Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 9513b/9153b – Robot Control

COURSE OUTLINE 2022-2023

DESCRIPTION

This graduate course presents an introduction to the design of control algorithms for robot manipulators. The objective of this course is to give a rigorous introduction into the basic tools and algorithms for control of robot motion and interaction with environment. During the course project, students will apply the methods and techniques learned to the design of control systems for specific robot manipulators.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in Electrical and Computer Engineering as well as any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

INSTRUCTOR CONTACT INFORMATION

Course instructor: Dr. Ilia Polushin, PhD
Email address: ipolushi@uwo.ca
Office: ACEB 3464
Office hours: TBA

PREREQUISITES

a) An undergraduate/graduate course in control systems (such as ECE 3330 or similar) is required.
b) Preparation in nonlinear systems/control and robotics is strongly recommended.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1.	Introduction to the course	• Lectures • Lecture slides • Additional reading material	Week 1
2.	Nonlinear Systems Background	• Lectures • Lecture slides • Additional reading materials • Help sessions (office hours)	Weeks 2-3

3.	Background on Robot Kinematics and Dynamics	• Lectures • Lecture slides • Additional reading materials • Help sessions (office hours)	Week 4
4.	Robot Motion Control	• Lectures • Lecture slides • Additional reading materials • Help sessions (office hours)	Weeks 5-9
5.	Robot Force Control	• Lectures • Lecture slides • Additional reading materials • Help sessions (office hours)	Weeks 10-11
6.	Overview and Preparation for the Final Examination	• Help/tutorial sessions (in class as well as office hours)	Week 12

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	35%	• Final Examination	• Understanding of advanced concepts and theories • Awareness of important current problems in the field of study • Understanding of computational and/or empirical methodologies to solve related problems
Research & scholarship	20%	• Project	• Ability to conduct critical evaluation of current advancements in the field of specialization • Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	30%	• Project • Final Examination	• Ability to apply knowledge in a rational way to analyze a particular problem • Ability to use coherent approach to design a particular engineering system using existing design tools
Professional capacity / autonomy	5%	• Project	• Awareness of academic integrity • Ability to implement established procedures and practices in the coursework

			• Defends own ideas and conclusions
Communication skills	10%	• Project	• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively

ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Final Examination (take-home, 12 hours)	Topic 2-5	April 12th, 2023, 9:00 am – 9:00 pm	50%
Project	Topic 2-5	April 21st, 2023	50%

ACTIVITIES IN WHICH STUDENTS MUST WORK ALONE (COLLABORATION IS NOT PERMITTED):

- Final Examination
- Performing algorithm design and simulations for the course project
- Writing course project report

REQUIRED TEXTBOOK:
There is no assigned textbook for this course. Lecture slides will be provided.

OPTIONAL COURSE READINGS:

- M. W. Spong, S. Hutchinson, and M. Vidyasagar, ``Robot Modeling and Control'', Wiley, 2005.
- R. M. Murray, Z. Li, and S. S. Sastry, ``A Mathematical Introduction to Robotic Manipulation'', CRC Press, 1994
- ``Theory of Robot Control'', C. Canudas de Wit, B. Siciliano, and G. Bastin (Eds.), Springer, 1996.
- F. Lewis, D. Dawson, and C.T. Abdallah, ``Robot Manipulator Control: Theory and Practice'', Marcel Dekker Publishing Company, New York, NY, 2003.
- R. Kelly, V. Santibáñez and A. Loría ``Control of Robot Manipulators in Joint Space'', Springer-Verlag, London, 2005.

COURSE CONTENT

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

CONDUCT

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS SERVICES

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at http://www.health.uwo.ca/.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment.

Students who are in emotional/mental distress should refer to Mental Health@Western: http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:
https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.