MECH8204

Advanced Engineering Materials

Session 2, In person-scheduled-weekday, North Ryde 2026

School of Engineering

Contents

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General Information

Unit convenor and teaching staff
Lecturer
Yijiao Jiang
yijiao.jiang@mq.edu.au
Contact via +61 2 7242 0228
294, 9 Wally's Walk
1-3pm Monday

Credit points
10

Prerequisites
40 CP at 6000 level or above including MECH6005

Corequisites

Co-badged status

Unit description
This unit will deliver in-depth training on advanced engineering materials and their sustainable application. Students will be trained on the cutting-edge realm of materials science, and the unique properties that have shaped the modern world. The content will include uncovering the inner workings of nanomaterials and the investigation of high-performance alloys and composites. It offers knowledge and skills in the principles of diverse material technologies and their practical applications across industries. The overarching goal of the unit is to enable students to appreciate the evolving landscape of advanced engineering materials and to leverage this knowledge to produce innovation.

Learning in this unit enhances student understanding of global challenges identified by the United Nations Sustainable Development Goals (UNSDGs) Industry, Innovation and Infrastructure; Responsible Consumption and Production

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Critically analyze and evaluate the unique properties and behaviors of advanced

engineering materials, considering factors such as mechanical, thermal, and chemical characteristics to make informed decisions for specific applications.

ULO2: Demonstrate expertise in selecting suitable advanced materials based on rigorous analysis of their properties and compatibility with intended uses, demonstrating a deep understanding of material-performance relationships.

ULO3: Design novel applications and products that leverage the exceptional properties of advanced engineering materials, while considering factors such as sustainability and functionality.

ULO4: Exhibit advanced skills in critical assessment and data-driven material design for complex real-world engineering applications in diverse industries based on their performance, sustainability, cost, and manufacturability, integrating literature analysis, advanced engineering principles and materials database tools.

ULO5: Demonstrate the ability to communicate the material selection process clearly and professionally, articulating their rationale with supporting evidence and responding to questions with confidence and depth of understanding during the oral examination

General Assessment Information

In order to pass this unit a student must obtain a mark of 50 or more for the unit (i.e. obtain a passing grade P/ CR/ D/ HD). There are no hurdle assessments.

Students enrolled in this unit with all written assessments will have the following university standard late penalty applied. Please see https://students.mq.edu.au/study/assessment-exams/assessments for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. This is to allow the timely release of assessments to the rest of the class. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern.

In this unit, late submissions will accept as follows:

• Essay and critical analysis – YES, Standard Late Penalty applies

• Advanced materials selection and design study – YES, Standard Late Penalty applies

• Oral examination – NO, unless Special Consideration is Granted

All assessments will be graded according to standards set in the marking rubrics. Students will receive a numerical grade for each assessment which will be representative of a fail (0-49%), pass (50-64%), credit (65-74%), distinction (75-84%) or high distinction (85-100%) as defined by the university standards based assessment guidelines. The definitions of these standards will be posted on the iLearn page. All marking rubrics specific to each assessment will be released on

the iLearn page indicating requirements to achieve a particular standard. These will be released well in advance of the assessment due date or are specified below.

Essay and critical analysis **(40/100)**

This individually assessed assignment evaluates the student's ability to conduct a literature review and critically analyze the unique properties and applications of a chosen advanced engineering material. Students should explore its advantages, limitations, and potential innovative uses across various industries. The assessment emphasizes the synthesis of technical information and the development of a well-structured, evidence-based argument. A detailed rubric will be provided in the assessment handout.

Advanced materials selection and design study (30/100)

In this assignment, students will conduct a data-driven material design study focused on a complex, real-world engineering application. The task involves integrating literature-based analysis, materials database tools, and advanced engineering principles to propose and justify the optimal material selection for a high-performance application. Students will define design requirements, review relevant literature, and systematically screen candidate materials. Selection will be based on key criteria such as performance, sustainability, cost, and manufacturability. The outcome will be a comprehensive technical report that clearly documents the decision-making process and presents a well-justified final recommendation. Design report will be assessed according to a rubric to be made available on the iLearn page.

Oral Examination (30/100)

In this short, structured session, students will present a brief overview of their chosen application, design requirements, and final material recommendation, followed by a question-and-answer segment with examiners. The oral examination assesses the student's understanding of advanced engineering materials principles, their ability to justify design decisions, and their critical thinking in evaluating alternatives. It also serves to confirm the originality of the work and the student's ability to apply theoretical knowledge to real-world engineering problems.

Assessment Tasks

Name	Weighting	Due
Essay and critical analysis	40%	Week 7
Advanced materials selection and design study	30%	Week 13
Oral Examination	30%	Examination Period

Assessment Tasks

Name	Weighting	Hurdle	Due	Groupwork/Individual	Short Extension	AI Approach
Essay and Critical Analysis	40%	No	13/09/2026	Individual	Yes	Open
Advanced materials selection and design study	30%	No	08/11/2026	Individual	Yes	Open
Oral examination	30%	No	Examination Periode	Individual	No	Observed

Essay and Critical Analysis

Assessment Type [1]: Written Submission
Indicative Time on Task [2]: 30 hours
Due: **13/09/2026**
Weighting: **40%**
Groupwork/Individual: Individual
Short extension [3]: Yes
AI Approach: Open

Students will conduct a literature review and critically analyze the unique properties and applications of a chosen advanced engineering material. Students should explore its advantages, limitations, and potential innovative applications across various industries. This essay-based assessment measures students' ability to synthesize technical information and present a well-structured, evidence-based argument.

