UNSW AUSTRALIA

Course Outline

Semester 1 2015

Never Stand Still | Faculty of Engineering | School of Mechanical and Manufacturing Engineering

MMAN3400

Mechanics of Solids 2

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MMAN3400 MECHANICS OF SOLIDS 2

COURSE OUTLINE

1. COURSE STAFF

Contact details and consultation times for course convener

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

2. COURSE DETAILS

Units of credit

This is a 6 unit-of-credit (UoC) course, and involves 6 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.”

For a standard 24 UOC in the semester, this means 600 hours, spread over an effective 15 weeks of the semester (thirteen weeks plus stuvac plus one effective exam week), or 40 hours per week, for an average student aiming for a credit grade Various factors, such as your own ability, your target grade, etc., will influence the time needed in your case.

Some students spend much more than 40 h/w, but you should aim for not less than 40 h/w on coursework for 24 UOC.

This means that you should aim to spend not less than about 10 h/w on this course, i.e. an additional 4 h/w of your own time. This should be spent in making sure that you understand the lecture material, completing the set assignments, further reading about the course material, and revising and learning for the examination.

There is no parallel teaching in this course.

Course aims

The course aims include developing and further your skill in solving technical problems and familiarizing you with analysis: of membrane stresses in axisymmetric thin shells, stresses in long thin beams, buckling of columns, torsion of thin tubes, deflection analysis, statically indeterminate beams. You also will learn elementary concepts in the area of mechanics of fracture and fatigue. Knowledge of these topics is vital in design, analysis and integrity assessment of mechanical systems.

This is a third year course in the area of mechanics of solids. Having learnt the basis of statics in MMAN1300 and elementary topics in area of the mechanics of solids including basic stress/strain analyses in MMAN2400, this course applies the knowledge obtained in the previous statics and mechanics of solids courses to analysis of thin shells, beams and columns as well as introduces the students to some advanced topics in mechanics of solids such as mechanics of fracture and fatigue.

Student learning outcomes

On completion of this course, you will be expected to have learnt the following topics:

- Membrane stresses in axisymmetric shells/vessels
- Simple bending, moment and product of inertia of an area
- Unsymmetrical bending of beams
- Bending of composite beams, reinforced concrete beams
- Transverse shear stresses in beams.
- Shear centre
- Column buckling
- Torsion of thin tubes
- Deflection analysis of trusses
- Deflection analysis of long thin beams
- Analysis of statically indeterminate beams
- Introduction to mechanics of fracture and fatigue
- Develop further your skill of technical problem-solving
- Develop further your teamwork capacity, and
- Develop further your capacity for analysis of technical problems.

Graduate attributes

UNSW's graduate attributes are shown at
https://my.unsw.edu.au/student/atoz/GraduateAttributes.html

UNSW aspires to develop graduates who are rigorous scholars, capable of leadership and professional practice in a global community. The university has, thus, articulated the following Graduate Attributes as desired learning outcomes for ALL UNSW students.

UNSW graduates will be

1.	Scholars who are:		
	(a)	understanding of their discipline in its interdisciplinary context	✓
	(b)	capable of independent and collaborative enquiry	
	(c)	rigorous in their analysis, critique, and reflection	
	(d)	able to apply their knowledge and skills to solving problems	✓
	(e)	ethical practitioners	
	(f)	capable of effective communication	✓
	(g)	information literate	✓
	(h)	digitally literate	
2.	Leaders who are:		
	(a)	enterprising, innovative and creative	
	(b)	capable of initiating as well as embracing change	
	(c)	collaborative team workers	✓

3. Professionals who are:
   (a) capable of independent, self-directed practice ✓
   (b) capable of lifelong learning
   (c) capable of operating within an agreed Code of Practice

4. Global Citizens who are:
   (a) capable of applying their discipline in local, national and international contexts ✓
   (b) culturally aware and capable of respecting diversity and acting in socially just/responsible ways
   (c) capable of environmental responsibility

   ✓ = Developed in this course

In this course, you will be encouraged to develop Graduate Attributes 1(a), 1(d), 1(f), 1(g), 2(b), 3(a), and 4(a) by undertaking the selected activities and knowledge content. These attributes will be assessed within the prescribed assessment tasks, as shown in the assessment table on Page 7.

3. RATIONALE FOR INCLUSION OF CONTENT AND TEACHING APPROACH

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 tutorials 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.

Dialogue is encouraged between you, others in the class and the lecturers. Diversity of experiences is acknowledged. Your experiences are drawn on to illustrate various aspects, and this helps to increase motivation and engagement.

