



Mechanical and Manufacturing Engineering

Course Outline

Term 3 2019

MMAN2100

Engineering Design 2

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1. Staff contact details

Course Convenor: Dr. Ang Liu

Office: Ainsworth Building (J17) Level 4, Room 408C

Tel: (02) 9385 4080

Email: ang.liu@unsw.edu.au

Consultation Hours: 9:00am-11:00am every Thursday in the lecturer's office

Course Lecturer: Kana Kanapathipillai

Office: Ainsworth Building (J17) Level 4, Room 408J

Tel: (02) 9385 4251

Email: s.kanapathipillai@unsw.edu.au

In addition to the weekly consultation hours, all students and groups are encouraged to schedule additional face-to-face meetings with the lecturer. Given the large class size (i.e., 500 students), a meeting appointment via email beforehand is required for additional consultation meetings.

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

Head Demonstrator: Ms. Tamara Neil

Email: tamarajaneneil@gmail.com

Please see the course [Moodle](#).

2. Important links

- [Moodle](#)
- [Lab Access](#)
- [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 6 hours per week (h/w) of face-to-face 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 14 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

	Section	Day	Time	Location	Week
Lectures		Mon	14:00 - 16:00	Ainsworth G03 (K-J17-G03)	1-3,5-11
		Fri	09:00 - 11:00	Ainsworth G03 (K-J17-G03)	1-10
Tutorials	M16A	Mon	16:00 - 17:30	John Goodsell LG21 (K-F20-LG21)	1-3,5,7-11
		Mon	16:00 - 17:30	Ainsworth 204 (K-J17-204)	6
		Tue	13:00 - 14:30	John Goodsell LG19 (K-F20-LG19)	1-5,7-10
		Tue	13:00 - 14:30	Ainsworth 204 (K-J17-204)	6
	M16B	Mon	16:00 - 17:30	Ainsworth 203 (K-J17-203)	6
		Mon	16:00 - 17:30	Old Main Building 151 (K-K15-151)	1-3,5,7-11
		Tue	13:00 - 14:30	John Goodsell LG21 (K-F20-LG21)	1-5,7-10
		Tue	13:00 - 14:30	Ainsworth 203 (K-J17-203)	6
	T09A	Tue	09:00 - 10:30	Ainsworth 204 (K-J17-204)	6
		Tue	09:00 - 10:30	Ainsworth G01 (K-J17-G01)	1-5,7-10
		Thu	12:30 - 14:00	Electrical Engineering G09 (K-G17-G09)	1-5,7-10
		Thu	12:30 - 14:00	Ainsworth 204 (K-J17-204)	6
	T09B	Tue	09:00 - 10:30	Ainsworth 101 (K-J17-101)	1-5,7-10
		Tue	09:00 - 10:30	Ainsworth 203 (K-J17-203)	6
		Thu	12:30 - 14:00	Electrical Engineering G03 (K-G17-G03)	1-5,7-10
		Thu	12:30 - 14:00	Ainsworth 203 (K-J17-203)	6
	T10A	Tue	10:30 - 12:00	Ainsworth 204 (K-J17-204)	6
		Tue	10:30 - 12:00	Old Main Building 151 (K-K15-151)	1-5,7-10
		Thu	09:00 - 10:30	Ainsworth 203 (K-J17-203)	6
		Thu	09:00 - 10:30	Ainsworth G01 (K-J17-G01)	1-5,7-10
	T10B	Tue	10:30 - 12:00	Ainsworth 101 (K-J17-101)	1-5,7-10
		Tue	10:30 - 12:00	Ainsworth 203 (K-J17-203)	6
		Thu	09:00 - 10:30	Ainsworth 201 (K-J17-201)	1-5,7-10
		Thu	09:00 - 10:30	Ainsworth 204 (K-J17-204)	6
	T14A	Tue	14:30 - 16:00	John Goodsell LG19 (K-F20-LG19)	1-5,7-10
		Tue	14:30 - 16:00	Ainsworth 204 (K-J17-204)	6
		Wed	12:00 - 13:30	Ainsworth 201 (K-J17-201)	1-5,7-10
		Wed	12:00 - 13:30	Ainsworth 203 (K-J17-203)	6
	T14B	Tue	14:30 - 16:00	John Goodsell LG21 (K-F20-LG21)	1-5,7-10
		Tue	14:30 - 16:00	Ainsworth 203 (K-J17-203)	6
		Wed	12:00 - 13:30	John Goodsell LG19 (K-F20-LG19)	1-5,7-10
		Wed	12:00 - 13:30	Ainsworth 204 (K-J17-204)	6
W09A	Wed	09:00 - 10:30	Ainsworth 201 (K-J17-201)	1-5,7-10	
	Wed	09:00 - 10:30	Ainsworth 203 (K-J17-203)	6	
	Thu	14:00 - 15:30	John Goodsell LG21 (K-F20-LG21)	1-5,7-10	

