UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Semester 2 2018

MMAN2100

ENGINEERING DESIGN 2

Contents

1. Staff contact details

Contact details and consultation time for course convenor

Course Convenor: Dr. Ang Liu
Office: Ainsworth Building (J17) Level 4, Room 408
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: Phil Howlin
Office: Ainsworth Building (J17) Level 3, Room 311E
Tel: (02) 9385 4180
Email: p.howlin@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 from time to time. Since this is a very large class of 400 students, a meeting appointment via email beforehand is appreciated.

Contact details and consultation times for additional demonstrators

Please see the course Moodle.

2. Important links

- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

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 (3 hour lecture and 3 hour tutorial).

The UNSW website states "The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week."

This means that you should aim to spend about 12 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	A and Web	Tue	14:00 – 16:00	Law Theatre G04 (K-F8-G04)	1-4, 6-13
		Wed	17:00 – 18:00	Ainsworth G03 (K-J17-G03)	1-4, 6-13
Tutorials	F14A	Tue	12:30 - 14:00	Ainsworth 201 (K-J17-201)	2-5,12-13
		Tue	12:30 - 14:00	Ainsworth 203 (K-J17-203)	6-9,10-11
		Fri	14:30 - 16:00	Ainsworth 203 (K-J17-203)	6-9,10-11
		Fri	14:30 - 16:00	Ainsworth G01 (K-J17-G01)	2-5,12-13
	M09A	Mon	09:00 - 10:30	Mathews 309 (K-F23-309)	2-5,12-13
		Mon	09:00 - 10:30	Ainsworth 204 (K-J17-204)	6-9,10-11
		Thu	16:00 - 17:30	Ainsworth 204 (K-J17-204)	6-9,10-11
		Thu	16:00 - 17:30	Old Main Building 151 (K-K15-151)	2-5,12-13
	M09B	Mon	09:00 - 10:30	Ainsworth 201 (K-J17-201)	2-5,12-13
		Mon	09:00 - 10:30	Ainsworth 203 (K-J17-203)	6-9,10-11
		Thu	09:00 - 10:30	John Goodsell LG19 (K-F20-LG19)	2-5,12-13
		Thu	09:00 - 10:30	Ainsworth 204 (K-J17-204)	6-9,10-11
	M16A	Mon	16:30 - 18:00	Ainsworth 204 (K-J17-204)	6-9,10-11
		Mon	16:30 - 18:00	Old Main Building 151 (K-K15-151)	2-5,12-13
		Fri	14:30 - 16:00	Ainsworth 201 (K-J17-201)	2-5,12-13
		Fri	14:30 - 16:00	Ainsworth 204 (K-J17-204)	6-9,10-11
	M16B	Mon	16:30 - 18:00	Colombo LG02 (K-B16-LG02)	2-5,12-13
		Mon	16:30 - 18:00	Ainsworth 203 (K-J17-203)	6-9,10-11
		Wed	15:00 - 16:30	Ainsworth 204 (K-J17-204)	6-9,10-11
		Wed	15:00 - 16:30	Ainsworth G01 (K-J17-G01)	2-5,12-13
	T11A	Tue	11:00 - 12:30	Ainsworth 204 (K-J17-204)	6-9,10-11
		Tue	11:00 - 12:30	Ainsworth G01 (K-J17-G01)	2-5,12-13
		Thu	09:00 - 10:30	Mathews 309 (K-F23-309)	2-5,12-13
		Thu	09:00 - 10:30	Ainsworth 203 (K-J17-203)	6-9,10-11
	T11B	Tue	11:00 - 12:30	Ainsworth 201 (K-J17-201)	2-5,12-13
		Tue	11:00 - 12:30	Ainsworth 203 (K-J17-203)	6-9,10-11
		Fri	13:00 - 14:30	Ainsworth 101 (K-J17-101)	2-5,12-13
		Fri	13:00 - 14:30	Ainsworth 203 (K-J17-203)	6-9,10-11
	T12A	Tue	12:30 - 14:00	Ainsworth 204 (K-J17-204)	6-9,10-11
		Tue	12:30 - 14:00	Ainsworth G01 (K-J17-G01)	2-5,12-13
		Fri	13:00 - 14:30	Ainsworth 204 (K-J17-204)	6-9,10-11
		Fri	13:00 - 14:30	Ainsworth G01 (K-J17-G01)	2-5,12-13
	W18A	Wed	18:00 - 19:30	Tyree Energy G17 (K-H6-G17)	2-5,12-13
		Wed	18:00 - 19:30	Ainsworth 204 (K-J17-204)	6-9,10-11
		Thu	18:00 - 19:30	Tyree Energy G17 (K-H6-G17)	2-5,12-13
		Thu	18:00 - 19:30	Ainsworth 204 (K-J17-204)	6-9,10-11

