



Faculty of Engineering

**DESN1000**  
**ENGINEERING DESIGN**  
**AND INNOVATION**

**Course Outline**  
2022 Term 1

Course Convenor  
Ilpo Koskinen

This outline informs you how this course will be run.

### If you need more help...

Before the course starts, ask at the [Nucleus](#).

Once you are enrolled, the [Moodle](#) Learning Management site has more specific information for this course

## Quick-start To-Do List

### Week 0 (O-Week)

- Read this course outline
- Check you can access the course site on [Moodle](#)
- Prepare to attend the first lecture on Monday 14/02 from 2:00 – 5:00 pm.
- Research availability of reference text: Dym et al. *Engineering Design*.
- [Install Office 365 using your free UNSW license](#)
- [Familiarise yourself with Microsoft Teams](#)

### Week 1

#### Monday, 14/02

2:00 – 5:00 pm Attend the first lecture online via [Teams](#): introducing this course and the available projects. After the lecture, select your project for the term using the tool on [Moodle](#).

#### Thursday, 17/02

2:00 – 5:00 pm Participate in the *Impromptu Design Day*. After the session, complete the *Reflective Writing Assessment Task*, worth 5% of your final grade. More information on [Moodle](#).

### Weeks 2 to 10

#### Monday and Thursday

2:00 – 5:00 pm From week 2 your class activities will be determined by your selected project. Please refer to your project-specific section on [Moodle](#) for more information. Your selected project will determine class activities.

# 1. Course Staff

---

This course is coordinated jointly by the Faculty of Engineering and Design Next. Academic staff from various Engineering Schools coordinate specific Projects and Technical streams within the course.

Faculty	Convenor contacts
Design Next	Prof Ilpo Koskinen Dr Nicholas Gilmore Dr Arianna Vignati <a href="mailto:designnext@unsw.edu.au">designnext@unsw.edu.au</a>

---

Projects	Coordinator contacts
Autonomous Container Delivery	Matthew Priestley - <a href="mailto:m.priestley@unsw.edu.au">m.priestley@unsw.edu.au</a>
Bionic Hand	Michael Stevens - <a href="mailto:michael.stevens@unsw.edu.au">michael.stevens@unsw.edu.au</a>
Bridge to Share	Darson Li - <a href="mailto:darson.li@unsw.edu.au">darson.li@unsw.edu.au</a>
Mars Rover	Binghao Li - <a href="mailto:binghao.li@unsw.edu.au">binghao.li@unsw.edu.au</a>
Project EV	Peter Neal - <a href="mailto:peter.neal@unsw.edu.au">peter.neal@unsw.edu.au</a>
Renewable Energy from Waves	Mitch Harley - <a href="mailto:m.harley@unsw.edu.au">m.harley@unsw.edu.au</a> Ian Turner - <a href="mailto:ian.turner@unsw.edu.au">ian.turner@unsw.edu.au</a>
Soccer Droids	Michael Schofield - <a href="mailto:michael.schofield@unsw.edu.au">michael.schofield@unsw.edu.au</a>
Shock-proof Buildings	Wei Gao - <a href="mailto:w.gao@unsw.edu.au">w.gao@unsw.edu.au</a>
Solar Raceway	Ziv Hameiri - <a href="mailto:z.hameiri@unsw.edu.au">z.hameiri@unsw.edu.au</a>
Surveying with Triangles	Yi Liu - <a href="mailto:yi.liu@unsw.edu.au">yi.liu@unsw.edu.au</a>
The Purple House	Lucy Marshall - <a href="mailto:lucy.marshall@unsw.edu.au">lucy.marshall@unsw.edu.au</a>

---

## 2. Course Information

---

Units of credit: 6 UOC

Prerequisite(s): None

### 2.1 Course summary

In this course, you will experience first-hand one of the major things that engineers do: designing and building creative solutions to problems. You will learn to think the way that engineers think, coming up with good solutions to problems despite being limited by budget, time and resources, the requirement to also meet environmental and social objectives and, of course, the limitations of the laws of physics. This will help you appreciate engineering design's central ideas as an on-time, on-budget and fit for purpose solution to a poorly specified, open-ended problem.

You will start to build critical skills for engineers that will be called upon repeatedly in your academic and professional lives, including concept development, critical thinking and evaluation skills, clear communication, research and information literacy skills and the skills involved in successfully functioning within a team environment to complete a given task.

A key part of the course is a design project. You will select one project from the ones offered in the Faculty of Engineering. Once you've joined a project, you will be assigned to a team of around 5-6 students. With this team, you will work to practically solve your design problem.

Your team must also ensure that it has enough technical skills to complete the project. Some projects will offer a selection of Technical Streams to select from week 2 onwards.

Common Faculty-wide activities and assessments will complement this project-specific work. Further, the Faculty ensures that all project-specific work achieves the same learning outcomes. Any differences in assessments and learning activities between projects are reviewed to ensure equivalence.

### 2.2 Course aims

This course aims to make you familiar with the process of engineering design and the use of design methods for: (1) defining an open-ended design problem; (2) generating alternative conceptual solutions; (3) evaluating these solutions and implementing them. We also want to give you opportunities to develop your professional skills, such as technical writing, public speaking, teamwork and project management.

