Course Outline

Instructor
- Prof. Ahmed Ashraf
  E3-504B EITC
  (204) 474–8179
  Ahmed.Ashraf@umanitoba.ca

Office Hours
- By appointment

Teaching Assistant
- Vahab Khoshdel
  khoshdev@myumanitoba.ca

Contact Hours
- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:
- ECE 4150 Control Systems
- ECE 4240 Microprocessor Interfacing

Course Website:
https://ece.eng.umanitoba.ca/undergraduate/ECE4180/

Important Dates
- Term Test
  Friday, March 1st, 2019
  6:00PM–8:00PM
- Voluntary Withdrawal Deadline
  March 20th, 2019
- Spring Break
  February 18th–22nd, 2019
No classes or examinations

ECE 4180 – Introduction to Robotics

Course Objectives
This course provides fundamental concepts of robotics, including robot classification and applications, robot kinematics, sensor and actuators, sensor interfacing, motor control, trajectory planning, basics of modeling, path planning and robot programming. Robotics is an interdisciplinary subject involving aspects of electrical, computer, and mechanical engineering, and applies mathematical techniques and algorithms to overcome automation problems. Both the theoretical aspect of robotics and real applications will be discussed and presented, including Robocup Rescue, Soccer and Humanoid robots leagues.

Course Content
The following topics will be covered:
- Actuators, Drives and Motion Controllers
- Torque, Velocity and Position Controllers
- Sensors, Transducers and filters used for Robotics
- Kinematic and Inverse Kinematic
- Modeling and Differential Equations
- Hough Transform and its applications
- Intro to Fuzzy Logic and Fuzzy sets
- Lagrangian Mechanics
- Simultaneous Localization and Mapping (SLAM)
- Autonomous Path Planning and Obstacle Avoidance
- Tele-Robotics and Virtual Reality
- Rescue Robots
- Computer vision and Object Detection
- Introduction to Machine Learning and Reinforcement Learning

Textbook

Other Resources

Academic Integrity
Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations on Academic Integrity, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Retention of Student Work
Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University’s Intellectual Property Policy and the protection of privacy provisions of The Freedom of Information and Protection of Privacy Act (Manitoba). Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.
Accreditation Details

Accreditation Units
- Mathematics: 25%
- Natural Science: 25%
- Complementary Studies: 0%
- Engineering Science: 25%
- Engineering Design: 25%

Attributes
A1: A knowledge base for engineering
A2: Problem analysis
A3: Investigation
A4: Design
A5: Use of engineering tools
A6: Individual and team work
A7: Communication skills
A8: Professionalism
A9: Impact of engineering on society/environment
A10: Ethics and equity
A11: Economics and project management
A12: Life-long learning

Competency Levels
1 - Knowledge (Able to recall information)
2 - Comprehension (Ability rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

Grading Scale

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<th>Letter</th>
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<tr>
<td>A+</td>
<td>95–100</td>
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<td>85–94</td>
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<td>70–79</td>
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<td>C</td>
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<td>D</td>
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Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Learning Outcomes
1. Understand the mechanical aspects of robots
2. Become familiar with the principle of sensors and actuators and their usages in robotics
3. Understanding of the kinematics of robots
4. Designing a simple rescue robot and testing it
5. Learning about tele-robotics and virtual reality

Expected Competency Levels

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<th>Outcome</th>
<th>A1</th>
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Evaluation
The final course grade will be determined from a student's performance in laboratories, assignments, and on examinations. Programmable calculators are not allowed in the mid-term and final examination. Students must receive a minimum of 50% on the final examination and must complete all the laboratories in order to be eligible to receive a passing grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Value (%)</th>
<th>Method of Feedback</th>
<th>Learning Outcomes Evaluated</th>
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* Method of Feedback: F - Formative (written comments and/or oral discussion), S - summative (numerical grade)

Requirements/Regulations
- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University’s General Academic Regulations, as well as Section 3 of the Faculty of Engineering Academic Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Information