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 focuses on the subject of engineering design, which plays the unique role in guiding an individual engineer or a team of engineers to think like a designer along 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 becoming too complex to be addressed by a single engineer based on separate disciplinary knowledge. 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, demonstration, project-based learning, etc.

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.

Demonstration: during the demonstration 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]	Date	Lecture Topic	Demonstration Topic	Deliverable Due
1	07/23--07/29	Definition of design, innovation, and design thinking	NO demonstration session in week 1	
2	07/30--08/05	Solicit customer voices and identify an innovation opportunity	Team building and logbook writing	Team Formation
3	08/06--08/12	Formulate a unique design problem as functional requirements	Demonstrate functional design process	
4	08/13--08/19	Generate design concepts by systemic design methods	Demonstrate QFD and report writing	T2a: Functional Design Report T4: Peer Evaluation (I)
5[b]	08/20--08/26	Organize design concepts based on the independence axiom	Demonstrate concept generation and sketching	
6	08/27--09/02	Evaluate design concepts based on the information axiom	Demonstrate concept organization and evaluation	
7	09/03--09/09	Improve design concepts by resolving contradictions	Demonstrate TRIZ and CAD drawing	T1: Logbook (First Submission)
8	09/10--09/16	Component introduction and shaft design	Overall layout and shaft design	
9	09/17--09/23	Bearings, couplings and alignment	Bearing life and connection selection	T2b: Conceptual Design Report T4: Peer Evaluation (II)
TEACHING RECESS (No Class)				
10	10/01--10/07	Belt and chain drive	Flexible drives	
11	10/08--10/14	Motor selection and fly wheels	Team design presentations	T3: Design Presentation T4: Peer Evaluation (III)
12	10/15--10/21	Assembly, access, maintenance	Final assembly and verification	T1: Logbook (Final Submission)
13	10/22--10/28	Flexible Arrangement (Guest Lecture or Feedback)		T2c: Component Design Report T4: Peer Evaluation (IV)

[a]The lecturer reserves the right to adjust the above schedule based on learning progression.
[b]The lecturer will be away on business travel in week 5. The lectures will be either cancelled or prerecorded, while the demonstration sessions will carry on as usual.

6. Assessment

Assessment overview

Task		Assessment	Length	Weight	Learning Outcomes Assessed	Assessment Criteria	Submission	Due Date	Deadline of Absolute Fail	Return Marks
T1		Logbook	Up to 100 pages	30%[a]	Outcome 1-4	• Will be posted on Moodle together with the assignment specification	• Handwritten • Submit original hardcopy to tutors	Week 7 and 12	4 days after due date and time	Within two weeks after the due date
T2	T2a	Functional Design Report	Up to 20 pages	10%	Outcome 1	• Will be posted on Moodle together with the assignment specification	• Digital report • PDF format • Submit via Moodle	Week 4	2 days after due date and time	Within two weeks after the due date
	T2b	Conceptual Design Report	Up to 50 pages	25%	Outcome 2	• Will be posted on Moodle together with the assignment specification	• Digital report • PDF format • Submit via Moodle	Week 9	4 days after due date and time	Within two weeks after the due date
	T2c	Component Design Report	Up to 50 pages	25%	Outcome 4	• Will be posted on Moodle together with the assignment specification	• Online survey via Moodle	Week 13	4 days after due date and time	Within two weeks after the due date
T3		Design Presentation	15 -20 minutes	10%	Outcome 3	• Will be posted on Moodle together with the assignment specification	• Digital format • Submit via Moodle	Week 11	1 days after due date and time	Within one weeks after the due date
T4		Peer Evaluation	None	70%[b]	Outcome 1-4	• Will be posted on Moodle together with the confidential survey	• Digital format • Submit via Moodle	Week 4, 9, 11, and13	1 day after due date and time	Within two weeks after presentation

