UNSW Course Outline

ZEIT4160 Autonomous Robots - 2024

Published on the 01 Jul 2024

General Course Information

Course Code : ZEIT4160
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Engineering and Technology
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course exposes engineering, computer science and cyber security students to the field of autonomous robotic systems. Concepts such as sensing, motion control, path planning, self-localisation and mapping will be introduced. Through hands on practical experience, students

will be exposed to state-of-the art methods for controlling robots and autonomous systems such as the robot operating system.

Course Aims

This course aims to teach students the skills needed to control the motion of mobile robots which sense and interact with their environment. At the end of the course, students should be able to apply classical approaches to sensing, motion control and path planning. Furthermore, they will be able to explain the fundamental concepts of how robots sense, navigate and move.

Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Engineering Technologist (Stage 1)
CLO1 : Describe the technologies involved in developing and operating autonomous systems	• ET1.1 : Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain
CLO2 : Explain the principles and trade-offs between different kinds of robot perception, locomotion, navigation and reasoning	• ET1.3 : In-depth understanding of specialist bodies of knowledge within the technology domain
CLO3 : Utilise the robot operating system to achieve desired robot behaviour	• ET2.1 : Application of established engineering methods to broadly-defined problem solving within the technology domain
CLO4 : Implement path planning and obstacle avoidance algorithms for mobile robots	• ET1.1 : Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain
CLO5 : Plan, design and implement algorithms and software needed to safely operate robotic and autonomous systems	• ET1.4 : Discernment of knowledge development within the technology domain

Course Learning Outcomes	Assessment Item
CLO1 : Describe the technologies involved in developing and operating autonomous systems	• Lab Assignment 1 • Final Exam • Group Project
CLO2 : Explain the principles and trade-offs between different kinds of robot perception, locomotion, navigation and reasoning	• Lab Assignment 1 • Final Exam • Group Project
CLO3 : Utilise the robot operating system to achieve desired robot behaviour	• Lab Assignment 2 • Final Exam • Group Project
CLO4 : Implement path planning and obstacle avoidance algorithms for mobile robots	• Lab Assignment 2 • Final Exam • Group Project
CLO5 : Plan, design and implement algorithms and software needed to safely operate robotic and autonomous systems	• Lab Assignment 1 • Lab Assignment 2 • Final Exam • Group Project

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+
» Safari 10+
** Internet Explorer is not recommended

** Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click here.

Log in to Moodle here.

If you need further assistance with Moodle:

For enrolment and login issues please contact:
IT Service Centre
Email: itservicecentre@unsw.edu.au
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support
Email: externalteltsupport@unsw.edu.au

Phone: (02) 9385-3331
International: +61 2 938 53331

Opening hours:
Monday – Friday 7:30am – 9:30 pm
Saturday & Sunday 8:30 am – 4:30pm

Additional Course Information

Academic Integrity and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Plagiarism undermines academic integrity and is not tolerated at UNSW. *It is defined as using the words or ideas of others and passing them off as your own, and* can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

https://student.unsw.edu.au/plagiarism

Referencing

In this course, students are required to reference following the APA 7 / Chicago NB referencing style. Information about referencing styles is available at: https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720

Study at UNSW Canberra

https://www.unsw.adfa.edu.au/study

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters
- Getting your passwords set up
- How to log on to Moodle
- Accessing the Library and other areas.

Additional Information as required

CRICOS Provider no. 00098G

The University of New South Wales Canberra.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Lab Assignment 1 Assessment Format: Individual	25%	Start Date: Not Applicable Due Date: Test: week 4; Lab assignment 1: 18/08/2024 12:00 AM
Lab Assignment 2 Assessment Format: Individual	25%	Start Date: Not Applicable Due Date: 22/09/2024 12:00 AM
Final Exam Assessment Format: Individual	30%	
Group Project Assessment Format: Group	20%	Start Date: Not Applicable Due Date: 25/10/2024 12:00 AM

Assessment Details

Lab Assignment 1

Assessment Overview

Robot Motion and Control

Course Learning Outcomes

- CLO1 : Describe the technologies involved in developing and operating autonomous systems
- CLO2 : Explain the principles and trade-offs between different kinds of robot perception, locomotion, navigation and reasoning
- CLO5 : Plan, design and implement algorithms and software needed to safely operate robotic and autonomous systems

Detailed Assessment Description

In-class Test:

- **Weight:** This test accounts for 5% of your overall grade.
- **Coverage:** It will cover content from Weeks 1 to 3.
- **Question Types:**
  - Multiple choice
  - Fill in the blank
  - Short answer
- **Total Marks:** The total marks for this test are 20.

- **Test date:** week 4

Lab Assignment 1:

- **Weight:** This assignment accounts for 20% of your overall grade.
- **Due date:**18 AUG

Submission notes

Details can be found in the assessment submission link on Moodle.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Lab Assignment 2

Assessment Overview

Path Planning

Course Learning Outcomes

- CLO3 : Utilise the robot operating system to achieve desired robot behaviour
- CLO4 : Implement path planning and obstacle avoidance algorithms for mobile robots
- CLO5 : Plan, design and implement algorithms and software needed to safely operate robotic and autonomous systems

Submission notes

Details can be found in the assessment submission link on Moodle.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Final Exam

Assessment Overview

The final exam will assess all components of the course

Course Learning Outcomes

- CLO1 : Describe the technologies involved in developing and operating autonomous systems
- CLO2 : Explain the principles and trade-offs between different kinds of robot perception, locomotion, navigation and reasoning
- CLO3 : Utilise the robot operating system to achieve desired robot behaviour
- CLO4 : Implement path planning and obstacle avoidance algorithms for mobile robots
- CLO5 : Plan, design and implement algorithms and software needed to safely operate robotic and autonomous systems

Group Project

Assessment Overview

This assessment task will give the students the ability to work on a project of their choice and extend their abilities beyond the normal class content.

