

MTRN4110

Robot Design

Term 2, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Liao Wu	liao.wu@unsw.edu.au	9:00 am - 5:00 pm, Monday - Friday	Room 301C, Ainsworth Building J17	02-93856548

Administrators

Name	Email	Availability	Location	Phone
Ming Xuan Chua	mingxuan.chua@unsw.edu.au	9:00 am - 5:00 pm, Monday - Friday		

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

[School of Mechanical and Manufacturing Engineering](#)

[Engineering Student Support Services](#)

[Engineering Industrial Training](#)

[UNSW Study Abroad and Exchange](#) (for inbound students)

[UNSW Future Students](#)

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

Email

[Engineering Student Support Services](#) – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

[School Office](#) – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

Important Links

- [Student Wellbeing](#)
- [Urgent Mental Health & Support](#)
- [Equitable Learning Services](#)
- [Faculty Transitional Arrangements for COVID-19](#)
- [Moodle](#)
- [Lab Access](#)
- [Computing Facilities](#)
- [Student Resources](#)
- [Course Outlines](#)
- [Makerspace](#)
- [UNSW Timetable](#)
- [UNSW Handbook](#)

Course Details

Units of Credit 6

Summary of the Course

The course is aimed at developing skills on how to design and implement the capabilities of a robotic platform. It includes both theories covered in the lectures and assessed in the quizzes and practices trained in the labs and assignments. It deals with the following contents: Introduction to robot design. Mechanisms and kinematic of wheeled robots. Sensors used for the perception capabilities of the robot. Perception, including vision, applied to allow the robot to understand the context of operation. Motion planning and control of the robot in complex contexts.

Course Aims

This course enables students to explore relevant aspects of autonomous robotic systems. These include the implementation of functions such as selecting, understanding, and installing the sensing capabilities of the robot, processing of the sensor measurements for performing perception, and applying low- and high-level control processes to enable the robotic platform to operate in complex contexts.

This course allows students to apply the concepts introduced in the course, in combination with previously acquired knowledge (from subjects related to Programming, Mathematics, Control, Mechanics, Electronics), in order to solve the complex course projects that involve tasks such as the full design and implementation of a small robotic platform to give it the intelligence to operate in an unknown context. The intelligence of the platform involves performing perception tasks such as obstacle detection, mapping, planning and visualization for human interaction with the intelligent agent. All these components of the agent are implemented by the students.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localization utilising onboard sensors, navigation and path planning, for complex problem-solving	PE1.1
2. Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving	PE1.1
3. Demonstrate hands-on skills in mechatronics design, fabrication, and implementation by completing practical activities	PE2.1
4. Collaborate effectively within a team via participation in a problem-solving competition	PE3.6

Teaching Strategies

Lectures in the course are designed to cover theory and practical matters. Students are able to appreciate that the knowledge acquired in many of the previous subjects has an effective application for properly solving real problems.

Laboratory work and projects are designed to provide students with the opportunity to create a real complex robotic system.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Quiz	40%	Weeks 2, 3, 4, 5, 7, 8, 9, 10	1, 2
2. Individual Project	42%	Weeks 4, 7, 10	1, 2, 3
3. Group Project	18%	Week 12	1, 2, 3, 4

Assessment 1: Quiz

Assessment length: Up to 30 minutes

Submission notes: via Moodle

Due date: Weeks 2, 3, 4, 5, 7, 8, 9, 10

Deadline for absolute fail: N/A

Marks returned: Within 1 week of submission

There will be eight quizzes during the lectures of weeks 2, 3, 4, 5, 7, 8, 9, 10.

Each quiz is scheduled between 1:00 pm and 1:30 pm on Wednesday (the last 30 minutes of the lecture).

The examined content of each quiz will be based on the content covered in the previous week's lecture.

Each quiz will make up 5% of the overall course marks.

This is not a Turnitin assignment

Assessment criteria

Refer to the announcements

Additional details

Students should contact the lecturer well in advance if they cannot sit the quiz during the scheduled time.

Assessment 2: Individual Project

Assessment length: N/A

Submission notes: via Moodle

Due date: Weeks 4, 7, 10

Deadline for absolute fail: Five days after the due date.

Marks returned: Within 2 weeks after due date.

Three individual projects on problem-solving in robot design:

1. The first individual project (14% of the overall course marks) is on driving and perception. It will be released at 17:00 Monday Week 1 and due by 13:00 Monday Week 4. There will be a progress check (1% of the overall course marks, included in the 14%) in the lab session of Week 2;

2. The second individual project (14% of the overall course marks) is on path planning. It will be released at 17:00 Monday Week 4 and due by 13:00 Monday Week 7. There will be a progress check (1% of the overall course marks, included in the 14%) in the lab session of Week 5;

3. The third individual project (14% of the overall course marks) is on computer vision. It will be released at 17:00 Monday Week 7 and due by 13:00 Monday Week 10. There will be a progress check (1% of the overall course marks, included in the 14%) in the lab session of Week 8;

This is not a Turnitin assignment

Assessment criteria

Refer to the assignment specs and announcements.

Assessment 3: Group Project

Assessment length: N/A

Submission notes: via Moodle

Due date: Week 12

Marks returned: Within 2 weeks after the due date.

