



IE 590 – Electromagnetic Robotic Systems

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Course Information

- IE 590 – Electromagnetic Robotic Systems
- CRN: 22843-EP1
- Meeting day(s) and time(s): This is an online course therefore there are no scheduled meeting times.
- Instructional Modality: Online
- Course credit hours: 3

Instructor(s) Contact Information

The best way to reach me is via email. If you email during the week, I'll make every attempt to get back to you within 24 hours.

- Instructor: Ramses Martinez
- Office: Grissom Hall 258
- Email: rmartinez@purdue.edu
- Office Hours: TBD on Zoom

Course Description

This course develops a holistic view of an initial competency in engineering design by conceiving, designing, manufacturing, and optimizing robotic systems. Activities include rapid prototyping of electronic/robotic devices using Arduino microcontrollers and different servo motors. The focus is on the design and the implementation of robotic systems. The pedagogy is based on active learning and a balance of lectures and hands-on activities.

Learning Resources, Technology & Texts

- Textbook
 - There is NO required textbook for this course.
- Use of AI and LLM in this Class
 - The use of AI and LLM are permitted in the following scenarios:
 - Using AI to help you code Arduino projects.
 - Using AI to help you understand concepts in this class.
 - The use of AI and LLM are NOT permitted in the following scenarios:
 - Finding answers to the quiz questions at the end of each of weekly prep
 - At the end of each weekly prep, there is a quiz designed to test your knowledge. You can take the quiz as many times as you would like to obtain 100%. If you complete the preps, you will gain bonus points, you will not be penalized for not completing them. Therefore, I ask you do not use AI to find the answer to these questions as it will likely stop you from understanding a holistic picture of what we're exploring that week.
 - Explaining your answers for each project submission
 - While using AI to help with coding is acceptable, you need to explain what the code means **in your own words** to earn full credit on your projects.
- Hardware Requirements
 - Given the practical and hands-on nature of this course (implementing robotic systems) you are required to purchase an appropriate beginner "Arduino board" kit to complete all of the projects in this class. Below is a link to Amazon for an example of a kit that would fit the needs of this course (list price \$44.99).
 - [Link to Amazon Elegoo "Arduino Board" Starter Kit](#)
 - **Please notify me immediately if you do not have the means to purchase the required starter kit for this course.**
 - Access to a webcam on a computer or laptop or a phone/tablet camera to record your project submissions and for attending optional office hours (via Zoom).
- Optional Software
 - I encourage you to sign up for a free, educational account via **Tinkercad** to prototype and test circuits and code. Throughout the interactive lessons, you'll encounter Tinkercad circuits. You are not required to sign up for this program to engage in it during the lessons. Finally, while you are free to use Tinkercad

to complete and submit your projects, it may not be possible to complete all of your projects using this program.

- **Brightspace Learning Management System**

- I will use Brightspace to organize the content, communicate announcements, and grade your projects.
- Every Friday morning, the next week’s information will become available, allowing you to prepare for the following week while finishing the work for this week.

Learning Outcomes

After successfully completing this course, you should be able to...

1. Program using robotics and automated processes using Arduino boards and Python.
2. Familiarize yourself with the manufacturing of robotic devices and laboratory equipment to understand the current possibilities in this field.
3. Identify the fundamentals of engineering design and communication between various systems.
4. Create and control robotics systems via Wi-Fi using cellphone applications.

Course Logistics

Each week will start on Monday and end on Sunday night at 11:59 pm (EST). You are expected to complete each weekly “module” or unit throughout the week instead of trying to cram all the information in one day or sitting. Every Friday morning, the next week’s module will open in Brightspace so you can get an early preview of what to expect. I prefer that you do not try to work ahead of schedule as I want you to absorb this information throughout the week thoughtfully. Although we do not have a scheduled meeting time, you are more than welcome to come to my open office virtual office hours or schedule separate meeting times.

Assignments

In this class there are three types of assignments: Preps, Projects, and Midterm/Final Application. I’ll outline each these assignments in more detail below. **You can expect to have your projects graded in Brightspace within one week of the due date.**

Assignments	Due	Percentage
Weekly Preps (15)	Throughout the semester	N/A
Projects (12)	Throughout the semester	50%
Midterm Project (1)	End of Week 8	25%
Final Exam Project (1)	Final Week	25%
		Total: 100%

Weekly Preps: The preps are interactive lessons that prepare you for what we will work on each week. The content will build on each other as we continue to progress through the semester, therefore it is imperative that you take your time completing the weekly preps and review them throughout the week. Within these preps are interactive elements and sample projects for you to work on. At the end of each prep, there is a short quiz that is designed to test your basic understanding of the concepts. **The quiz is not punitive. You can take it as many times as you want until you earn 100%. If you complete the weekly preps on time each week, you will receive bonus points toward your total grade at the end of the semester.**

