# ELECTRICAL ENGINEERING (TRADITIONAL AND ONLINE M.S. WITH SEMICONDUCTOR CONCENTRATION)

## Admission Requirements

Admission to these programs is contingent upon admission to the Graduate School (http://bulletins.wayne.edu/graduate/general-information/admission/). All applicants whose B.S. degree is not from an ABET-accredited college or university are required to submit additional pertinent information, including results of the general test of the Graduate Record Examination (GRE), publications, and/or inventions.

Students with B.S. degrees from selected science and engineering undergraduate programs not specifically related to this discipline may be admitted into the master's program after completing a sequence of undergraduate courses designed to prepare them for the graduate curriculum.

## ECE AGRADE Program

Outstanding undergraduates in the ECE department who meet eligibility criteria may enroll in the ECE AGRADE program. This program allows students to count up to 16 credits towards both the B.S. and M.S. degrees, enabling students to complete the B.S. and M.S. degrees within 5 years of full-time study. More information about eligibility, degree requirements, course selections, and policies may be found on the department's website (https://engineering.wayne.edu/ece/programs/agrade.php).

## Interdisciplinary Physics-ECE AGRADE Program

Outstanding seniors in Physics (both Applied Physics option and Fundamental Physics option) who meet eligibility criteria may apply for the cross-college AGRADE program between the Physics undergraduate program (College of Liberals Arts and Sciences) and Electrical Engineering (EE) Master's programs (James and Patricia College of Engineering). The Physics-ECE AGRADE program allows students to count up to 16 credits of selected graduate courses towards a B.S. degree in physics as well as an M.S. degree in Electrical Engineering. This enables students to complete both degrees within 5 years of full-time study. More information about eligibility, degree requirements, course elections, and academic policies may be found on the department's website (https://engineering.wayne.edu/ece/programs/agrade.php).

## Requirements – Traditional Program

The Master of Science in Electrical Engineering degree requires a minimum of thirty credits. It is offered under plan Plan A: Thesis (p. 1), which includes a six credit thesis, or Plan C: Coursework (p. 2). For either plan, students may choose from courses in one or more areas of specialization within the ECE curriculum.

All course work must be completed in accordance with the regulations of the Graduate School (http://bulletins.wayne.edu/graduate/general-information/academic-regulations/) and the James and Patricia Anderson (http://bulletins.wayne.edu/graduate/college-engineering/academic-regulations/)College of Engineering (http://bulletins.wayne.edu/graduate/college-engineering/academic-regulations/).

## Plan A: Thesis

| Code | Title | Credits |
|---|---|---|
| **Required courses** | | |
| Select 4 ECE graduate courses in Major Area - Electrical Engineering, including at least one at 7000 level. [1] | | |
| ECE 5100 | Quantitative Physiology | |
| ECE 5280 | Introduction to Cyber-Physical Systems | |
| ECE 5330 | Modeling and Control of Power Electronics and Electric Vehicle Powertrains | |
| ECE 5340 | Advanced Energy Storage Systems for Electrification of Vehicles | |
| ECE 5350 | Alternative Energy Sources and Conversions | |
| ECE 5410 | Power Electronics and Control | |
| ECE 5425 | Robotic Systems I | |
| ECE 5430 | Electric Energy Systems Engineering | |
| ECE 5440 | Traditional and Machine Learning-Based Computer-Controlled Systems | |
| ECE 5460 | Stochastic Processes in Engineering | |
| ECE 5470 | Control Systems II | |
| ECE 5550 | Solid State Electronics | |
| ECE 5560 | Analysis and Design of Analog Integrated Circuits | |
| ECE 5575 | Introduction to Micro and Nano Electro Mechanical Systems (MEMS/NEMS) | |
| ECE 5580 | Advanced Nanoelectronics | |
| ECE 5620 | Embedded System Design | |
| ECE 5650 | Computer Networking and Network Programming | |
| ECE 5675 | Sensors and Sensor Instrumentation | |
| ECE 5680 | Computer-Aided Logical Design and FPGAs | |
| ECE 5690 | Introduction to Digital Image Processing | |
| ECE 5700 | Digital Communications | |
| ECE 5770 | Digital Signal Processing | |
| ECE 5870 | Optical Communication Networks | |
| ECE 5880 | Introduction to Microwave Engineering | |
| ECE 5960 | Introduction to VLSI Systems | |
| ECE 6570 | Smart Sensor Technology I: Design | |
| ECE 7030 | Mathematical Methods in Engineering I | |
| ECE 7100 | Mathematical Modeling in Impact Biomechanics | |
| ECE 7420 | Nonlinear Control Systems | |
| ECE 7425 | Robotics Systems II | |
| ECE 7430 | Discrete Event Systems with Machine Learning | |
| ECE 7440 | Optimal Control with Machine Learning and Applications | |
| ECE 7530 | Advanced Digital VLSI Design | |
| ECE 7570 | Smart Sensor Technology II: Characterization and Fabrication | |
| ECE 7650 | Scalable and Secure Internet Services and Architecture | |
| ECE 7680 | Advanced Digital Image Processing and Applications | |
| ECE 7690 | Fuzzy Systems and Machine Learning | |
| ECE 7700 | Statistical Communication Theory | |
| ECE 7730 | Telematics | |
| ECE 7850 | Photonics | |
| ECE 7860 | Operation and Control of Modern Power Systems | |

**Elective courses**

The combined number of credits for Required and Elective courses must be at least 24.

