UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Semester 1 2018

MMAN3400

MECHANICS OF SOLIDS 2

Contents

1. Staff contact details

Contact details and consultation times for course convenor

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Generally, problem-solving class time should be used for direct consultation. Following problem-solving class if you need further consultation, then you may use phone or email for making an appointment for further consultation.

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 5 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	Monday	2pm - 4pm	Chem Sc M18
	Wednesday	1pm - 2pm	CLB 7
Demonstrations	Wednesday	12pm – 1pm	QuadG031/45
	Wednesday	2pm – 3pm	QuadG032/34
	Wednesday	3pm – 4pm	QuadG032/34
	Friday	11am – 12pm	QuadG031/34
	Friday	12pm – 1pm	QuadG031/34
	Friday	1pm – 2pm	QuadG031/34
Lab	Monday	9am – 11am, 11am – 1pm, 4pm – 6pm	UTL
	Tuesday	9am – 11am, 11am – 1pm, 1pm – 3pm	UTL

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 continue the development of a systematic approach to problem-solving that commenced in earlier courses. It will focus on Membrane stresses in axisymmetric shells, simple bending, bending of composite and reinforced concrete beams, principal and cross moments of area, unsymmetrical bending, transverse shear stresses in beams, shear centre, column buckling, theory of elasticity: compatibility – equilibrium – constitutive equations – plane stress and strain, torsion of multiply connected thin-walled sections, deflection analysis based on the principle of virtual work, various modes of fracture, crack-tip stresses, stress intensity factor, fracture toughness, and crack growth due to fatigue.

The course follows on from the basis of statics in MMAN1300 and elementary topics in MMAN2400 Mechanics of Solids 1 and applies the knowledge obtained to the analysis of thin shells, beams and columns as well as introduces you to some advanced topics in mechanics of solids, such as mechanics of fracture and fatigue. The lecture topics relate closely to mechanical engineering applications with a balance between theory and practice. Assessments will have a strong emphasis on problem-solving skills to address practical applications.

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.	Determine stresses in axisymmetric shells/vessels, unsymmetrical bending, shear and column buckling	PE 1.1, 1.2,1.3, 2.1
2.	Analyse deflection of trusses and beams using principle of virtual work	PE 1.1, 1.2,1.3, 2.1
3.	Investigate mechanics of fracture and fatigue	PE 1.1, 1.2,1.3, 2.1
4.	Develop further your skill of technical problem-solving	PE 1.1, 1.2,1.3, 2.1, 2.3, 3.1

4. Teaching strategies

Effective learning is supported when you are actively engaged in the learning process and by a climate of enquiry, and these are best achieved through learning activities like lectures and problem-solving classes using practical examples combined with laboratory demonstrations and hands-on activities.

You become more engaged in the learning process if you can see the relevance of your studies to professional, disciplinary and/or personal contexts. This relevance is shown in all parts of the course through lectures by way of examples drawn from industry.

Discussions are encouraged between you, others in the class and the lecturer. The diversity of experiences is acknowledged. Your experiences are drawn on to illustrate various aspects, and this helps to increase motivation and engagement.

The teaching strategies that will be used include:

- Presentation of the material in weekly lectures so that the students develop the understanding of the underlying concepts of the various topics covered in the course.
- Provision of weekly supervised problem-solving classes where students can obtain assistance and develop their skill in solving technical problems.
- Provision of laboratory classes where students work in teams to perform physical experiments, analyse data and produce pertinent reports about which students will receive timely feedbacks.

