, software, peripherals, computer-controlled systems, and hardware-software integration, as well as computer applications in the multitude of areas listed above.

Both electrical engineering and computer engineering are broad-based engineering disciplines that provide for a wide range of career choices within the engineering field as well as providing an excellent basis for careers in such diverse areas as business, law, and medicine.

The electrical engineering curriculum is designed to provide an understanding of basic electrical engineering principles with emphasis on the development of problem solving skills. The computer engineering curriculum draws from software courses taken in computer science and hardware related courses taken from Electrical and Computer Engineering, culminating in the integration of hardware and software in systems design. An extensive laboratory experience is integrated with the classroom work to assure that the student develops a working knowledge of the fundamentals. Upper level courses integrate the knowledge base with current technology and computational tools resulting in a graduate capable of making a contribution to the engineering profession by either entering the work force or pursuing a graduate education.

### Faculty

Eric Balster, Chairperson
Professors Emeriti: Evers, Kee, Loomis, Moon, Rogers, Scarpino, Thiele, Williamson
Professors: Asari, Banerjee, Chatterjee, Chodavarapu, Duncan, Hardie, Haus, Ordonez, Penno, Sarangan, Subramanyam, Taha, Vorontsov, Weber, Wicks, Zhan
Associate Professors: Balster, Daniels, Hirakawa
Assistant Professor: Ye
Adjunct Professors: R. Asari, Barrera, Bogle, Browning, Diskin, Doll, Evans, Grote, Kaufman, Kebede, Kim, Kladitis, Korkik, Kumar, Malas, Mears, Ouchen, Patterson, Ratliff, Shin, Wang, Wang, Watson, Yakopcic, Zhang

# Bachelor of Electrical Engineering (ELE) minimum 134 hours

**Common Academic Program (CAP)** [1]

| | | |
|---|---|---|
| First-Year Humanities Commons [2] | | 12 cr. hrs. |
| HST 103 | The West & the World | |
| REL 103 | Introduction to Religious and Theological Studies | |
| PHL 103 | Introduction to Philosophy | |
| ENG 100 | Writing Seminar I [3] | |
| Second-Year Writing Seminar [4] | | 0-3 cr. hrs. |
| ENG 200 | Writing Seminar II | |
| Oral Communication | | 3 cr. hrs. |
| CMM 100 | Principles of Oral Communication | |
| Mathematics | | 3 cr. hrs. |
| Social Science | | 3 cr. hrs. |
| SSC 200 | Social Science Integrated | |
| Arts | | 3 cr. hrs. |
| Natural Sciences [5] | | 7 cr. hrs. |
| Crossing Boundaries | | up to 12 cr. hrs. |
| Faith Traditions | | |
| Practical Ethical Action | | |
| Inquiry [6] | | |
| Integrative | | |
| Advanced Study | | |
| Philosophy and/or Religious Studies (6 cr. hrs.) | | |
| Historical Studies (3 cr. hrs.) [7] | | |
| Diversity and Social Justice [8] | | 3 cr. hrs. |
| Major Capstone [9] | | 0-6 cr. hrs. |

1 The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

2 May be completed with ASI 110 and ASI 120 through the Core Program.

3 May be completed with ENG 100A and ENG 100B, by placement.

4 May be completed with ENG 114 or ENG 198 or ASI 120.

5 Must include two different disciplines and at least one accompanying lab.

6 U.S. History AP and CLEP credit will not satisfy this requirement.

7 May be completed with ASI 110 and ASI 120 through the Core Program. U.S. History AP and CLEP credit will not satisfy this requirement.

8 May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.

9 The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

**Major Requirements**

| | | |
|---|---|---|
| CHM 123 | General Chemistry | 3 |
| CMM 100 | Principles of Oral Communication | 3 |
| CPS 150 | Algorithms & Programming I | 4 |
| ECE 101 | Introduction to Electrical & Computer Engineering II | 0 |
| ECE 201 | Circuit Analysis | 3 |
| ECE 201L | Circuit Analysis Laboratory | 1 |
| ECE 203 | Introduction to MATLAB Programming | 1 |
| ECE 204 & 204L | Electronic Devices and Electronic Devices Laboratory | 4 |
| ECE 215 & 215L | Introduction to Digital Systems and Digital Systems Laboratory | 4 |
| ECE 300 | Professional Development Seminar II | 0 |
| ECE 303 & 303L | Signals & Systems and Signals & Systems Laboratory | 4 |
| ECE 304 & 304L | Electronic Systems and Electronic Systems Laboratory | 4 |
| ECE 314 & 314L | Fundamentals of Computer Architecture and Fundamentals of Computer Architecture Laboratory | 4 |
| ECE 332 | Electromagnetics | 3 |
| ECE 333 | Applied Electromagnetics | 3 |
| ECE 334 | Discrete Signals & Systems | 3 |
| ECE 340 | Engineering Probability & Random Processes | 3 |
| ECE 401 & 401L | Communication Systems and Communication Systems Laboratory | 4 |
| ECE 415 | Control Systems | 3 |
| ECE 431L | Multidisciplinary Design I | 2 |
| ECE 432L | Multidisciplinary Design II | 3 |
| EGR 102 | Introduction to the University Experience for Engineers | 0 |
| EGR 103 | Engineering Innovation | 2 |
| EGR 150 | Enrichment Workshop I | 0 |
| EGR 151 | Enrichment Workshop II | 0 |
| EGR 200 | Professional Development Seminar | 0 |
| or COP 200 | Introduction to Engineering Cooperative Education | |

