School of Mechanical and Manufacturing Engineering

UNSW Engineering

MECH9420

Composite Materials and Mechanics

Term 1, 2022

Infrastructure
Testing
Fatigue

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Gangadhara Prusty	G.Prusty@unsw.edu.au	Friday 12-1 p.m. in-person and Via Moodle	208F	0293855939

Administrators

Name	Email	Availability	Location	Phone

1. Lectures to introduce properties of composite materials, micro and macro-mechanical studies
2. Hands-on laboratory and team-work to apply fundamental concepts in in understanding the material properties and their use in engineering applications.

Are there any spelling and/or punctuation errors? Is technical jargon correctly used throughout the literature review?	
Do the references cited properly conform to APA style? Is the reference list properly formatted using APA style for each type of references?	
Contents	
Introduction	How well have the context and aims of a literature review been introduced?
	Is the overview statement of the literature clearly and succinctly presented?
	Does the author clearly describe the significance of a topic and
	Is the appropriate inquiry question established as a scholarly article?
	Are the findings and results of reviewed articles judiciously compared, contrasted and connected to each other?
Main text	Are the chosen articles closely pertinent to the initial inquiry question described in the introduction?
	Has the author successfully managed to deliver the main argument and meaningful findings of articles reviewed?
	Are arguments and analyses from multiple sources in the literature coherently integrated to link author's main topic and argument together?
	Are all arguments and contents evidenced using correct references for the academic integrity?
	Are all similarities and differences of ideas and research outcomes related to the topic of a literature review correctly identified and demonstrated from a reference to a reference?
	Has the author successfully verified through evidence and facts? You must remain objective through scientific facts or evidence and statistics.
Conclusions	Does the conclusion of the review summarise knowledge acquired from the review well in context of the specific focus described in the introduction?
	Are the obvious gaps and methodological flaws in research of the area identified explicitly? - The conclusions must briefly evaluate 'state-of-the-art' for the literature reviewed, indicating major gaps in research, inconsistencies in theory and findings and current issues pertinent to the topic of interest.
	Has a proper closing remark been provided at the conclusion of a literature review? – The conclusions sometimes need to finish by providing author's overall perspective and insight into the topic and outline of what the obvious next stage of research would be.

Assessment 2: Assignment 2

Assessment length: 15 1.5-spaced pages, not including the references page, with Times New Roman at 12 pts and the standard margins (3 cm for the top and 2.54 cm for the rest).
Due date: 01/04/2022 05:00 PM

The aim of this assignment is to expand your knowledge and understanding of composite materials under mechanical loads using standardized test methods of ASTM International (American Society for Testing and Materials). In this assignment, you will be able to conduct lae

Assessment criteria

Report writing instruction (Using all groups data)

1. Introduction: (Marks 10)

1. Calculate the areal mass in kg/m2 of the cured laminate for the single skin portion of the panel on page 1and 2.
2. Calculate the areal mass in kg/m2 of the sandwich portion of the panel.

3. Show *dsjj umpigleq dmp c_af clrpw*, then complete the following table for the 200g/m2 woven carbon ply (refer to the *KCAF720.]Dg`pc Dp_argml GIrcpnmj_rmp*.xlsx spreadsheet on the Course Moodle):

1. Using the spreadsheet *KCAF720.]Dg`pc Dp_argml GIrcpnmj_rmp*.xlsx, perform the same calculations as in (c) above for the 612g/m2 DB E-glass ply. Do *lmr* show full workings. Just provide a copy of the completed spreadsheet for these two cases.
2. Complete the grey-shaded cells in the following table to 2 decimal places:

Question 2 ني 20 marks

(1   2 pages as a guide)

Given the following data:

Transform the section according   446.5=6.77

Carbon ply thickness 0.22mm and Glass ply thickness 0.51mm

And observing the XX- and YY- axes convention shown on the drawing on page 1;

1. Calculate the moment of inertia, Ixx of the sandwich laminate in mm4/(mm width).
2. Calculate the section modulus, Zxx of the sandwich laminate in mm3/(mm width).
3. Calculate the moment of inertia, Ixx of the single skin in mm4/(mm width).

4. Calculate the section modulus, Zxx of the single skin in mm3/(mm width).

HINT: To complete (a) to (d) successfully, you must firstly perform a transformed تجequivalent sectionيم of the laminate cross-section as the plies of the laminate do not have the same Young’s elastic modulus in the x-x direction (Eb xx [GPa]). Refer to *Bcqgel] ksjrgj_wcpj_kgl_rcqgl djcvspc*.pdf in Assignment 3 section of Course Moodle for help with the method.

1. Calculate the bending stiffness (laminate flexural rigidity Elam•Ixx) of the laminate. What can be said about the bending stiffness of the single skin region compared to the bending stiffness of the sandwich laminate region in the x-x direction? What is the main reason for the difference?

Question 3 ني 20 marks

(1   2 pages as a guide)

Vacuum resin infusion is a widely-adopted composites processing method.

1. List four advantages and disadvantages of the method.
2. Write approximately 150 words describing the method, as found in one existing application that you have researched and found interesting. Include a photograph and/or diagram including reference in APA style.
3. Suggest a *lmtcj* application of the vacuum resin infusion processing method for a composite component that you can think of, as opposed to an established method. Briefly explain what advantages the use of the method would bring to the application in approx.150 words.