4. TEACHING STRATEGIES

The teaching strategies that will be used include:

- Presentation of the material in weekly lectures so that the students develop 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.

Problem solving classes are designed to provide you to work through set problems in preparation for examinations and to investigate problem areas in depth. The guidance will assist you to develop the capacity to make judgements based on sound engineering practice and solid theory. You will be expected to seek out necessary information, or ask for help.

5. ASSESSMENT

General

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 assessments are based on closed book.

Quizzes (3)	18%
Laboratory classes (2)	14%
Mid-semester Examination	28%
Final Examination at the end of the Semester	40%
Total	100%

In order to pass the course, you must achieve an overall mark of at least 50%.

Laboratory experiments and reports: A standard specification is available from the School office to facilitate the presentation of your laboratory reports (in all courses). All submissions should have a standard School cover sheet. All submissions are expected to be neatly typed and clearly set out. All calculations (may be hand-written) should be shown as, in the event of incorrect answers, marks are mainly awarded for method and understanding.

The preferred set-out of any numerical calculation is similar to the following:

$\Delta = \rho\nabla$ (Equation in symbols)
$= 1.025 \times 200$ (Numbers substituted)
$= 205$ t (Answer with units)

The deadline for the lab reports is Friday, 4pm on 08th May 2015 (Week 9). The reports are expected to be hard copy based and submitted through the School Assignment Boxes assigned for MMAN3400.

Late submissions attract a penalty of ten percent per working day.

Criteria

The following criteria will be used to grade assignments:

For report-style assignments the following criteria will be used:

- Identification of key facts and the integration of those facts in a logical development.
- Clarity of communication—this includes development of a clear and orderly structure and the highlighting of core arguments.
- Sentences in clear and plain English—this includes correct grammar, spelling and punctuation.
- Correct referencing in accordance with the prescribed citation and style guide.

All other assignments involve numerical calculations, for which the following criteria will be used:

- Accuracy of numerical answers.
- All working shown.
- Use of diagrams, where appropriate, to support or illustrate the calculations.
- Use of graphs, were appropriate, to support or illustrate the calculations.
- Use of tables, where appropriate, to support or shorten the calculations.
- Neatness.

Examination

There will be one two-hour examination at the end of the semester, based on the material covered in Lectures 1 to 20 as stated in the Table on page 9.

You will need to provide your own calculator, of a make and model approved by UNSW, for the examination. The list of approved calculators is shown at: https://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 for All Courses*, available from the School website.

Task	Assignment	Mark	Contribution	Learning Outcomes assessed*	Graduate attributes assessed	Due
T1	Quiz 1	6%	Individual	Membrane Stresses (Lectures 1 – 2)	1(a) 1(b) 1(d) 1(f) 1(g)	Week 3 Wed, 4pm
T2	Quiz 2	6%	Individual	Unsymmetrical bending, and Composite beams (Lectures 3 – 6)	1(a) 1(b) 1(d) 1(f) 1(g)	Week 5 Wed, 4pm
T3	Mid-semester Examination	28%	Individual	Lectures 1 to11	1(a) 1(b)1(d) 1(f) 1(g)	Week 7 Wed, 2pm
T4	Laboratory Assignments (2)	14%	Individual	Pressure Vessel & Unsymmetrical bending of beams	1(a) 1(d) 1(g) 1(f) 3(c)	Week 9 Friday 4pm
T5	Quiz 3	6%	Individual	Lectures 13 – 17	1(a) 1(b)1(d) 1(f) 1(g)	Week 11 Wed, 4pm
T6	Final Examination	40%	Individual	Lectures 1 to 20	1(a) 1(b)1(d) 1(f) 1(g) 3(b)	UNSW Exam period

*The material covered for assessment of learning outcomes may vary slightly. Any variation will be updated in the lecture and the Moodle.

6. Academic honesty and plagiarism

Plagiarism is using the words or ideas of others and presenting them 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 booklet which provides essential information for avoiding plagiarism: https://my.unsw.edu.au/student/academiclife/Plagiarism.pdf

There is a range of resources to support students to avoid 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. Information is available on the dedicated website Plagiarism and Academic Integrity website: http://www.lc.unsw.edu.au/plagiarism/index.html

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 a honours thesis) even suspension from the university. The Student Misconduct Procedures are available here: http://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 for All Courses*, available on the School website.

7. Course schedule

Table 1 (Block 1) describes lectures, tutorial and laboratory classes for fundamental topics and Table 2 (Block 2) describes lectures, tutorial and laboratory classes for more advanced topics. The schedule shown may be subject to change at short notice to suit exigencies.

