ENME480 - Intro to Robotics

Term: *Fall 2025*
Professor: Dr. Nikhil Chopra
Email: nchopra@umd.edu
Office Hours: Wed 10-11:30 (2149 Martin Hall)
https://umd.zoom.us/j/99088503503?pwd=pQKi2zBOOaUWaaRqNaEESbRxLlDzqh.1

Teaching Assistant: Alex Beyer, Kaustubh Joshi
Email: abeyer@umd.edu, kjoshi@umd.edu
Office Hours: TBD

Credits: 3
Course Dates: Sep 2 2025 - Dec 12 2025

Lecture (Prof. Chopra)	MW	2 pm-2:50 pm	TWS1100
Studio 0101	Th	12 pm-2 pm	KEB 2111/EAF 3119
Studio 0102	Fr	8 am-10 am	KEB 2111/EAF 3119
Studio 0103	Tu	12 pm-2 pm	KEB 2111/EAF 3119

Course Description

This course is an introductory robotics course that will educate students on the elementary concepts of robotics. The course will encompass both theory and laboratory components. The labs will be structured to encourage interdisciplinary collaboration amongst students as they develop and test various types of code on a real robotic arm.

Learning Outcomes

After completing this course, you will be able to:

- An ability to apply knowledge of mathematics, science, and engineering to robotics problems
- An ability to analyze and interpret experimental data in robotics experiments
- An ability to utilize the geometry of robots for analyzing robot kinematics
- An ability to use robot dynamics for robot planning and control

Required Resources

- Course Website: elms.umd.edu
- Book: Robot Modeling and Control, 2nd Edition, M.W. Spong, S. Hutchinson, and M. Vidyasagar, 2020 ISBN 978-1119523994
- A laptop capable of running ROS2 (we will walk you through the recommended setup during the lab)

Course Structure

- **Lectures and In-Class Assignments**
    - Lecture sections will be led by Dr. Chopra, with TAs assisting as needed. During specific lectures, an in-class assignment may be given, consisting of a short question to check comprehension of the

lecture content. These questions will be due within a few days of the lecture and will contribute to the extra credit in the course.

- **Studios and Labs**
  - Studios and Labs will be run by the TAs, who will guide the students in developing and testing their own code to run on a UR3e robotic arm. We will use two classrooms for this - KEB2111 (the computer lab) and EAF3117 (the Robotics and Autonomy Lab). Refer to the course schedule below for details on meeting locations and times. Please note that the location may change as we progress through the course, so students should monitor Piazza for updates. Most of the lab work will be completed in instructor-assigned groups. *Students will be required to complete a short safety seminar and online training to use the robots in RAL.*
- **Homework Assignments**
  - Assignments will be posted on Fridays at 11:59 pm and will be due a week later online via Canvas. All extension requests must come through Piazza. Extension requests will be given sparingly, as we intend to release solutions to the homeworks shortly after they are due. Since this is a very interdisciplinary class, collaboration with your peers is encouraged on the homework.
- **Exams**
  - Two exams will be given. The exam dates are listed in the Grade Distribution above and on the course schedule below. The quiz will allow one page of notes (each front and back). Material will be drawn from reading assignments, lectures, homework, and studio assignments.
- **Final Project**
  - For the final project, students will combine all the code they have been working on during the semester to create a pipeline for locating blocks on a table, moving the arm to them, and picking them up to build a tower. The project will be completed with your lab group and will require a write-up and video showing off your work.

Tips for Success in this Course

1. **Participate.** I invite you to engage deeply, ask questions, and talk about the course content with your classmates. You can learn a great deal from discussing ideas and perspectives with your peers and professor. Participation can also help you articulate your thoughts and develop critical thinking skills.
2. **Manage your time.** Students are often very busy, and I understand that you have obligations outside of this class. However, students perform best when they allocate adequate time for coursework. Block your schedule and set aside ample time to complete assignments, including extra time to address any technology-related issues.
3. **Login regularly.** You should log in to ELMS-Canvas several times a week to view announcements, discussion posts, and replies to your posts. You may need to log in multiple times a day when group submissions are due.
4. **Do not fall behind.** This class moves at a rapid pace, and each week builds upon the previous content. If you are starting to fall behind, please check in with the instructor as soon as possible so we can work together to troubleshoot the issue. It will be challenging to keep up with the course content if you fall behind in the pre-work or post-work assignments.