### 2.3 Relationship with the rest of your program and the discipline

This course looks at what it means to be a design engineer. You will see the big picture and how all your studies, such as mathematics and science, fit together. It will also look at some of the non-technical issues which are just as vital to a successful engineering career.

You will study and experience Engineering Design as a multi-faceted activity, which requires considerable creativity, as well as judgement, decision making and problem-solving skills. You will see the need to take context into account and be able to complete design projects on time and within budget. The problem solving and project management skills that you learn in this course will be invaluable for later courses in your degree, in your career and for life in general.

The following table explains how DESN1000 is designed to align with Engineers Australia's Stage 1 Competencies. These are the Program Learning Outcomes for the Bachelor of Engineering (Honours).

<b>Course Learning Outcome (CLO)</b>	<b>At the successful completion of this course, you should be able to:</b>	<b>Engineers Australia Stage 1 Competencies</b>
CLO1	Demonstrate a systematic approach to design in response to a specified set of project requirements.	1.5, 2.1, 2.2, 2.3, 2.4, 3.3
CLO2	Test the suitability of designs using analytical and practical validation methods pertinent to the project.	1.5, 2.1, 2.2, 2.3, 3.3
CLO3	Apply foundational technical theory and skills to a design project.	1.1, 1.3, 2.1, 2.2, 2.3
CLO4	Demonstrate the attributes of an effective team member, including the use of basic organisational and interpersonal tools.	2.4, 3.3, 3.4, 3.5, 3.6
CLO5	Use foundational project management techniques to plan, execute and complete a design project.	2.4, 3.3, 3.4, 3.5, 3.6
CLO6	Explain designs using oral, written and visual forms of professional communication within the project context.	2.5, 3.4, 3.5, 3.6

## 2.4 Course evaluation and development

Engineering Design is a team effort, and we are particularly interested in your feedback. We want your suggestions of what is good and should be retained, and what is not so good and should be improved (with ideas on how to do it).

In addition to the standard UNSW Course and Teaching Evaluation and Improvement (myExperience) surveys, we will be asking for your feedback in other ways during the course. Do make attempts to communicate constructive feedback to your lecturers. Feedback on individual tasks is often requested during the course.

## 3. Strategies and Approaches to Learning

---

### 3.1 Learning philosophy

This course is, first and foremost, an exercise in experiential learning, with emphasis on reflection on the design process. You will work together in teams to design a solution to a specified but open-ended problem. This project will be supported with a variety of additional student experiences to help you acquire individual and group skills in areas needed for communicating the design, including graphical representation, collaboration, report writing and any necessary discipline-specific knowledge.

### 3.2 Learning and teaching activities

Teaching in this course is centred on the project. For example, you will develop communication skills by communicating about the project; you will develop teamwork and project management skills in the context of your project team, and you will experience the kinds of technical problems resolved by engineers in your selected project area. How this will work out in detail will depend upon the project. You will receive a separate handout describing this once you have finalised your choice. If you want to see details earlier, refer to the Moodle site for this course.

### 3.2 Expectations of students

#### Integrity and Respect

The [UNSW Student Code of Conduct](#) among other things, expects all students to demonstrate integrity in all the academic work and to treat all staff, students and visitors to the University with courtesy, tolerance and respect.

#### Time commitment

UNSW expects students to spend approximately 150 hours to successfully complete a 6 UOC course like DESN1000. Since there is no final exam, this translates to approximately 12-15 hours per week of work for this course. We expect 60 hours to be spent participating in face-to-face classes, with the remaining 90 hours spent collaborating with your teammates outside of class time and in private study.

#### Participation

When you attend classes (whether those are delivered face-to-face or online), we expect you to actively participate in the activities organised. This may mean listening, taking notes, asking questions or engaging in peer discussions. It may also mean working by yourself or in groups on tutorial exercises.

To complete the design project, you are required to work in a team. We expect all team members to agree on how they will manage the team (e.g. making and documenting decisions), to assign the project work equitably and contribute to the delivery of project outputs to the best of their ability. If this is not feasible, discuss this with your mentor as soon as possible. Low or no participation in your team may lead to some or all of your team marks to be removed.

Students are expected to contribute to online discussions through the course forum on Moodle and your project's Microsoft Teams instance. You may wish to discuss challenges faced through this course, ask questions about course content, and discuss solutions to project challenges.

#### Attendance and punctuality

We expect students to be punctual and attend all lectures, mentor meetings and classes. While exceptions may be made for special circumstances, we do expect University commitments to take precedence over regular work activities, holidays etc. If you miss a class, you should catch up in your time. Lectures will be recorded and made available through Teams and/or Moodle.

## 4. Course Schedule and Structure

### 4.1 Teaching times and locations

In general, you will have DESN1000 classes on Mondays and Thursdays from 2 to 5 pm.

At 3 pm on Monday of Week 2, you will attend your first project-specific class. The details of this class will be available via your project-specific section in [Moodle](#) and a project-specific Microsoft Team. Make sure to check these details before the end of Week 1. Most of your classes will be online, although some projects may allow for some workshop time in [UNSW Makerspaces](#).

