MECEE 4602: Introduction to Robotics

Fall 2024, Lectures: Tuesday 4:10 pm - 6:00 pm, Venue: Mudd 833
Zoom Sessions: Tutorials/Class Presentations will average 40 min/week)

Instructor: Sunil K. Agrawal, Ph.D.
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Office Hrs: Tuesday 2:00 – 3:00 pm, 230 Mudd Hall
TAs: Fitsum Petros (fp2405@columbia.edu)

Textbook: Robot Dynamics & Control, M. W. Spong and M. Vidyasagar, Wiley 1989
ISBN-13: 978-0471612438
Prerequisites: All students must have taken introductory classes in Dynamics, Control, Linear Algebra. Familiarity and programing in Matlab is required.

Schedule:

9/3	Introduction to Robotics: Structures of robotic chains, Serial and parallel robots, Chapter 1
9/10	Rigid Motion and Homogeneous Transformations: Chapter 2
9/17	Angular Velocity and Linear Velocity: Chapter 2 Contd.
9/24	Forward Kinematics, Computing end-effector motions: Chapter 3
10/1	Inverse Kinematics, Computing joint angles: Chapter 4
10/8	Velocity Kinematics – Jacobians: Chapter 5 Review Chapters 1-5
10/15	**Mid-Term Exam: Chapters 1-5**
10/22	**Project 1: Zoom Presentations (4:10 pm – 7:30 pm)**
10/29	Dynamics: Chapter 6
11/5	**University Holiday**
11/12	**Preliminary Project: Zoom Presentations (4:10 pm – 7:30 pm)**
11/19	Independent and Coordinated Joint Control: Chapter 7
11/26	Parallel robots and other architectures
12/3	**Final Project Presentation (In Class + Zoom Presentation)**
12/10	**Final Project Report Due**

Grading:

Home Work:	15%
Weekly on-line Quiz:	5%
Project 1:	10%
Mid-Term Exam:	30%
Final Project (Preliminary Presentation)	5%
Final Project Presentation/Report	30%
Class Participation/Attendance	5%

Additional Course Details:

(i) **Home works** will be assigned after the completion of each topic. These will be due in a week from the assigned date.

(ii) **Quiz**: A weekly quiz will be assigned after the completion of each topic. These will be timed tests and will be completed on-line.

(iii) **Project 1**: These will be performed in assigned groups of four. Your group will choose a paper on a topic of interest from a recent ICRA, IROS, BioRob Proceedings (last 2 years). Please send an email to the instructor/TAs and obtain permission to work on your project. Please pick a paper based on a basic scientific problem or application in robotics.

Prepare 6 Powerpoint slides with the following content: Problem statement, Prior research, Solution approach, Results, Conclusions and Future Extensions. **A 5-minute narrated video from your group has to be submitted on the paper**.

(iv) **Mid-Term Exam**: This exam will be in-class based on material of Chapters 1-5.

(v) **Final Project**: The students will work in self-selected groups of 4. Define a problem that involves design, analysis, simulation, etc. using the principles that you have studied in this course. The problem should have a good motivation and should have elements of novelty. It should be approved by the Instructor/TA.

Preliminary Presentation – Prepare a 3 -minute narrated video of your project outlining what is the problem, what is the novelty, what is your approach, and what results you expect. Please include a sketch of the problem.

Presentation - Prepare 6 Powerpoint slides with the following contents: Problem statement, Solution approach, Results, Conclusions and Future Extensions. **A 5-minute narrated video from your group has to be submitted followed by Q**&A.

Technical Paper - Write a 3 page technical report in word (2 column 10 point) using the typical format of an ICRA paper.

(vi) **Course Ethics**: Discussion of the lecture material among students is encouraged. However, home-works must be performed and submitted individually.