# Introduction to Robotics

**Engineering MECH 4503**  
Winter Term: Lectures 3 hours/week

**Instructor:**  
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## Lecture Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction; History of robotics; Definitions and classifications; Common robots applications; Representation of robot function; Robot designs;</td>
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<td>2</td>
<td>Sensors and Actuators in Robotics.</td>
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<td>3</td>
<td>Spatial descriptions and transformations; Homogeneous transformations</td>
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<td>4</td>
<td>Kinematics equations; Manipulators kinematics.</td>
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<td>5</td>
<td>Solving kinematics equations; Inverse manipulator kinematics; Differential relationships. Jacobians.</td>
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<td>6</td>
<td>Manipulator dynamics.</td>
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<td>7</td>
<td>Perception. Robot’s Sensors; Internal and External Sensors.</td>
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<td>8</td>
<td>Motion trajectories: generation, path planning and tracking.</td>
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<tr>
<td>9-10</td>
<td>Control systems for manipulators; Position control of manipulators; Control laws; Practical considerations; Adaptive control of manipulators.</td>
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<tr>
<td>12-13</td>
<td>Industrial applications for robots and manipulators.</td>
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**Evaluation:** Midterm (20%) Projects (20%) and Final (60%)

**Text**

**Recommended Text:**

**References**

**Strongly suggested software**
1. MAPLE 13 Software or later [www.maplesoft.com](http://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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IMPORTANT NOTICES:

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.

May 2023