Table 1: BLOCK 1 – Fundamental Topics				
Approx Week – Day	**Topic**	**Textbook - Notes**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
1 – Monday & Wednesday	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	Product of Inertia of an Area.	Hibbeler: Appendices A.1 to A.5	Hibbeler: Examples A.1 to A.6	Problem Solving Class (Mon 11 -12)
2 – Wed	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 (Wed 4 – 5 pm)
3 – Mon	Unsymmetric bending	Hibbeler: Web Notes + Ch 6.5	Hibbeler: 6-108, 6-112, 6-114, 6-115,6-116	**Laboratory** Problem Solving Class (Mon)
3 – Wed	Composite Beams	Hibbeler: Ch 6.6 & 6.7	Hibbeler: 6-120,6-121,6-124,6-128,6-132,6-135	**Laboratory** **Quiz 1 (Wed 4–5 pm)**
4 – Mon	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** Problem Solving Class (Mon)
4 – Wed	Shear Flow.	Hibbeler: Ch 7.4	Hibbeler: 7- 50,7-52,7-53,7-55,7-56,7-59	**Laboratory** Problem Solving Class (Wed)
5 – Mon	Shear Centre	Hibbeler: Ch 7.5	Hibbeler: 7-60,7- 63,7-64,7-66,7- 68,7-69, 7-70	**Laboratory** Problem Solving Class (Wed)
5 – Wed	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	**Laboratory** **Quiz 2 (Wed 4–5 pm)**

Table 1: BLOCK 1 - Fundamental Topics – Continued				
Approx Week – Day	**Topic**	**Textbook - Notes**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
6 – Mon	Column buckling:	Hibbeler: Ch 13.4 to 13.5	Hibbeler 13-35,13-36,13-40, 13-41,	Problem Solving Class (Mon&Wed)
6– Wed	Column buckling:	Hibbeler: Ch 13.6	Hibbeler: 13-46, 13-48, 13-56, 13-110,13-118	Problem Solving Class (Wed)
7 – Mon	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 (Mon)
7 – Wed	**Mid-Semester Exam**	Material covered in Lectures 1 to 11 (inclusive).	**Will be held on Wednesday from 2 pm to 4 pm: Venues (to be announced)**	Problem Solving Class (Wed)

Table 2: BLOCK 2 – Advanced Topics				
Approx Week – Day	**Topic**	**Textbook - Notes**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
8– Mon	Principle of virtual work	Hibbeler: Ch 14.1 to 14.3	Hibbeler: 14-25 to 14-36	Problem Solving Class (Mon
8 – Wed	Principle of virtual work	Hibbeler: Ch 14.3, 14.5	Hibbeler: 14-25 to 14-36	Problem Solving Class (Wed)
9 – Mon	Principle of virtual work applied to trusses	Hibbeler: Ch 14.6	Hibbeler: 14-72 to 14-86	Problem Solving Class (Mon)
9 – Wed	Principle of virtual work applied to thin and long beams	Hibbeler: Ch 14.7	Hibbeler: 14-87 to 14-122	Problem Solving Class (Wed) **Deadline for lab reports: Friday 4pm**

Table 2: BLOCK 2 – Advanced Topics – Continued				
Approx Week - Day	**Topic**	**Textbook – Notes**	**Ref & Questions**	**Problem Solving/Lab/Quiz**
10 – Mon	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 (Mon)
10 – Wed	Fracture Mechanics	Moodle Notes	Moodle Questions	Problem Solving Class (Mon & Wed)
11– Mon	Stress intensity factor & Various methods of determining stress intensity factors including FEM (crack-tip modelling) and typical values)	Moodle Notes	Moodle Questions	Problem Solving Class (Mon)
11 – Wed	Fracture criterion, Fracture toughness	Moodle Notes	Moodle Questions	**Quiz 3 (Wed 4–5 pm)**
12– Mon	Crack growth due to fatigue & its FE modelling, Paris & Forman equations	Moodle Notes	Moodle Questions	Problem Solving Class (Mon)
12 – Wed	Review			Problem Solving Class (Wed)
13 – Mon & Wed	No Lectures			Problem Solving Class (Mon & Wed)

8. 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 tutorial 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 tutorials.

Students seeking additional resources can also obtain assistance from the UNSW Library. One starting point for assistance is:
info.library.unsw.edu.au/web/services/services.html

9. Continual evaluation and development

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 problem solving 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.

The assessment of the course has been reviewed recently as a reflection of the student feedback. The lecturer will focus on more interaction with the students.

10. Administrative matters

You are expected to have read and be familiar with *Administrative Matters*, available on the School website. This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

Dr Kana Kanapathipillai

16 February 2015