

# MEC401 Advanced Engineering Materials

**School:** School of Science, Technology and Engineering

2026 | Trimester 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](http://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 |
|--|-------|----------------|-----------|
| <b>BLENDED LEARNING</b>  |       |                |           |
| <b>Learning materials</b> – Asynchronous weekly learning material  | 1hr   | Week 1         | 12 times  |
| <b>Seminar</b> – On campus   | 1hr   | Week 1         | 3 times   |
| <b>Tutorial/Workshop 1</b> – On campus   | 2hrs  | Week 1         | 12 times  |
| <b>Laboratory 1</b> – 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 indices for selecting materials for different engineering 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 architected materials to design engineering composites to achieve material performance indices suited to the engineering function.  | Creative and critical thinker  | 2, 2.1.a, 2.1  |
| 4 Develop an understanding of 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, and properties for selection of materials to meet engineering functions.  | Empowered  | 2, 2.3.a, 2.3  |
| 6 Work independently and contribute to teamwork in the planning and preparation of an engineering 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 |

| CODE  | COMPETENCY   |
|-------|--|
| 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                       |
|                 |   |   |                           |
| GENERIC SKILLS: | Collaboration, Problem solving, Organisation, Information literacy  |   |                           |

### All - Assessment Task 2: Mid Trimester Exam

|                        |  |   |                                  |
|------------------------|--|---|----------------------------------|
| <b>GOAL:</b>           | 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.                                 |   |                                  |
| <b>PRODUCT:</b>        | Examination - not Centrally Scheduled  |   |                                  |
| <b>FORMAT:</b>         | 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. |   |                                  |
| <b>CRITERIA:</b>       | <b>No.</b>   |   | <b>Learning Outcome assessed</b> |
|                        | 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                            |
| <b>GENERIC SKILLS:</b> | Problem solving, Applying technologies, Information literacy   |   |                                  |

### All - Assessment Task 3: Final Exam

|                        |  |   |                                  |
|------------------------|--|---|----------------------------------|
| <b>GOAL:</b>           | To demonstrate your understanding of the theory and application of materials processing and how these affect the functional properties of materials for specific applications. |   |                                  |
| <b>PRODUCT:</b>        | Examination - Centrally Scheduled  |   |                                  |
| <b>FORMAT:</b>         | Assessment of all or part of the course by examination.  |   |                                  |
| <b>CRITERIA:</b>       | <b>No.</b>   |   | <b>Learning Outcome assessed</b> |
|                        | 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                            |
| <b>GENERIC SKILLS:</b> | Problem solving, Organisation, Applying technologies, Information literacy   |   |                                  |

## 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:

- (a) The final mark is in the percentage range 47% to 49.4%; and
- (b) The course is graded using the Standard Grading scale

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 submissions may be penalised up to and including the following maximum percentage of the assessment task's identified value, with weekdays and weekends included in the calculation of days late:

- (a) One day: deduct 5%;
- (b) Two days: deduct 10%;
- (c) Three days: deduct 20%;
- (d) Four days: deduct 40%;
- (e) Five days: deduct 60%;
- (f) Six days: deduct 80%;
- (g) Seven days: A result of zero is awarded for the assessment task.

The following penalties will apply for a late submission for an online examination:

Less than 15 minutes: No penalty  
From 15 minutes to 30 minutes: 20% penalty  
More than 30 minutes: 100% penalty

### 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](mailto: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](mailto: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](mailto: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](mailto: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](mailto: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

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**Email:** [studentcentral@usc.edu.au](mailto:studentcentral@usc.edu.au)