On successful completion you will be able to:

- Critically analyze and evaluate the unique properties and behaviors of advanced engineering materials, considering factors such as mechanical, thermal, and chemical characteristics to make informed decisions for specific applications.
- Demonstrate expertise in selecting suitable advanced materials based on rigorous analysis of their properties and compatibility with intended uses, demonstrating a deep understanding of material-performance relationships.
- Exhibit advanced skills in critical assessment and data-driven material design for complex real-world engineering applications in diverse industries based on their performance, sustainability, cost, and manufacturability, integrating literature analysis, advanced engineering principles and materials database tools.

Advanced materials selection and design study

Assessment Type [1]: Experiential task
Indicative Time on Task [2]: 30 hours
Due: **08/11/2026**
Weighting: **30%**
Groupwork/Individual: Individual
Short extension [3]: Yes
AI Approach: Open

Students will perform a data-driven material design study targeting a complex, real world engineering applications. The design task will integrate literature-based analysis, materials database tools, and advanced engineering principles to propose and justify an optimal material selection for a high-performance engineering application. Students will document the material selection by defining design requirements, reviewing relevant literatures, and screening candidates. Materials are evaluated based on their performance, sustainability, cost, and manufacturability, leading to a comprehensive technical report, demonstrating justified final recommendation.

On successful completion you will be able to:

- Demonstrate expertise in selecting suitable advanced materials based on rigorous analysis of their properties and compatibility with intended uses, demonstrating a deep understanding of material-performance relationships.
- Design novel applications and products that leverage the exceptional properties of advanced engineering materials, while considering factors such as sustainability and functionality.
- Exhibit advanced skills in critical assessment and data-driven material design for complex real-world engineering applications in diverse industries based on their performance, sustainability, cost, and manufacturability, integrating literature analysis, advanced engineering principles and materials database tools.

Oral examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **Examination Periode**
Weighting: **30%**
Groupwork/Individual: Individual
Short extension [3]: No
AI Approach: Observed

In a short and structured session, students will briefly outline their chosen application, design requirements, and final material recommendation, followed by questions from examiners. The

oral examination assesses student's understanding of advanced engineering materials principles, their ability to justify design decisions, and their critical thinking in evaluating alternatives. It also helps confirm the originality of the work and the student's ability to apply theory to real-world engineering problems.

On successful completion you will be able to:

- Critically analyze and evaluate the unique properties and behaviors of advanced engineering materials, considering factors such as mechanical, thermal, and chemical characteristics to make informed decisions for specific applications.
- Demonstrate expertise in selecting suitable advanced materials based on rigorous analysis of their properties and compatibility with intended uses, demonstrating a deep understanding of material-performance relationships.
- Design novel applications and products that leverage the exceptional properties of advanced engineering materials, while considering factors such as sustainability and functionality.
- Exhibit advanced skills in critical assessment and data-driven material design for complex real-world engineering applications in diverse industries based on their performance, sustainability, cost, and manufacturability, integrating literature analysis, advanced engineering principles and materials database tools.
- Demonstrate the ability to communicate the material selection process clearly and professionally, articulating their rationale with supporting evidence and responding to questions with confidence and depth of understanding during the oral examination

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- Academic Success for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation.

[3] An automatic short extension is available for some assessments. Apply through the Service Connect Portal.

Delivery and Resources

There is no single core text for this course. However, the following texts are recommended:

1. Callister, W. D., & Rethwisch, D. G. (2022). *Fundamentals of materials science and engineering*. John Wiley & Sons.

2. Ashby, M. F., & Jones, D. R. (2012). *Engineering materials 1: an introduction to properties, applications and design* (Vol. 1). Elsevier.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit connect.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Academic Success

Academic Success provides resources to develop your English language proficiency, academic writing, and communication skills.

- Ask a Study Coach
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via the Service Connect Portal, or contact Service Connect.

IT Help

For help with University computer systems and technology, visit https://students.mq.edu.au/support/technology/service-desk.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Engineers Australia Competency Standard

Engineers Australia Competency Standard		Unit Learning Outcomes
Knowledge and Skill Base	1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.	1,2
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	1,2
	1.3 In-depth understanding of specialist bodies of knowledge	3,4
	1.4 Discernment of knowledge development and research directions	2, 3, 4
	1.5 Knowledge of engineering design practice	1, 2, 3, 4
	1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.	1,2,3, 4
Engineering Application Ability	2.1 Application of established engineering methods to complex problem solving	2,3,4
	2.2 Fluent application of engineering techniques, tools and resources.	3, 4
	2.3 Application of systematic engineering synthesis and design processes.	3,4
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	2,3
Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	4
	3.2 Effective oral and written communication in professional and lay domains.	4, 5
	3.3 Creative, innovative and pro-active demeanour.	4, 5
	3.4 Professional use and management of information.	4, 5
	3.5 Orderly management of self, and professional conduct.	4, 5
	3.6 Effective team membership and team leadership	4, 5

Unit information based on version 2026.02 of the Handbook