EGR455/EGR598 Robotics-I

Syllabus

Ira A. Fulton Schools of Engineering
Arizona State University

Section 1: Course Overview

Instructor Information

Instructor: Sangram Redkar
Email: sredkar@asu.edu
Phone: 480-727-1129
Office Hours: by appointment
Office Location: Polytechnic Campus, Tech center 101B

Course Description

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

Course Credit: 3

Class Meetings

Section(s)	Days	Time	Location
	M/W	3-4.15	Picacho 150

Enrollment Requirements

Textbook & Course Materials

Introduction to Robotics: Analysis, Control, Applications 3rd Edition by Saeed B. Niku. ISBN-978-1119527626

Course Objectives:

1. Understand Kinematics, Dynamics and Control of robots

2. Use software (MATLAB, Mathematica and SolidWorks) to solve robotics problem

Student Learning Outcomes

- Understand and apply kinematics and dynamics principles application to robotics
- Understand engineering applications of robotic systems
- Using software tools (MATLAB, Solidworks) for solving robotic systems

Section 2: Course Policies

How to Succeed in this Course

- Attend all of the face-to-face classroom sessions.
- Complete all pre-class preparation assignments and reading.
- Complete all post-class follow up assignments and reading.
- Participate in office hours.
- Check your ASU email regularly.
- Log in to the course website at least once each week.
- Communicate with your instructor.
- Create a study schedule so that you do not fall behind on assignments.
- Utilize additional instructional videos that could be helpful for absorbing course content, including those from YouTube and Khan Academy.

Grading

Please include the course's grading breakdown here. This should be explicit (preferably as a table, not text) showing the percentage assigned to each item such as HW, exams, projects, etc. Check that percentages add to 100%.

Please also develop and include a grading scale. A sample scale is listed below.

Grade	Range
A	90 and above
B	80 and above
C	70 and above
D	60 and above
E	0 – 59

Assignments	**60%**
Project	**40%**

Submitting Assignments

All assignments, unless otherwise announced, MUST be submitted to the designated area of Canvas. Do not submit an assignment via email.

Late or 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. The preceding policies are based on ACD 304–04, "Accommodation for Religious Practices" and ACD 304–02, "Missed Classes Due to University-Sanctioned Activities."

Drop and Add Dates/Withdrawals

This course adheres to a compressed schedule and may be part of a sequenced program, therefore, there is a limited timeline to drop or add the course. Consult with your advisor and notify your instructor to add or drop this course. If you are considering a withdrawal, review the following ASU policies: Withdrawal from Classes, Medical/Compassionate Withdrawal, and a Grade of Incomplete.

Grade Appeals

Grade disputes must first be addressed by discussing the situation with the instructor. If the dispute is not resolved with the instructor, the student may appeal to the department chair per the University Policy for Student Appeal Procedures on Grades.

Course Evaluation

Students are expected to complete the course evaluation. The feedback provides valuable information to the instructor and the college and is used to improve student learning. Students are notified when the online evaluation form is available.

Syllabus Disclaimer

This syllabus is to be used as a guideline only. The information provided is a summary of topics to be covered in the class. Information contained in this document such as assignments, grading scales, due dates, office hours, required textbooks are subject to change. Students will be notified accordingly.

Section 3: Class Schedule

Class		Textbook Topics	Hw/Quizzes	Notes	Video Lectures
1	**Week 1**	Chapter 1: Fundamentals	**Assignment 1 Assigned**	Review of Syllabus, Course Structure, Expectations, Q&A	**1. Intro** **https://youtu.be/HcvArKwaxw0**
2		Chapter 2: Kinematics		2.1 to 2.4- Vectors, Examples	**2. Kinematic Analysis** **https://youtu.be/2AxZ48w_cL4**
3	**Week 2**	Chapter 2: Kinematics		2.5 to 2.7 Homogeneous Transformation – Translation, Rotation, Examples	**3. Kinematics** **https://youtu.be/9Tqmhl5gvag**

4		Chapter 2: Kinematics		2.8-2.11 Forward Kinematics of Robots-Theory	**4. Kinematics** https://youtu.be/bJvMyTXxR1c
5	**Week 3**	Chapter 2: Kinematics	**Assignment 1 Due Assignment 2 Assigned**	Kinematics Examples 2.8-2.11 Forward Kinematics of Robots-MATLAB	**5. Kinematics** https://youtu.be/gJVJiWys78g
6		Chapter 2: Kinematics		2.13-2.14 Inverse Kinematics Theory	**6. Kinematics** https://youtu.be/LYt4SPNuwWQ
7	**Week 4**	Chapter 2: Kinematics		2.13-2.14 Inverse Kinematics Examples	**7. Kinematics** https://youtu.be/8fRpc_bsy2U
8		Chapter 2: Kinematics		Kinematics Examples	**8. 3D Kinematics** https://youtu.be/qu9drdvAIX0
9	**Week 5**	Chapter 2: Kinematics	**Assignment 2 Due Assignment 3 Assigned**	2.12 – D-H Parameters Theory	**9. DH Parameters** https://youtu.be/qu9drdvAIX0
10		Chapter 2: Kinematics		2.12- D-H Parameters Examples	**10. DH Parameters** https://youtu.be/e5xLi4bF-a0
11	**Week 6**	Chapter 5: Differential Motions		5.1-5.5- Differential Transformations-Theory	**11.Velocity Analysis** https://youtu.be/Tom4QkgWdog
12		Chapter 5: Differential Motions		5.6-5.10-Differential Transformations-Jacobian, Examples	**12.Velocity** https://youtu.be/h-9z3gvtoM4
13	**Week 7**	Chapter 6: Dynamics	**Assignment 3 Due Assignment 4 Assigned**	Virtual Work	**13.Virtual Work** https://youtu.be/Fps-21BSfvU
14		Chapter 6: Dynamics		Static Forces	**14. Static Forces** https://youtu.be/HLrXd-CQQSQ