### 4.2 Course Schedule

**Blue items** are faculty-wide activities completed by every DESN1000 student. They consist of common lectures and the Impromptu Design Day. **Yellow items** are activities determined by your selected Project or Technical Stream. Your Project Coordinator (see 1. Course Staff) will provide additional details and a schedule once you have selected your project during week 1. Importantly, this generic schedule is superseded by the schedule provided by your Project Coordinator.

Week	Monday 2 – 5pm	Thursday 2- 5pm
1	<b>Common lecture</b> An overview of the course and introduction to projects offered, followed by a briefing for the Impromptu Design Day	<b>Impromptu Design Day</b> A team-based rapid prototyping design challenge, followed by a reflective writing assessment task.
2	<b>Common lecture</b> – Teamwork and project management Project activities	<b>Common lecture</b> – Problem definition and requirements Project or technical stream activities
3	<b>Common lecture</b> Conceptualisation and oral presentation skills Project activities	Project or technical stream activities
4	<b>Common lecture</b> – <i>Report writing</i> Project activities	Project or technical stream activities
5	<b>Common lecture</b> – Testing and verification Project activities	Project or technical stream activities
6	<i>Revision week</i>	
7	Project activities	Project or technical stream activities
8	Project activities	Project activities
9	Project activities	Project activities
10	<i>Public holiday</i>	Project activities

## 5. Design Projects

---

### 5.1 Introduction

We want you to experience the engineering design process as well as hear about it and reflect upon it. So, in this course, you will learn by doing; by working on tasks connected with a project.

Performance of your design will be a critical part of the assessment; the other marks will be awarded for the process (what you do) and your reflection (thinking about and showing that you have understood what you do).

### 5.2 Range of Projects and Project Selection

After the Week 1 Monday lecture, the next step is to review the 1-page project descriptions available on [Moodle](#). This information complements the project pitches provided in the common lecture on the Monday of Week 1.

Projects fall within the topic areas listed below. Some areas have more than one project. You may select any of the projects independently of your preferred field of study.

Project title(s)	Engineering topic areas
Autonomous Container Delivery	Computing, Electrical, Mechanical
Bionic Hand	Biomedical, Mechanical
Bridge to Share	Mechanical
Mars Rover	Computing, Electrical, Mechanical
Project EV	Chemical, Renewable Energy, Mechanical, Electrical
Renewable Energy from Waves	Environmental, Renewable Energy, Civil
Soccer Droids	Computing, Electrical, Mechanical
Shock-proof Buildings	Civil, Mechanical
Solar Raceway	Photovoltaic, Renewable Energy, Mechanical, Electrical, Computing
Surveying with Triangles	Civil, Environmental
Purple House	Environmental, Humanitarian, Chemical, Mechanical, Electrical

All projects are subject to quotas, so complete your project selection as soon as the tool opens to secure your preferred project. Be sure of your preferred project before committing to it, as selections cannot be changed after the deadline.

**The project selection tool opens: Monday Week 1, 14/02 at 9pm.**

**The project selection tool closes: Wednesday Week 1, 16/09 at 6pm.**

For exceptional circumstances, you may [contact the course convenor](#).



## 6. Assessments

### 6.1 Assessment tasks

DESN1000 has been designed to ensure equivalence and alignment between the various projects offered in this course. Each project operates within an agreed framework of assessments, as indicated in the following table. Full details of each project's specific assessment activities and their weightings are provided in the project outlines available on the Moodle site after the project has been selected. You are encouraged to preview these and download them for future reference.

Task	Weight	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
<b>Impromptu Design - Reflective Writing</b> Due Week 2, Thursday at 5:00 pm	5 %	+			+		+
<b>Engineering Design Process (EDP)</b> Due Week 4, Sunday at 11:59 pm	15 %	++	++	++	+	++	++
<b>Project assessments</b> Consult your project outline and coordinator for a detailed breakdown.	60 %	++	++	++	++	++	++
<b>Technical stream assessments*</b> Consult technical stream guide and coordinator for a detailed breakdown.	20 %	+	+	++		+	+

*\*Some projects will not include a technical stream, and instead have 80% project assessments.*

### 6.2 Assessment criteria and standards

The marking rubrics used in DESN1000 will be provided separately on Moodle. Students should familiarise themselves with these rubrics well before the assessment due date. Because of differences between each Project's specific learning and assessment activities, it may be necessary to moderate/adjust marks (up or down) to ensure fairness. This will be undertaken after all the results are available at the end of the semester and done by a representative panel of the Faculty.

Note that for team submissions, marks for individual team members may be adjusted to account for their level of contribution towards the submission. For this purpose, project coordinators may use team evaluations and mentor insights to gauge individual students' level of participation.

### 6.3 Submission of assessment tasks

Most assessments will be submitted through Moodle. Presentations are generally given in front of other groups in class, a live virtual meeting, or are submitted as a video. Submission of testing assessments is dependent on your project, and not all projects will facilitate online delivery modes. Specific submission details for each assessment will be provided separately on Moodle.