[a] 15% is allocated to the mid-term submission in week 6, and 15% is allocated to the final submission in week 12

[b] The team grades for T2a, T2b, T2c and T3 will be converted to individual grades based on the peer evaluation of individual contribution to teamwork. In other words, as much as 70% of the grade may be affected by the result of T4.

The final grade is calculated based on your performance for the following assessments that carry different weights:

- 30% - One design logbook based on **individual efforts**
    - 15% - The first submission in week 7
    - 15% - The final submission in week 13
- 60% - Three design reports based on **team efforts**
    - 10% - The functional design report
    - 25% - The conceptual design report
    - 25% - The component design report
- 10% - One design presentation based on **team efforts**
- 70% - Four **peer evaluations** of individual contribution to teamwork (the above-mentioned three reports and one presentation)

Students enrolled in the same demonstration session will be divided into multiple project teams, each team with 5-6 students. Students in the same team will work together throughout the semester to collaboratively accomplish a design project and its associated assignments (i.e. design reports and design presentation).

Assignments

Design Logbook

Every student is required to create a personal design logbook. The purpose of the logbook is to keep a record of your individual contribution to the design project. In industry, the 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.

In essence, the logbook is 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 weeks 6 and 12. Each logbook submission counts 15% of the final grade.

Design Report

Throughout the semester, each team is required to submit a total of three (3) design reports. The reports correspond to the three phases of a systematic design process: functional design, conceptual design, and component design. A detailed specification of report requirements, format, and organization will be posted on Moodle. The functional design

report, conceptual design report, and component design report each count as 10%, 25%, and 25% of the final grade, respectively.

In light of the iterative nature of engineering design, a special resubmission policy applies. Specifically, a team is allowed to significantly revise its submitted report and resubmit it for remarking. Any team has only one chance of resubmission for each report. Resubmission is only allowed for the functional design report and conceptual design report, excluding the component design report. The resubmission window is open for 7 days after the initially submitted report is returned to you with comments from the reviewer. 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. Take the functional design report for example: if a team received 7 marks in the initial submission and 9 marks in the resubmission, then the final grade that shows in the grade-book is 8 marks. 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.

Design Presentation

Every team will be required to make a 15-20 minute public presentation about the functional design and conceptual design in front of the lecturer, demonstrators, and classmates. The presentation is scheduled in week 11 and organised within each demonstration session. The design presentation counts 10% of the final grade.

Peer Evaluation

In correspondence to the three design reports and the design presentation, 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 70% of the 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. Some time 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 any inactive team members who failed to contribute at all, you should inform the lecturer and demonstrators as early as possible.

Presentation

All non-electronic submissions should have a standard School cover sheet which is available from this course's Moodle page. 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 per cent (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,
b. Online quizzes where answers are released to students on completion, or
c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
d. Pass/Fail assessment tasks.

Marking

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

Special consideration and supplementary assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see the School intranet, and 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.

For this course, recent improvements resulting from previous student feedback include: (1) reengineering the report resubmission policy; (2) adding more practical examples in the lecture content; (3) adjusting the assessment schedule; (4) adjusting the peer evaluation methods; (5) redistributing the weights carried by different assignments; and (6) including some new content for component design.

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: 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

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

10. Administrative matters and links

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

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support Services

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership