egr 455

Ira A. Fulton Schools of Engineering
Arizona State University

Robotic Systems I

Fall 2024 Syllabus

Course Overview

EGR 455 and RAS 455 Course Catalog Description

Analysis and design of robotic systems focusing on kinematics, dynamics, coordinate transformations, and modeling.

Course Objective

Students gain proficiency in the basics of robotic design and analysis, focusing on forward kinematics of linkages, actuation and feedback, motion control, sensors, and machine vision.

- Students can analyze robotic systems commonly found in industry, including manipulator components and types, forward and inverse kinematics, and coordinate transformation.
- Students are familiar with the terminology and basic concepts fundamental to robotics design and can design appropriate simple robotic systems to accomplish a task in a manner that is effective and safe.
- Students can distinguish between open-loop and feedback control for velocity and position of a single joint and can implement feedback for single-joint position control.
- Students are able to select appropriate sensors and make use of digital and analog sensors (including visible-light cameras) to obtain and utilize information in a robotic system.

Prerequisites

- Prerequisite(s) with C or better: EGR 217; EGR 219 OR Robotics and Autonomous Systems BS major; RAS 110; RAS 220; Credit is allowed for only EGR 455 or EGR 545 or EGR 598 (Robotic Systems I) or RAS 455 or RAS 545 OR Visiting University Student.

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Course Information

Sections

Class #	Instructor	Days and Times
65651 88854	Dr Kevin Nichols	T/TH 10:30 am - 11:45 am
81062		T/TH 12:00 pm - 1:15 pm

Physical Location

ASU Polytechnic Campus, Technology Center, Room 162 (TECH 162)

Number of Units: 3

No Class or Office Hours on ASU Holidays:

- Labor Day Observed: Sept 2, 2024
- Fall Break: Oct 12-15, 2024.
- Veterans Day Observed: Nov 11, 2024.
- Thanksgiving Holiday Observed: Nov 28-29, 2029.

Textbook

- In lieu of a required textbook, students will be provided electronic supplements, resources, and/or web links as needed to complete assignments.
- Suggested textbook: *Introduction to Robotics: Analysis, Control, Applications 3rd Edition.* Saeed B. Niku. Wiley. IBSN-13: 978-1119527626
    - Available online at ASU Library

Materials

Students will receive the course robotics kit directly from the instructor. The kit's components will be used extensively throughout the class's in-class labs and the 'final challenge' project in the last few weeks of class. Additionally, the robotic kit will continue to be used in the following Robotics II course, and students are expected to have maintained their kit throughout the two courses.

Computer Programs and Network

- PSoC™ Creator:
  - https://softwaretools.infineon.com/tools/com.ifx.tb.tool.psoccreator
- Python:
  - https://www.python.org/downloads/
- Reliable broadband Internet connection (e.g., 3G, 4G, Cable, DSL, Wi-Fi) to access Canvas for course lectures, schedules, assignments, and quizzes.

Attendance

On-time attendance and participation in class activities are essential parts of the learning process, and students are expected to attend class regularly. Please notify your instructor before the scheduled class time if you cannot attend a specific class meeting. Only with adequate notification or under special circumstances will students be allowed to make up missed assignments. Accommodations will be made for religious observances, provided that students notify the instructor at the beginning of the semester concerning those dates.

Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. Excused absences for classes (with prior notification to your professor) will be given without penalty to the grade in the case of

1) Religious holidays [ACD 304–04 “Accommodation for Religious Practices;” a list can be found here https://eoss.asu.edu/cora/holidays]
2) A university-sanctioned event [ACD 304–02 “Missed Classes Due to University-Sanctioned Activities”]
3) Work performed in the line of duty according [SSM 201–18]
4) Illness, quarantine, or self-isolation related to illness as documented by a health professional.

Missing more than two classes will result in noticeable penalties to your final grade. Please coordinate with your fellow students or project team members to ensure someone takes notes during class if you will be unavoidably absent.