### 6.3 Requests for special consideration

There are no formal examinations in this course. However, if you find that your performance in an assessable component has been significantly affected by illness or other unexpected circumstance, then you should make an application for special consideration as soon as possible by visiting the [Nucleus Student Hub](#). Talk to the project/course coordinator too. Note that consideration is not granted automatically and often requires an application to be lodged ahead of an assessment due date.

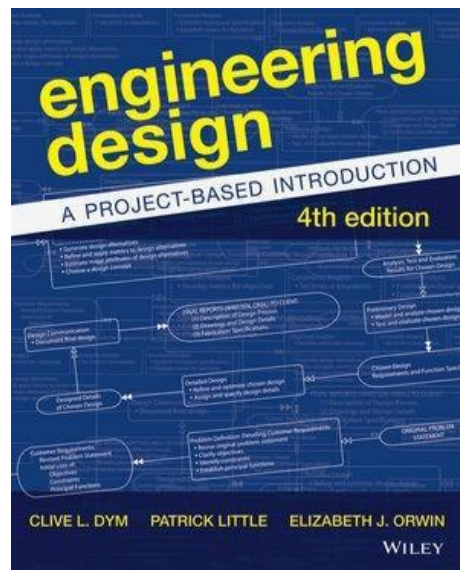
### 6.4. Feedback on assessment

You will receive feedback on you and your team's performance in many ways throughout this course. Sometimes it may be written, other times verbal comments. The use of rubrics also provides students with guidance on how they well they are performing in the course. In addition to feedback from the teaching staff, from time to time, you will also receive feedback from your peers – particularly your teammates.

## 7. Additional information

### RESOURCES

The recommended text for this course is:



Dym, Clive L., Little, Patrick., Orwin, Elizabeth J.  
*Engineering Design: A Project Based Introduction.*

You should have access to a copy as it provides a useful reading on several relevant topics throughout your degree. It is available as a text and as an accompanying eBook from the UNSW Bookshop. There are copies available for purchase from the University Book Store and available in the University Library Reserved Collection. The coordinator of your selected project will tell you if alternative or additional textbooks are recommended. References specific to a particular project are given in the School outlines that will be supplied after you have finalised your decision and may be previewed on the Moodle site for this course.

#### Online resources:

Moodle and Microsoft Teams will be used to disseminate teaching materials. Assessment marks will also be made available via Moodle: <https://moodle.telt.unsw.edu.au/login/index.php>.

### ASSESSMENT SUBMISSION AND MARKING CRITERIA

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.

### PENALTIES

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:

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.

### **SPECIAL CONSIDERATION & SUPPLEMENTARY EXAMINATION**

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.

### **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](http://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:

<http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf>

### **DATES TO NOTE**

Refer to MyUNSW for Important Dates available at: <https://student.unsw.edu.au/dates>

## 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.

## GENERAL CONDUCT & BEHAVIOUR

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

## HEALTH, SAFETY & ON-CAMPUS CLASS ATTENDANCE

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 a limited number of on-campus classes by Sunday, Week 1, if available. 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. 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>

## COURSE IMPROVEMENT

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the online student survey myExperience.

You can also provide feedback to your student society who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods including updated lecture notes, workshops, blended learning resources, in-class demonstrations, and industry guest lectures.

## ADMINISTRATIVE MATTERS AND LINKS

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](#)
- [Moodle](#)
- [Faculty Transitional Arrangements for COVID-19](#)
- [UNSW Timetable](#)
- [UNSW Handbook](#)
- [Equitable Learning Services](#)

## **EQUITY AND DIVERSITY**

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

## **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 A: UNSW Graduate Capabilities**

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.
- Developing digital and information literacy and lifelong learning skills through assignment work.

## Appendix B: Engineers Australia (EA) Competencies

### Stage 1 Competencies for Professional Engineers

	<b>Program Intended Learning Outcomes</b>
<b>PE1: Knowledge and Skill Base</b>	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
<b>PE2: Engineering Application Ability</b>	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
<b>PE3: Professional and Personal Attributes</b>	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

## Project Description



### PROBLEM DESCRIPTION

A mining company needs to transport important fragile equipment from the storage-zone to the working-zone of a mine. At present, they are using drivers with freight trucks to perform this role. However, a company engineer has forecasted that switching to an autonomous freight vehicle will reduce the risk for accidents. Hence, the engineer wants to showcase this idea to their company's executive team. Your team has been contracted by the company engineer to create a scaled prototype of an autonomous freight vehicle. This prototype will be used to explain to the executive team how an autonomous vehicle could be used to transport fragile freight. Note that these stakeholders do not have engineering backgrounds and hence require an entertaining prototype experience. Therefore, you have decided to use an egg to represent the fragile mining equipment as this will provide entertainment upon failure.



As per Figure 1, the aim of the project is to prove that the prototype vehicle can:

1. Pick up an egg from the storage container in the starting area without breaking it and hold the egg for at least 3 seconds.
2. Travel from the storage zone to the drop-off zone and stay within the bounds of the road.
3. Autonomously detect where the drop-off zone container is and stop next to it.
4. Deposit the egg into the drop-off container without breaking it.
5. Automatically detect an obstacle (like a hand in front of it) and stop before a collision occurs. This simulates a pedestrian running out in front of the vehicle.

For the scaled model, we know that the container will be around 3 m away (but not exactly) from the storage zone. Note that you will be presenting the prototype to the company engineer (who is played by a UNSW academic) in Week 10 to showcase its functionality.

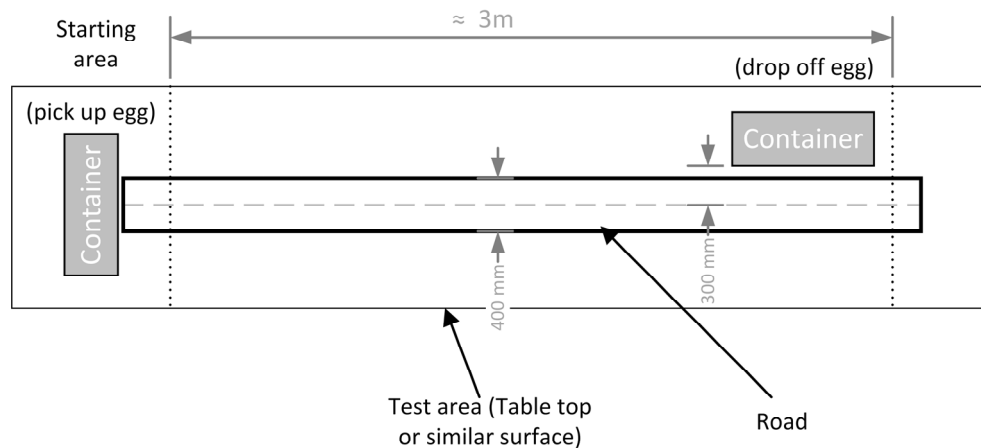


Figure 1. Testing area (top view), not to scale.





School of Electrical Engineering and Telecommunications

Term 1, 2022

Project Brief – Autonomous Container Delivery (ACD)

# DESN1000 Introduction to Engineering Design and Innovation

## PROJECT SUMMARY

### Project Staff

Project coordinator: Dr. Matthew Priestley, Building G17, Room EE314, [m.priestley@unsw.edu.au](mailto:m.priestley@unsw.edu.au)

### Project Timetable

Project learning activities and important assessment dates are detailed in the ACD Project Timetable document in the ACD Project Overview section of Moodle. You need to be familiar with the timetable as it will tell you where and when the lectures and laboratories are being conducted.

## INTRODUCTION

Today, autonomous delivery of large industrial goods is technically feasible and becoming a reality in mines ([Mining video](#)), ports ([Port video](#)) and warehouses ([Warehouse video](#)). In this project, we will build our own autonomous vehicles, learn about some of their basic electric principles, and have plenty of fun on the journey.

## PROBLEM DESCRIPTION

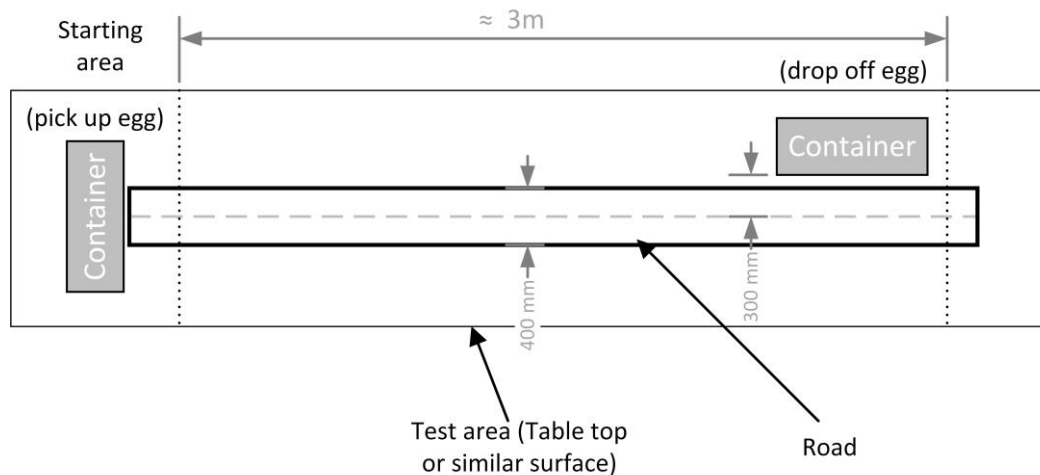
A mining company needs to transport important fragile equipment from the storage-zone to the working-zone of a mine. At present, they are using drivers with freight trucks to perform this role. However, a company engineer has forecasted that switching to an autonomous freight vehicle will reduce the risk for accidents. Hence, the engineer wants to showcase this idea to their company's executive team. Your team has been contracted by the company engineer to create a scaled prototype of an autonomous freight vehicle. This prototype will be used to explain to the executive team how an autonomous vehicle could be used to transport fragile freight. Note that these stakeholders do not have engineering backgrounds and hence require an entertaining prototype experience. Therefore, you have decided to use an egg to represent the fragile mining equipment as this will provide entertainment upon failure.

The aim of the prototype is to prove that the vehicle can take an egg from the storage-zone to the working zone and then deposit the egg into a container. For the scaled model, we know that the container will be around 3 m away (but not exactly) from the storage zone. The company engineer has informed that the vehicle must travel along a road autonomously and must not traverse outside of the road area. Note that you will be presenting the prototype to the company engineer (who is played by a UNSW academic) in Week 10 to showcase its functionality.

