# ROBOTICS MINOR

College of Engineering

Program Website (https://www.engineering.cornell.edu/mae/degree/robotics-minor-requirements/)

## Program Description

The robotics minor covers the fundamentals of designing, building and programming robots, and in addition requires students to dive deeper in a specific area of robotics.

## Eligibility

All undergraduates, except those completing minors in Electrical and Computer Engineering (ECE), Mechanical Engineering (ME), or Computer Science (CS). Pre-approval of minor plan is required.

## Academic Standards

- A grade of C or better in each course.

## Minor Requirements

1. Six distinct courses including at least three Fundamentals courses and three Specialization courses from a single category, must be completed.
2. ME majors may not count MAE 3780 Mechatronics / MAE 3783 Mechatronics if it is used to satisfy the ME circuits requirement.
3. Students may petition to use one semester of independent research (minimum 3 credits of CS 4999 Independent Reading and Research or ECE 4999 Electrical and Computer Engineering Independent Projects or INFO 4900 Independent Reading and Research or MAE 4900 Individual and Group Projects in Mechanical Engineering) in lieu of one Specialization course. Such petitions must include a short description of the project and a note from the faculty advisor commenting on the robotics aspect of the project.

### Fundamentals

| Code | Title | Hours |
|---|---|---|
| Select three of the following: | | |
| CS 3700 | Foundations of AI Reasoning and Decision-Making | 3-4 |
| or CS 3780 | Introduction to Machine Learning | |
| or ECE 4200 | Fundamentals of Machine Learning | |
| or ECE 5420 | Fundamentals of Machine Learning | |
| CS 4756 | Robot Learning | 4 |
| or CS 5756 | Robot Learning | |
| INFO 4410 | Re-Designing Robots | 3 |
| or INFO 6420 | Re-Designing Robots | |
| MAE 3780 | Mechatronics | 4 |
| or MAE 3783 | Mechatronics | |
| MAE 4180 | Autonomous Mobile Robots | 3 |
| or MAE 5180 | Autonomous Mobile Robots | |
| MAE 4190 | Fast Robots | 4 |
| or MAE 5190 | Fast Robots | |
| MAE 4760 | Foundations of Robotics | 4 |
| or CS 5750 | Foundations of Robotics | |
| MAE 4810 | Robot Perception | 3 |
| or MAE 5810 | Robot Perception | |
| MAE 5780 | Feedback Control Systems | 3-4 |

### Specialization

Choose three courses in one of the below categories

### Intelligence

| Code | Title | Hours |
|---|---|---|
| CS 4700 | | |
| CS 4756 | Robot Learning | 4 |
| or CS 5756 | Robot Learning | |
| CS 4780 | | 0-4 |
| or CS 5780 | Introduction to Machine Learning | |
| CS 6756 | Learning for Robot Decision Making | 3 |
| CS 6758 | Deep Learning for Robotics | 4 |
| ECE 6970 | Graduate Topics in ECE (Bio-Inspired Coordination of Multi-Agent Systems) | 1-4 |
| MAE 4180 | Autonomous Mobile Robots | 3 |
| or MAE 5180 | Autonomous Mobile Robots | |
| MAE 4760 | Foundations of Robotics | 4 |
| or CS 5750 | Foundations of Robotics | |
| MAE 6730 | Robot Manipulation | 3 |
| or CS 6751 | Robot Manipulation | |
| MAE 6790 | Intelligent Sensor Planning and Control | 3 |
| MAE 6710 | Human-Robot Interaction: Algorithms and Experiments | 3 |
| MAE 6770 | Formal Methods for Robotics | 3 |
| MAE 6790 | Intelligent Sensor Planning and Control | 3 |

### Modeling, Dynamics, and Control

| Code | Title | Hours |
|---|---|---|
| MAE 4190 | Fast Robots | 4 |
| or MAE 5190 | Fast Robots | |
| MAE 4710 | | |
| or MAE 5710 | | |
| MAE 4730 | Intermediate Dynamics | 3 |
| or MAE 5730 | Intermediate Dynamics | |
| MAE 4760 | Foundations of Robotics | 4 |
| or CS 5750 | Foundations of Robotics | |
| MAE 4780 | Feedback Control Systems | 4 |
| or MAE 5780 | Feedback Control Systems | |
| MAE 6730 | Robot Manipulation | 3 |
| or CS 6751 | Robot Manipulation | |
| MAE 6760 | Model-Based Estimation | 4 |
| MAE 6770 | Formal Methods for Robotics | 3 |
| MAE 6780 | Multivariable Control Theory | 4 |
| MAE 6800 | Design and Control of Haptic Systems | 3 |

