UNSW AUSTRALIA

Course Outline

Semester 2 2015

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

MMAN2100

ENGINEERING DESIGN 2

Contents

1. Staff Contact Details

Contact details and consultation times for course convenor

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2. Course details

Credit Points:

This is a 6 unit-of-credit (UoC) course, and involves <insert hours> hours per week (h/w) of face-to-face contact.

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

Contact Hours

	Day	Time	Location
Lectures	Wednesday	14:00 – 15:00	Ainsworth G03
	Thursday	09:00 – 10:00	Ainsworth G03
Demonstrations	Wednesday and Thursday	15:00 – 16:00 10:00 – 11:00	Red Centre M032 Ainsworth 102
	Wednesday and Thursday	15:00 – 16:00 10:00 – 11:00	Valentine 121 Ainsworth G02
	Wednesday and Thursday	15:00 – 16:00 10:00 – 11:00	Ainsworth G02 Ainsworth 202
	Wednesday and Thursday	16:00 – 17:00 11:00 – 12:00	Red Centre M032 Ainsworth 102
	Wednesday and Thursday	16:00 – 17:00 11:00 – 12:00	Valentine 121 Ainsworth G02
	Wednesday and Thursday	16:00 – 17:00 11:00 – 12:00	Ainsworth G02 Ainsworth 202

Summary of the Course

This course will give the students practical experience in the design process, applying fundamentals learned in other engineering courses. This course is intended to deliver to the student a broad overview of the engineering principles involved with designing a product in a logical and orderly fashion.

Aims of the Course

This course will familiarise you with the processes used in industry to design products. The focus is on *how* to design, creating an ability to go from product requirements to production in a formal and organised fashion.

Regardless of whether your future lies in mechanical, mechatronic, aerospace or manufacturing engineering, understanding this process is a fundamental skill useful for the rest of your careers.

Design is an open-ended problem for which there is normally no single correct answer, only “locally optimal” solutions. Design lies in the middle-ground between creativity, customer requirements, industry standards, and machining capabilities.

In this course you will gain experience in the process from concept through prototype of a small product. You will spend time with a “customer”, scoping requirements, sketching options, and drafting schematics. Then you will iterate your designs through a process of construction, testing, and refinement to get as close to an “optimum” performance of the product as possible.

You will work in teams, and each team will compete for the best product for use by the customer. The best designs will be chosen by the customer for prototyping. Expect to get your hands dirty, but they will get dirty in an organised and productive fashion.
These tasks also enable you to improve your written communication skills, drawing capability through presentation of design reports including proper engineering drawings for manufacturing and assembly.

The design and build project enables you to improve your ability in group cooperation, project planning and budget consideration from concepts to completion (prototype testing).

Student learning outcomes

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

After successfully completing this course, you should be able to:

Learning Outcome		**EA Stage 1 Competencies**
1.	Apply formal design processes to a practical engineering problem and develop, from start-to-finish, a small product using industry standards. You should be familiar with the basic approaches in design tasks involving design considerations, constraints, process and management	PE 1.1
2.	Find the right balance in scoping product requirements. Too many requirements can complicate development. Too few can fall short of a customer's needs	PE 1.5 and 1.6
3.	Identify the issues in designing and planning the interfaces between product parts, and know how to measure the quality of a design concept, for use in concept selection	PE 2.3
4.	Understand and utilise modern influences to design, such as 3D printing and other tools, and their impacts to the design process	PE 2.4
5.	Cooperate in, and effectively contribute to, group projects	PE 3.5 and 3.6
6.	Have improved written communication skills and drawing capabilities	PE 3.2 and 3.3

3. CAD Drawings

While DESIGN PROCESS as such is the real message of this course, the CAD system is the medium which you are expected to use for the design work you do. Remember that a good drawing is NOT done by just pressing a button on the computer. It is the user who makes the outcome good or bad quality.

Remember to:

- Follow the Australian drawing standards throughout your work.
- Provide only minimal outline representation for proprietary items, e.g. couplings, pulleys, sprockets, gears, belts, chains, bearings, seals, nuts, screws, washers and bolts, etc.
- Where features are repeated, show in full once only and indicate repeats notionally.
- Use symmetry to advantage where it exists. Centrelines are a vital feature to achieve this.
- Last but not least, directly dimension sizes based on function requirements, rather than sequentially or from one corner of the product.
- Failure to abide by these guidelines will attract a significant penalty.

4. Teaching strategies

Lectures and demonstrations in the course are designed to cover the core knowledge areas in Engineering Design to help you develop a range of skills such as design processes, sketching, tools (CAD, 3D Printing, etc.), working with a project team, as well as application of analytical skills learnt in other courses.

Demonstrators will provide you with feedback and discussion on the assignments, and to understand the concepts and problems in greater depth. Assignments and marking structure are designed to give the “feel” of working on a project in industry.