## DETAILS OF TEST CONDITIONS

Using the testing setup in **Figure 1**, the autonomous container delivery (ACD) prototype must be able to:

1. Once the start button has been pressed, the vehicle must autonomously pick up an egg from the first container. Note that the vehicle will start right next to the container here.
2. The vehicle must then travel to the second container and drop off the egg in this container.
3. The egg must stay intact for the duration of the journey. You will be penalized for destroying the egg and will need to clean it up.



**Figure 1.** Testing area (top view), not to scale.

Your prototype must satisfy the following constraints:

- Your vehicle must comprise of only one physical system. For example, you cannot have multiple cars here.
- As a team you are restricted to spending no more than \$100 on materials for the system as presented for testing (development costs do not need to be included in this total). Note that you may be asked for receipts to prove the cost of your design.
- The system must begin completely behind the start line of the storage zone, behind which manual adjustments/interventions/operations are allowed before beginning the test attempt. There must be a “go” button or switch, which initiates system operation.
- The system must operate autonomously (automatically), i.e., without any manual intervention: once the “go” button has been pressed, no manual adjustment/intervention/operation is allowed.
- Your vehicle must stay within the bounds of the road according to Figure 1. Note that you are allowed to add anything you need to the road system to help achieve this requirement as long as the \$100 material cost limit is not exceeded.
- Each group will be given a container with the same dimensions to use for testing.
- The distance between the storage-zone and working-zone will be an arbitrary distance around but not equal to 3 m.
- The vehicle must have a wheelbase no wider than 200 mm.

Note that there are also additional features that will further impress the company engineer and result in extra marks. These features are listed in the next section.

## FINAL ACCEPTANCE TESTING ASSESSMENT

Your prototype will be assessed during the final acceptance testing day in week 10. Note that the final acceptance testing contributes 15% to your final course grade.

Your vehicle **must** adhere to the specifications outlined in **Table 1**. Not adhering to these specifications, will result in your team receiving less than 50% for the final acceptance testing assessment component.

**Table 1.** Required Specifications to Pass the Final Acceptance Testing assessment.

Required Features
The width of the vehicle is less than 200 mm, and the length is less than 300 mm.
The cost of the prototype and materials is less than \$100.
Your vehicle must comprise of only one physical system.

The final acceptance test grade is divided into four components according to **Table 2**.

**Table 2.** Final Acceptance Testing Assessment Breakdown.

	Important Specifications	Additional Features	Innovation Score	Aesthetic Score
Weighting	60%	20%	10%	10%

**Innovation Score**

This will be subjectively determined by the panel of judges based on the uniqueness of your design in comparison to the other entries. In general, this is related to the way in which you utilize technology to perform the primary functions of the design and the degree of difference between your solution and the other competitors. It is also related to the simplicity and elegance of your solution (simpler systems are cheaper to manufacture). Here, you will receive a score from 1-10 where 10 is most innovative and 1 is the least innovative.

**Aesthetic Score**

This will be subjectively determined by the panel of judges based on the visual attractiveness, use of a theme or visual novelty. Here, you will receive a score from 1-10 where 10 is aesthetically appealing and 1 is not aesthetically appealing.

**Important Specifications**

The important specifications are listed in **Table 3**. Note that a ‘pass’ is 10% and a ‘fail’ is 0% per specification. Since there are six important specifications, this table sums to 60% if a pass is achieved for all specifications.

**Table 3.** List of important specifications.

Important Specifications	Pass or Fail
The vehicle can be dropped from a 1.5 m height onto the ground (wheels first) and is able to drive forward after this test. Ten seconds of maintenance is allowed after the drop test. However, no external items (like tape, new components, etc.) may be added to the car during this time.	
The vehicle can pick up an egg from the storage zone container without breaking it and can hold the egg for at least 3 seconds.	
The vehicle can travel from the storage zone to the drop-off zone and will stay within the bounds of the road.	
The vehicle can autonomously detect where the drop-off zone container is and will stop next to it.	
The vehicle can deposit the egg into the drop-off container without breaking it.	
The vehicle can automatically detect an obstacle (like a hand in front of it) and stop before a collision occurs. This simulates a pedestrian running out in front of the vehicle.	

**Additional Features**

The additional features have different weightings depending on their importance to the company engineer. These weightings will be used to scale the ‘additional features’ mark. The additional features and their weightings are given in **Table 4**.

**Table 4.** List of additional features.

Additional Features	Weighting	Pass or Fail
Team arrives on-time to their session within ± 1 minute.	Low	
An LED circuit has been used to show a green light when moving and a red light when waiting for the egg.	Low	
No connection to or programming of the Arduino is required during testing session. Vehicle comes in ready to go.	Medium	
The vehicle is in the top five fastest teams to perform delivery of an egg from the start line to the container without breaking the egg.	Medium	
The vehicle makes a beeping sound from a speaker when it is reversing. This should sound like a truck reversing.	Medium	

A demonstration of project risk minimization has been shown. These risks are real, plausible risks that are likely to occur and could jeopardize success for the project team.	High	
The vehicle can go backwards autonomously to pick up another egg and then can take this egg back to the drop-off container and deposit it. No interaction with the vehicle is allowed and the vehicle must switch to the backwards operation mode by itself.	High	
Any other creative feature that aids in the demonstration of the prototype to the company engineer.	Depends on the Feature	

## FINE PRINT

Any materials may be considered for use. However, no toxic or dangerous materials will be allowed. Use of remote controls is not permitted.

