

MEC401 Advanced Engineering Materials

School: School of Science, Technology and Engineering

2024 | Semester 1

UniSC Sunshine Coast
UniSC Moreton Bay

**BLENDED
LEARNING**

Most of your course is on campus but you may be able to do some components of this course online.

Please go to usc.edu.au for up to date information on the teaching sessions and campuses where this course is usually offered.

1. What is this course about?

1.1. Description

This course equips participants with advanced theoretical and technical knowledge and skills on processes involved in engineering the functional properties of materials for different applications. An important role for an engineer is to select materials for specific purposes through understanding the connections between processing, properties, and performance. This course is supported by labs and workshops that allow you to apply this knowledge and develop skills for the assessment and selection of engineering materials.

1.2. How will this course be delivered?

ACTIVITY	HOURS	BEGINNING WEEK	FREQUENCY
BLENDED LEARNING			
Learning materials – Asynchronous weekly learning material	1hr	Week 1	13 times
Seminar – On campus	1hr	Week 1	3 times
Tutorial/Workshop 1 – On campus	2hrs	Week 1	12 times
Laboratory 1 – On campus, runs over two weeks and students rotate each week to complete the two labs.	2hrs	Week 5	2 times

1.3. Course Topics

Topics may include:

- Classifications of engineering materials
- Thermal processing of Materials
- Diffusional processes
- Phase diagrams
- Heat treatments
- Engineering alloys
- Steels
- Non Ferrous alloys
- Degradation and failure of materials
- Fracture
- Fatigue
- Corrosion
- Wear
- Materials selection

2. What level is this course?

400 Level (Graduate)

Demonstrating coherence and breadth or depth of knowledge and skills. Independent application of knowledge and skills in unfamiliar contexts. Meeting professional requirements and AQF descriptors for the degree. May require pre-requisites where discipline specific introductory or developing knowledge or skills is necessary. Normally undertaken in the third or fourth full-time study year of an undergraduate program.

3. What is the unit value of this course?

12 units

4. How does this course contribute to my learning?

COURSE LEARNING OUTCOMES	GRADUATE QUALITIES MAPPING	PROFESSIONAL STANDARD MAPPING *
On successful completion of this course, you should be able to...	Completing these tasks successfully will contribute to you becoming...	Engineers Australia Stage 1 Professional Engineer Competency Standards
1 Develop an understanding using multi-criteria visualisation to display compounded engineering properties of materials and develop the skills in determining materials performance index for selecting materials for special applications.	Knowledgeable	1, 1.3.a, 1.3
2 Explore the limits of primary engineering properties and understand the strategies for process design to extend these properties.	Creative and critical thinker	1, 1.3.a, 1.3
3 Apply the principles of architectural strategy in combining materials to design engineering composites to achieve a suited material performance index.	Creative and critical thinker	2, 2.1.a, 2.1
4 Develop an understanding fundamental atomistic transport phenomena in solids and apply this to Phase diagrams, Non equilibrium processing, and thermal processing to achieve desired microstructures in engineered materials.	Empowered	2, 2.1.a, 2.1
5 Develop an understanding of common engineering alloy systems and relate engineering designations to the processing, microstructure, properties and selection for engineering functions.	Empowered	2, 2.3.a, 2.3
6 Work independently and contribute in the planning of teamwork in the preparation of the process and content of a technical report.	Engaged	3, 3.6.b, 3.6

* Competencies by Professional Body

CODE	COMPETENCY
ENGINEERS AUSTRALIA STAGE 1 PROFESSIONAL ENGINEER COMPETENCY STANDARDS	
1	Elements of competency: Knowledge and Skill Base
1.3.a	Knowledge and Skill Base - In-depth understanding of specialist bodies of knowledge within the engineering discipline: Proficiently applies advanced technical knowledge and skills in at least one specialist practice domain of the engineering discipline.

1.3 Knowledge and Skill Base: In-depth understanding of specialist bodies of knowledge within the engineering discipline.