One group project (18% of the overall course marks) on problem-solving integrating all the concepts and skills learned from the course.

The group project will be released at 17:00 Monday Week 10 and due by 23:59 Sunday Week 12.

The groups will be determined before Monday Week 10 based on a survey run in Week 9.

A progress check (1% of the overall course marks, included in the 18%) will be held during the lab session of Week 10.

This is not a Turnitin assignment

Assessment criteria

Refer to the assignment specs and announcements.

Attendance Requirements

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

Course Schedule

[View class timetable](#)

Timetable

Date	Type	Content
O-Week: 23 May - 27 May		
Week 1: 30 May - 3 June	Lecture	Introduction, Locomotion, Perception
	Workshop	Assignment 1 demonstration
Week 2: 6 June - 10 June	Lecture	Localisation I
	Workshop	Assignment 1 Progress Check
Week 3: 13 June - 17 June	Lecture	Kinematics
	Workshop	Assignment 1 Help Session
Week 4: 20 June - 24 June	Lecture	Planning I
	Workshop	Assignment 2 Demonstration
Week 5: 27 June - 1 July	Lecture	Planning II
	Workshop	Assignment 2 Progress Check
Week 6: 4 July - 8 July		
	Workshop	Assignment 3 Help Session
Week 7: 11 July - 15 July	Lecture	Vision I
	Workshop	Assignment 3 Demonstration
Week 8: 18 July - 22 July	Lecture	Vision II
	Workshop	Assignment 3 Progress Check
Week 9: 25 July - 29 July	Lecture	Localisation II
	Workshop	Assignment 3 Help Session
Week 10: 1 August - 5 August	Lecture	Summary
	Workshop	Assignment 4 Progress Check

Resources

Recommended Resources

Lecture notes and assignment specifications will be available to students via Teams.

There will be no textbook required for this course. The students are suggested to read the following if they want to expand their learning:

- R. Siegwart, I. R. Nourbakhsh, D. Scaramuzza. Introduction to autonomous mobile robots. The MIT Press. Second edition. 2011.

UNSW Library website: <https://www.library.unsw.edu.au/>

UNSW Bookshop Print: <https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780262015356>

Moodle: <https://moodle.telt.unsw.edu.au/login/index.php>

Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

Example changes made based on last year's feedback include:

- Make quizzes weekly to reduce the revision workload for each quiz;
- Lower quizzes' weighting and increase assignments' weighting;
- Lower requirements on progress checks.

Submission of Assessment Tasks

Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Late policy

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For example:

- Your course has an assessment task worth a total of 100 marks.
- You submit the assessment 2 days (or part thereof) late (i.e. from 24-48 hours after the deadline).
- The submission is graded and awarded a mark of 65/100.
- A late penalty of 10 marks is deducted from your awarded mark (2 days @ 5% of 100 marks).
- Your adjusted final score is 55/100.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

1. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
2. Online quizzes where answers are released to students on completion, or
3. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
4. Pass/Fail assessment tasks.

Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations,

these are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates. For further information on exams, please see the [Exams](#) webpage.

Special Consideration

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

UNSW now has a [Fit to Sit / Submit rule](#), which means that if you attempt an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's [Special Consideration page](#).

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID-19 illness or isolation** will be required.

Special Consideration Outcomes

Assessments have default Special Consideration outcomes. The default outcome for the assessment will be advised when you apply for Special Consideration. Below is the list of possible outcomes:

Outcome	Explanation	Example
Time extension	Student provided more time to submit the assessment	e.g. 1 more week of time granted to submit a report
Supplementary assessment	Student provided an alternate assessment at a later date/time	e.g. a supplementary exam is scheduled during the supplementary exam period of the term
Substitute item	The mark for the missed assessment is substituted with the mark of another assessment	e.g. mark for Quiz 1 applied also applied as mark for Quiz 2, meaning if a student achieved a mark of 20/30 for Quiz 1 and was granted Special Consideration for Quiz 2, a mark of 20/30 would be applied for Quiz 2, etc
Exemption	All course marks are recalculated excluding this assessment and its weighting	e.g. The course has an assessment structure of: - Assignments 30%, - Lab report 30%, - Final Exam 40%. If the Lab report is missed and student is granted Special Consideration, then the assessment structure may be reweighted as follows: - Assignments 50% - Final Exam 50% as though the Lab report did not exist
Non-standard	Course Coordinator is contacted for the outcome when special consideration is granted as the outcome differs on a case-by-case basis	e.g. typical for group assessments where time extension supplementary assessment could be granted to the group member, time extension could be granted to the whole group, etc. Clarify with your Course Convenor for

Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

****T2-2022 UPDATE****

Public distancing conditions must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. No over-enrolment is allowed in face-to-face classes. Students enrolled in online classes can swap their enrolment from online to on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by [NSW health](#) or government authorities. Current alerts and a list of hotspots can be found [here](#). **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the FAQs: <https://www.covid-19.unsw.edu.au/safe-return-campus-faqs>

Guidelines

All students are expected to read and be familiar with UNSW guidelines and policies. In particular, students should be familiar with the following:

- [Attendance](#)
- [UNSW Email Address](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)

- [Academic Honesty and Plagiarism](#)

Note: This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Photo by Stephen Blake March 2017, Willis Annexe (J18) Thermofluids lab

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	✓