5. **Use ELMS-Canvas notification settings.** Pro tip! Canvas ELMS-Canvas can ensure you receive timely notifications in your email or via text. Be sure to enable announcements to be sent instantly or on a daily basis.
6. **Use Piazza**. Important information will often be posted on Piazza (and sometimes *only* on Piazza). Students are strongly encouraged to create an account and follow the announcements there, as well as read and contribute to public questions on the site. If you have a question, chances are someone else has the same one!
7. **Ask for help if needed.** If you need help with ELMS-Canvas or other technology, IT Support. If you are struggling with a course concept, reach out to the teaching staff and your classmates for support.

Policies and Resources for Undergraduate Courses

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please visit www.ugst.umd.edu/courserelatedpolicies.html for the Office of Undergraduate Studies' full list of campus-wide policies and follow up with me if you have questions.

Course Guidelines

Names/Pronouns and Self-Identifications:

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to in this class, both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). Keep in mind that the pronouns someone uses are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, it is your choice whether to disclose how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity (e.g., should it come up in classroom conversation about our experiences and perspectives), and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Communication with Instructor:

Piazza will be the official medium for course-related inquiries and issues. We cannot guarantee a prompt response in case you send an email to individual instructors/teaching staff. Further, the instructors/teaching staff may not respond to the questions asking for information already given in the lectures.

Register: piazza.com/umd/fall2025/enme480

Canvas will be the official medium for posting class materials, such as class notes and homework solutions. We will also use Canvas to send an email to the class. It is your responsibility to ensure that your email address on Canvas is accurate. The labs will post content to the class GitHub page, located at https://github.com/ENME480.

Communication with Peers:

With a diversity of perspectives and experience, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work together to foster and preserve a virtual classroom environment in which we can respectfully discuss and deliberate controversial questions. I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, that free speech has its limits, and this course is NOT the space for hate speech, harassment, and derogatory language. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.

Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert me immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Major Assignments

Homework Assignments

- Multiple choice
- Short worked problems
- Show why an answer is/isn't correct

Exams

- Similar structure to the homework

Studios and Labs

- Group assignments (we will make groups early in the semester)
- Focused on turning the math learned in a lecture into code, which will run on the real robots
- Split between KEB2111 (Programming studios) and EAF3119 (Lab space with robots)

Final Project

- Vision-enabled pick and place task using the UR3 arms
- Focuses on integrating all the work you will have done earlier in the semester into a single working code)

Grading Structure

Assignment	Percentage %
Homework	**20%**
Studio/Lab Assignments	**20%**
Midterm 1	**20%**

Midterm 2	**20%**
Final Project	**20%**
Extra Credit: In Class Assignments	**Up to 5%**
Total	**100% (105% with Extra Credit)**

Academic Integrity

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications, as all acts of academic dishonesty will be dealt with in accordance with the provisions outlined in this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**

It is important to note that course assistance websites, such as CourseHero, or AI-generated content, are not permitted sources unless the instructor explicitly gives permission. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might be inaccurate or biased and most importantly, relying on restricted sources will hamper your learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, students may naturally choose to use online forums for course-wide discussions (e.g., Group lists or chats) to discuss concepts in the course. However, collaboration on graded assignments is strictly prohibited unless otherwise stated. Examples of prohibited collaboration include: asking classmates for answers on quizzes or exams, asking for access codes to clicker polls, etc. Please visit the Office of Undergraduate Studies' full list of campus-wide policies and reach out if you have questions.