| | | |
|---|---|---|
| EGR 201 | Engineering Mechanics | 3 |
| EGR 202 | Engineering Thermodynamics | 3 |
| ENG 100 | Writing Seminar I | 3 |
| ENG 200 | Writing Seminar II | 3 |
| or ENG 114 | First-Year Writing Seminar | |
| or ENG 198 | Honors Writing Seminar | |
| HST 103 | The West & the World | 3 |
| or HST 198 | History Scholars' Seminar | |
| MTH 168 | Analytic Geometry & Calculus I | 4 |
| MTH 169 | Analytic Geometry & Calculus II | 4 |
| MTH 218 | Analytic Geometry & Calculus III | 4 |
| MTH 219 | Applied Differential Equations | 3 |
| PHL 103 | Introduction to Philosophy | 3 |
| PHL 316 | Engineering Ethics | 3 |
| or PHL 319 | Information Ethics | |
| PHY 206 | General Physics I - Mechanics | 3 |
| PHY 210L | General Physics Laboratory I | 1 |
| PHY 232 | The Physics of Waves | 3 |
| REL 103 | Introduction to Religious and Theological Studies | 3 |
| Electives (Arts, History, Religion, Philosophy) | | 12 |
| ECE Electives1 [1] | | 6 |
| Technical Electives [2] | | 6 |
| Math elective [3] | | 3 |
| Total Hours | | 134 |

[1] Any course, 300 level and above in ECE

[2] Select from list approved by the Department of Electrical and Computer Engineering.

[3] MTH 301, 308, 310, 404, or CPS 341 (MTH 301 preferred).

# Bachelor of Science in Computer Engineering (CPE) minimum 134 hours

**Common Academic Program (CAP)** [1]

| | | |
|---|---|---|
| First-Year Humanities Commons [2] | | 12 cr. hrs. |
| HST 103 | The West & the World | |
| REL 103 | Introduction to Religious and Theological Studies | |
| PHL 103 | Introduction to Philosophy | |
| ENG 100 | Writing Seminar I [3] | |
| Second-Year Writing Seminar [4] | | 0-3 cr. hrs. |
| ENG 200 | Writing Seminar II | |
| Oral Communication | | 3 cr. hrs. |
| CMM 100 | Principles of Oral Communication | |
| Mathematics | | 3 cr. hrs. |
| Social Science | | 3 cr. hrs. |
| SSC 200 | Social Science Integrated | |
| Arts | | 3 cr. hrs. |
| Natural Sciences [5] | | 7 cr. hrs. |
| Crossing Boundaries | | up to 12 cr. hrs. |
| Faith Traditions | | |
| Practical Ethical Action | | |
| Inquiry [6] | | |
| Integrative | | |
| Advanced Study | | |
| Philosophy and/or Religious Studies (6 cr. hrs.) | | |
| Historical Studies (3 cr. hrs.) [7] | | |
| Diversity and Social Justice [8] | | 3 cr. hrs. |
| Major Capstone [9] | | 0-6 cr. hrs. |

[1] The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

[2] May be completed with ASI 110 and ASI 120 through the Core Program.

[3] May be completed with ENG 100A and ENG 100B, by placement.

[4] May be completed with ENG 114 or ENG 198 or ASI 120.

[5] Must include two different disciplines and at least one accompanying lab.

[6] U.S. History AP and CLEP credit will not satisfy this requirement.

[7] May be completed with ASI 110 and ASI 120 through the Core Program. U.S. History AP and CLEP credit will not satisfy this requirement.

[8] May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.

