UNSW AUSTRALIA

Course Outline

Semester 2 2015

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

MECH4900

MECHANICS OF FRACTURE AND FATIGUE

Contents

1. Staff Contact Details

Contact details and consultation times for course convenor and lecturer

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Consultation concerning this course is available during the problem solving guidance sessions. You may make appointment for consultation by email.

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.

There is no parallel teaching in this course.

Contact Hours

	Day	**Time**	**Location**
Lectures	Monday	2pm - 4pm	EEG25
Demonstrations	Monday	4pm – 5pm	EEG25

Summary of the Course

This course is an advanced course in the field of mechanics of solids. The course introduces the students to the terminology, principles, methods and practice used to safeguard structures against fracture and fatigue failures. In particular, the course teaches students to

perform “damage tolerance analysis” of structures that are pertinent in design of advanced structures such as aerospace, naval, automobile structural components.

Aims of the Course

Fracture is a problem that society has faced to from beginning. The problem is actually worse today than previous centuries because more can go wrong in our complex technological society. It is imperative for graduates in a number of engineering disciplines including mechanical engineering to be familiar with the concept of fracture and fatigue. In this course, the students learn about the fundamental of mechanics of fracture and fatigue and the concept of damage tolerance analysis that is used in design of industrial components to avoid fracture and fatigue failures.

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.	Studying various modes of fracture	PE 1.1, 1.2, 1.3, 2.1, 2.3
2.	Evaluation of fracture toughness	PE 1.1,1.2,1.5, 2.1,2.3,2.4
3.	Understanding of crack growth and fatigue	PE1.1, 1.2, 1.4
4.	Analysis of damage tolerance	PE1.1,1.3, 2.1, 2.2, 2.4

3. Teaching strategies

- 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 guidance sessions 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 feedbacks.

4. Course schedule

The following table shows the time table of lecture topics and problem solving guidance sessions times.

		Monday 2 – 4 pm EEG25	**Monday 4 – 5 pm EEG25**	**Due**
Date	**Week**	**Lecture Topic**	**Problem solving guidance**	**Task**
27 July	1	Introduction to damage tolerance analysis and fracture mechanics		
03 August	2	Plastic collapse	✓	
10 August	3	Modes of fracture, crack-tip stresses and displacements, stress intensity factor.	✓	
17 August	4	Fracture criterion	✓	
24 August	5	Various methods of determining stress intensity factor Fracture toughness	✓	**Quiz**
31 August	6	Crack-tip plasticity **& Description of Major Assignment**	✓	
07 Sept	7	Fracture toughness	✓	
14 Sept	8	Residual Strength Diagram	✓	
21 Sept	9	**Laboratory – Fracture toughness testing & Description of FEA Assignment**		**Lab**
		Semester break		
05 Oct	10	Holiday	✓	**Lab report**
12 Oct	11	Crack growth and fatigue	✓	**FEA Assignment**
19 Oct	12	Crack growth diagram	✓	**Major Assignment**
26 Oct	13	Damage tolerance analysis		

The timing of the above schedule is indicative and minor adjustments may occur.

5. Assessment

This course will be assessed by a laboratory test/report, an in-semester quiz, an assignment and a final formal examination.

Details of each assessment component, the marks assigned to it, and the dates of submission:

Undergraduate students:

	Mark	**Week**	**Learning outcomes assessed**
In-semester Quiz	20%	5	1
Fracture Toughness Laboratory Report	15%	10	1, 2
FEA Assignment	5%	11	1, 2, 3, 4
Final Formal Examination	60%	TBC	1, 2, 3, 4
Total	**100%**		

Postgraduate students:

	Mark	**Week**	**Learning outcomes assessed**
In-semester Quiz	20%	5	1
Fracture Toughness Laboratory Report	15%	10	1, 2
FEA Assignment	5%	11	1, 2, 3, 4
Major Assignment	15%	12	1, 2, 3, 4
Final Formal Examination	45%	TBC	1, 2, 3, 4
Total	**100%**		

The assessment tasks will be provided during class as shown in the course schedule They may be found on Moodle as well. The above-mentioned dates are indicative depending on progress in lectures. If so, the new dates for the tests and lab will be announced during the lectures. In order to pass the course, you must achieve a total mark of 50% or higher.

The assignments and the lab report will be submitted electronically through a drop box in Moodle by 11 pm, Friday in the weeks indicated in the course schedule.

Assignments

Presentation

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

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.

Submission

The assignments and the lab report will be submitted electronically through a drop box in Moodle by 11 pm, Friday in the weeks indicated in the course schedule.

Late submissions will be penalised 5 marks per calendar day (including weekends). 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 https://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.

Examination

There will be one two-hour examination at the end of the semester, based on all material covered during the whole semester. For further information on exams, please see Administrative Matters.

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 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, available on the School website and on Moodle, and the information on UNSW's Special Consideration page.

6. Expected Resources for students

Textbook & notes details

1. Zarrabi K, “Mechanics of Fracture and Fatigue”, March 2000 available electronically from Blackboard.
2. Anderson T L, “Fracture Mechanics: Fundamentals and Applications”, 3rd Edition, CRC Press.

List of required and suggested additional readings

1. Ewalds H L E and Wanhill R J H, “Fracture Mechanics”, Edward Arnold, 1989.
2. Broek D, “Elementary Engineering Fracture Mechanics”, Nijoff, 1985.
3. Murakami Y, “Stress Intensity Factors Handbook”, Vols 1&2, Pergamon Press, 1987.
4. Aliabadi M H, “Database of Stress Intensity Factors”, UK (1995 or 1996).
5. Sanford R J, “Principles of Fracture Mechanics”, Pearson Education, USA, 2003.
6. http://www.dsto.defence.gov.au/publications/1880/DSTO-GD-0103.pdf

Copies of the above reference books are available in the Main Library. One starting point for assistance is UNSW Library website:
http://info.library.unsw.edu.au/web/services/services.html

7. Course 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 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 demonstration examples and more interactive teaching.

8. 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: https://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:
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, available on the School website.

9. Administrative Matters

You are expected to have read and be familiar with *Administrative Matters*, available on the School website: https://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.

Dr Kana Kanapathipillai
20/07/2015

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