UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Term 1 2020

MANF3100

PRODUCT AND MANUFACTURING DESIGN

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1. Staff contact details

Contact details and consultation times for course convenor

Dr Erik van Voorthuysen
Office: Ainsworth Building (J17), Room 507
Telephone: 9385 4147
Email: erikv@unsw.edu.au

Consultation concerning this course is available immediately after classes. Face to face consultation is preferred.

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

Dr Ron Chan
Office: Ainsworth Building (J17), Room 507
Telephone: 9385 1535
Email: r.chan@unsw.edu.au

Consultation concerning this course is available immediately after classes. Face to face consultation is preferred.

Please see the course Moodle.

2. Important links

- Moodle
- Lab Access
- Health and Safety
- 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 4 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 25 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	Monday	10:00-11:30	Ainsworth G02 (weeks 1-8,10-11)
Lab	Monday	11:30-13:00	Ainsworth G02 (weeks 1-8, 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 making certain that a complex design—whether mechanical, mechatronic or aerospace—can also be successfully manufactured, from a quality as well as cost perspective.

The key concept is the ability to translate functional requirements of a design into detailed subsystem-, equipment- and ultimately component-level specifications. These design-related specifications are then further developed into process specifications and ultimately support process selection and planning.

Whereas the course has a strong focus on processing and transformation technology, the economic analysis of manufacturing processes is also an important part of the course. The reason for this is that around 70% of manufacturing costs—including material, processing and assembly—are determined by design specifications before the product even hits the factory floor. The remaining 30% of costs are determined by operational decisions, including machine selection, process planning, scheduling, routing and so on.

Topics include an overview of transformation processes and related cost and quality drivers, design for manufacturing related methodologies including quality function deployment (QFD), concurrent design, lifecycle design, value analysis, value engineering, robust design,

axiomatic design and tolerance analysis. The course also introduces basic jig and fixture design for different levels of automation and manufacturing processes as well as an introduction to metrology for manufacturing engineers. Modern CAD/CAM systems contain sophisticated functionality and modules that automate some of the analysis and design functions with respect to process planning and even jig design. We have planned for an industry expert to give a guest lecture on this topic.

The course will combine lectures with practical case studies that require the theory taught to be applied to actual product designs and prototypes. Students have the option to bring their own examples and case studies into the course or alternatively select one of the recently developed designs provided in class.

The course aims to develop you into a skilled and all-rounded design engineer able to carry out and manage the key design processes in parallel and concurrently. Design is inherently complex and a systematic, yet flexible, agile and interdisciplinary approach is required to bring product to the market successfully and in less time. The course teaches this approach based on global best-practice methodologies, and incorporates case studies and projects, even your own designs and plans, to apply these methodologies and become proficient at them.

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.	Understand and apply systematic design principles including: • Quality Function Deployment (QFD) • VDI-2206 and 2221 Design Standards • Axiomatic and robust design principles • Value analysis and value engineering methods.	PE1.1, 1.2, 1.3, 1.5, 1.6 PE2.1, 2.2, 2.3, 2.4
2.	Analyze and characterize manufacturing transformation processes and measurement techniques in terms of key technical and economic drivers and factors.	PE1.1 , 1.2, 1.6 PE2.2, 2.3, 2.4 PE 3.1, 3.4
3.	Develop an engineering design or prototype into a design that can be effectively and efficiently manufactured to meet customer as well as OEM requirements.	PE1.4, 1.6 PE2.1, 2.2, 2.3, 2.4 PE3.1, 3.2, 3.3, 3.4, 3.5, 3.6

Learning Outcome		EA Stage 1 Competencies
4.	Understand the principles of manufacturing economics as it applies to material transformation processes as well as assembly processes and to apply economic analysis to develop cost and production estimates for your design.	PE1.1 PE2.1, 2.2, 2.3, 2.4 PE 3.1, 3.4

4. Teaching strategies

Lectures in the course are designed to cover the terminology and core concepts and theories in the area of design for manufacturing. They do not simply reiterate the texts but build on the lecture topics using examples taken directly from industry to show how the theory is applied in practice and the details of when, where and how it should be applied.

Tutorials are designed to provide you with feedback and discussion on the assignments, and to investigate problem areas in greater depth to ensure that you understand the application.