5. Course schedule

Table 1: BLOCK 1 – Fundamental Topics				
Week – Day(venue)	**Topic**	**Suggested Readings**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
1 – Mon & Wed (ChemSc M18/CLB7)	Membrane stresses in axisymmetric shells/vessels.	Moodle Notes + Hibbeler: Ch 8.1	Moodle -Web Questions + Hibbeler: 8-3, 8-4,8-5,8-8,8-12	No Problem Solving Class
2 - Mon (ChemSc M18)	Product of Inertia of an Area.	Hibbeler: Appendices A.1 to A.5	Hibbeler: Examples A.1 to A.6	Problem Solving Class 1 QuadG031/32/34/45
2 – Wed (CLB7)	Revision: Simple bending	Hibbeler: Ch 6.3 & 6.4	Hibbeler: 6-47,6-48,6-52, 6-55,6-56,6-60,6-61,6-69,6-76,6-80,6-88, 6-96,6-100	Problem Solving Class 2 QuadG031/34
3 – Mon (ChemSc M18)	Unsymmetric bending	Hibbeler: Web Notes + Ch 6.5	Hibbeler: 6-108, 6-112, 6-114, 6-115,6-116	**Laboratory (Willis 116 Mon or Tues)** Problem Solving Class 1 QuadG031/32/34/45
3 – Wed (CLB7)	Composite Beams	Hibbeler: Ch 6.6 & 6.7	Hibbeler: 6-120,6-121,6-124,6-128,6-132,6-135	**Quiz 1 Wed 6pm–7pm (Mathews A)** Problem Solving Class 2 QuadG031/34
4 – Mon (ChemSc M18)	Revision: shear stresses in beams	Hibbeler: Ch 7.1 to 7.3	Hibbeler: 7-3,7-4,7-8, 7-12,7-19,7-23,7-24,7-28, 7-32,7-36,7-38,7-42,7- 45,7-47,7-48	**Laboratory (Willis 116 Mon or Tues)** Problem Solving Class 1 QuadG031/32/34/45
4 – Wed (CLB7)	Shear Flow.	Hibbeler: Ch 7.4	Hibbeler: 7- 50,7-52,7-53,7-55,7-56,7-59	Problem Solving Class 2 QuadG031/34
5 – Mon (ChemSc M18)	Shear Centre	Hibbeler: Ch 7.5	Hibbeler: 7-60,7-63,7-64,7-66,7-68,7-69, 7-70	Problem Solving Class 1 QuadG031/32/34/45

Table 1: BLOCK 1 – Fundamental Topics				
Week – Day(venue)	**Topic**	**Suggested Readings**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
5 – Wed (CLB7)	Column buckling:	Hibbeler: Ch 13.1 to 13.3	Hibbeler: 13-1,13-2,13-4,13-6,13-12,13-13,13-14,13-16,13-20,13-23	**Quiz 2 Wed 6pm–7pm (Mathews A)** Problem Solving Class 2 QuadG031/34
6 – Mon (ChemSc M18)	Column buckling:	Hibbeler: Ch 13.4 to 13.5	Hibbeler 13-35,13-36,13-40, 13-41,	Problem Solving Class 1 QuadG031/32/34/45
6– Wed (CLB7)	Column buckling:	Hibbeler: Ch 13.6	Hibbeler: 13-46, 13-48, 13-56, 13-110,13-118	Problem Solving Class 2 QuadG031/34
7 – Mon (ChemSc M18)	**Mid-Semester Exam**	Material covered in Lectures 1 to 11 (inclusive).	**Will be held on Monday between 2pm and 4pm.**	Problem Solving Class 1 QuadG031/32/34/45
7 – Wed (CLB7)	Torsion of prismatic and thin-walled tubes having closed cross-section	Hibbeler: Ch 5.2, 5.4, 5.5, 5.7	Hibbeler: 5-80, 5-84, 5-88, 5-109 to 5-119	Problem Solving Class 2 QuadG031/34

Table 2: BLOCK 2 – Advanced Topics				
Approx Week – Day	**Topic**	**Textbook - Notes**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
8 – Mon (ChemSc M18)	Principle of virtual work	Hibbeler: Ch 14.1 to 14.3	Hibbeler: 14-25 to 14-30	Problem Solving Class 2 QuadG031/34
9 - Mon (ChemSc M18)	Principle of virtual work	Hibbeler: Ch 14.3, 14.5	Hibbeler: 14-31 to 14-36	Problem Solving Class 1 QuadG031/32/34/45
9 – Wed (CLB7)	Principle of virtual work applied to trusses	Hibbeler: Ch 14.6	Hibbeler: 14-72 to 14-86	Problem Solving Class 2 QuadG031/34 **Deadline for lab reports: Friday midnight**