2 Elements of competency: Engineering Application Ability

2.1.a Engineering Application Ability - Application of established engineering methods to complex engineering problem solving: Identifies, discerns and characterises salient issues, determines and analyses causes and effects, justifies and applies appropriate simplifying assumptions, predicts performance and behaviour, synthesises solution strategies and develops substantiated conclusions.

2.3.a Engineering Application Ability - Application of systematic engineering synthesis and design processes: Proficiently applies technical knowledge and open ended problem solving skills as well as appropriate tools and resources to design components, elements, systems, plant, facilities and/or processes to satisfy user requirements.

2.1 Engineering Application Ability: Application of established engineering methods to complex engineering problem solving.

2.3 Engineering Application Ability: Application of systematic engineering synthesis and design processes.

3 Elements of competency: Professional and Personal Attributes

3.6.b Professional and Personal Attributes - Effective team membership and team leadership: Functions as an effective member or leader of diverse engineering teams, including those with multi-level, multi-disciplinary and multi-cultural dimensions.

3.6 Professional and Personal Attributes: Effective team membership and team leadership.

5. Am I eligible to enrol in this course?

Refer to the [UniSC Glossary of terms](#) for definitions of “pre-requisites, co-requisites and anti-requisites”.

5.1. Pre-requisites

Enrolled in GC003, GD003, MC003, GC006, GD006, MC006 or SC411

5.2. Co-requisites

Not applicable

5.3. Anti-requisites

Not applicable

5.4. Specific assumed prior knowledge and skills (where applicable)

Not applicable

6. How am I going to be assessed?

6.1. Grading Scale

Standard Grading (GRD)

High Distinction (HD), Distinction (DN), Credit (CR), Pass (PS), Fail (FL).

6.2. Details of early feedback on progress

Early feedback will be provided through completion of weekly activities in workshops. Furthermore, feedback on each assessment will be provided which will be used to help with the following assessment.

6.3. Assessment tasks

DELIVERY MODE	TASK NO.	ASSESSMENT PRODUCT	INDIVIDUAL OR GROUP	WEIGHTING %	WHAT IS THE DURATION / LENGTH?	WHEN SHOULD I SUBMIT?	WHERE SHOULD I SUBMIT IT?
All	1	Report	Individual and Group	30%	Approx. 3000 words total	Refer to Format	Online Assignment Submission with plagiarism check
All	2	Examination - not Centrally Scheduled	Individual	20%	2 hours	Week 8	Online Assignment Submission with plagiarism check
All	3	Examination - Centrally Scheduled	Individual	50%	2 hours	Exam Period	Online Assignment Submission with plagiarism check

All - Assessment Task 1: Lab Reports

GOAL:	Understanding the connection between the processing, the structure and the functional properties of materials is essential to effectively select the right materials to meet the design objectives of any device.	
PRODUCT:	Report	
FORMAT:	Written report based on experiments conducted to determine phase relationships in a binary system and you will also evaluate the mechanical properties of thermally processed materials. Due weeks 5, 7 and 9	
CRITERIA:	No.	Learning Outcome assessed
	1	Apply the principles of materials performance index to determine suitable materials in specific engineering applications 3 4
	2	Application of advanced elasticity principles to analyse the behaviour of engineering materials, including metals and composites, under complex loading scenarios and at high stresses and strains. 1 4
	3	Design and optimisation of engineering components and structures by considering the mechanical behaviour and properties of materials, ensuring suitability for complex loading conditions and high stress environments. 1 4 5
	4	Independent work and contribution in the planning of teamwork in the preparation of the process and content of a technical report. 6
	5	Development of advanced knowledge of strains beyond the elastic limit in engineering materials. 1
	6	Differentiation between isotropic, anisotropic, monoclinic, and orthotropic materials in relation to stress and strain characteristics. 1 2

All - Assessment Task 2: Mid Semester Exam

GOAL:	To demonstrate your understanding of the theory and application of thermal processing and how these affect the functional properties of materials used in specific applications.
PRODUCT:	Examination - not Centrally Scheduled
FORMAT:	This will be an online exam that will consist of short answer questions. This exam will cover learning materials for the first 7 weeks. Questions will include diagrams and tabular set of materials properties.