				6.5 -Static Force Analysis	
15	**Week 8**	Chapter 6: Dynamics		Lagrangian	**15. Lagrangian** https://youtu.be/B8n2HyKSZfQ
16		Chapter 6: Dynamics		6.1-6.3- Dynamic Analysis, Lagrangian Mechanics. Intro	**16.Lagrangian Examples** https://youtu.be/SSyWJuNpmts
17	**Week 9**	Chapter 6: Dynamics	**Assignment 4 Due Assignment 5 Assigned**	6.1-6.3- Dynamic Analysis, Lagrangian Mechanics.	**17. Dynamics** https://youtu.be/vmo9a2_jTys
18		Chapter 6: Dynamics		6.6-6.8 Application to Robots-Examples	**18. Dynamics** https://youtu.be/u47kGTYWBq0
19	**Week 10**	Chapter 6: Dynamics		6.6-6.8 Application to Robots-Examples	**19. Dynamics** https://youtu.be/gYnn5e4d2bg
20		Chapter 7: Trajectory planning		7.1-7.58 Trajectory Planning	**20. Trajectory Planning** https://youtu.be/ClJTLCO1KVs
21	**Week 11**	Chapter 6: Dynamics	**Assignment 5 Due Assignment 6 Assigned**	Solving Dynamics problems using MATLAB	**21. Dynamics with MATLAB** https://youtu.be/b2lsL_2g45o
22		Chapter 6: Dynamics		Solving Dynamics problems using MATLAB	**22. Dynamics with MATLAB** https://youtu.be/saZWOqxIU0Q
23	**Week 12**	Chapter 8: Motion Control Systems		8.1-8.5 Motion Control Theory-Theory	**23. Robot Motion Control** https://youtu.be/XRdoGwpxKxg
24		Chapter 8:		8.6-8.9-Transfer Functions-Laplace Transform MATLAB	**24. Laplace Transform** https://youtu.be/FGwrmugtt34

		Motion Control Systems			
25	**Week 13**	Chapter 8: Motion Control Systems	**Assignment 6 Due Assignment 7 Assigned**	8.10-8.15 -Root locus/PID and Examples	**25. Controls** https://youtu.be/JH0QAW_r9Y0
26		Chapter 8: Motion Control Systems		8.16-8.23 -State Space and examples	**26. Controls** https://youtu.be/ncR3j6jonXE
27	**Week 14**	Chapter 8: Motion Control Systems		8.24-8.25-Nonlinear Control and examples	**27. Controls** https://youtu.be/kGXdIKsagaQ
28					**Review**
29	**Week 15**		**Assignment 7 Due**		**Review**
30					

Section 4: University Policies

Classroom Behavior

Cell phones and pagers 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. See SSM 104–02, "Handling Disruptive, Threatening, or Violent Individuals on Campus."

Academic Integrity & Copyright Laws

One of the core topics of this course is academic integrity. You will be discussing it further throughout the course. ASU expects and requires all its students to act with honesty and integrity, and respect the rights of others in carrying out all academic assignments. Fulton Schools of Engineering takes academic integrity VERY seriously. The Fulton Honor Code will be discussed during a future class.

Students in this class must adhere to ASU's academic integrity policy, which can be found at https://provost.asu.edu/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 record of all violations and has access to academic integrity violations committed in all other ASU college/schools.

Course content, including lectures, are copyrighted materials and students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute course content or notes taken during the conduct of the course (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.

Plagiarism

Although ASU encourages collaboration between students, and faculty, in the sharing of ideas and experiences, individual work needs to represent the student's original thought and be distinguishably different from other students' work. Copying from other people's work in part or in whole will result in a ZERO grade for the whole work. Recurring plagiarism will result in obtaining an XE and reporting each student's misconduct.

Threatening Behavior Policy

Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services (see SSM 104-02). 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.

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.

As a mandated reporter, I am obligated to report any information I 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 discuss any concerns confidentially and privately.

Disability Resources

Any students who have special needs or need accommodations in this course are encouraged to communicate with me as soon as possible to make appropriate arrangements for these accommodations. The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. One element of this legislation requires that all qualified students with documented disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation please contact the Disability Resource Center (DRC) at ASU Polytechnic located in Student Affairs Quad # 4 or call 480-727-1039 / TTY: 480-727-1009. Please note that students who may need accommodations must register with the ASU Disability Resource Center and provide documentation of that registration to the instructor. Eligibility and documentation policies online: http://www.asu.edu/studentaffairs/ed/drc/

Technical Support

- This course uses Canvas to deliver content. It can be accessed through MyASU at http://my.asu.edu or the Canvas home page at https://myasucourses.asu.edu
- To monitor the status of campus networks and services, visit the System Health Portal at http://syshealth.asu.edu/
- To contact the help desk call toll-free at 1-855-278-5080.