Question 4 ني 20 marks

Write a report *(3   4 pages as a guide)* on the mechanical testing that you participated (Own group results) in during the period Week 4-10. Your report *ksqr* include the following elements identified in bold:

1. Write the experimental Aims in bullet-point form.
2. Two test methods are used—ASTM D3039 for tensile properties and ASTM D790 Procedure A for flexural properties. Provide full citations for the two Test Methods using APA style (*see Instruction 5 below). Copies of the two test methods are on the Course Moodle site in the Assignment 3 section.
3. Provide photos of the specimen you tested; before, during and after failure. Clearly label each photo with a caption identifying the laminate type, test method (abbreviated) and before/during/after failure.
4. A Results section according to both of the test methods. Each must include:

- Date and location of test. Test machine name and model.
-

software output (Own group results).

- Can you attempt a calculation of the tensile stress, tensile strain and tensile chord modulus (see ASTM D3039 at 13.1, 13.2 and 13.3.1/13.3.1.1 respectively) of your own group results? If so, please include your attempt.
- Can you attempt a calculation of modulus in bending (see ASTM D790 at 13.1.12 (tangent modulus only) and flexural stress at break in 13.1.15)? If so, please include your attempt.

1. Summarise the key Observations you made.
2. Write up a Discussion of Results.
3. State your Conclusions.
4. Write a Statement explaining what you have learned about the nature of typical failure modes in composites compared with, for example, metals. [Hint: Consider the use of such terms as `*pgrrjc* and *bsargjc*].

Question 5 ي 20 marks

(1 page as a guide)

Write a brief reflection on what you see as the learning outcomes of this assignment (in bullet-point form; max. 500 words).

Instructions:

1. Your assignment must be typed in Arial 11-point x 1.5-spacing or 1 mark will be deducted.

Page limits 12 excluding References and Appendix

Note: Please put all figures in Appendix

1. Each page must be marked in the footer with your name, student number and page X of Y page numbering format.
2. File format is to be either MS Word or Adobe Acrobat pdf.
3. Run Spelling-and-Grammar check (F7) before finishing.
4. *Citations must use APA style https://student.unsw.edu.au/american-psychological-association-apa-referencing-system , http://www.apastyle.org/ .

Assessment 4: Class Test 1

Start date: 10/03/2022 07:00 PM
Assessment length: Space will be allocated in the Test paper
Due date: 10/03/2022 08:00 PM
Marks returned: Wk 5

1 Hour on-line test via Moodle

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Assessment criteria

Total number of questions: 2

Answer all the questions

Total value: 20 marks

Assessment 5: Class Test 2

Start date: 21/04/2022 07:00 PM
Submission notes: The on-line test will be via Moodle
Due date: 21/04/2022 08:00 PM
Marks returned: Wk 11

Details of the test:

Time allowed: ONE hour

Total number of questions: 2

Answer all questions

Total value: 20 marks.

Candidates may use electronic calculators

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Additional details

Details of the test:

Time allowed: ONE hour

Total number of questions: 2

Answer all questions

Total value: 20 marks.

Candidates may use electronic calculators

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Resources

Prescribed Resources

1. Expected resources for students

Reference Texts

1. Isaac M. Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University Press, 1994.
2. Mel M. Schwartz, Composite Materials, Vol 2, Prentice Hall, New Jersey, 1997.
3. R. A. Shenoi and J. F. Wellicome, Composite Materials in Maritime Structures, Vol 1&2, Cambridge University Press, U.K., 1993.

SLQU Jg`p_pw uc`qgrc8 https://www.library.unsw.edu.au/

Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Recommended Resources

Reference Texts

1. Isaac M. Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University Press, 1994.
2. R. A. Shenoi and J. F. Wellicome, Composite Materials in Maritime Structures, Vol 1&2, Cambridge University Press, U.K., 1993.

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Kmmbjc8 https://moodle.telt.unsw.edu.au/login/index.php

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.

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

exams, please see the Exams webpage.

Special Consideration

If you have experienced an illness or misadventure beyond your control that will interfere with your

Outcome	Explanation	Example
Time extension	Student provided more time to submit the assessment	e.g. 1 more week of time granted to submit a report
Supplementary assessment	Student provided an alternate assessment at a later date/time	e.g. a supplementary exam is scheduled during the supplementary exam period of the term
Substitute item	The mark for the missed assessment is substituted with the mark of another assessment	e.g. mark for Quiz 1 applied also applied as mark for Quiz 2, meaning if a student achieved a mark of 20/30 for Quiz 1 and was granted Special Consideration for Quiz 2, a mark of 20/30 would be applied for Quiz 2, etc
Exemption	All course marks are recalculated excluding this assessment and its weighting	e.g. The course has an assessment structure of: - Assignments 30%, - Lab report 30%, - Final Exam 40%. If the Lab report is missed and student is granted Special Consideration, then the assessment structure may be reweighted as follows: - Assignments 50% - Final Exam 50% as though the Lab report did not exist
Non-standard	Course Coord	‰ ‰ ‰ t

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. *Nj_eg_pgqk _r SLQU gq bcdglcb _q sqgle rfc umpbq mp gbc_q md mrfcpq _lb n_qqgle rfck mdd _q wmsp mul,*

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

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

T1-2022 UPDATE
- -

Public distancing conditions must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. No over-enrolment is allowed in face-to-face classes. Students enrolled in online classes can swap their enrolment from online to on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered mandatory PPE for students and staff.

For more information, please refer to the FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Guidelines

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

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	