CRITERIA:	No.	Learning Outcome assessed
	1	Analysis and prediction of the mechanical behaviour of isotropic, anisotropic, monoclinic, and orthotropic materials under various stress and strain conditions. 1 2 3
	2	Application of advanced elasticity principles to analyse the behaviour of engineering materials, including metals and composites, under complex loading scenarios and at high stresses and strains. 1 4
	3	Development of advanced knowledge of strains beyond the elastic limit in engineering materials. 1
	4	Differentiation between isotropic, anisotropic, monoclinic, and orthotropic materials in relation to stress and strain characteristics. 1 2 3

All - Assessment Task 3: Final Exam

GOAL:	To demonstrate your understanding of the theory and application of materials processing and how these affect the functional properties of materials for specific applications.	
PRODUCT:	Examination - Centrally Scheduled	
FORMAT:	Assessment of all or part of the course by examination.	
CRITERIA:	No.	Learning Outcome assessed
	1	Analysis and prediction of the mechanical behaviour of isotropic, anisotropic, monoclinic, and orthotropic materials under various stress and strain conditions. 1 2 3
	2	Application of advanced elasticity principles to analyse the behaviour of engineering materials, including metals and composites, under complex loading scenarios and at high stresses and strains. 1 4
	3	Development of advanced knowledge of strains beyond the elastic limit in engineering materials. 1
	4	Differentiation between isotropic, anisotropic, monoclinic, and orthotropic materials in relation to stress and strain characteristics. 1 2 3

7. Directed study hours

A 12-unit course will have total of 150 learning hours which will include directed study hours (including online if required), self-directed learning and completion of assessable tasks. Student workload is calculated at 12.5 learning hours per one unit.

8. What resources do I need to undertake this course?

Please note: Course information, including specific information of recommended readings, learning activities, resources, weekly readings, etc. are available on the course Canvas site– Please log in as soon as possible.

8.1. Prescribed text(s) or course reader

There are no required/recommended resources for this course.

8.2. Specific requirements

N/A

9. How are risks managed in this course?

Health and safety risks for this course have been assessed as low. It is your responsibility to review course material, search online, discuss with lecturers and peers and understand the health and safety risks associated with your specific course of study and to familiarise yourself with the University's general health and safety principles by reviewing the [online induction training for students](#), and following the instructions of the University staff.

10. What administrative information is relevant to this course?

10.1. Assessment: Academic Integrity

Academic integrity is the ethical standard of university participation. It ensures that students graduate as a result of proving they are competent in their discipline. This is integral in maintaining the value of academic qualifications. Each industry has expectations and standards of the skills and knowledge within that discipline and these are reflected in assessment.

Academic integrity means that you do not engage in any activity that is considered to be academic fraud; including plagiarism, collusion or outsourcing any part of any assessment item to any other person. You are expected to be honest and ethical by completing all work yourself and indicating in your work which ideas and information were developed by you and which were taken from others. You cannot provide your assessment work to others. You are also expected to provide evidence of wide and critical reading, usually by using appropriate academic references.

In order to minimise incidents of academic fraud, this course may require that some of its assessment tasks, when submitted to Canvas, are electronically checked through Turnitin. This software allows for text comparisons to be made between your submitted assessment item and all other work to which Turnitin has access.

