DESN2000 T2, 2022

Units of Credit	**6**
Contact hours	6 per week

Design is one of the critical foundations of engineering and a main component in creating value. A good engineer has complex technical skills, but also creative skills, project management and teamworking skills, and knowledge of professional ethical standards in design.

DESN2000 aims to further develop your skills in engineering design with a particular focus on the early stages, where innovative concepts are created in response to open-ended problems. These skills will be developed in the context of an engineering project, with a focus on three areas: (1) research techniques needed to understand design problems and discover concepts, (2) technical skills needed to build a concept, and (3) evaluation methods for evaluating the concept. Alongside the development of design skills, the course also aims to develop your readiness for professional practice by deepening your understanding and skills in effective project management, teamwork and communication.

The course builds on the teamwork, communication, and project management skills introduced in ENGG1000/DESN1000. Skills learned in DESN2000 are further deepened in DESN3000, which will develop skills for managing design in commercial context.

Faculty Coordinators	Prof Ilpo Koskinen Arianna Vignati Dr Nicholas Gilmore *Design Next, Kens J17 Lv5 Room 503* *(direct all email to designnext@unsw.edu.au)*
School Coordinator and Lecturer	Dr David Tsai (d.tsai@unsw.edu.au) Bioscience South, Kens E26, Lv1 Room 1003
Head demonstrator	Jonah Meggs (j.meggs@unsw.edu.au)
Demonstrator	Rebekah Rae (z5206258@ad.unsw.edu.au) Jack Murray (jack.murray@unsw.edu.au) Shai Alaloff (z5311773@ad.unsw.edu.au) Sabine Seeto (z5312137@ad.unsw.edu.au) Samuel Chapman (z5218557@ad.unsw.edu.au) Shiqi (Charlotte) Han (z5312977@ad.unsw.edu.au) Ronakraj Gosalia (r.gosalia@unsw.edu.au) Zhuoyu (Tony) Chen (z5210863@ad.unsw.edu.au) Bradley Lin (z5258949@ad.unsw.edu.au) Riley Dean (z5308666@ad.unsw.edu.au) Jonathan Podiono (z5278938@ad.unsw.edu.au) Zachary Milgate (z5015456@ad.unsw.edu.au) Sumanth Devathi (z5160042@ad.unsw.edu.au) Oishik Sarkar (o.sarkar@unsw.edu.au)

INFORMATION ABOUT THE COURSE

Prerequisites and assumed knowledge

The pre-requisites for this course comprise ENGG1000/DESN1000 (Engineering Design & Innovation), ELEC2141 (Digital Circuit Design) and COMP1511 (Programming Fundamentals) or COMP1521 (Computer Systems Fundamentals). Students should have a good understanding, in particular, on number systems, C programming and basic computer architecture. The course shares substantial content with ELEC2142 (Embedded Systems Design), which is no longer offered. You cannot take this course after completing ELEC2142.

HANDBOOK DESCRIPTION

See link to virtual handbook*:*

https://preview.handbook.unsw.edu.au/undergraduate/courses/2022/DESN2000/

OBJECTIVES

This course will give students skills for creating innovative design concepts in the context of a electrical and electronical engineering project. Specifically, DESN2000 aims to further develop your skills in engineering design with a particular focus on the early stages, where innovative concepts are created in response to open-ended problems. These skills will be developed in the context of an engineering project, with a focus on three areas:

(1) research techniques needed to understand design problems and discover concepts,

(2) technical skills needed to build a concept, and

(3) methods for evaluating the concept.

Alongside the development of design skills, the course also aims to develop your readiness for professional practice by deepening your understanding and skills in effective project management, teamwork and communication.

This course combines generic design content with discipline-specific content. The common section focuses on mapping contextual information including human factors; analysis of the information; creative methods for translating the information into design concepts; communication of the information; and evaluation methods for analysing the validity of the design proposals.

Technical skills focus on the design for embedded systems. These systems are pervasive in all areas of society from sensor taps to satellites and knowledge of how to design them is a vital skill for all electrical and computer science engineers. The discipline-specific objective of this course is to equip students with the knowledge and skills that enable them to design basic embedded systems, where a microcontroller is the central element.