5. Course schedule

Week	Topic	Location	Suggested Readings
1	Design Theory, QFD, Developing Functional Requirements, V-Model design theory, Axiomatic Design, Concurrent Design	Ainsworth G02 Monday 10:00-13:00	Lecture notes
2	Economics, Costing, Value Engineering, Quality, and Process Capability	Ainsworth G02 Monday 10:00-13:00	Lecture Notes, Swift & Booker, Chapters 1, 12
3	Computer Aided Manufacturing (CAM)	Ainsworth G02 Monday 10:00-13:00	Laboratory on CAM
4	Process and Material Selection Methods	Ainsworth G02 Monday 10:00-13:00	Lecture Notes, Swift & Booker, Chapter 2
5	Primary and Secondary Processes	Ainsworth G02 Monday 10:00-13:00	Lecture Notes, Swift & Booker, Chapters 3, 4, 6
6	Rapid Prototyping, Plastics and Composites, EDM, Laser, Water-jet, PCB and Electronics Manufacturing, Joining Processes and Materials	Ainsworth G02 Monday 10:00-13:00	Lecture Notes, Swift & Booker, Chapters 5, 7, 8, 11
7	Design for Assembly (DFA), Design for Manufacturing (DFM)	Ainsworth G02 Monday 10:00-13:00	Lecture Notes, Swift & Booker, Chapters 10, 13
8	Metrology, limits, fits and tolerancing	Ainsworth G02 Monday 10:00-13:00	Lecture notes
9	Surface Engineering	Ainsworth G02 Monday 10:00-13:00	Lecture Notes, Swift & Booker, Chapters 9
10 (11)	Jigs and Fixtures	Ainsworth G02 Monday 10:00-13:00	Lecture notes

6. Assessment

Assessment overview

Assessment	Group Project?	If Group, # Students per group	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Laboratory – process planning & costing	No	1	2 hours laboratory attendance, short answers	10% Total	2 and 4	A pre-designed CAD model is to be analyzed in terms of primary and secondary processing and an appropriate costing estimate is to be developed based on machine and tool selection	In-class, week 4 during laboratory time	N/A	Two weeks after submission
Quiz 1 and 2	No	N/A	1 hour each	20% Total	1, 2, 3 and 4	All course content from weeks 1-9 inclusive.	Week 5 and 10 during class time	N/A	Two weeks after submission
Assignment Part 1 – prototype development & preliminary costing	Yes	2-3	2000 Words	30%	1, 2, 3 and 4	All course content from weeks 1-6 inclusive.	End of Week 6 Submission via Moodle	One week after deadline	Two weeks after submission
Assignment Part 2 – prototype detailed costing	Yes	2-3	3000 Words	40%	1, 2, 3 and 4	All course content from weeks 1-10 inclusive	End of Week 10 Submission via Moodle	One week after deadline	Upon release of final results

Assignments

Full requirements for Assignment Part 1 and Part 2 will be placed on Moodle. Assistance for the assignment will be provided during allocated tutorial sessions.

Quiz 1 and 2

Two invigilated quizzes will be conducted during class time (either during the lecture or lab time as confirmed by the lecturer at least one week in advance) on the dates allocated in the table above. Each Quiz is nominally 1 hour, but extra time may be given. Each Quiz will cover all material taught up to that week in the term.

Lab Exercises

Lab exercises will be held during the laboratory period and the written submission will be due at the end of that week. Requirements for the lab exercise will be given out during the lab.

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 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 is no final examination for this course.

Calculators

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 available 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 Engineering Student Supper Services Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

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

Reference books

1. Manufacturing Process Selection Handbook: From Design to Manufacture, Swift K.G., Booker J.D., 2013, Burlington, Elsevier Science, ISBN 9780080993607 – available from our library electronically
2. Applied Metrology for Manufacturing Engineering, Grous A, 2011, ISTE, John Wiley & Sons, Inc, ISBN 9781848211889

3. Low-cost Jigs, Fixtures & Gages, for limited production, Boyes W.E. ed., Society of Manufacturing Engineers, 1986, Dearborn, Michigan
4. Fundamentals of Modern Manufacturing, Groover M.P., 2nd ed., 2002 John Wiley

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

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

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

Ron Chan & Erik van Voorthuysen, January 2020

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