List of eligible elective courses:

ECE 5000-7999 including courses in the Electrical Engineering, or Computer Engineering major area, ECE 5990 Directed Study (1 – 3 cr., repeatable up to 3 cr.), Special Topics courses ECE 5995 and ECE 7995 (repeatable up to 12 cr.), Industrial Internship ECE 6991 (1 cr., repeatable up to 3 cr.).

Non-ECE courses: Up to 6 credits of elective credits may be taken in other WSU departments or transferred from another institution, including following:

BME, ME, CHE, MSE or EVE 5000-7999 excluding directed study, research, or internship.

Selected classes offered by the College of Engineering:

| Code | Title |
|------|-------|
| EGR 5995 | Special Topics in Engineering |

Selected classes offered by Department of Computer Science:

| Code | Title |
|------|-------|
| CSC 5825 | Introduction to Machine Learning and Applications |
| CSC 7825 | Machine Learning |

Selected classes offered by Department of Industrial Engineering:

| Code | Title |
|------|-------|
| IE 7220 | Advanced Statistical Methods |
| IE 7710 | Stochastic Processes |

PHY 5000-7999 excluding directed study, physics for teachers, research, and directed study, or internship.

Selected classes offered by the Department of Mathematics:

| Code | Title |
|------|-------|
| MAT 5600 | Introduction to Analysis I |
| MAT 5610 | Introduction to Analysis II |
| MAT 5710 | Introduction to Stochastic Processes |
| MAT 5870 | Methods of Optimization |
| MAT 7600 | Real Analysis I |
| MAT 7610 | Real Analysis II |
| STA 5030 | Statistical Computing and Data Analysis |
| STA 6830 | Design of Experiments |
| STA 6840 | Applied Regression Analysis |

**Thesis course**

| Code | Title |
|------|-------|
| ECE 8999 | Master's Thesis Research and Direction (This course can be taken either as a single 6-credit course during the last term in the program or as repeated courses, totaling 6 credits, during last two terms.) |

[1] Special Topics courses ECE 5995 and ECE 7995, depending on the courses subjects, may also be counted as courses in Major Area – upon approval by Graduate Program Director.

## Plan C: Coursework

| Code | Title | Credits |
|------|-------|---------|
| **Required courses** | | |

Select 5 ECE graduate courses in Major Area - Electrical Engineering, including at least 2 at 7000 level. [1]

| Code | Title |
|------|-------|
| ECE 5100 | Quantitative Physiology |
| ECE 5280 | Introduction to Cyber-Physical Systems |
| ECE 5330 | Modeling and Control of Power Electronics and Electric Vehicle Powertrains |
| ECE 5340 | Advanced Energy Storage Systems for Electrification of Vehicles |
| ECE 5350 | Alternative Energy Sources and Conversions |
| ECE 5410 | Power Electronics and Control |

| Code | Title |
|------|-------|
| ECE 5425 | Robotic Systems I |
| ECE 5430 | Electric Energy Systems Engineering |
| ECE 5440 | Traditional and Machine Learning-Based Computer-Controlled Systems |
| ECE 5460 | Stochastic Processes in Engineering |
| ECE 5470 | Control Systems II |
| ECE 5550 | Solid State Electronics |
| ECE 5560 | Analysis and Design of Analog Integrated Circuits |
| ECE 5575 | Introduction to Micro and Nano Electro Mechanical Systems (MEMS/NEMS) |
| ECE 5580 | Advanced Nanoelectronics |
| ECE 5620 | Embedded System Design |
| ECE 5650 | Computer Networking and Network Programming |
| ECE 5675 | Sensors and Sensor Instrumentation |
| ECE 5680 | Computer-Aided Logical Design and FPGAs |
| ECE 5690 | Introduction to Digital Image Processing |
| ECE 5700 | Digital Communications |
| ECE 5770 | Digital Signal Processing |
| ECE 5870 | Optical Communication Networks |
| ECE 5880 | Introduction to Microwave Engineering |
| ECE 5960 | Introduction to VLSI Systems |
| ECE 6570 | Smart Sensor Technology I: Design |
| ECE 7030 | Mathematical Methods in Engineering I |
| ECE 7100 | Mathematical Modeling in Impact Biomechanics |
| ECE 7420 | Nonlinear Control Systems |
| ECE 7425 | Robotics Systems II |
| ECE 7430 | Discrete Event Systems with Machine Learning |
| ECE 7440 | Optimal Control with Machine Learning and Applications |
| ECE 7530 | Advanced Digital VLSI Design |
| ECE 7570 | Smart Sensor Technology II: Characterization and Fabrication |
| ECE 7650 | Scalable and Secure Internet Services and Architecture |
| ECE 7680 | Advanced Digital Image Processing and Applications |
| ECE 7690 | Fuzzy Systems and Machine Learning |
| ECE 7700 | Statistical Communication Theory |
| ECE 7730 | Telematics |
| ECE 7850 | Photonics |
| ECE 7860 | Operation and Control of Modern Power Systems |