The first half of the course will focus on ARM processor architecture, instruction sets, assembly language fundamentals and techniques. The second half of the course will look at input and output, interrupts, and exceptions. On completion students should be able to design reliable embedded system using ARM processors in particular, and other processors in general. The course touches upon several technical topics you need in designing embedded systems:

- Binary numbers, hexadecimal numbers, signed / unsigned numbers, 2s complement, status flags and ASCII;
- Programmer's model of ARM7TDMI processor core, registers, fetch-decode-execute cycle and ARM v4T instruction set architecture (ISA);
- Assembly language programming, data processing instructions, arithmetic operations and logical operations;
- Memory access instructions, load-store architecture, word and byte addressing, memory alignment and block data transfer;
- Control flow, conditional branches, loops and jump tables;
- Functions and subroutines calls, link register, stack, stack frames, register conventions and AAPCS standard;
- Fixed-point numbers, range and precision;
- Compiler, assembler, linker, loader, assembler directives, pseudo-instructions, and object files;
- Input/output, memory mapped I/O, polling and interrupts;
- Exceptions and modes of operation.

TEACHING STRATEGIES

The primary teaching vehicle of the course is an engineering project in which students learn to apply scientific, engineering, and user-centred knowledge to a design problem. Details of this project are provided in a separate *Project Brief*.

Students will complete both individual and group work. For each hour of contact it is expected that you will put in at least 1.5 hours of private study. It is expected that groups meet outside of the scheduled times and progress their group project independently.

Communication

This course uses both Moodle and Microsoft Teams as the portal for remote teaching and learning. It will be used for file sharing, virtual classrooms, announcements and other communications. You are expected to check the platforms regularly. In the first instance, you are encouraged to ask questions after lectures. Otherwise course discussions and questions take place on Moodle forum. Your demonstrators and academic staff will actively monitor these posts. Please use replies and keep discussions in appropriate channels. If required, emails must be made from your student email address with DESN2000 in the subject line.

All class materials will be delivered online via Moodle and some communications via MS Teams. This includes the project brief, lecture notes, lab guides, workshop guides and assessment guides. You will be added to the DESN2000 ELEC Teams instance automatically.

MS Teams and/or Blackboard Collaborate Ultra may be used for lecture recordings and virtual classrooms. Links are posted well in advance of scheduled times.

Lectures

You are expected to attend all lectures, which are all delivered online. These provide the backbone for your practical work in the workshops and your project.

Workshops

Weekly workshops are the primary means through which students work through their project and associated exercises aimed at developing understanding of the course materials. Demonstrators are available to provide guidance and support teams in their project development. Guides for these classes will be made available in MS Teams.

Laboratories

The laboratory scheduled is designed to provide practical, hands-on exposure to the concepts conveyed in lectures soon after they are covered in class. There will be 6 laboratory tasks. Each week, a new design problem related to the lectured material is presented. You will be required to step through the problem to a complete solution using the guidelines given per lab exercise. You are strongly encouraged to **read over all the material and attempt any code writing before coming to your lab session**, as it will allow you to complete the required tasks within the allocated time slot.

Throughout the labs, a NXP LPC2478 microcontroller (based on an ARM7TDMI-S core) and Keil µVision4 Integrated Development Environment (IDE) will be used.

- In the first three exercises, tasks will be focused on various fundamental assembly programming techniques: data processing, control flow, and functions.
- The interaction of the processor with inputs and outputs peripherals and handling interrupts will be the subject of the remaining labs.

Laboratory attendance WILL be kept, and you **MUST attend at least 7/8 of the labs to pass this course**. There is no laboratory exemption for this course regardless of whether equivalent labs have been completed in previous courses. If, for medical reasons (a valid medical certificate must be provided), you are unable to attend a lab, you will need to apply for a catch-up lab during another lab time, as agreed by the head laboratory demonstrator.

All local students will attend on-campus labs, unless agreed otherwise with course authority. For remote students, the labs will be accessible remotely, through strategies that have been standardized across many large-cohort EE&T courses. A MS Teams setup will be configured for you and your lab partner to control the lab PC remotely and to communicate with your demonstrator. A live feed of the LPC2478 board, plus an internet-enabled oscilloscope, provide real-time access. Your demonstrator (and generally, also an assistant demonstrator) will be physically present in the lab to help with any issue.

The online workshops for students will be delivered via MS Teams. You will find links to the online sessions on MS Teams in your class channel.

Your class times may vary week to week. Please check your myUNSW timetable for your class times each week.

EXPECTED LEARNING OUTCOMES

This course is designed to address the learning outcomes above 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.

Course Learning outcomes (CLO)		
#	**Learning outcome description**	**EA stage 1 Competencies**
1	Develop design concepts using standard methods to collect, assess and integrate end user, stakeholder and project requirements.	1.5, 2.1, 2.2, 2.3, 3.3
2	Validate the suitability of designs using standard technical methods, while considering end-user and stakeholder contexts.	1.5, 1.6, 2.1, 2.2, 2.3, 3.3
3	Implement disciplinary technical theory and skills pertinent to the design project.	1.3, 2.1, 2.2, 2.3
4	Contribute to the work of a team and collaborate on the design project, including the implementation of organisational and interpersonal tools.	2.4, 3.3, 3.4, 3.5, 3.6
5	Integrate project management techniques to plan, execute and complete an open-ended design project.	2.4, 3.4
6	Explain designs to various audiences using oral, written, and visual forms of professional and persuasive communication.	1.2

COURSE PROGRAM

Class Topics and lecture schedule

Please check your myUNSW timetable for specific workshop times. Tuesday workshops, if restrictions permit us, take place in the Renewables Makerspace in TETB LG09/LG10. If you will be attending these workshop sessions remotely, make sure to interact with your team during the session times via zoom or teams as if you were physically present in the workshop.