Table 2: BLOCK 2 – Advanced Topics				
Approx Week – Day	**Topic**	**Textbook - Notes**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
10 – Mon (ChemSc M18)	Principle of virtual work applied to thin and long beams	Hibbeler: Ch 14.7	Hibbeler: 14-87 to 14-122	Problem Solving Class 1 QuadG031/32/34/45
10 – Wed (CLB7)	Statically indeterminate beams & shafts – Superposition method	Hibbeler: Ch 12.9 & 5.5	Hibbeler: 12-121 to 12-132 & 5-77 to 5-89	Problem Solving Class 2 QuadG031/34
11 – Mon (ChemSc M18)	Fracture Mechanics	Moodle Notes	Moodle Questions	Problem Solving Class 1 QuadG031/32/34/45
11 – Wed (CLB7)	Stress intensity factor & Various methods of determining stress intensity factors including FEM (crack-tip modelling) and typical values)	Moodle Notes	Moodle Questions	**Quiz 3 Wed 6pm–7pm (Mathews A)** Problem Solving Class 2 QuadG031/34
12 – Mon (ChemSc M18)	Fracture criterion, Fracture toughness	Moodle Notes	Moodle Questions	Problem Solving Class 1 QuadG031/32/34/45
12– Wed (CLB7)	Crack growth due to fatigue & its FE modelling, Paris & Forman equations	Moodle Notes	Moodle Questions	Problem Solving Class 2 QuadG031/34

Table 2: BLOCK 2 – Advanced Topics				
Approx Week – Day	**Topic**	**Textbook - Notes**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
13 – Mon & Wed	No Lectures			Problem Solving Class 1 QuadG031/32/34/45 Problem Solving Class 2 QuadG031/34

All the lecture notes and in-class problems along with the relevant information about laboratory experiments will be available on Moodle.

6. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Quizzes (3)	50 minutes	18% (3x6%)	1 and 4	Quiz 1 (Lectures 1&2) Quiz 2 (Lectures 3-6) Quiz 3 (Lectures 13-16)	Wed 6pm in Week 3, 5 and 11	N/A	One week after each quiz
Lab Assignments (2)	2,000 words	14% (2x7%)	1 and 4	Pressure Vessel & Unsymmetrical bending of beams	Week 9 Friday midnight via Moodle	Week 10 Friday midnight via Moodle	Two weeks after submission
Mid-semester exam	1 hour and 45 minutes	28%	1, 2,3 and 4	Lectures 1 to11	Week 7 Monday 2 pm	N/A	Two weeks after the exam
Final exam	2 hours	40%	1, 2,3 and 4	All course content from weeks 1-12 inclusive.	Exam period, date TBC	N/A	Upon release of final results

You will be assessed by way of in-semester quizzes, mid-semester examination, laboratory assignments and a final examination. The topics covered in all assessments are directly related to the student learning outcomes listed above. All examinations are closed-book. The laboratory reports are to be submitted through a drop box in Moodle.

Assignments

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

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Special consideration for assessment tasks 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.

Where there is no special consideration granted, the 'deadline for absolute fail' in the table above indicates the time after which a submitted assignment will not be marked, and will achieve a score of zero for the purpose of determining overall grade in the course.

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 will be one two-hour final examination at the end of the semester, based on the material covered in Lectures 1 to 20.

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2

For further information on exams, please see the Exams section on the intranet.

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 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 the School intranet, and the information on UNSW's Special Consideration page.

7. Attendance

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the School intranet and the UNSW attendance page for more information.

8. Expected resources for students

Recommended Textbook and Notes

(1) R. C. Hibbeler, "Mechanics of Materials", 9th Ed. In SI Units, 2013, Pearson/Prentice Hall (Book Store).
(2) Notes on the Membrane Stresses in Thin Axisymmetric Shells – see Moodle.
(3) Notes on the Mechanics of Fracture and Fatigue – see Moodle.
(4) Supplementary in-class problems some of which are based on past exam questions – see Moodle.

Suggested Readings

There are numerous valuable resources available on the web, and additional sources will be provided in lectures and problem-solving sessions.

Students seeking additional resources can also obtain assistance from the UNSW Library.
UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

9. 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 more interaction with the students and provide more practical examples in the lectures.

10. 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.

11. 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)
- 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