Course Learning Outcomes

- CLO1 : Describe the technologies involved in developing and operating autonomous systems
- CLO2 : Explain the principles and trade-offs between different kinds of robot perception, locomotion, navigation and reasoning
- CLO3 : Utilise the robot operating system to achieve desired robot behaviour
- CLO4 : Implement path planning and obstacle avoidance algorithms for mobile robots
- CLO5 : Plan, design and implement algorithms and software needed to safely operate robotic and autonomous systems

Detailed Assessment Description

The assessment breakdown is as follows:

- Group Project Demonstration: 10% (Individual)
- Group Project Report: 10% (Group)

Only one group project report needs to be submitted per group. Peer assessments will be conducted to reflect each individual's contribution to the project.

Submission notes

Details can be found in the assessment submission link on Moodle.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

General Assessment Information

Referencing

APA 7th Edition.

Extensions and Special Consideration (School of Business, Undergraduate)
All extension requests for this course must be submitted as a Special Consideration application.

Applications should be submitted BEFORE the assessment due date.

If extenuating circumstances prevent you from submitting an application before the due date, please notify your course convenor by email and submit the application as soon as possible.

If your application is approved, the outcome may be one of the following:

- A supplementary or alternative assessment,
- An extended deadline for the assessment (note the extension granted is normally equivalent to the period of impact outlined in your supporting documentation),
- An aggregated or averaged mark derived from other comparable completed assessments.

Please note that applying for Special Consideration does not automatically mean that you will be granted additional assessment, or that you will be awarded an amended result.

Special consideration and application process: https://www.student.unsw.edu.au/special-consideration.

Late submission of assessment

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessment tasks where a penalty applies,
- capped at five days (120 hours) from the assessment submission deadline. In case of approved Equitable Learning Plan (ELP) provision, special consideration or short extension, the late penalty applies from the date of approved time extension. After five days from the original or extended deadline, a student cannot submit an assessment and a grade of 0 will be applied, and
- no permitted variation.

Students are expected to manage their time to meet assessment task submission and completion deadlines, and to apply for extensions as early as possible before the assessment task deadline.

Use of Generative AI in Assessments

You can use generative AI software in the assessments to the extent specified in the assessment instructions. Any output of generative software within your assessment must be attributed with full referencing. Generative AI software is not allowed in the final exam. If the outputs of generative AI such as ChatGPT form part of your submission and are not appropriately attributed, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

Grading Basis

Standard

Requirements to pass course

Students must achieve at least 50% overall to pass the course. Students are expected to engage actively in course learning activities and attempt all assessment requirements in the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Introduction to Autonomous Systems
	Laboratory	Robot Demonstration, Introduction to Python and Ubuntu
Week 2 : 22 July - 26 July	Lecture	Robot Localization: Odometry, IMU, and VICON
	Laboratory	Introduction to Robot Operating System (ROS)
Week 3 : 29 July - 2 August	Lecture	Robot Localization and Sensor Fusion
	Laboratory	Robot Localization
Week 4 : 5 August - 9 August	Lecture	Path Planning
	Laboratory	Robot Localization
	Assessment	This test accounts for 5% of your overall grade. It will cover content from Weeks 1 to 3. The types of questions included are: • Multiple choice • Fill in the blank • Short answer The total marks for this test are 20.
Week 5 : 12 August - 16 August	Lecture	Path Planning
	Laboratory	Path Planning
	Assessment	Lab Assignment 1 Due
Week 6 : 19 August - 23 August	Lecture	Locomotion Concepts and Mobile Robot Kinematics
	Laboratory	Path Planning
Week 7 : 9 September - 13 September	Lecture	Motion Control
	Laboratory	Motion Control
Week 8 : 16 September - 20 September	Lecture	Obstacle Avoidance
	Laboratory	Group Project
	Assessment	Lab Assignment 2 Due
Week 9 : 23 September - 27 September	Lecture	Perception (Vision)
	Laboratory	Group Project
Week 10 : 30 September - 4 October	Lecture	Robotics and AI
	Laboratory	Group Project
Week 11 : 7 October - 11 October	Laboratory	Group Project
Week 12 : 14 October - 18 October	Laboratory	Group Project
Week 13 : 21 October - 25 October	Assessment	Group Project Demonstration
	Assessment	Group Project Report Due

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

Due to military training days, no labs during the following sessions:

- **Week 8**: Wednesday, 12:00 PM - 3:00 PM

- **Week 11**: Thursday, 3:00 PM - 6:00 PM

For more information, please visit the course Moodle site.

Course Resources

Prescribed Resources

There are no compulsory textbooks for this course. All required course readings will be made available on the Course Moodle site.

Recommended Resources

Siegwart, R., Nourbakhsh, I. R., & Scaramuzza, D. (2011). Introduction to Autonomous Mobile Robots, 2nd Edition. MIT press

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Feedback is collected formally via myExperience surveys. Informal feedback will be sought mid-semester by the course convenor. Students are encouraged to provide informal feedback throughout the course to the course convenor.

Students can also provide feedback during the semester via: direct contact with the lecturer, the “On-going Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Matt Garratt		Building 21, Room 371, School of Engineering and Technology, UNSW Canberra	+61 2 5114 5150	Please email for an appointment	No	No
Lecturer	Sreenatha Anavatti		Building 17 Room 203, School of Engineering and Technology, UNSW Canberra	+61 2 5114 5116	Please email for an appointment	No	No
	Md Rafiqul Islam		Building 21, Room 370, School of Engineering and Technology, UNSW Canberra	+61 480 110 997	Please email for an appointment	No	Yes