Finally, on each exam or assignment, you must write out and sign the following pledge: ***"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."*** If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, ***if you are ever unclear*** about acceptable levels of collaboration, ***please ask***!

AI Usage

In this class, you may use AI tools (TerpAI, ChatGPT, Gemini, Grammarly, etc.) for brainstorming and review (summarizing lecture notes, defining complex terms for your own understanding, etc.). However, you must develop your final assignments independently to reinforce critical skills, which is a major goal of this class. If you have questions or suggestions, please post to Piazza.

Using AI generated code on a physical system is inherently unsafe for you, your classmates, the TAs and the robots. Any student caught running code written by an AI (Claude, ChatGPT, etc.) on a physical system risks being forbidden from using the robots again.

Grades

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please make a private Piazza post with Dr. Chopra and the TAs to discuss.

Homework assignments will be posted on Fridays at 11:59pm and will be due a week later online via Canvas. All extension requests must come through Piazza. Extension requests will be given sparingly, as we intend to release solutions to the homeworks shortly after they are due.

The studio portion of this class provides students with an opportunity to learn more about an actual manipulator, the realization of concepts learned in class, and its related programming. Students will be provided introductory material on simulators and related programming tools. To accomplish this, students will be assigned to interdisciplinary teams, with whom they will collaborate on completing the Studio assignments and the Final Project.
Studio attendance is mandatory, and students who miss a studio session must make arrangements with the TAs and their lab group (as applicable) to make up work and contribute to group assignments. Additionally, due to the studio's structure, it is crucial to arrive at your studio session on time. Students who are repeatedly late or absent may face deductions from their grade. During the semester, the TAs will also send anonymous surveys to gauge how well teams are collaborating. Students who are found not to be contributing to their team may also face grade reductions. In exceptional cases, a student may be allowed to attend a Studio session they are not a part of, although this is to be done sparingly, as the Studios are designed to be completed with your assigned team. If a student knows they will miss their assigned lab time, they should reach out to the TAs via Piazza so arrangements can be made before the Studio session occurs.

Two exams will be given. The exam dates are listed in the Grade Distribution above and on the course schedule below. The quiz will allow one page of notes (each front and back). Material will be drawn from reading assignments, lectures, homework, and studio assignments.

Final Grade Cutoffs									
+	97.00%	+	87.00%	+	77.00%	+	67.00%	+	
A	94.00%	B	84.00%	C	74.00%	D	64.00%	F	<60.0%
-	90.00%	-	80.00%	-	70.00%	-	60.00%	-	

Course Outline

Labs listed in black are scheduled to meet in KEB2111 while those in red meet at EAF3119. Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

	Date	Lecture Topic	Date	Lab Topic	Date	Lecture Topic	Date	Lab Topic	Date	Lab Topic
Week 1	9/1	No Lecture	9/2	Lab Intro	9/3	Introduction & Linear Algebra Primer	9/4	Lab Intro	9/5	Lab Intro
Week 2	9/8	Linear Algebra Primer	9/9	RAL Intro, Setup	9/10	Linear Algebra Primer	9/11	RAL Intro, Setup	9/12	RAL Intro, Setup
Week 3	9/15	Rigid Motions	9/16	Python Intro, ROS Intro, Studio 1	9/17	Rigid Motions	9/18	Python Intro, ROS Intro, Studio 1	9/19	Python Intro, ROS Intro, Studio 1
Week 4	9/22	Rigid Motions	9/23	Gazebo Demo, Studio 2	9/24	Rigid Motions	9/25	Gazebo Demo, Studio 2	9/26	Gazebo Demo, Studio 2
Week 5	9/29	Forward Kinematics	9/30	FK Lab 1.1	10/1	Forward Kinematics	10/2	FK Lab 1.1	10/3	FK Lab 1.1
Week 6	10/6	Velocity Kinematics	10/7	FK Lab 1.2	10/8	Velocity Kinematics	10/9	FK Lab 1.2	10/10	FK Lab 1.2
Week 7	10/13	No Lecture	10/14	No Lecture	10/15	Velocity Kinematics	10/16	No Lab (Makeup Lab/Office Hours)	10/17	No Lab (Makeup Lab/Office Hours)
Week 8	10/20	Exam	10/21	IK Studio	10/22	Inverse Kinematics	10/23	IK Studio	10/24	IK Studio