[9] The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

**Major Requirements**

| | | |
|---|---|---|
| CHM 123 | General Chemistry | 3 |
| CMM 100 | Principles of Oral Communication | 3 |
| CPS 150 | Algorithms & Programming I | 4 |

| | | |
|---|---|---|
| CPS 151 | Algorithms & Programming II | 4 |
| CPS 341 | Discrete Structures | 3 |
| or MTH 308 | Foundations & Discrete Mathematics | |
| CPS 350 | Data Structures & Algorithms | 3 |
| CPS 356 | Operating Systems: Modern Mobile Devices and Massive Concurrency | 3 |
| CPS 444 | UNIX/Linux Programming | 3 |
| ECE 101 | Introduction to Electrical & Computer Engineering II | 0 |
| ECE 201 & 201L | Circuit Analysis and Circuit Analysis Laboratory | 4 |
| EGR 200 | Professional Development Seminar | 0 |
| or COP 200 | Introduction to Engineering Cooperative Education | |
| ECE 203 | Introduction to MATLAB Programming | 1 |
| ECE 204 & 204L | Electronic Devices and Electronic Devices Laboratory | 4 |
| ECE 215 & 215L | Introduction to Digital Systems and Digital Systems Laboratory | 4 |
| ECE 300 | Professional Development Seminar II | 0 |
| ECE 303 & 303L | Signals & Systems and Signals & Systems Laboratory | 4 |
| ECE 304 & 304L | Electronic Systems and Electronic Systems Laboratory | 4 |
| ECE 314 & 314L | Fundamentals of Computer Architecture and Fundamentals of Computer Architecture Laboratory | 4 |
| ECE 334 | Discrete Signals & Systems | 3 |
| ECE 340 | Engineering Probability & Random Processes | 3 |
| ECE 431L | Multidisciplinary Design I | 2 |
| ECE 432L | Multidisciplinary Design II | 3 |
| EGR 102 | Introduction to the University Experience for Engineers | 0 |
| EGR 103 | Engineering Innovation | 2 |
| EGR 150 | Enrichment Workshop I | 0 |
| EGR 151 | Enrichment Workshop II | 0 |
| EGR 201 | Engineering Mechanics | 3 |
| EGR 202 | Engineering Thermodynamics | 3 |
| ENG 100 | Writing Seminar I | 3 |
| ENG 200 | Writing Seminar II | 3 |
| or ENG 114 | First-Year Writing Seminar | |
| or ENG 198 | Honors Writing Seminar | |
| HST 103 | The West & the World | 3 |
| or HST 198 | History Scholars' Seminar | |
| MTH 168 | Analytic Geometry & Calculus I | 4 |
| MTH 169 | Analytic Geometry & Calculus II | 4 |
| MTH 218 | Analytic Geometry & Calculus III | 4 |
| MTH 219 | Applied Differential Equations | 3 |
| REL 103 | Introduction to Religious and Theological Studies | 3 |
| PHL 103 | Introduction to Philosophy | 3 |
| PHY 206 | General Physics I - Mechanics | 3 |
| PHY 210L | General Physics Laboratory I | 1 |
| PHY 232 | The Physics of Waves | 3 |
| SSC 200 | Social Science Integrated | 3 |
| Electives (Arts, History, Religion, Philosophy) | | 12 |
| ECE electives [1] | | 6 |
| Technical Elective [2] | | 3 |
| Advanced digital elective (ECE401, 415, 441, 444, 445, 447, 449, 486 or 487) | | 3 |
| Total Hours | | 134 |

1. Any course 300 level and above in ECE
2. Select from list approved by the Department of Electrical and Computer Engineering.

# Concentration in Electrical Energy Systems (ENS)

The Electrical Energy Systems Concentration will prepare our Electrical and Computer Engineering students in all aspects of Electrical Energy Systems including generation, transmission, distribution, utilization, and storage, as well as enabling technologies for the smart grid.

Required ECE courses:

| | | |
|---|---|---|
| ECE 316 | Introduction to Electrical Energy Systems | 3 |
| or ECE 499 | Special Problems in Electrical & Computer Engineering | |
| ECE 414 | Electromechanical Devices | 3 |
| ECE 471 | Contemporary Power Systems & the Smart Grid | 3 |
| Select one course from: | | 3 |
| ECE 472 | Smart Grid Technologies | |
| MEE 473 | Renewable Energy Systems | |
| Total Hours | | 12 |

# Concentration in Electro-Optics (EOP)

The departments of Electrical and Computer Engineering and Physics, with the support of the Electro-Optics Graduate Program at University of Dayton, offers an undergraduate concentration in Electro-Optics. This multidisciplinary concentration is open to Electrical Engineering, Computer Engineering and Physics undergraduates with appropriate prerequisite background. This concentration will enable students to pursue new coop opportunities and possible careers in photonics, and better prepare students to pursue new coop opportunities and possible careers in photonics and better prepare students who wish to pursue graduate degrees in the area of optics. All the courses listed below are approved as free technical electives for ECE undergraduate students.

| | | |
|---|---|---|
| ECE 443 | Introduction to Electro-Optics | 3 |
| PHY 404 | Physical Optics | 3 |
| Select two courses from: | | 6 |
| EOP 501 | Fundamentals of Optical Design | |
| EOP 502 | Light and Matter Interaction | |
| EOP 505 | Introduction to Lasers | |
| EOP 506/ ECE 573 | Photonic Devices & Systems | |
| EOP 513/ ECE 572 | Linear Systems & Fourier Optics | |
| EOP 514/ ECE 574 | Guided-Wave Optics | |
| Total Hours | | 12 |