Projects: At the end of most weeks (look at the schedule for exact project due dates) you will submit a video of your project showcasing what you did on your Arduino board and answer a series of questions. The projects are designed for you to apply what you are learning each week in a relevant way. There is a rubric provided for you to that helps you understand how you are graded for these projects. **Please read the project directions in Brightspace carefully before working and submitting your projects.**

Midterm & Final Project: At the end of Week 8 and 17, you have a final exam project that will ask you to complete a more comprehensive Arduino board design that brings together all the important topics and concepts that we’ve

discussed up to this point in the semester. While the midterm project will encompass the first 8 weeks of our course, the final will ask you to apply all concepts we've discussed throughout the entire course.

Grading Scale

In this class, grades reflect the sum of your achievement of learning outcomes throughout the session. You will accumulate points as described in the assignments portion above, with each assignment graded according to a rubric. At the end of the session, final grades will be calculated by adding the total points earned and translating those numbers (out of 100) into the following letters (there will be no partial points or rounding).

A	B	C	D	F
100 – 90 %	89 – 80 %	79 – 70 %	69 – 60 %	≤ 59 %

Course Schedule

Unless otherwise stated below, all projects and preps are due by the end of the week (Sunday, at 11:59 PM EST).

Week	What Topic(s) Will We Explore?	What's Due at the End of the Week?
Week 1	Introduction to Electronic Microcontrollers	<ul style="list-style-type: none"> • Prep 1: Introduction to Microcontrollers (Due by Wednesday, January 10th, 11:59 pm) • Prep 2: Basics of Electronics
Week 2	Basics of Electronics	<ul style="list-style-type: none"> • Prep 3: Potentiometers and Joysticks • Project 1
Week 3	Potentiometers and Joysticks	<ul style="list-style-type: none"> • Prep 4: Understanding Inputs, Functions, and Loops • Project 2
Week 4	Understanding Inputs, Functions, and Loops	<ul style="list-style-type: none"> • Prep 5: Interfacing with External Sensors • Project 3
Week 5	Interfacing with External Sensors	<ul style="list-style-type: none"> • Prep 6: Liquid Crystal Displays (LCDs) • Project 4
Week 6	Liquid Crystal Displays (LCDs)	<ul style="list-style-type: none"> • Prep 7: Electric Motors • Project 5
Week 7	Electric Motors	<ul style="list-style-type: none"> • Prep 8: Wireless Communication Between Microcontrollers • Project 6
Week 8	Wireless Communication Between Microcontrollers	<ul style="list-style-type: none"> • Project 7
Week 9	Midterm Project	<ul style="list-style-type: none"> • Midterm Project – Electric Guitar or Pinball Machine
Week 10	Spring Break	<ul style="list-style-type: none"> • Prep 9: Augmenting Arduino with Python
Week 11	Augmenting Arduino with Python	<ul style="list-style-type: none"> • Prep 10: Computer Vision • Project 8:
Week 12	Computer Vision	<ul style="list-style-type: none"> • Prep 11: Image Identification • Project 9

Week	What Topic(s) Will We Explore?	What's Due at the End of the Week?
Week 13	Image Identification Using Computer Vision Techniques	<ul style="list-style-type: none"> • Prep 12: Image Tracking • Project 10
Week 14	Image Tracking	<ul style="list-style-type: none"> • Prep 13: Image Classification • Project 11
Week 15	Image Classification Using Machine Learning	<ul style="list-style-type: none"> • Project 12
Week 16	Autonomous Cyber-Physical System	
Week 17	Final Exam Project	Final Project

* Schedule and assignments subject to change. Any changes will be posted in the learning management system.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace under University Policies and Statements.

Nondiscrimination Statement

Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies and Statements.

Accessibility

Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone at 765-494-1247.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try [WellTrack](#). Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the [Office of the Dean of Students](#). Call 765-494-1747. Hours of operation are M-F, 8 a.m.- 5 p.m.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., sign up for free one-on-one virtual or in-person sessions with a [Purdue Wellness Coach at RecWell](#). Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is free and can be done on BoilerConnect.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday.

Emergency Preparedness

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's

control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

A link to Purdue's Information on [Emergency Preparation and Planning](#) is located on our Brightspace under "University Policies and Statements." This website covers topics such as Severe Weather Guidance, Emergency Plans, and a place to sign up for the Emergency Warning Notification System. I encourage you to download and review the *Emergency Preparedness for Classrooms* document ([PDF](#)) or ([Word](#)).