	Section	Day	Time	Location	Week
		Thu	14:00 - 15:30	Ainsworth 204 (K-J17-204)	6
	W09B	Wed	09:00 - 10:30	Electrical Engineering G09 (K-G17-G09)	1-5,7-10
		Wed	09:00 - 10:30	Ainsworth 204 (K-J17-204)	6
		Thu	14:00 - 15:30	Mathews 309 (K-F23-309)	1-5,7-10
		Thu	14:00 - 15:30	Ainsworth 203 (K-J17-203)	6

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Summary and Aims of the course

This course will focus on the subject of **engineering design**, which plays the unique role in guiding an individual engineer or a team of engineers to follow a systemic, rational, and creative pathway towards breakthrough innovations of new products/services. The course provides students with a holistic understanding of the big picture, wide spectrum, and structured process of engineering design. In particular, it focuses on the early stage design, with respect to functional design and conceptual design, as well as component design.

Unlike the purely technical engineering subjects, engineering design is characterized by the synergy between “analysis” and “synthesis”, between “rationality” and “optimality”, as well as between “do the right thing” and “do the thing right”. Therefore, this course aims to make you understand the sociotechnical nature of engineering design that concerns both social reality and physical reality and provide you with the capacity of not only solving a given design problem using relevant engineering knowledge, but also formulating a new design problem.

Design thinking is a fundamental skill that every engineer must have for the 21st Century. It is one of the skills that profoundly distinguishes human intelligence from artificial intelligence, which greatly impacts an engineer’s long-term career success in the workplace. Therefore, this course also aims to equip you with the domain-independent and solution-neutral design thinking, which can be applied to whatever technical stream (e.g., aerospace, mechanical, manufacturing, mechatronic, or naval engineering) you choose to pursue in the future.

Today’s engineering problems are too complex to be addressed by a single engineer based on separate disciplinary knowledge and skills. Therefore, this course additionally aims to make you understand both opportunities and challenges of collaborative design. Through team-based learning, it is expected that your collaborative communication, negotiation, and decision-making skills will be enhanced.

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	Conduct collaborative product planning to formulate a unique design problem by translating customer needs to functional requirements	PE1.1, PE1.5, PE3.6, PE2.1 - PE2.4
2	Perform collaborative conceptual design to generate, evaluate, and select the functionally simple and physically certain concepts	PE1.2, PE1.5, PE3.6, PE2.1 - PE2.4
3	Document the design process and present the design outcome through presentation, report, logbook, and CAD drawing.	PE3.2, PE3.4, PE3.6
4	Design mechanical components to satisfy the target functional requirements against design constraints	PE1.1, PE1.2, PE1.6

4. Teaching strategies

Design is the hallmark of human creativity in general and the essence of the engineering profession in particular. Engineering students can learn “design” most effectively when they:

- Profoundly understand the social-technical nature of engineering design, as well as the fundamental difference between “do the right thing” and “do the thing right”.
- Actively engage in continuous interactions with instructor, classmates, teammates, and practitioners to construct not only novel artefacts but also new knowledge, skill, wisdom, and entrepreneurship.
- Proactively employ the design insights gained in classroom to frame their daily life struggles, decisions, and observations as a unique innovation opportunity and to create both purposeful and functional “artefacts” to capture the opportunity.

Based on the above teaching philosophy, this course adopts the following teaching strategies: face-to-face lecture, face-to-face tutorial, and project-based learning.

Face-to-Face Lecture: the purpose of lectures is to deliver design knowledge and deepen understanding of the delivered knowledge. Generally speaking, there are two kinds of lectures for this course: content-oriented and context-focused. The former is intended to deepen your theoretical understanding of relevant design theory and methodology, whereas the latter focuses on enhancing your practical skills of using design methods to address real-world problems. During the lecture time, you are expected to pay 100% of your attention. You are highly encouraged to take notes.