# Concentration in Robotics (ROB)

| | | |
|---|---|---|
| **Robotics (CPE Majors)** | | 15 |
| ECE 415 | Control Systems | 3 |
| ECE 416 | Introduction to Industrial Robotic Manipulators | 3 |
| ECE 447 | Digital Control Systems | 3 |
| Select two courses from: | | 6 |
| CPS 480 | Artificial Intelligence | |
| ECE 414 | Electromechanical Devices | |
| ECE 444 | Advanced Digital Design | |
| ECE 445 | Signal Processing | |
| MEE 321 | Theory of Machines | |
| MEE 434 | Mechatronics | |
| MEE 438 | Robotics & Flexible Manufacturing | |
| **Robotics (ELE Majors)** | | 12 |
| ECE 416 | Introduction to Industrial Robotic Manipulators | 3 |
| ECE 447 | Digital Control Systems | 3 |
| Select two courses from: | | 6 |
| CPS 480 | Artificial Intelligence | |
| ECE 414 | Electromechanical Devices | |
| ECE 444 | Advanced Digital Design | |
| ECE 445 | Signal Processing | |
| MEE 321 | Theory of Machines | |
| MEE 434 | Mechatronics | |
| MEE 438 | Robotics & Flexible Manufacturing | |

# Minor in Computer Systems (COS)

This minor is open to chemical, civil, and mechanical engineering majors, and other students with appropriate prerequisite background who receive permission from the ECE Department Chairperson. The program builds strength in the area of computer systems and digital design, with emphasis on computer hardware.

| | | |
|---|---|---|
| **Computer Systems (non-MEE majors)** | | 16 |
| CPS 150<br>or ECE 444 | Algorithms & Programming I<br>Advanced Digital Design | 4 |
| ECE 215<br>& 215L | Introduction to Digital Systems<br>and Digital Systems Laboratory | 4 |
| ECE 314<br>& 314L | Fundamentals of Computer Architecture<br>and Fundamentals of Computer Architecture Laboratory | 4 |
| EGR 203 | Electrical & Electronic Circuits | 3 |
| EGR 203L | Electrical and Electronic Circuits Lab | 1 |
| **Computer Systems (MEE majors)** | | 15 |
| CPS 150 | Algorithms & Programming I (or equivalent) | 4 |
| ECE 215<br>& 215L | Introduction to Digital Systems<br>and Digital Systems Laboratory | 4 |
| ECE 314<br>& 314L | Fundamentals of Computer Architecture<br>and Fundamentals of Computer Architecture Laboratory | 4 |
| ECE 444 | Advanced Digital Design | 3 |

# Minor in Signals and Systems (SAS)

This minor is open to chemical, civil, and mechanical engineering majors, and other students with appropriate prerequisite background who receive permission from the ECE Department Chairperson. The program provides the essential background in signals and systems theory including continuous and discrete systems. An advanced course is selected by the students to allow them to specialize in controls or signal processing.

| | | |
|---|---|---|
| ECE 201L | Circuit Analysis Laboratory | 1 |
| ECE 203 | Introduction to MATLAB Programming | 1 |
| ECE 303<br>& 303L | Signals & Systems<br>and Signals & Systems Laboratory | 4 |
| ECE 334 | Discrete Signals & Systems | 3 |
| ECE 415<br>or ECE 445 | Control Systems<br>Signal Processing | 3 |
| ECE 201 | Circuit Analysis | 3 |
| Total Hours | | 15 |

# Electrical Engineering

**First Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| EGR 102 | 0 | ECE 101 | 0 |
| PHY 206 (Satisfies CAP Natural Science) | 3 | CHM 123 | 3 |
| EGR 103 | 2 | CPS 150 | 4 |
| EGR 150 | 0 | EGR 151 | 0 |
| MTH 168 (Satisfies CAP Math Requirement) | 4 | MTH 169 | 4 |
| HST 103 (Satisfies CAP First Year Humanities Common) | 3 | CMM 100 (Satisfies CAP Communication) | 3 |
| PHL 103 (Satisfies CAP First Year Humanities Common) | 3 | REL 103 (Satisfies CAP First Year Humanities Common) | 3 |
| ENG 100 (Satisfies CAP Writing Seminar) | 3 | | |
| | 18 | | 17 |

**Second Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| COP 200 or EGR 200 | 0 | PHY 232 | 3 |
| PHY 210L | 1 | ECE 215 | 3 |
| ECE 203 | 1 | ECE 215L | 1 |
| EGR 201 | 3 | MTH 219 | 3 |
| MTH 218 | 4 | ECE 204 | 3 |
| ECE 201 | 3 | ECE 204L | 1 |
| ECE 201L | 1 | EGR 202 | 3,4 |
| ENG 200 (Satisfies CAP Second Year Writing Seminar) | 3 | | |
| | 16 | | 17-18 |