### Perception

| Code | Title | Hours |
|---|---|---|
| CS 4670 | Introduction to Computer Vision | 4 |
| or CS 5670 | Introduction to Computer Vision | |
| or CS 6670 | Computer Vision | |
| or ECE 5470 | Computer Vision | |

| | | |
|---|---|---|
| CS 6758 | Deep Learning for Robotics | 4 |
| MAE 4180 | Autonomous Mobile Robots | 3 |
| or MAE 5180 | Autonomous Mobile Robots | |
| MAE 4190 | Fast Robots | 4 |
| or MAE 5190 | Fast Robots | |
| MAE 4320 | Integrated Micro Sensors and Actuators: Bridging the Physical and Digital Worlds | 4 |
| MAE 4810 | Robot Perception | 3 |
| or MAE 5810 | Robot Perception | |
| MAE 6760 | Model-Based Estimation | 4 |
| MAE 6790 | Intelligent Sensor Planning and Control | 3 |

### Systems and Design

| Code | Title | Hours |
|---|---|---|
| BEE 3900 | Bio-Robotics | 3 |
| or BEE 5900 | Bio-Robotics | |
| CS 4754 | Re-Designing Robots | 3 |
| or INFO 6420 | Re-Designing Robots | |
| CS 5755 | Mobile Human Robot Interaction Design | 3 |
| or INFO 5755 | Mobile Human Robot Interaction Design | |
| or INFO 6755 | Mobile Human Robot Interaction Design | |
| DEA 5210 | Interaction Design Studio | 4 |
| DEA 6210 | Architectural Robotics | 3 |
| ECE 4760 | Digital Systems Design Using Microcontrollers | 4 |
| ECE 5725 | Design with Embedded Operating Systems | 4 |
| ECE 5960 | Advanced Topics in Electrical and Computer Engineering (Micro and Nano Robotics) | 3-4 |
| ECE 6680 | Bio-inspired Coordination of Multi-Agent Systems | 4 |
| ECE 6950 | Graduate Topics in Electrical and Computer Engineering | 3 |
| INFO 4320 | Introduction to Rapid Prototyping and Physical Computing | 4 |
| INFO 4420 | Human Computer Interaction Studio | 4 |
| MAE 3780 | Mechatronics | 4 |
| or MAE 3783 | Mechatronics | |
| MAE 4190 | Fast Robots | 4 |
| or MAE 5190 | Fast Robots | |
| MAE 4320 | Integrated Micro Sensors and Actuators: Bridging the Physical and Digital Worlds | 4 |
| MAE 6710 | Human-Robot Interaction: Algorithms and Experiments | 3 |
| MAE 6800 | Design and Control of Haptic Systems | 3 |

# Graduation Requirements for Engineering Minor Degree Programs

## Requirements

Students may pursue minors in any department in any college that offers them, subject to limitations placed by the department offering the minor or by the students' major. Completed minors will appear on the student's transcript. Not all departments offer minors. Additional information on specific minors can be found above, in the *Engineering Undergraduate Handbook*, in the undergraduate major office of the department or school offering the minor, and in Engineering Advising.

An engineering minor recognizes formal study of a particular subject area in engineering normally outside the major. Students undertaking a minor are expected to complete the requirements during the time of their continuous undergraduate enrollment at Cornell. Completing the requirements for an engineering minor (along with a major) may require more than the traditional eight semesters at Cornell. However, courses that fulfill minor requirements may also satisfy other degree requirements (e.g., distribution courses, advisor-approved, or major-approved electives), and completion within eight semesters is possible.

An engineering minor requires:

- successful completion of all requirements for an undergraduate degree.
- enrollment in a major that approves participation in the minor.
- satisfactory completion of six courses (at least 18 credits) in a college-approved minor.

Students may apply for certification of a minor at any time after the required course work has been completed in accordance with published standards. An official notation of certification of a minor appears on the Cornell transcript following graduation.