Stony Brook University

Course Syllabus

MEC 529: Introduction to Robotics – Theory and Applications

Fall 2025

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Office Hours	MoWe 11:00 AM – 12:00 PM (and, any other time by appointment)
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* All non-personal course-related questions should be posted on Brightspace Discussions Forum (see section Tools below). Email should be used only for strictly personal issues. I will respond to your emails as soon as possible, however, please allow up to 48 hours for a response. Please use your SBU email for all your communications.

Teaching Assistant	Anh Tung Ho (AnhTung.Ho@stonybrook.edu)
Office Hours & Office	Tuesday 10:00 – 11:30 AM, 101 Heavy Engineering

Course Detail

Title	MEC 529: Introduction to Robotics – Theory and Applications
Credit	3
Lecture	Wednesday, 6:30 – 9:20 PM, Frey Hall 328
Prerequisites	A knowledge of undergraduate-level kinematics, a foundation in linear algebra and calculus, and an ability to program in Python.

Recommended References

- Kevin M. Lynch and Frank C. Park, *Modern Robotics: Mechanics, Planning, and Control*, Cambridge University Press, 2017 [Publisher, Amazon, PDF (freely available by publisher)].
- Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, *Robotics: Modelling, Planning and Control*, Springer, 2009 [Publisher, Amazon].
- Mark W. Spong, Seth Hutchinson, M. Vidyasagar, *Robot Modeling and Control*, 2nd Edition, John Wiley & Sons Inc, 2020 [Publisher, Amazon].
- Richard M. Murray, Zexiang Li, and S. Shankara Sastry, *A Mathematical Introduction to Robotic Manipulation*, CRC Press, 1994 [Publisher, Amazon].
- John Craig, *Introduction to Robotics: Mechanics and Control*, 4th Edition, Pearson, 2018 [Publisher, Amazon].

Course Description

This course provides an overview of fundamental concepts in robotics. The aim is to provide the fundamental knowledge and tools needed for modeling, design, planning, and control of robotic systems. The main focus of the course will be on rigid-body rotation and transformation, forward and inverse kinematics, velocity kinematics, trajectory and motion planning, and kinematic control within the context of serial robotic manipulators. This course is intended for graduate students with an interest in robotics. Advanced undergraduates with a demonstrated interest in robotics are also welcome.

Course Learning Objectives

- Understand Degrees of Freedom (DOF), configuration space, workspace, and task space of robots.
- Know about different representations of the configuration of a rigid body.
- Solve forward kinematics, inverse kinematics, and velocity kinematics problems of serial manipulators.
- Compute Jacobian of serial manipulators and use it in singularity and redundancy analysis.
- Know trajectory planning techniques for serial manipulators.
- Implement trajectory planning techniques in computer programs/simulations.

Tools

Brightspace: It is required that you use the Brightspace for this course. Brightspace is used for facilitation of communications between faculty and students, posting of the course materials, important announcements, and grades, and submission of assignments. You need to check your SBU email or Brightspace announcements regularly [Android App, iOS App].

Brightspace Discussions Forum: By using the Discussions tool/forum in Brightspace, you can get help fast and efficiently from your classmates, the TA(s), and the instructor. All non-personal course-related questions that might be of interest to other students should be posted (either anonymously or identified) on the Brightspace Discussions forum and not emailed to the TA(s) or the instructor. Email should be used only for strictly personal problems or issues.
Note that this discussion forum is for additional learning and assistance. It is not the place for cyber-bullying, memes, grade complaints, concerns/comments/criticisms about the course, or in general, anything unrelated to the course material and student learning. Improper behavior will result in reporting of the individual's behavior to the Office of Student Conduct and Community Standards.

Python: It is required to use the Python programming language for all homework and projects in this course. You will need to use Python 3.12.x along with the following libraries: NumPy, SciPy, SymPy, Matplotlib, and pytransform3d. Refer to the following tutorials to get started with Python and Jupyter Notebooks:

- Getting started with Python in VS Code: YouTube
- Getting started with Jupyter Notebooks in VS Code: YouTube
- A concise tutorial on NumPy, SciPy, SymPy, and Matplotlib: GitHub or Google Colab
- MATLAB users can use NumPy for MATLAB users to transition to Python.
- Markdown cheatsheet: GitHub or Google Colab

Homework and Final Project Submission Guidelines

1. **Submission Format**
   - Submit your report as a **single Jupyter Notebook (.ipynb)** file, which should include your Python code, report text (in Markdown cells), mathematical expressions (in LaTeX math format), and figures. Do not submit your virtual environment files.
   - Name your notebook as `HW#1_FirstName_LastName.ipynb`.
2. **Notebook Requirements**
   - The notebook must run from top to bottom without errors on a fresh kernel.
   - Include all the necessary helper or auxiliary functions (if any) inside the notebook (no external .py files). Place them in an "Helper Functions" section near the top of the notebook.
   - Before submitting, run all cells in your notebook so that the outputs are visible.
3. **Figures and Animations**
   - Embed small/medium figures directly in the notebook using `matplotlib`. These figures are usually the output of your code.
   - If you have external figures or animations that do not embed well in notebooks, save them in a folder named `figures` and reference them in the notebook where relevant.
   - Submit both the notebook `HW#1_FirstName_LastName.ipynb` and the `figures` folder as a single zipped archive and name it as `HW#1_FirstName_LastName.zip`.
4. **Readability**
   - Code must be accompanied by supporting explanations. Utilize Markdown cells for section headers, result explanations, and conclusions.
   - Add proper comments to your code, which detail what each part of the code is doing.
5. Reports will be graded on code and results correctness, explanation clarity, and notebook organization.
6. A minimal sample report template in Jupyter Notebook format to use for your homework and final project submissions: GitHub or Google Colab

Homework Assignments, Paper Presentation, and Final Project

- Homework assignments will be posted on Brightspace.
- Students are allowed to discuss assignments with their classmates; however, they must submit their own work. Any discussion or assistance received from classmates should be explicitly acknowledged by including their names and the type of help provided. A student's homework must not be a copy of another classmate's work.
- If students use AI tools to assist with homework or projects, they must clearly cite and acknowledge the use of such tools in the acknowledgment section, specifying the type and extent of assistance received.
- Students are permitted up to 15 late days for use on homework assignments throughout the semester; however, no assignment may be submitted more than 5 days late. Once a student has used the 15-day allowance, each additional late day will result in a 25% penalty applied to the grade for that assignment.
- Each student will review, present, and discuss a related scientific paper with the class.
- You have to submit a final project report and present it in the class. Final project will be done in groups of 2–4 students. More information will be provided during the semester.
- No late submission is allowed for the final project report.
- All students are expected to attend all paper presentations and final project presentations.
- Students' code will not be debugged during office hours or over email; they are responsible for troubleshooting their own code.

Examinations

Midterm Exam	Wednesday, Oct. 8, 2025 (in class)
Final Project Presentation/Report	Monday, Dec. 15, 2025, 8:30 – 11:00 PM (in class)

(a) Make-up exams are considered only for students who provide documentation of a compelling reason (e.g., medical emergency) before or within two days following the missing exam. There will be no make-up exams for reasons that can be within your control (e.g., pre-arranged travel or other engagements).

(b) The exam dates are subject to change. Students will be notified in a timely manner of any changes.

Grading Policy

Homework	35%
Paper Review & Presentation	10%
Midterm Exam	20%
Final Project & Presentation	35%

Grading Scale

A	[100, 90]%	**A**$^-$	(90, 85]%		
B$^+$	(85, 80]%	**B**	(80, 75]%	**B**$^-$	(75, 70]%
C$^+$	(70, 65]%	**C**	(65, 60]%	**C**$^-$	(60, 55]%
F	(55, 0]%				

Tentative Course Schedule

	Date	Topic
1	08/27	A Review of Linear Algebra
2	09/03	An Introductory Example
3	09/10	Configuration Space and Workspace
4	09/17	Rigid-Body Motion – Part 1 (Rotation)
5	09/24	Rigid-Body Motion – Part 1 (Rotation), Part 2 (Transformation)
6	10/01	Rigid-Body Motion – Part 2 (Transformation)
7	10/08	**Midterm Exam**
8	10/15	Forward Kinematics
9	10/22	Velocity Kinematics – Part 1 (Jacobian and Singularity)
10	10/29	Velocity Kinematics – Part 2 (Inverse and Statics)
11	11/05	Inverse Kinematics
12	11/12	Trajectory Planning, Kinematic Control
13	11/19	Paper Presentation 1/2
14	10/26	Thanksgiving Break
15	12/03	Paper Presentation 2/2
16	12/15	**Final Project Presentation and Report Due**

Syllabus Disclaimer

The instructor views the course syllabus as an educational understanding between the instructor and students. Every effort will be made to avoid changing the course schedule, materials, assignments, and deadlines, but the possibility exists that unforeseen events will make syllabus changes necessary. The instructor reserves the right to make changes to the syllabus as deemed necessary. Students will be notified in a timely manner of any syllabus changes via email or Brightspace announcements.

University Policies and Statements

Academic Integrity Statement

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html.

Student Accessibility Support Center (SASC) Statement

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential. Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center (SASC). For procedures and information go to Evacuation Guide for People with Physical Disabilities and search Fire Safety and Evacuation and Disabilities.

Critical Incident Management Statement

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Copyright Statement

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