**Third Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| ECE 332 | 3 | ECE 300 | 0 |
| ECE 314 | 3 | ECE 333 | 3 |
| ECE 314L | 1 | ECE 340 | 3 |
| MTH Elective | 3 | ECE 334 | 3 |
| ECE 303 | 3 | ECE 304 | 3 |
| ECE 303L | 1 | ECE 304L | 1 |

| | | | |
|---|---|---|---|
| Art Study (Satisfies CAP Art Study) and may also satisfy CAP Crossing Boundaries Faith Traditions or Diversity and Social Justice | 3 | SSC 200 | 3 |
| | 17 | | 16 |

**Fourth Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| TECH Elective | 3 | TECH Elective | 3 |
| TECH Elective | 3 | TECH Elective | 3 |
| ECE 415 | 3 | ECE 432L (Satisfies CAP Capstone Requirement) | 3 |
| ECE 431L | 2 | Advanced History (May also satisfies CAP Crossing Boundaries Faith Traditions or Diversity and Social Justice) | 3 |
| ECE 401 | 3 | Advanced PHL Ethics (Satisfies CAP Crossing Boundaries and Practical Ethical Action) | 3 |
| ECE 401L | 1 | | |
| Advanced REL or PHL (May also satisify CAP Crossing Boundaries Faith Traditions, Diversity and Social Justice) | 3 | | |
| | 18 | | 15 |

Total credit hours: 134-135

# Computer Engineering

**First Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| CPS 150 | 4 | CPS 151 | 4 |
| ENG 100 (Satisfies CAP Writing Seminar) | 3 | REL 103 (Satisfies CAP First Year Humanities Common) | 3 |
| PHL 103 (Satisfies CAP First Year Humanities Common) | 3 | PHY 206 | 3 |
| CHM 123 | 3 | PHY 210L | 1 |
| MTH 168 (Satisfies CAP Math Requirement) | 4 | MTH 169 | 4 |
| EGR 102 | 0 | EGR 103 | 2 |
| EGR 150 | 0 | ECE 101 | 0 |
| | | EGR 151 | 0 |
| | 17 | | 17 |

**Second Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| ECE 203 | 1 | CPS 341 | 3 |
| ENG 200 (Satisfies CAP Second Year Writing Seminar) | 3 | HST 103 | 3 |
| ECE 201 | 3 | ECE 215 | 3 |
| ECE 201L | 1 | ECE 215L | 1 |
| MTH 218 | 4 | MTH 219 | 3 |
| EGR 201 | 3 | ECE 204 | 3 |
| CMM 100 | 3 | ECE 204L | 1 |
| COP 200 or EGR 200 | 0 | | |
| | 18 | | 17 |

**Third Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| CPS 350 | 3 | CPS 356 | 3 |
| EGR 202 | 3,4 | CAP Adv PHL/REL | 3 |
| ECE 314 | 3 | ECE 334 | 3 |
| ECE 314L | 1 | SSC 200 (CAP Social Science) | 3 |
| ECE 303 | 3 | ECE 304 | 3 |
| ECE 303L | 1 | ECE 304L | 1 |
| PHY 232 | 3 | ECE 300 | 0 |
| | 17-18 | | 16 |

**Fourth Year**

| Fall | Hours | Spring | Hours |
|---|---|---|---|
| CPS 444 | 3 | TECH Elect | 3 |
| TECH Elect | 3 | TECH Elect | 3 |
| ARTS | 3 | HST (CAP Adv HST) | 3 |
| ECE 431L | 2 | ECE 432L (Satisfies CAP Capstone Requirement) | 3 |
| ECE 340 | 3 | PHL/REL (CAP Adv PHL/REL) | 3 |
| ECE 401, 415, 441, 444, 445, 447, 449, 486, or 487 | 3 | | |
| | 17 | | 15 |

Total credit hours: 134-135

## Courses

**ECE 101. Introduction to Electrical & Computer Engineering II. 0 Hours**
Introduction to electrical and computer engineering faculty, facilities, and curriculum. Career opportunities in electrical and computer engineering and areas of specialization are discussed. Second semester seminar.

**ECE 201. Circuit Analysis. 3 Hours**
Principles of linear circuit analysis and problem solving techniques associated with circuits containing both passive and active components. Includes analysis of linear circuits with direct current (DC) and alternating current (AC) excitation, as well as a study of transient behavior. Course includes an additional mandatory supervised weekly problem session. Prerequisite(s): MTH 168 and sophomore status. Corequisite(s): ECE 201L.

**ECE 201L. Circuit Analysis Laboratory. 1 Hour**
Laboratory course stressing experimental techniques, laboratory reporting, safety, and instrumentation. Experimental investigation of linear circuit component behavior and the DC, AC, and transient response of linear circuits. Corequisite(s): ECE 201 or EGR 203.