The teaching strategies that will be used include:

- Presenting material in lectures so that you know how to approach various design tasks.
- Discussion and practice in demonstrators to answer queries and provide feedback on your design work.
- Group projects to familiarise you with dynamics experienced in real world engineering.

Suggested approaches to learning in the course

This class has hands-on skills and brain-thinking skills. Practice your hands-on skills as much as you can (that’s the fun part) but also understand how to apply some basic industry standards and tolerances to your designs.

- Attend the lectures. There are a few abstractions which seem simple when reading the moodle slide but require a bit of discussion (*and practice*) to get the context. The lowest marks from previous years are from people who sent their mates to take notes.
- Keep the material as a reference. Practice is better than book-memorizing.
- Gain hands-on experience in the demonstrations. Break things, make mistakes, then fix them again through iteration.
- Practice your skills every week so the skills can “burn in”. They get rusty over time.
- Keep your logbook up to date. Work on it every session. This is a very good habit to learn now that will benefit you in the future. Every session means EVERY session.
- Strive for attention to detail from day one.
- Help your mates, in class, and especially in project groups. We’re all in this together.
- Done practicing yet? No you’re not. This class is only the beginning ☺

5. Course schedule

Week	***Wednesday (1-hr)***	***Thursday (1-hr)***	***Demonstration and Labs***	***Deliverable***
1	Introduction / overview	Design processes Research & Logbook	n/a	n/a
2	Feasibility Requirements scoping	Project Planning Mass / Power budgeting	Group formation & RFP research	n/a
3	Conceptual design	Concept Sketching	Requirements System Design	n/a
4	Structures	Structures	Concept Selection	**Research and Requirements**
5	Drawing symbols Drawing views	Thermal Systems design	Concept Selection	n/a
6	Electric Power Sys Batteries	Mechatronic Command data handling	Lab prototyping Design Reviews	**Logbook 1**
7	Motor selection (AC/DC, Steppers)	(Guest Lecture) FEA intro	Presentations	**Conceptual Doc**
8	Detailed Design Testing, V&V	**Midterm Exam**	Lab prototyping	**n/a**
9	Prototyping	Refinement	Lab prototyping	**Detailed Design & V&V Doc**
10	Design Reviews	Design Reviews	Refinement	n/a
11	Design Reviews	Design Reviews	Design refinements	n/a
12	Design Reviews	Design Reviews	Final presentations	n/a
13	Agile and Lean processes	Future of design	Final presentations	**Logbook fin**

RED items are group submissions. **GREEN** items are individual submissions.

Note: the course schedule is subject to change at short notice. Please make sure to keep updated during the lectures and via the course Moodle news forum.

6. Assessment

Assessment task	Weight	Learning outcomes assessed	Due date, time, and submission requirements
Research and Requirements Document	6.67%	1 and 2	Thursday Week 4, in Tutorial
Logbook 1st submission	15%	1, 3, and 6	Thursday Week 6, in Tutorial
Conceptual Document	6.67%	1, 3, 5, and 6	Thursday Week 7, in Tutorial
Midterm Exam	10%	1 and 3	Thursday Week 8, in Lecture
Detailed Design and V&V Document	6.67%	1, 3, 4, and 5	Thursday Week 9, in Tutorial
Logbook 2nd submission	15%	1, 3, and 6	Thursday Week 13, in Tutorial
Group Project	40%	1, 2, 5, and 6	Thursday Week 13, in Tutorial
TOTAL	**100%**		

You will be assessed on your design process, ability to follow standards for your chosen industry, and on the quality of your final product. There is no final exam.

Assignments are structured in a fashion similar to what you may experience in industry, and you should treat your demonstrator as you would a customer or an employer. All assignments are “deliverables”, completed by the team. Your team will need to show the ability to complete each assignment to a high standard (80% or better) in order to allow submission of the next deliverable. A 90% or better is required prior to attempting to go to prototype (3D printing). However, each team is allowed four resubmissions of assignments during the semester so you will have a chance to recover from the types of mistakes that would normally put you in peril of losing a job.

Each student will keep a logbook to evaluate your design process and provide feedback. Logbooks will be collected at week six and at the end of the project.

A midterm will test your individual (and practical) understanding of skills.

The Group Project will make the final grade. You will be evaluated on your ability to understand and meet customer requirements with your design and final product submission.

The submission will include a 3D printed prototype, the final presentation, and the final report.

For group marks, **your support of the team is important**, **and in some cases students may get marked fractionally if they are identified as being non-performers**.

Presentation

All submissions should have a standard School cover sheet which is available from this subject's Moodle page.

The cover sheet is not a title page and not considered as part of the document but contains information for us to identify you and record your mark. Please fill in properly and indicate your group number, regardless whether it is an individual or group work, for easy return of the marked work.

