UNSW Course Outline

BIOM9561 Mechanical Properties of Biomaterials - 2024

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General Course Information

Course Code : BIOM9561
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : Graduate School of Biomedical Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate, Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

In this course you will learn the principles explaining the mechanical properties of a range of materials and their biomedical applications.

You will familiarise yourself with the process of selection of a material based on the requirements of a biomedical application through the study of multiple practical examples. This will make you appreciate the fundamental relationships between the mechanical properties of a range of biomaterials and their usage.

Finally, you will learn how to practically perform mechanical assessments of biomedical devices using state-of-the art computational techniques considering the current international standards.

Course Aims

The aims of this course are to:

1) develop an understanding of the relationships between the mechanical properties of materials and their biomedical applications.

2) review several biomedical applications of materials and identify the principles that have led to choose those materials, based on their material properties and the application requirements.

3) familiarise with computational methods for in silico mechanical testing and characterisation of medical devices and biological materials and some of the international standards regulating this approach.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Discuss, develop and apply fundamental mechanical principles to a range of biomaterials and medical applications.
CLO2 : Critically retrieve, review, summarise and communicate findings in the biomaterial literature using oral and written methods.
CLO3 : Apply and evaluate computational methods (finite element analysis), for in silico assessment of the mechanical properties of biomaterials and biological materials.

Course Learning Outcomes	Assessment Item
CLO1 : Discuss, develop and apply fundamental mechanical principles to a range of biomaterials and medical applications.	• Computational assignments • Group project and presentation • Progress
CLO2 : Critically retrieve, review, summarise and communicate findings in the biomaterial literature using oral and written methods.	• Computational assignments • Group project and presentation • Progress
CLO3 : Apply and evaluate computational methods (finite element analysis), for in silico assessment of the mechanical properties of biomaterials and biological materials.	• Computational assignments

Learning and Teaching Technologies

Moodle - Learning Management System

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Computational assignments Assessment Format: Individual	35%	Due Date: Not Applicable
Group project and presentation Assessment Format: Group	20%	Start Date: 23/09/2024 12:00 AM Due Date: 04/11/2024 12:00 AM
Progress Assessment Format: Individual	45%	Due Date: Not Applicable

Assessment Details

Computational assignments

Assessment Overview

Problems to solve with the computational approaches learnt in class.

Course Learning Outcomes

- CLO1 : Discuss, develop and apply fundamental mechanical principles to a range of biomaterials and medical applications.
- CLO2 : Critically retrieve, review, summarise and communicate findings in the biomaterial literature using oral and written methods.
- CLO3 : Apply and evaluate computational methods (finite element analysis), for in silico assessment of the mechanical properties of biomaterials and biological materials.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Group project and presentation

Assessment Overview

Project and presentation (20%): students will work in groups to a project aiming to characterise the requirements and function of a biomedical device from the biomaterials point of view. The results of this work will be presented to the entire cohort and a report will be produced.

Course Learning Outcomes

- CLO1 : Discuss, develop and apply fundamental mechanical principles to a range of biomaterials and medical applications.
- CLO2 : Critically retrieve, review, summarise and communicate findings in the biomaterial literature using oral and written methods.

Assignment submission Turnitin type

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

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.
If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

Progress

Assessment Overview

There will be at minimum two main tests, one at week 5 and one at week 10, to assess the student learning of the content offered until that checkpoint. Each test will include a mix of questions about the biomaterial content and a short hand-on exercise of computational nature.

Course Learning Outcomes

- CLO1 : Discuss, develop and apply fundamental mechanical principles to a range of biomaterials and medical applications.
- CLO2 : Critically retrieve, review, summarise and communicate findings in the biomaterial literature using oral and written methods.

Generative AI Permission Level

No Assistance

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General Assessment Information

Grading Basis

Standard

Requirements to pass course

Students are required to achieve a composite mark of at least 50 out of 100 to pass the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Lecture	• Introduction to BIOM9561 • Introduction to Biomaterials
	Tutorial	No tutorial in Week 1.
Week 2 : 16 September - 22 September	Lecture	Metals - part 1
	Tutorial	• Practical introduction to finite element analysis. • Convergence of finite element analysis.
Week 3 : 23 September - 29 September	Lecture	Metals - part 2
	Tutorial	• Multistep simulations and linear analyses • Tensile test
Week 4 : 30 September - 6 October	Lecture	Metallic orthopaedic implants
	Tutorial	In silico testing of hip femoral stems (ASTM standard F2996)
Week 5 : 7 October - 13 October	Lecture	Polymers and polymeric biomaterials
	Tutorial	Time for group project
	Assessment	Midterm assessment
Week 6 : 14 October - 20 October	Other	Flexibility week Mid-course questionnaire
Week 7 : 21 October - 27 October	Lecture	Ceramics
	Tutorial	In silico testing of total knee femoral components (ASTM standard F3161)
Week 8 : 28 October - 3 November	Lecture	Composite materials
	Tutorial	From computed tomography scans to bone geometry and material properties
Week 9 : 4 November - 10 November	Lecture	• Natural materials and bioinspired materials • Group Project presentations
	Tutorial	Simulating the effect of a lateral fall on the proximal femur
Week 10 : 11 November - 17 November	Assessment	Final Assessment

Attendance Requirements

Please note that recordings are not available for the computational tutorials. Students are strongly encouraged to attend all tutorials and contact the Course Authority to make alternative arrangements for classes missed.

Group presentations will be scheduled during lecture and/or tutorial time and require student attendance.

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following attendance information.

Course Resources

Recommended Resources

These books are recommended for consultation:

- Ashby M.F. and Jones D.R.H., *Engineering Materials 1 – An Introduction to their Properties, Applications and Design.* 5th Edition. Butterworth Heinemann, 2018.
- Jones D.R.H. and Ashby M.F., *Engineering materials 2 - An introduction to microstructures and processing*. 4th Edition. Butterworth-Heinemann, 2013.
- Agrawal C. M., Ong, J. L., Appleford M.R. and Mani G., *Introduction to biomaterials*. Cambridge University Press, 2014.

Online versions of the first two books are available through the UNSW library website.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Luca Modenese		Building E26, room 1001			Yes	Yes

Other Useful Information

Academic Information

I. 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, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, 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.

II. 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

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

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.

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 or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) 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. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be 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 will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;

- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School Contact Information

Student Services can be contacted via unsw.to/webforms.