No new content for week 10 to allow free time to work on projects.

Date	Design component		Technical component	
	Lectures	**Workshops**	**Lectures**	**Laboratories**
Week 1	Introduction to concept design 1 hr Ilpo Koskinen	Design Sprint	Introduction to ARM 3 hr David Tsai	*(no lab this week)*
Week 2	Research and analysis 1 hr Arianna Vignati	Planning user research and analysis	Data processing operations and memory access 3 hr David Tsai	*(no lab this week, unless you are in Monday lab)*
Week 3	Concept generation 1h Nick Gilmore	Problem statement and concept generation	PUBLIC HOLIDAY	1. Introduction to QVGA board, µVision, and debugging.
Week 4	Prototyping and user testing 1h Arianna Vignati	Planning user testing	Control flow and conditional operations 3 hr David Tsai	2.1 Data types, control flow,assembly programming
Week 5	Pitching 1h Shahe Momdjian	Storytelling by pitching	Functions, subroutines, and AAPCS 3 hr David Tsai	2.2 Data types, control flow, assembly programming
Week6		Project guidance, Q&A	Revision David Tsai	3. Functions and subroutines
Week 7		Project guidance, Q&A	AAPCS and I/O interface (Intro) 3 hr David Tsai	4. I/O
Week 8		Project guidance, Q&A	I/O interface (GPIO, DAC) 3 hr David Tsai	5.1 D/A conversion
Week 9		Project guidance, Q&A	Pseudo instructions and literal pools	5.2 D/A conversion

			3 hr David Tsai	
Week 10		Project guidance, Q&A	Exceptions & interrupts 3 hr David Tsai	6. LCD & touchscreen

ASSESSMENTS

Assessment Outline

	Item	Weight	CLO	Assessment criteria	Due date
Design 40%	**Design Journal (👤)**	20%	1-6	Refer to assessment guide	8:00 pm Friday July 1 (Week 5)
	Design presentation (pitch) (👥)	20%	1-6	Refer to assessment guide	8:00 pm Friday 5 August (Week 10)
Technical 60%	**Lab exercises (👥)**	20 %	1-6	Refer to assessment guide	Weekly as per lab schedule (Weeks 3-10)
	Code implementation (👥)	10 %	1-6	Refer to assessment guide	11:59 pm Friday 5 August (Week 10)
	Final exam (👤)	30 %	1-6	Refer to assessment guide	TBD (UNSW exam week)

(👤) individual assessment. (👥) group assessment.

Details for each assessment are presented in separate assessment guides for each task. Individual contribution to group assessments will be evaluated via a team evaluation survey for each submission. Marks will be returned within 2 weeks of the submission due date.

RELEVANT RESOURCES

- van Roeijen, Annemiek et al. 2015. Delft Design Guide. BIS Publisher, Amsterdam. Second edition.
- Preece (2019), 5th ed., Interaction Design: Beyond Human-Computer Interaction. John Wiley & Sons
- Reinders, Angèle et al. 2012, *The Power of Design: Product Innovation in Sustainable Energy Technologies*, Chichester, West Sussex, U.K. : John Wiley & Sons.
- Siegel, Neil G. 2019, *Engineering project management*, Hoboken, NJ, USA, John Wiley and Sons, Incorporated.

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.

DATES TO NOTE

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

ASSESSMENT SUBMISSION AND MARKING CRITERIA

Refer to assessment guide.

PENALTIES

Completion of 7/8 labs is compulsory for successful completion of DESN2000. You must schedule catch-up lab with the Head Lab Demonstrate if you missed your lab (along with medical certificate).

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 5 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.

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.

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 & 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.

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: https://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

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

In the event that class resumes on campus in T3 2022, physical 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 on a first come first serve basis.

Due to the COVID-19 pandemic, circumstance may change very quickly. Please refer to your course's Microsoft Teams and Moodle sites for more up-to-date information about class attendance for in-person and online classes. 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 on NSW Health's website.

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 with the course coordinator. 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: 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 polices. 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 🦁

ACKNOWLEGEMENT OF COUNTRY

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

APPENDIX

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

	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