Face-to-Face Tutorial: during the tutorial sessions, the demonstrators will showcase how to follow the design methods taught in the lectures to solve real-world design problems, answer any questions about course assignments, and provide guidance for your team project. Different from the lectures, there is no standard format for a demonstration session. The demonstrators should be treated, with full respect, as your “coach” who can guide you through the practice instead of competing for you in the field. Before you attend a demonstration session, in the best interest of your own learning, you should thoroughly reflect on the lecture content and purposefully prepare a set of smart questions to ask.

Project-based learning: the best way to learn design is through design practice based on a specific design project together with other engineers. Therefore, the class will be divided into a number of teams of 5-6 students, which will be tasked to follow relevant design methods to collaboratively accomplish two design projects and their associated assignments. Note that,

given the large class size of 450 students, the team formation will be conducted within each demonstration session. No teams can be formed across different demonstration sessions.

5. Course schedule

Week^a	Lecture Topic	Tutorial Topic
1	Course introduction and motor selection	<ul style="list-style-type: none"> • Team building and logbook writing • Assignment Introduction & Motor selection
2	Belt and chain drive, as well as fly wheels	<ul style="list-style-type: none"> • Belt drive selection • Chain drive selection
3	Shaft design and couplings	<ul style="list-style-type: none"> • Shaft design • Flywheel inertia calculations
4	Solicit customer voices and identify an innovation opportunity	<ul style="list-style-type: none"> • Demonstrate functional design process
5	Formulate a unique design problem as functional requirements	<ul style="list-style-type: none"> • Demonstrate QFD and report writing
6	Generate design concepts by systemic design methods	<ul style="list-style-type: none"> • Demonstrate concept generation and sketching • Demonstrate CAD drawing
7	Organize design concepts based on the independence axiom	<ul style="list-style-type: none"> • Demonstrate concept organization
8	Evaluate design concepts based on the information axiom	<ul style="list-style-type: none"> • Demonstrate concept evaluation
9	Improve design concepts by resolving contradictions	<ul style="list-style-type: none"> • Demonstrate cconcept improvement
10	Emerging technologies on engineering design	<ul style="list-style-type: none"> • Team design presentation

6. Assessment

Assessment overview

Assessment	Group Project? (# of students per group)	Length	Weight	Learning Outcomes Assessed	Assessment Criteria	Submission	Due Date	Deadline of Absolute Fail	Return Marks
Logbook	No	Up to 50 pages	25% ^a	Outcome 1-4	<ul style="list-style-type: none"> Will be posted on Moodle together with the assignment specification 	<ul style="list-style-type: none"> Handwritten Submit original hardcopy to tutors 	Week 6 and 10	3 days after due date and time	Within two weeks after the due date
Component Design Report	Yes (5-6)	Up to 50 pages	25%	Outcome 1 and 2	<ul style="list-style-type: none"> Will be posted on Moodle together with the assignment specification 	<ul style="list-style-type: none"> Digital report PDF format Submit via Moodle 	Week 5	7 days after due date and time	Within two weeks after the due date
Conceptual Design Report	Yes (5-6)	Up to 70 pages	35%	Outcome 4	<ul style="list-style-type: none"> Will be posted on Moodle together with the assignment specification 	<ul style="list-style-type: none"> Digital report PDF format Submit via Moodle 	Week 9 and 12	7 days after due date and time	Within two weeks after the due date
Design Presentation	Yes (5-6)	15 -20 minutes	15% ^b	Outcome 1-3	<ul style="list-style-type: none"> Will be posted on Moodle together with the assignment specification 	<ul style="list-style-type: none"> Digital format Submit via Moodle 	Week 10	1 days after due date and time	Within one weeks after the due date

^a 10% is allocated to the mid-term submission in week 6, and 15% is allocated to the final submission in week 10

^a 10% is determined based on team performance, and 5% is determined based on individual performance

Assignments

Design Logbook

Every student is required to create an individual design logbook, which is intended to keep a record of your individual contribution to the design project. In industry, logbook serves as a professional document that indicates the complete research, planning, and thinking process of a certain engineer working on a particular project, such that if a new engineer takes over the project, the logbook would allow him/her to smoothly resume from where the previous engineer finished.

The logbook is a comprehensive documentation of the design project, in which your unique contributions should be highlighted. A good logbook is characterized by a general (but complete) description of the whole project, with detailed explanations of your individual work. Note that you are required to add new entries to the logbook on a highly regular and consistent basis (at least twice a week). The logbook is not a document that can be made up overnight in a retrospective fashion. A detailed logbook marking guideline will be published on Moodle. Note that the logbook must be prepared and submitted as the original copy in your own handwriting, with dates added, and signed off. No digital copy is allowed, unless pre-approved. Your logbook will be collected, marked during the demonstration sessions in week 6 and 10. The logbook counts 25% of the final grade.