**ECE 203. Introduction to MATLAB Programming. 1 Hour**
MATLAB system and development environment, vector and matrix operations using MATLAB, linear algebra and calculus using MATLAB, MATLAB graphics, flow control, symbolic math toolbox. Prerequisite(s): (CPS 132 or CPS 150) or equivalent.

**ECE 204. Electronic Devices. 3 Hours**
Study of the terminal characteristics of electronic devices and basic single stage amplifier configurations using bipolar junction transistors and field-effect transistors. Analysis of the devices includes a qualitative physical description, volt-ampere curves, and the development of small- and large-signal equivalent circuit models. Prerequisite(s): EGR 203 or ECE 201. Corequisite(s): ECE 204L.

**ECE 204L. Electronic Devices Laboratory. 1 Hour**
Laboratory investigation of electronic devices: diodes, bipolar junction transistors, field-effect transistors and operational amplifiers. Corequisite(s): ECE 204.

**ECE 215. Introduction to Digital Systems. 3 Hours**
Introduction to binary systems, logic circuits, Boolean algebra, simplification methods, combinational circuits and networks, programmable logic devices, flip flops, registers, counters, memory elements, and analysis and design of sequential circuits. Prerequisite(s): EGR 203 or ECE 201. Corequisite(s): ECE 215L.

**ECE 215L. Digital Systems Laboratory. 1 Hour**
Laboratory investigation of digital logic circuits and systems covered in ECE 215. Logic gate characteristics; combinational logic design and analysis; latches and flip-flops; synchronous and asynchronous sequential logic; simple digital systems. Experiments include design and analysis of digital systems using breadboarding, FPGA boards, modeling and simulation tools, hardware description languages, and logic synthesis tools. Prerequisite(s): ECE 201, ECE 201L. Corequisite(s): ECE 215.

**ECE 300. Professional Development Seminar II. 0 Hours**
Junior level professional development seminar. Presentations on contemporary and professional engineering subjects by students, faculty, and engineers in active practice. The seminar addresses topics in key areas that complement traditional courses and prepare distinctive graduates, ready for life and work. Registration required for all junior ECE students. Prerequisite(s): EGR 200 or COP 200.

**ECE 303. Signals & Systems. 3 Hours**
Mathematical framework associated with the analysis of linear systems including signal representation by orthogonal functions, convolution, Fourier and Laplace analysis, and frequency response of circuits and systems. Prerequisite(s): ECE 204, MTH 219 and ECE 203. Corequisite(s): ECE 303L.

**ECE 303L. Signals & Systems Laboratory. 1 Hour**
Laboratory investigation of signals and systems including signal decomposition, system impulse response, convolution, frequency analysis of systems, and filter design and realization. Prerequisite(s): ECE 204. Corequisite(s): ECE 303.

**ECE 304. Electronic Systems. 3 Hours**
ELECTRONIC SYSTEMS Study of cascaded amplifiers, feedback amplifiers, linear integrated circuits, and oscillators including steady state analysis and analysis of frequency response. Prerequisite(s): ECE 303. Corequisite(s): ECE 304L.

**ECE 304L. Electronic Systems Laboratory. 1 Hour**
Design, construction and verification of multistage amplifiers, differential amplifiers, feedback amplifiers, passive and active filters, and oscillators. Prerequisite(s): ECE 303. Corequisite(s): ECE 304.

**ECE 314. Fundamentals of Computer Architecture. 3 Hours**
Study of computer systems organization, representation of data and instructions, instruction set architecture, processor and control units, memory devices and hierarchy, I/O devices and interfacing peripherals, high- to low-level language mapping, system simulation and implementation, applications and practical problems. Prerequisite(s): CPS 150; ECE 215. Corequisite(s): ECE 314L.

**ECE 314L. Fundamentals of Computer Architecture Laboratory. 1 Hour**
Laboratory investigation of digital computer architecture covered in ECE 314. Computer sub-systems such as central processing units, control units, I/O units, and hardware/software interfaces will be experimentally considered. Simulation and implementation will be used to study applications and practical problems. Prerequisite(s): ECE 215. Corequisite(s): ECE 314.

**ECE 316. Introduction to Electrical Energy Systems. 3 Hours**
A broad introduction to electric energy concepts. Generation, transmission, distribution, and utilization of electric energy. Renewable energy, three phase systems, transformers, power electronics, motors and generators. Contemporary topics. Prerequisite(s): ECE 201 or EGR 203 or equivalent.

**ECE 332. Electromagnetics. 3 Hours**
Study of vector calculus, electro- and magneto-statics, Maxwell's equations, and electromagnetic plane waves and their reflection and transmission from discontinuities. Prerequisite(s): PHY 232.