ABET Accreditation Learning Outcomes

- Engineering Problem Solving (ABET 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- User-Centered Design (ABET 2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

- Communications (ABET 3) an ability to communicate effectively with a range of audiences.
- Professional Context (ABET 4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- Multidisciplinary Teamwork (ABET 5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- Critical Thinking and Decision Making (ABET 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Questions

Post all questions to the Canvas discussion board to reach the professor and other class members. **Do not send emails through Canvas.**

Course Schedule

The current schedule can be found on the course Canvas site. Please note that it is subject to change. Should a change be required, you will be notified of the change and the schedule will be updated accordingly.

Laboratory

Approved personal protection equipment (PPE) is required when working in any ASU laboratory. Please check the lab assignments prior to class to ensure you are prepared since a few of our lab actives will require closed toe shoes.

There may be specific requirements in designated areas so verify PPE requirements before using any equipment.

Classroom Behavior

- Cell phones and other electronic devices must be turned off during class to avoid causing distractions. The use of recording devices is not permitted during class. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

- This classroom is a place where individuals of all visible and nonvisible differences are welcomed. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.
- **Professionalism is required** in all communication related to this course, including in-class discussions, presentations, canvas discussion board posts,

and e-mail. We will not reply to rude or unprofessional emails. In addition, please preface the subject line of all emails to professors or course staff with [ESD].
- If your success in this class is in question, please see your professor. The sooner you do, the more likely we will be able to find a resolution.

Grading

Grading Overview

Areas	Points	% towards Final Grade	(note)
Quizzes:	50	16.0%	(5 points for each of the 10 quizzes)
Labs:	132	42%	(12 points for each of the 11 labs)
Course Review:	10	3%	(10 points for two-course reviews)
Final Challenge:	120	38%	
Total	587	100.0%	

Deliverables

This course will consist of quizzes, labs, and a final challenge. A current schedule of deliverables is available on Canvas's calendar. All deliverables are due at 11:59 PM on the due date unless otherwise specified. **It is your responsibility to check whether each of your Canvas submissions was successful. It is recommended that you take a screenshot of each successful submission to provide evidence in case the submission goes awry. If you are unable to submit to Canvas due to a system outage, email the submission to your instructor before the assignment deadline.**

Notes

- There will be no mid-term or final exam.
- You will receive formative feedback on assignments throughout the semester.

Exams and Quizzes:

Examinations are not traditionally part of a project course but there may be several short quizzes distributed throughout the semester. All quizzes shall be based upon lecture notes, assigned research, and lab exercises. The quizzes for this course are intended to verify the student's understanding of the concepts presented in the course, therefore reference materials such as textbooks and course notes may not be used during quizzes unless indicated by the instructor.

*Make-up quizzes **will not** be given except in the following situations:*

1) *Prior notification to instructor and instructor's written approval.*
2) *Documented illness, injury, or another reasonable valid emergency, approved by the instructor.*

Labs:

There are a total of 11 labs throughout the semester. Each lab is designed to allow students to practice applying the theoretical concepts learned from the lecture. The labs are graded in two parts. The first part is on a pass/fail basis by completion, which involves showing your working lab in class in order to receive credit. The second part is you need to show your work by submission of your work code unless noted otherwise in the lab assignment. You will not receive credit for just the submission of work without receiving credit for the demonstration of that lab assignment.

Assignments (deadlines listed on Canvas)

All assignments shall be completed in a professional manner. Handwritten assignments will not be accepted. Assignments are due at the beginning of class on dates indicated by the instructor. Late assignments without proper approval will not be accepted, and the grade shall be 0% for the assignment.

Grading Policies

- Students must be present during demonstrations to receive credit.
- Assignments and labs that require a Canvas submission must be submitted to Canvas to receive credit.
- Assignments submitted incorrectly (e.g., incorrect file types, some required files missing) but that are still “gradable” will lose 25% of the total points that the assignment is worth.
- The grading scale for this course is as follows:

Letter Grade	Cutoff %
A+	97%
A	93%
A-	90%
B+	87%
B	83%
B-	80%
C+	77%
C	70%
D	60%
E	0%

Cutoffs may be lowered but will never be raised.

