UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

# Course Outline

Term 2 2020

# MTRN4110

# ROBOT DESIGN

# Contents

# 1. Staff contact details

**Contact details and consultation times for course convenor**

Name: Dr Leo Wu
Tel: (02) 9385 6548
Email: liao.wu@unsw.edu.au
Moodle: https://moodle.telt.unsw.edu.au/user/profile.php?id=2321980
Microsoft Teams Video Chat Hours: 9:00 – 17:00

**Contact details and consultation times for additional lecturers/demonstrators/lab staff**

Demonstrators:

| | |
|---|---|
| Mr Zhihao Zhang | zhihao.zhang1@unsw.edu.au |
| Mr Jian Hu | jian.hu1@unsw.edu.au |
| Mr Daniel Latimer | d.latimer@unsw.edu.au |
| Mr Leigh Huang | leigh.huang@unsw.edu.au |
| Ms Antonia Workman | a.workman@unsw.edu.au |
| Mr Yuen Chan | y.t.chan@student.unsw.edu.au |

Please see the course Moodle.

# 2. Important links

- Moodle
- Lab Access
- Health and Safety
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering

# 3. Course details

**Credit points**

This is a 6 unit-of-credit (UoC) course and involves 4 hours per week (h/w) of scheduled online contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 12.5 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

**Contact hours**

| | Day | Time | Delivery Mode |
|---|---|---|---|
| **Lectures** | Monday | 10:00 – 12:00 | Microsoft Teams Recorded Lectures |
| | | | |
| **Demonstrations** | Tuesday | 12:00 – 14:00 | Microsoft Teams Chat Channel |
| | Thursday | 12:00 – 14:00 | Microsoft Teams Chat Channel |
| | | | |

All classes in T2 2020 will be online. Please consult this course's Moodle module for details about delivery.

**Summary and Aims of the course**

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.

**Student learning outcomes**

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

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 localisation using onboard sensors, navigation and path planning, for practical problem-solving | PE1.1 |
| 2. | Apply computer vision techniques for feature/object detection and tracking in complicated environments | PE1.1 |
| 3. | Demonstrate practical skills in mechatronics design, fabrication, and implementation | PE2.1 |
| 4. | Demonstrate teamwork skills relevant to team-based projects | PE3.6 |

## 4. 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.

## 5. Course schedule

| Week | Topic | Delivery Mode | Suggested Readings |
|---|---|---|---|
| 1 | Introduction, Locomotion, Perception | Online | Moodle lecture notes |
| 2 | Localisation I | Online | Moodle lecture notes |
| 3 | Planning I | Online | Moodle lecture notes |
| 4 | Vision I | Online | Moodle lecture notes |
| 5 | Vision II | Online | Moodle lecture notes |
| 6 | Flexibility Week | | |
| 7 | Kinematics | Online | Moodle lecture notes |
| 8 | Localisation II | Online | Moodle lecture notes |
| 9 | Planning II | Online | Moodle lecture notes |
| 10 | Summary | Online | Moodle lecture notes |

# 6. Assessment

## Assessment overview

| Assessment | Group Project? (# Students per group) | Length | Weight | Learning outcomes assessed | Assessment criteria | Due date and submission requirements | Deadline for absolute fail | Marks returned |
|---|---|---|---|---|---|---|---|---|
| Quiz (8) | No | Up to 10 questions | 45% | 1 and 2 | Weekly lecture material | 0:00 - 24:00 Friday of week 1 - 5, 7 - 9 | N/A | One week after submission |
| Individual assignment (3) | No | Source code | 45% | 1, 2, and 3 | Refer to assignment specifications provided via Moodle for exact details | 17:00 Sunday of week 3, 6, 9 | 100 hours later | One week after assessment |
| Group assignment | Yes | Source code and presentation | 10% | 1, 2, 3, and 4 | Refer to assignment specifications provided via Moodle for exact details | 17:00 Sunday of week 11 | 100 hours later | Upon release of final results |

## Assignments

*Presentation*

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.

*Submission*

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) 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.

Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item.

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:

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

*Marking*

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.

## Special consideration and supplementary assessment

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.

**Please note** that 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.

## 7. Expected resources for students

Lecture notes, tutorials, and assignment specifications will be available on Moodle in advance before the class.

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

## 8. 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.

In this course, recent improvements resulting from student feedback include:

- more tutorials provided to students
- more clarification on the assignments.

## 9. 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

## 10. Administrative matters and links

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

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

# Appendix A: Engineers Australia (EA) Competencies

*Stage 1 Competencies for Professional Engineers*

| | **Program Intended Learning Outcomes** |
|---|---|
| **PE1: Knowledge and Skill Base** | PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals |
| | PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing |
| | PE1.3 In-depth understanding of specialist bodies of knowledge |
| | PE1.4 Discernment of knowledge development and research directions |
| | PE1.5 Knowledge of engineering design practice |
| | PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice |
| **PE2: Engineering Application Ability** | PE2.1 Application of established engineering methods to complex 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 |
| **PE3: Professional and Personal Attributes** | PE3.1 Ethical conduct and professional accountability |
| | PE3.2 Effective oral and written communication (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 |