**ECE 333. Applied Electromagnetics. 3 Hours**
Electromagnetic theory applied to problems in the areas of waveguides, radiation, electro-optics and electromagnetic interference and electromagnetic compatibility. Prerequisite(s): ECE 332.

**ECE 334. Discrete Signals & Systems. 3 Hours**
Introduction to discrete signals and systems including sampling and reconstruction of continuous signals, digital filters, frequency analysis, the z-transform, and the discrete Fourier transform. Prerequisite(s): ECE 303.

**ECE 340. Engineering Probability & Random Processes. 3 Hours**
Axiomatic probability, derived probability relationships, conditional probability, statistical independence, total probability and Bayes' Theorem, counting techniques, common random variables and their distribution functions, transformations of random variables, moments, autocorrelation, power spectral density, cross correlation and covariance, random processes through linear and nonlinear systems, linear regression, and engineering decision strategies. Prerequisite(s): ECE 303; MTH 218.

**ECE 398. Multidisciplinary Research & Innovation Laboratory. 1-6 Hours**
Students participate in 1.) selection and design, 2.) investigation and data collection, 3.) analysis, and 4.) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming, and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

**ECE 401. Communication Systems. 3 Hours**
Study of amplitude, angle, pulse, and digital communication systems including generation, detection, and analysis of modulated signals and power, bandwidth, and noise considerations. Prerequisite(s): ECE 304, 340. Corequisite(s): ECE 401L.

**ECE 401L. Communication Systems Laboratory. 1 Hour**
Design, fabrication, and laboratory investigation of modulators, detectors, filters, and associated communication components and systems. Prerequisite(s): ECE 304. Corequisite(s): ECE 401.

**ECE 414. Electromechanical Devices. 3 Hours**
Properties and theory of electromechanical devices: nonlinear electromagnetic actuators; rotating machine analysis; field and circuit concepts and direct current, synchronous, and induction machines: special-purpose machines and fractional horsepower machines. Prerequisite(s): ECE 316 or equivalent.

**ECE 415. Control Systems. 3 Hours**
Study of mathematical models for control systems and analysis of performance characteristics and stability. Design topics include pole-placement, root locus, and frequency domain techniques. Prerequisite(s): ECE 303.

**ECE 416. Introduction to Industrial Robotic Manipulators. 3 Hours**
Topics include homogeneous transformations, direct and inverse kinematics, trajectory generation, and selected topics of robot vision. Prerequisite(s): ECE 303.

**ECE 431L. Multidisciplinary Design I. 2 Hours**
Application of engineering fundamentals to sponsored multidisciplinary-team design projects. In a combination of lecture and lab experiences, students learn the product realization process and project management. Product realization topics include idea generation, proposal development, design specifications, conceptualization and decision analysis. Project management topics include cost estimation and intellectual property management. Design projects progress to the proof of concept and prototype development stages. Prerequisite(s): MEE students: EGM 303, MEE 321, and (MEE 344 or MEE 478 or RCL 578, or MEE 401 or MEE 409). ECE students: ECE 304 or ECE 314.

**ECE 432L. Multidisciplinary Design II. 3 Hours**
One hour lecture and five hours of lab per week. Detailed evaluation of the Product Realization Process focusing on conceptual design, embodiment design, final design and prototyping is taught. Analysis of the design criteria for safety, ergonomics, environment, cost and sociological impact is covered. Periodic oral and written status reports are required. The course culminates in a comprehensive written report and oral presentation. Prerequisite(s): MEE majors: MEE 431L; CPE majors: ECE 431L and (ECE334 or CPS444); ELE majors: ECE431L and (ECE 401 or ECE415).

**ECE 441. Integrated Circuit Electronics. 3 Hours**
Integrated circuit design, construction and verification including the study of biasing, multistage differential and analog power amplification, and computer assisted design tools for "on-chip" design and layout. Prerequisite(s): ECE 304.

**ECE 443. Introduction to Electro-Optics. 3 Hours**
Introductory overview of electro-optics starting with Maxwell's equations and leading to lasers, holography, and other timely applications. Prerequisite(s): ECE 332.

**ECE 444. Advanced Digital Design. 3 Hours**
An introduction to modern digital hardware logic design using a hierarchical system approach including top-down development process. An introduction to alternative design implementation forms including hardware description languages (HDLs) for the design of simple and complex combinatorial logic circuits and sequential logic designs with finite state machines. Good HDL coding practices such as readability, re-configurability, and efficient execution are emphasized along with the use of programmable logic circuits including Field-Programmable Gate Arrays (FPGAs). Prerequisite(s): ECE 215.

**ECE 445. Signal Processing. 3 Hours**
Selected topics in digital signal and image processing with design projects. The design projects are determined by the instructor and may come from a variety of signal processing applications including medical image processing, video processing, computer vision, statistical signal processing, speech processing, radar signal processing, etc. Prerequisite(s): ECE 334.