Component Design Report

Each team is required to prepare and submit a component design report. The report describes the design process of how a team follows the course design methods to design a specific mechanical component. All teams are tasked to solve the same component design problem. A detailed specification of report requirements, format, and organization will be posted on Moodle. The component design report is due on Friday in Week 5. The component design report counts 25% of the final grade.

Conceptual Design Report

Each team is required to prepare and submit a conceptual design report. The report describes the process of how the team follows the course-taught design methods to formulate design problem, generate design concepts, evaluate design concept, improve design concept, and visualize design concept. A set of open-ended design problems will be given, whereas it is up to each team to decide which product to conceptualize. A detailed specification of report requirements, format, and organization will be posted on Moodle. The conceptual design report has two due dates: the initial submission is due on Friday in Week 9 and the final resubmission is due on Friday in Week 12. The conceptual design report counts 35% of the final grade.

In light of the iterative nature of conceptual design, a special resubmission policy applies to the conceptual design report. Based on the feedback provided by the reviewers, a team is allowed to significantly revise its report submitted in Week 9 and resubmit it for remarking in Week 12. Any team has only one chance of resubmission. With respect to grade calculation, in the case of resubmission, the first submission counts half of the report grade, whereas the

resubmission counts for the other half. If a team received 70% in the initial submission and 90% in the resubmission, then the final grade that shows in the gradebook is 80%. In other words, the initial submission is equally important as the resubmission. Resubmission must be treated as an extra opportunity to polish your work instead of a buffer to lessen the negative effect of the initial submission. Note that, together with the resubmitted report, each team must provide a detailed rebuttal document that clearly outlines where, how, to what extent, and in what ways the report has been revised, in correspondence to the comments and suggestions raised by the reviewer. If a team is satisfied with the grade for the report submitted in Week 9, there is no need for resubmission in Week 12.

Design Presentation

Every team will be required to make one public presentation about the conceptual design process and outcome. The presentations are made in front of the lecturers, demonstrators, and classmates. The presentation is scheduled in Week 10 and organised within the demonstration sessions. The design presentations count 15% of the final grade (i.e., 10% team performance and 5% individual performance).

Peer Evaluation

In correspondence to the design reports and the design presentations, a total of four (4) peer evaluations will be conducted to assess every individual's unique contribution to the teamwork. Every student will be asked to fill out a confidential questionnaire that is designed to evaluate other team members' contribution to teamwork in different categories. The peer evaluation results will be used to calculate every member's individual contribution. Simply put, the more you contribute, the more marks you will receive on top of the team grade. On the other hand, the inactive participation in teamwork will be penalised as well. Based on previous experience, a team project can be successfully accomplished, if and only if every member is devoted to contributing actively and equally. Peer evaluation will be conducted for all the team-based assessments. It will affect as much as 80% of your final grade.

As an integral part of the design report, each team is required to submit a teamwork statement, which summarizes every member's contribution to the report. The teamwork statement will be used as a reference to cross-examine the accuracy of the peer evaluation results. Sometime of the weekly demonstration sessions is intentionally reserved for teamwork. Therefore, your attendance to the demonstration session will be recorded, and utilised as an important reference for adjusting the peer evaluation mark. Finally, in case of any dispute or inconsistency, the logbook will be referenced as well.

If there were inactive team members who failed to contribute, you should inform the lecturer and demonstrators as early as possible.

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.

Examinations

There are no examinations in this course.

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 sit 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

No textbook is required for this course; however, you are encouraged to gain easy access to some recommended reference books as the following:

- [1] “*Axiomatic Design – advances and applications*”, by Nam Suh, Oxford University Press.
- [2] “*Engineering design – A systematic approach*”, G. Pahl and W. Beitz, Springer-Verlag.
- [3] “*Shigley’s Mechanical Engineering Design*”, R Budynas & J Nisbett, 10th Ed in SI Units, McGraw Hill.

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

Some additional reading materials will be regularly published on the Moodle course page.

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 (1) reducing the difficulty of component design report; (2) reducing the weight of design logbook from 30% to 20%; and (3) increasing the weight of design presentation from 10% to 20%.

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 policies. In particular, students should be familiar with the following:

- [Attendance](#)
- [UNSW Email Address](#)
- [Computing Facilities](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)
- [Academic Honesty and Plagiarism](#)
- [Disability Support Services](#)
- [Health and Safety](#)
- [Lab Access](#)

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