Week 9	**10/27**	**Inverse Kinematics**	**10/28**	**IK Lab**	**10/29**	**Inverse Kinematics**	**10/30**	**IK Lab**	**10/31**	**IK Lab**
Week 10	**11/3**	**Inverse Kinematics**	**11/4**	**IK Lab**	**11/5**	**Dynamics**	**11/6**	**IK Lab**	**11/7**	**IK Lab**
Week 11	**11/10**	**Dynamics**	**11/11**	**Intro to Cameras**	**11/12**	**Dynamics**	**11/13**	**Intro to Cameras**	**11/14**	**Intro to Cameras**
Week 12	**11/17**	**Path and Trajectory Planning**	**11/18**	**Camera Lab**	**11/19**	**Exam 2**	**11/20**	**Camera Lab**	**11/21**	**Camera Lab**
Week 13	**11/24**	**Path and Trajectory Planning**	**11/25**	**No Lab (Makeup Lab/Office Hours)**	**11/26**	**No Lecture**	**11/27**	**No Lecture**	**11/28**	**No Lecture**
Week 14	**12/1**	**Path and Trajectory Planning**	**12/2**	**Final Project**	**12/3**	**Independent Joint Control**	**12/4**	**Final Project**	**12/5**	**Final Project**
Week 15	**12/8**	**Independent Joint Control**	**12/9**	**Final Project**	**12/10**	**Independent Joint Control**	**12/11**	**Final Project**	**12/12**	**Final Project**

Resources & Accommodations

Accessibility and Disability Services

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The Accessibility & Disability Service (ADS) provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at adsfrontdesk@umd.edu.

Emergency Preparedness

Emergencies on campus can happen at any time. To prepare, visit prepare.umd.edu or use the emergency symbol in the UMD App to review information. Resources for persons with disabilities are available on the emergency preparedness page of the ADA Coordinator's website.

Student Resources and Services

Taking personal responsibility for your own learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit UMD's Student Academic Support Services website to learn more about the wide range of campus resources available to you.

In particular, everyone can use some help sharpening their communication skills (and improving their grade) by visiting UMD's Writing Center and schedule an appointment with the campus Writing Center.

You should also know there are a wide range of resources to support you with whatever you might need (UMD's Student Resources and Services website may help). If you feel it would be helpful to have someone to talk to, visit UMD's Counseling Center or one of the many other mental health resources on campus.

Notice of Mandatory Reporting

Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Responsible University Employee," and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct. If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as CARE to Stop Violence (located on the Ground Floor of the Health Center) at 301-741-3442 or the Counseling Center (located at the Shoemaker Building) at 301-314-7651. You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142, or emailing titleIXcoordinator@umd.edu. To view further information on the above, please visit the Office of Civil Rights and Sexual Misconduct's website at ocrsm.umd.edu.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit UMD's Division of Student Affairs website for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional supports to our student veterans. You can access those resources at the office of Veteran Student life and the Counseling Center. Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.

Participation

- Given the interactive style of this class, attendance will be crucial to note-taking and thus your performance in this class. Attendance is particularly important also because class discussion will be a critical component for your learning.
- Each student is expected to make substantive contributions to the learning experience, and attendance is expected for every session.

- Students with a legitimate reason to miss a live session should communicate in advance with the instructor, except in the case of an emergency. *If a student knows they will miss a Lab/Studio section they should message the TAs over Piazza and make arrangements with their group to contribute to the assignment.*
- Students who miss a live session are responsible for learning what they miss from that session.
- Additionally, students must complete all readings and assignments in a timely manner in order to fully participate in class.

Course Evaluation

Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. Campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the Student Feedback on Course Experiences to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Copyright Notice