**ECE 446. Microelectronic Systems Design. 3 Hours**
Basic integrated circuit design concepts, system layout, application of design methodology, the fabrication process, manufacturing limitations of the design process, and CAD/CAE utilization to realize the design process. Prerequisite(s): ECE 304.

**ECE 447. Digital Control Systems. 3 Hours**
Analysis and synthesis of feedback control systems including digital compensators. Topics include performance and stability analysis, regulator and servomechanism design using time and frequency domain methods, and digital implementation case studies. Prerequisite(s): ECE 415; ECE 334 or equivalent.

**ECE 448. Fiber Optic Communications. 3 Hours**
General light guidance principles; ray optics; dispersion; single mode, multimode, and graded index fibers; basic laser and LED source principles; photodetectors; error probability in digital optical systems; rise time analysis; loss budget analysis; local area networks and long haul communication links. Prerequisite(s): ECE 333 Corequisite(s): ECE 401.

**ECE 449. Computer Systems Engineering. 3 Hours**
An introduction to advanced computer architecture and computer systems design. Topics include: exploration of principle architecture features of modern computers, pipelining, memory hierarchy, I/O devices, interconnection networks, introduction to parallel and multiprocessor systems, and the use of hardware description languages (HDLs) in system implementation. Prerequisite(s): ECE 314 and CPS 356.

**ECE 450L. Projects Laboratory. 1-3 Hours**
Project-oriented laboratory applying engineering skills in the design, development, and demonstration of electrical and electronic systems. Prerequisite(s): Permission of project advisor.

**ECE 465. Fundamentals of Solid-State Batteries. 3 Hours**
Introduction to the fundamental of solid-state, safe, durable, batteries, including working principles of a battery, state-of-the-art battery (Li-ion battery based on liquid-state electrolytes- advantages/disadvantages), battery safety, need for a safe battery system for low-high power applications (electric vehicles / unmanned-/manned aircrafts, space vehicles, etc.), different design of solid-state batteries (planner-stacked, 3 dimensional, etc.), engineering the structural battery (dual functionality system that can carry mechanical load and store energy), characterization methods to evaluate structure / electrical / electrochemical properties of all solid-state battery materials (cathode, anode, electrolytes), interfaces (electrodes/electrolyte), and electrical/ electrochemical testing of complete battery cells. Also, electrical test methods to evaluate solid-state Li-ion battery (including structural battery) performances, etc.), and understanding degradation mechanism of solid-state battery systems (including structural battery) will be discussed. Prerequisite(s): ECE 304 or equivalent.

**ECE 466. Fundamentals of Hybrid Electrochemical Power. 3 Hours**
Introduction to the fundamental of hybrid electrochemical power (battery + capacitor + fuel cell – integrated systems) including working principles of battery, capacitor, lithium-ion capacitor, and fuel cell, advantages/ disadvantages, necessity to hybridize battery / fuel cell / capacitor, electrical hybridization methods, electrochemical testing of hybrid power systems, degradation mechanism, and applications. Hybrid electrochemical power is highly desirable to meet requirements for wide range products (powering electronic gadget to transportation vehicles to space vehicles) requiring low to high power/energy, cycle-life, fast/slow charge/discharge, etc. Prerequisite(s): ECE 304 or equivalent.

**ECE 471. Contemporary Power Systems & the Smart Grid. 3 Hours**
Introduction to electrical power systems; generation, transmission and utilization; power system analysis; power system control; energy management; and an introduction to smart grid technologies. Prerequisites(s): ECE 316 or equivalent.

**ECE 472. Smart Grid Technologies. 3 Hours**
An introductory study of enabling technologies and energy issues necessary for full realizaton of the Smart Grid. Course topics vary. This course can be taken multiple times. Prerequisite(s): ECE 471 or equivalent.

**ECE 486. Computer Networks. 3 Hours**
Introduction to the fundamental of computer networks, including the Open Systems Interconnection reference model, transmission media, medium access protocol, data link protocols, routing, congestion control, applications, and network security.

**ECE 487. Wireless Security. 3 Hours**
Wireless security is a very important topic and attracting more and more attention from industry, research, and academia. This course gives a comprehensive overview on the recent advances in wireless network and system security. It will cover security issues and solutions in emerging wireless access networks and systems as well as multi-hop wireless networks. Prerequisite(s): ECE 203 or MEE 314.

**ECE 493. Honors Thesis. 3 Hours**
Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program.

**ECE 494. Honors Thesis. 3 Hours**
Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program. Prerequisite(s): ECE 493.

**ECE 498. Multidisciplinary Research & Innovation Laboratory. 1-6 Hours**
Students participate in 1.) selection and design, 2.) investigation and data collection, 3.) analysis, and 4.) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming, and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

**ECE 499. Special Problems in Electrical & Computer Engineering. 1-6 Hours**
Particular assignments to be arranged and approved by the department chairperson.