## ELIGIBILITY

The prototype system must be designed and built by engineering students registered in ENGG1000, without the help of either design or construction from anyone not registered in the course. Staff, students or university technicians may be used as consultants for specific information.

## TESTING PROCEDURE

The final testing of the systems will be conducted in a competition on **Thursday 21<sup>st</sup> April from 2:00-5:00 pm during Week 10**. The likely location of the testing is **Room EE202**.

You will be given two attempts to demonstrate your system. You will only be given 11 minutes to showcase the prototype and perform these attempts. It is strongly advised that teams do not plan to make modifications between attempts. No equipment will be provided to do so. You may wish to bring any tools and materials to make running repairs if necessary.

## GROUP ORGANIZATION

The group of 6 must be sub-divided into two or three sub-groups of 2-3. Your group must elect a leader and at least one note-taker<sup>1</sup> by the start of the first mentor meeting in **Week 2**. The members and purpose of each sub-group should be decided (by the team) by the end of this first mentor meeting as well. A suggested approach for determining the purpose of each sub-group is to come up with a conceptual design that breaks the overall problem into two or more sub-problems, which are then allocated to the sub-groups.

## Materials and Suppliers

The following suppliers of materials may be useful:

- Bunnings Randwick (Clovelly Road & Kemmis St, Randwick)
- Bunnings Eastgardens (140-148 Denison St, Hillsdale)
- Bunnings Alexandria (8/40 Euston Rd, Alexandria)
- Sunlite Mitre 10 (452 Oxford St, Bondi Junction)
- Jaycar Electronics (366-370 Botany Rd, Beaconsfield)
- Jaycar Electronics (125 Bronte Rd, Queens Park)
- Hobbyco (Shop 50/53 Queen Victoria, Building Level 2 & 3/455 George St Sydney)

An electronics starter kit of components will be supplied to each group in the **Week 2** lab. Note that these components will be used for the electrical technical stream labs. A limited range of electronic components (e.g., integrated circuits, transistors, diodes, LEDs, but not motors and not unusual or very specific components) will be available from the EE&T Electronics Workshop (EEG15). You can purchase these components from this workshop (so bring money). You are strongly advised to purchase your own prototyping board (or "breadboard"). These can be conveniently purchased from the Electrical Engineering School Office for \$15.

<sup>1</sup> All team members should be taking their own notes anyway. The team note-taker should be certain to record all decisions, tasks, times/dates and other key information.

Teams wishing to purchase other electrical equipment may consider trying Jaycar. Hobbyco may have some helpful materials and components. Online suppliers like Dick Smith, Little Bird Electronics or the locally based Oatley Electronics might be helpful.

This listing of materials and suppliers is not intended to be exhaustive nor even comprehensive. Rather, it is to provide your team with ideas that they may wish to follow up on. Neither the mentors nor the Course Coordinator can provide any information beyond that contained here.

It is quite likely that not all team members will have contributed equally towards covering expenses. It is therefore up to the team to decide how these costs are covered. It is strongly recommended that each team member makes an equal financial contribution.

## TECHNICAL STREAMS

There are three technical streams associated with the ACD project. These are:

- Electrical
- Computing
- Manufacturing

It is highly recommended that you divide your team into groups of two and each group of two attends a different technical stream. For example, two team members will attend the electrical stream, two different members will attend the computing stream and the last two remaining members will attend the manufacturing stream. Note that an individual cannot attend multiple streams and must select one stream. This is because each technical stream comprises of its own assessment. You will select your technical stream in **Week 2**.

### Electrical Stream

The electrical stream will cover technical information on electrical lab safety, basic electrical components (including the breadboard), electrical test equipment, circuit diagrams, and building motor drive circuits (including traction motors and servo motors), powerpacks, LED circuits, IR circuits and some other relevant basic circuits.

### Computing Stream

The computing stream will cover how to connect to an Arduino and program an Arduino to perform many different functions (including traction motor control, servo motor position control, and the interface with different sensors).

### Manufacturing Stream

The manufacturing stream will cover how to use CAD software to build important design drawings and how to use the 3D printer and laser cutting equipment.

Note: The technical streams will **NOT** give you all the information you need to build your prototype. You will need to do at least 2 hours of independent learning per week to solve different design challenges and be successful in this course.