**Elective courses**

The combined number of credits for Required and Elective courses must be at least 30.

List of eligible elective courses:

ECE 5000-7999 including courses in the Electrical Engineering, or Computer Engineering major area, ECE 5990 Directed Study (1 – 3 cr., repeatable up to 3 cr.), Special Topics courses ECE 5995 and ECE 7995 (repeatable up to 12 cr.), Industrial Internship ECE 6991 (1 cr., repeatable up to 3 cr.).

Non-ECE courses: Up to 6 credits of elective credits may be taken in other WSU departments or transferred from another institution, including following:

BME, ME, CHE, MSE or EVE 5000-7999 excluding directed study, research, or internship.

Selected classes offered by the College of Engineering:

| Code | Title |
| --- | --- |
| EGR 5995 | Special Topics in Engineering (repeatable up to 3 cr.) |
| Selected classes offered by Department of Computer Science: | |
| CSC 5825 | Introduction to Machine Learning and Applications |
| CSC 7825 | Machine Learning |
| Selected classes offered by Department of Industrial Engineering: | |
| IE 7220 | Advanced Statistical Methods |
| IE 7710 | Stochastic Processes |
| PHY 5000-7999 excluding directed study, physics for teachers, research, and directed study, or internship. | |
| Selected classes offered by Department of Mathematics: | |
| MAT 5600 | Introduction to Analysis I |
| MAT 5610 | Introduction to Analysis II |
| MAT 5710 | Introduction to Stochastic Processes |
| MAT 5870 | Methods of Optimization |
| MAT 7600 | Real Analysis I |
| MAT 7610 | Real Analysis II |
| STA 5030 | Statistical Computing and Data Analysis |
| STA 6830 | Design of Experiments |
| STA 6840 | Applied Regression Analysis |
| ECE 5340 | Advanced Energy Storage Systems for Electrification of Vehicles |
| ECE 5350 | Alternative Energy Sources and Conversions |
| ECE 5410 | Power Electronics and Control |
| ECE 5620 | Embedded System Design |
| ECE 5995 | Special Topics in Electrical and Computer Engineering I (Topics should be chosen in consultation with program advisor.) |
| ECE 7570 | Smart Sensor Technology II: Characterization and Fabrication |

[1] Special Topics courses ECE 5995 and ECE 7995, depending on the courses subjects, may also be counted as courses in Major Area – upon approval by Graduate Program Director.

# Requirements – Online Program

The online Master of Science in Electrical Engineering is offered with a concentration in Semiconductor Engineering. Semiconductor engineering focuses on developing technologies for manufacturing semiconductor devices in electronic circuits. The expertise spans from materials level research to device fabrication and chip packaging. Semiconductor technology is a critical driver of innovation in multiple industries ranging from computing, defense and automotive.

The program must be completed under Master's Degree Plan C, and it requires a minimum of thirty credits in course work. The online program also allows students to obtain six internship credits through an optional industrial internship experience. The internship activity should be in an area related to semiconductor engineering including but not limited to, design, validation, manufacturing, system integration, product development or applications.

| Code | Title | Credits |
| --- | --- | --- |
| The coursework-only plan requires a minimum of five courses from the core group (two courses must be at the 7000-level). The 6-credit internship option requires a minimum of four courses from the core group (one course must be at the 7000-level) | | |
| **Core Courses** | | |
| ECE 5550 | Solid State Electronics | |
| ECE 5560 | Analysis and Design of Analog Integrated Circuits | |
| ECE 5580 | Advanced Nanoelectronics | |
| ECE 5575 | Introduction to Micro and Nano Electro Mechanical Systems (MEMS/NEMS) | |
| ECE 5675 | Sensors and Sensor Instrumentation | |
| ECE 5680 | Computer-Aided Logical Design and FPGAs | |
| ECE 5960 | Introduction to VLSI Systems | |
| ECE 7530 | Advanced Digital VLSI Design | |
| ECE 7566 | Advanced Mixed Signal Integrated Circuits | |
| **Elective Courses** | | |