10.2. Assessment: Additional Requirements

Eligibility for Supplementary Assessment

Your eligibility for supplementary assessment in a course is dependent of the following conditions applying:

- The final mark is in the percentage range 47% to 49.4%
- The course is graded using the Standard Grading scale
- You have not failed an assessment task in the course due to academic misconduct

10.3. Assessment: Submission penalties

Late submission of assessment tasks will be penalised at the following maximum rate (the rates are cumulative):

- 5% (of the assessment task's identified value) per day for the first two days from the date identified as the due date for the assessment task
- 10% (of the assessment task's identified value) for the third day
- 20% (of the assessment task's identified value) for the fourth day and subsequent days up to and including seven days from the date identified as the due date for the assessment task
- A result of zero is awarded for an assessment task submitted seven days from the date identified as the due date for the assessment task.

Weekdays and weekends are included in the calculation of days late.

To request an extension, you must contact your Course Coordinator and supply the required documentation to negotiate an outcome.

Refer to the Assessment: Courses and Coursework Programs – Procedures

10.4. SafeUniSC

UniSC is committed to a culture of respect and providing a safe and supportive environment for all members of our community. For immediate assistance on campus contact SafeUniSC by phone: [07 5430 1168](tel:0754301168) or using the [SafeZone](#) app. For general enquires contact the SafeUniSC team by phone [07 5456 3864](tel:0754563864) or email safe@usc.edu.au.

The SafeUniSC Specialist Service is a Student Wellbeing service that provides free and confidential support to students who may have experienced or observed behaviour that could cause fear, offence or trauma. To contact the service call [07 5430 1226](tel:0754301226) or email studentwellbeing@usc.edu.au.

10.5. Study help

For help with course-specific advice, for example what information to include in your assessment, you should first contact your tutor, then your course coordinator, if needed.

If you require additional assistance, the Learning Advisers are trained professionals who are ready to help you develop a wide range of academic skills. Visit the [Learning Advisers](#) web page for more information, or contact Student Central for further assistance: +61 7 5430 2890 or studentcentral@usc.edu.au.

10.6. Wellbeing Services

Student Wellbeing provide free and confidential counselling on a wide range of personal, academic, social and psychological matters, to foster positive mental health and wellbeing for your academic success.

To book a confidential appointment go to [Student Hub](#), email studentwellbeing@usc.edu.au or call 07 5430 1226.

10.7. AccessAbility Services

Ability Advisers ensure equal access to all aspects of university life. If your studies are affected by a disability, learning disorder mental health issue, injury or illness, or you are a primary carer for someone with a disability or who is considered frail and aged, [AccessAbility Services](#) can provide access to appropriate reasonable adjustments and practical advice about the support and facilities available to you throughout the University.

To book a confidential appointment go to [Student Hub](#), email AccessAbility@usc.edu.au or call 07 5430 2890.

10.8. Links to relevant University policy and procedures

For more information on Academic Learning & Teaching categories including:

- Assessment: Courses and Coursework Programs
- Review of Assessment and Final Grades
- Supplementary Assessment
- Central Examinations
- Deferred Examinations
- Student Conduct
- Students with a Disability

For more information, visit <https://www.usc.edu.au/explore/policies-and-procedures#academic-learning-and-teaching>

10.9. Student Charter

UniSC is committed to excellence in teaching, research and engagement in an environment that is inclusive, inspiring, safe and respectful. The [Student Charter](#) sets out what students can expect from the University, and what in turn is expected of students, to achieve these outcomes.

10.10. General Enquiries

In person:

- **UniSC Sunshine Coast** - Student Central, Ground Floor, Building C, 90 Sippy Downs Drive, Sippy Downs
- **UniSC Moreton Bay** - Service Centre, Ground Floor, Foundation Building, Gympie Road, Petrie
- **UniSC SouthBank** - Student Central, Building A4 (SW1), 52 Merivale Street, South Brisbane
- **UniSC Gympie** - Student Central, 71 Cartwright Road, Gympie
- **UniSC Fraser Coast** - Student Central, Student Central, Building A, 161 Old Maryborough Rd, Hervey Bay
- **UniSC Caboolture** - Student Central, Level 1 Building J, Cnr Manley and Tallon Street, Caboolture

Tel: +61 7 5430 2890

Email: studentcentral@usc.edu.au