## PROJECT ASSESSMENT STRUCTURE

The autonomous container delivery project uses the following assessment structure for ENGG1000:

Assessment	Weight
Reflective writing (individual)	5%
Engineering Design Process (EDP): Problem statement and concept generation presentation (group/individual)	15%
Technical Stream Assessment (individual)	20%
Design journal mark (individual)	15%
Compliance testing, marked by the lecturer (group)	5%
Design proposal report, marked by the mentor (group)	10%
Final acceptance testing, marked by the lecturer (group)*	15%
Final design report, marked by a different mentor (group)*	15%

\* This mark is moderated by a 'Learning, Planning and Participation' mark as well as peer assessment (see below)

The assessment is approximately distributed evenly between individual and team marks, reflecting the requirement of the project. Experience from previous offerings of this course shows that well-organised groups that communicate, set high standards, self-organise, and resolve conflicts effectively are essential to succeeding in the project.

## **The Learning, Planning and Participation Mark**

The 'Learning, Planning and Participation' mark will be used to weight individual marks within group assessment. It is assessed by your mentor in weeks 3, 5 and 9 during the Monday 4-5pm mentor meetings. During these meetings, the mentor will give each team member a score of 1-10 for their learning, planning and participation in the project up until that point in time. Achieving a score of 10 means that you have been an extremely active team member. The mentor will average the scores from weeks 3, 5 and 9. If you receive an average score of less than 5 (four or lower) than you may receive an overall subject grade of unsatisfactory fail. This assessment item is here to discourage students from letting the rest of the team do all the work for them.

Please note:

- High marks will be given for demonstration of commitment to the success of the group (as defined by the group at the beginning of the project) and for helping the group to function effectively. You will also require active contribution to:
  - Mentor meetings and non-timetabled meetings.
  - The design, implementation and testing of the prototype.
  - The written submissions.
- Low marks will be given for:
  - Non-attendance without advance explanation.
  - Lack of engagement or participation (including silence in mentor meetings).
  - Failure to deliver on tasks assigned by the group.
  - Poorly detailed/missing lab notebooks.
  - Obstruction to group progress (e.g., falling out of contact while holding key project details).

## **Design Journal Assessment**

Design journals are a means of recording design, technical and organizational information for later use, and are a helpful tool both during study and in professional life. You must bring your design journal to all classes, and record both the introductory lab and notes from mentor meetings and later labs. Design journals will be assessed according to the following criteria:

- purpose of notes (why were they made?)
- date (when were they made?)
- clarity (could someone else understand them?)
- detail (e.g., if you sketch your circuit diagram, could someone else build it exactly from the sketch?)
- completeness of experimental notes
- interpretation of results or discussion of design/circuit
- and evidence of research or individual input (i.e., repeating lecture notes will not attract marks).

The design journal is assessed by your mentor in weeks 3, 5 and 9. Each journal assessment is worth 5%, yielding a total of 15% for this assessment item. The lecturer or mentor may request your design journal at any time for viewing.

## **Compliance Testing Assessment**

Compliance testing is a functional testing technique that is done to validate and confirm that the system developed meets the prescribed specifications. The motivation for the Compliance Testing on Thursday in Week 8 is to ensure that your team will be able to present a viable prototype for final testing on Thursday in Week 10.

Detailed objectives of this compliance testing include:

- Determining that the development meets the prescribed specifications.
- Ensures whether the deliverables of each phase of the development, meets the standards, procedures, and guidelines.
- Evaluate the documentation of the project to check for completeness and reasonableness.

A panel of mentors/demos/coordinator are the final judges of whether your prototype device is progressing accurately. This represents 5% of your overall grade for ENGG1000.

### **Design Proposal and Final Report**

Written communication is consistently among the top priorities for engineering employers. Hence, developing report writing skills is an important aspect of design and innovation. The criteria for assessing the design proposal and final design reports are given on the respective report cover sheets.

### **Teamwork Evaluation Assessment**

The final testing and final report marks will be moderated on an individual basis by peer assessment (as well as the Learning, Planning and Participation' mark). Formative peer assessment (i.e., does not contribute towards your final grade) will be conducted in weeks 3, 5 and 7. Here, you will score all your fellow team members on their contribution to the project. A poor score informs a team member that they should change their attitude and work ethic to achieve a better score for the assessable peer assessment in week 9. Feedback on whether your participation has been satisfactory is available at any time from your mentor and from your group.

A summative peer assessment (i.e., does contribute to your final grade) from your group members will be conducted in the final mentor meeting on Thursday Week 9. You must pass this assessment item to pass the course. Failure in this assessment item can result in an overall grade of Unsatisfactory Fail (UF), even if your overall mark is above 50. This would usually occur when both the mentor and group find that participation has been unsatisfactory. If you believe that your circumstances pose risks to your group participation, act early and discuss these with your group and mentor ahead of time, to avoid disappointment.

Formalized peer assessment will be conducted as follows:

- At the final mentor meeting, you will score all your fellow team members on their contribution to the project. The scores of your team members will be averaged to produce a peer assessment score for the project. This score will then be used to moderate the final testing and final report marks. Therefore, if you contribute little to the team, then your final testing and final report marks may be lower than other members in the team. However, if you are a strong contributor to the team, then your final testing and final report marks may be higher than for others. The peer assessment will be applied as an individual weighting to the final testing and final report group marks.

Peer assessment is an important part of assessing group projects, because your contribution to the team is vital to the team's success.

### **Late Submission of Assessment**

Late submissions of assessed work attract a penalty of 5% per day, including weekends. After 10 days, a mark of zero will be awarded.