All submissions are expected to be neat, and clearly set out. Your results are the pinnacle of all your hard work. Presenting them clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

The format of the assignment report, the design consideration and technical drawings (if appropriate) will also contribute to the assignment marks. All results with units must have their appropriate units written.

Submission

Late submissions will be penalised 5 marks per calendar day (including weekends). This penalty applies to the final mark, even after a resubmission. Ergo, late submissions risk failing the course.

An extension may only be granted in exceptional circumstances. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Examinations

You must be available for the midterm exam. For further information on exams, please see Administrative Matters.

You will need to provide your own calculator, of a make and model approved by UNSW, for the examinations. The list of approved calculators is shown at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an “Approved” sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an “Approved” sticker will not be allowed into the examination room.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see Administrative Matters, available on the School website and on Moodle, and the information on UNSW’s Special Consideration page.

Note that special consideration, if granted, is for an alternative assessment, rather than free marks, for the missing tasks. No special consideration will be accepted for group work when some group member(s) have problems to complete work in time. In this case, the rest of the group members shall take over the effected work so the whole group will not suffer otherwise.

7. Expected Resources for students

Textbooks are provided as suggested reading

SHIGLEY’S MECHANICAL ENGINEERING DESIGN, R.G. Budynas and J. K. Nisbett, 9th ed., McGraw Hill.

ENGINEERING DRAWING, A.W. BOUNDY, 7th ed., McGraw Hill.

In addition, partial lecture notes (.ppt) will be available online to assist revision.

FUNDAMENTALS OF MACHINE DESIGN, Vols. 1 to 5, Orlov, R., MIR Publishers, Moscow

MATERIALS AND PROCESSING IN MANUFACTURING, De Garmo, E.P., Collier MacMillan, New York/London.

MACHINE DESIGN, Deutschman, A.D., Michels, W.J. and Wilson, C.E., Collier MacMillan, New York.

STEEL DESIGNERS HANDBOOK, Gorenc, B.E. and Tinyou, R., NSWUP, Sydney.

MANUFACTURING ENGINEERING AND TECHNOLOGY, Kalpakjian, S., Addison-Wesley, New York.

MANUFACTURING PROCESSES, Yankee, H.Y., Prentice-Hall, New Jersey.

Manufacturers’ catalogues are useful in selecting components for the design project.

Additional materials provided on Web

Moodle: Lecture notes, assignment information, progress marks, announcements, class/group discussion forums, etc.

8. Course evaluation and development

The course has been completely redesigned in 2013 and has been through several iterations. Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) process, informal discussion in the final demonstration 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.

We've implemented several improvements based on the feedback from 2014. Improvements include a standardisation of CAD and better coordination with other courses. Lectures are shorter so there is more time to work on the project. We've also reduced the number of possible projects to allow better focus on key skills and better standardisation of marks.

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 presented in a School handout, Administrative Matters, available on the School website.

10. Administrative Matters

You are expected to have read and be familiar with *Administrative Matters*, available on the School website: www.engineering.unsw.edu.au/mechanical-engineering/sites/mech/files/u41/S2-2015-Administrative-Matters_20150721.pdf

This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

Student support services

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 Student Equity And Disabilities Unit (SEADU): 9385 4734, seadu@unsw.edu.au, www.studentequity.unsw.edu.au , Ground floor of the John Goodsell Building (F20). 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.

Information on Occupational Health and Safety policies and expectations

The OHS link is: www.hr.unsw.edu.au/ohswc/ohs/ohs_home.html

OVERALL

Remember that as a designer, it helps to:

1. Combine logical skills with creative thought. This means you use the design process as structure to meet your requirements but *be free thinking with the technical solution*; aim to avoid problems in the first instance, rather than having to deal with their results later.
2. Decouple problems; integrate solutions.
3. Have confidence in your own creativity and abilities in design.

4. Keep your nerve when it gets difficult.
5. Know your own strengths and weaknesses, and how you work best.
6. Know when you need help
    a. to generate ideas, or
    b. in specialist areas of practice,

    and
    c. Quantify- use analysis to prove the quality of your design solution
    d. Qualify- use surveys to show the interest in your design solution

And particularly remember that:

1. Ultimately it is the marketplace that defines success or failure for a product or design.
2. The computer is a great tool but your imagination is the real designer.
3. No amount of theoretical analysis will save a design from the bad results of a poor configuration, so get the configuration right first.
4. A superior product (specification, quality) at a competitive price and in an attractive format always succeeds.
5. Simplicity will always be the hallmark of design excellence.
6. Simplicity is often not easy to achieve.

Finally, this is a subject to be enjoyed! We enjoy presenting it, and we hope you enjoy developing in it.

Jason Held
20 July 2015

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	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