

CARLETON UNIVERSITY
Department of Mechanical and Aerospace Engineering

Introduction to Robotics

Engineering MECH 4503

Winter Term: Lectures 3 hours/week

Instructor: **Professor J.Z. Sasiadek**

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Lecture Outline

Week	Topics
1	Introduction; History of robotics; Definitions and classifications; Common robots applications; Representation of robot function; Robot designs;
2	Sensors and Actuators in Robotics.
3	Spatial descriptions and transformations; Homogeneous transformations
4	Kinematics equations; Manipulators kinematics.
5	Solving kinematics equations; Inverse manipulator kinematics; Differential relationships. Jacobians.
6	Manipulator dynamics.
7	Perception. Robot's Sensors; Internal and External Sensors.
8	Motion trajectories: generation, path planning and tracking.
9-10	Control systems for manipulators; Position control of manipulators; Control laws; Practical considerations; Adaptive control of manipulators.
11	Mobile robots, Sensor fusion. Guidance, Navigation and Control (GNC) of mobile robots.
12-13	Industrial applications for robots and manipulators.

Evaluation: Midterm (20%) Projects (20%) and Final (60%)

Text Saeed B. Niku, *Introduction to Robotics - Analysis, Control, Applications*, 3-rd Edition, John Wiley and Sons 2020, ISBN 978-1-119-52762-6 E-Book 978-1-119-52760-2

Recommended Text:

Milan Sonka, *Image Processing, Analysis, and Machine Vision*, 4-th Edition, CENGAGE Learning 2014, ISBN-13: 978-1133593607

References

1. Peter Corke, *Robotics, Vision and Control*, Springer Verlag, 2020, ISBN 978-3-542-20143-1
2. Mark W. Spong, Seth Hutchinson and M. Vidyasagar, *Robot Modeling and Control*, 2nd Edition, John Wiley and Sons, 2020, ISBN 0-471-64990-8
3. Norman S. Nise, *Control Systems Engineering*, 7th edition, Prentice-Hall, 2004
4. Bruno Siciliano et al, *Robotics – Modeling, Planning and Control*, Springer, 2009
5. Reza N. Jazar, *Applied Robotics – Kinematics, Dynamics and Control*”, Springer 2007
6. J.H. Williams, Jr. *Fundamentals of Applied Dynamics*, John Wiley and Sons.
7. H.R. Everett, *Sensors for Mobile Robots: theory and application*, HBJ College Publishers.
8. Joseph L. Jones & Anita M. Flynn, *Mobile Robots: inspiration to implementation*, A K Peters, Ltd.
9. J.B. Marion, S.T. Thornton, *Classical Dynamics*, HBJ College Publishers.

Strongly suggested software

1. MAPLE 13 Software or later www.maplesoft.com
2. The Student Edition of MATLAB (version 8.0 or later) for Windows, software and book, Prentice Hall.
3. The Student Edition of SIMULINK (version 8.0 or later) for Windows, software and book, Prentice Hall.

- NOTE:**
1. In order to pass the course the students must pass the Final Examination in the course.
 2. The Final Examination is for evaluation purposes only and will not be returned to the students. The students cannot review their final exams.
 3. The schedule (date and hours) of this course may change as deemed appropriate.
 4. Any part of this course description could be changed during the first 4 weeks of the course.

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- 1) Please be aware by registering in this course you acknowledge that this course may use online proctoring tools. These online proctoring tools could require you to identify yourself via webcam. Additionally, while you are completing a proctored exam, your activities will be monitored. This could include direct observation via webcam and through the use of screen recording software.**
- 2) E-Proctoring: Please note that tests and examinations in this course will use a remote proctoring service provided by Scheduling and Examination Services. You can find more information at <https://carleton.ca/ses/e-proctoring/>.**

The minimum computing requirements for this service are as follows:

Hardware: Desktop, or Laptop

OS: Windows 10, Mac OS 10.14, Linux Ubuntu 18.04

Internet Browser: Google Chrome, Mozilla Firefox, Apple Safari, or Microsoft Edge

Internet Connection (High-Speed Internet Connection Recommended)

Webcam (HD resolution recommended)

Note: Tablets, Chromebooks and Smartphones are not supported at this time. Windows-based tablets are not supported at this time.

- 3) Any evidence of violation of Academic Integrity Policy of the Carleton University in especially during an exam or a quiz will be treated seriously. Please review this policy thoroughly at:
<https://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf>**
- 4) Due to future development of number of factors, the conditions of the in-person and/or on-line delivery of this course may change requiring adjustments to the structure, delivery and evaluation of the course, the terms outlined below should be considered as conditional. Any such changes will be announced via the course site on *Brightspace* platform.**
- 5) Particular lectures could be delivered in person or on-line but not in both modes simultaneously.**