General Grading Rubric

Unless otherwise specified in assignments, we will use the following grading rubric:

Quality	% of Points
Not Submitted	0%
Does Not Meet Expectations	40%
Below Expectations	55%
Meets Expectations	70%
Above Expectations	85%
Exceeds Expectations	100%

Workspaces

It is your responsibility to maintain a clean and orderly classroom and lab space. Our resources are finite and your ability to complete your work may be impacted by the actions of others. If you see someone disrespecting the space, please reach out to the instructors and *copy* Cameron Noe. *Failure to respect the lab space may result in loss of lab privileges.*

If you see a workstation where tools, probes, or material are non-functioning, please email Cameron Noe and *copy* the instructors.

- Technology Center, Room 162 is our primary workspace with electronic components and test equipment. It may be available for use while other classes are in session with permission from the instructor.
  Note: You are also required to wear safety glasses and closed-toe shoes when operating specific tools such as soldering irons.

  Lab Manager: Cameron Noe.

- The Innovation Hub (Technology Center, Room 199, hours) has a variety of prototyping equipment, including a Shop Bot (2-D wood router), laser cutter and engraver, 3D printer, 3D scanner, vinyl cutter, sewing machines, vacuum former (useful for creating project enclosures), and more.

  Lab Manager: Sean Dengler

- *Peralta Hall*, Room 109 (*Peralta Engineering Studios*)(*Hours*) has a printed circuit board manufacturing line. It is available during the day and selected evenings and weekends.

  Lab Manager: Scott Bainbridge

- The Simulator Building has a machining and manufacturing center with CNC mills and lathes, a welding room, and fiber glassing equipment.
- The Polytechnic Campus Library has small group meeting rooms with whiteboards and is open late.

Additional Information

- The campus provides a number of valuable resources to help you achieve both personal and academic success. These include:
  - Student Success and Writing Center - http://tutoring.asu.edu The Poly Tutoring & Writing Center offers free academic support services to all ASU students. At the Poly Tutoring & Writing Center, you will receive help in math, science, engineering, computer science, and writing. To book an appointment, please use their website or call 480-727-1452.
  - Counseling Center - https://eoss.asu.edu/counseling
  - Career & Professional Development Services - https://eoss.asu.edu/cs
  - Other Student Resources from the Ira A. Fulton Schools of Engineering

- **Academic Integrity.** Students in this class must adhere to ASU's academic integrity policy. Students are responsible for reviewing this policy and understanding each of the areas in which academic dishonesty can occur. In addition, all engineering students are expected to adhere to both the ASU Academic Integrity Honor Code and the Fulton Schools of Engineering Honor Code. **All academic integrity violations will be reported to the Fulton Schools of Engineering Academic Integrity Office (AIO).** The AIO maintains a record of all violations and has access to academic integrity violations committed in all other ASU colleges/schools.

- **Copyrighted Materials.** The contents of this course, including lectures and other instructional materials, are copyrighted materials. Students may not share outside the class, including uploading, selling or distributing course content or notes taken during the conduct of the course. Any recordings of class sessions is authorized only for the use of students enrolled in this course during their enrollment in this course. Recordings and excerpts of recordings may not be distributed to others (see ACD 304–06, "Commercial Note Taking Services" and ABOR Policy 5-308 F.14 for more information).
  - You must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all

applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

- **Policy Against Threatening Behavior.** Per the Student Services Manual SSM 104-02**,** students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services. Interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. All incidents and allegations of violent or threatening conduct by an ASU student (whether on- or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students.

- **Disability Accommodations.** Suitable accommodations are made for students having disabilities. Students needing accommodations must register with Student Accessibility and Inclusive Learning Services and provide documentation of that registration to the instructor. Students should communicate the need for an accommodation in sufficient time for it to be properly arranged. See ACD 304-08 Classroom and Testing Accommodations for Students with Disabilities.

- **Harassment and Sexual discrimination.** Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.

  Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

  Mandated sexual harassment reporter: As mandated reporters, professors are obligated to report any information we become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish to discuss any concerns confidentially and privately.

Any information in this syllabus is established as a guide for the course and is subject to change during the semester. Students will be notified of any changes.