



# ENEM12009 *Structural Mechanics*

## Term 1 - 2023

Profile information current as at 05/10/2023 08:57 am

All details in this unit profile for ENEM12009 have been officially approved by CQUniversity and represent a learning partnership between the University and you (our student). The information will not be changed unless absolutely necessary and any change will be clearly indicated by an approved correction included in the profile.

## General Information

### Overview

In this unit, you will study the behaviour of solid bodies under different loadings by applying basic stress analysis principles and the introductory knowledge of engineering materials. You will gain in-depth understanding of the concepts of continuum stress, strain and deflection; analyse the response of mechanical components to axial, transverse, torsional, bending and buckling loads in the linear elastic regime. You will apply the theory of generalised Hooke's law to design pressure vessels and similar thin walled structures. You will perform calculations concerned with the mechanical properties of materials and conceptually design different mechanical components and structures based on strength, stiffness and stability. You will acquire the skills and knowledge required to develop analytical techniques that are used to solve a wide range of linear stress/strain problems in engineering practice.

### Details

Career Level: *Undergraduate*

Unit Level: *Level 2*

Credit Points: 6

Student Contribution Band: 8

Fraction of Full-Time Student Load: 0.125

### Pre-requisites or Co-requisites

Pre-requisites: (MATH11160 Technology Mathematics or MATH11218 Applied Mathematics) AND (ENEG11006 Engineering Statics or ENEM12007 Statics & Dynamics) AND (ENEG11008 Materials for Engineers or ENEG12005 Material Science and Engineering).

Important note: Students enrolled in a subsequent unit who failed their pre-requisite unit, should drop the subsequent unit before the census date or within 10 working days of Fail grade notification. Students who do not drop the unit in this timeframe cannot later drop the unit without academic and financial liability. See details in the [Assessment Policy and Procedure \(Higher Education Coursework\)](#).

### Offerings For Term 1 - 2023

- Bundaberg
- Cairns
- Gladstone
- Mackay
- Online
- Rockhampton

### Attendance Requirements

All on-campus students are expected to attend scheduled classes – in some units, these classes are identified as a mandatory (pass/fail) component and attendance is compulsory. International students, on a student visa, must maintain a full time study load and meet both attendance and academic progress requirements in each study period (satisfactory attendance for International students is defined as maintaining at least an 80% attendance record).

### Website

[This unit has a website, within the Moodle system, which is available two weeks before the start of term. It is important that you visit your Moodle site throughout the term. Please visit Moodle for more information.](#)

## Class and Assessment Overview

### Recommended Student Time Commitment

Each 6-credit Undergraduate unit at CQUniversity requires an overall time commitment of an average of 12.5 hours of study per week, making a total of 150 hours for the unit.

### Class Timetable

#### [Regional Campuses](#)

Bundaberg, Cairns, Emerald, Gladstone, Mackay, Rockhampton, Townsville

#### [Metropolitan Campuses](#)

Adelaide, Brisbane, Melbourne, Perth, Sydney

### Assessment Overview

#### 1. **Written Assessment**

Weighting: 20%

#### 2. **Written Assessment**

Weighting: 20%

#### 3. **Written Assessment**

Weighting: 20%

#### 4. **Written Assessment**

Weighting: Pass/Fail

#### 5. **Examination**

Weighting: 40%

### Assessment Grading

This is a graded unit: your overall grade will be calculated from the marks or grades for each assessment task, based on the relative weightings shown in the table above. You must obtain an overall mark for the unit of at least 50%, or an overall grade of 'pass' in order to pass the unit. If any 'pass/fail' tasks are shown in the table above they must also be completed successfully ('pass' grade). You must also meet any minimum mark requirements specified for a particular assessment task, as detailed in the 'assessment task' section (note that in some instances, the minimum mark for a task may be greater than 50%). Consult the [University's Grades and Results Policy](#) for more details of interim results and final grades.

## CQUniversity Policies

**All University policies are available on the [CQUniversity Policy site](#).**

You may wish to view these policies:

- Grades and Results Policy
- Assessment Policy and Procedure (Higher Education Coursework)
- Review of Grade Procedure
- Student Academic Integrity Policy and Procedure
- Monitoring Academic Progress (MAP) Policy and Procedure – Domestic Students
- Monitoring Academic Progress (MAP) Policy and Procedure – International Students
- Student Refund and Credit Balance Policy and Procedure
- Student Feedback – Compliments and Complaints Policy and Procedure
- Information and Communications Technology Acceptable Use Policy and Procedure

This list is not an exhaustive list of all University policies. The full list of University policies are available on the [CQUniversity Policy site](#).

## Previous Student Feedback

### Feedback, Recommendations and Responses

Every unit is reviewed for enhancement each year. At the most recent review, the following staff and student feedback items were identified and recommendations were made.

#### Feedback from Student evaluation

**Feedback**

The unit delivery and student learning was good

**Recommendation**

This good practice will be continued.

#### Feedback from Student grades

**Feedback**

A high number of students had to sit Supplementary Examinations

**Recommendation**

Additional resources and guidance will be provided to assist students with their exam preparations.

## Unit Learning Outcomes

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

1. Analyse the elastic behaviour of engineering structures and components and determine stresses, principal stresses, strains and deflections and the effects of impact loads
2. Analyse stress and strain using theoretical methods
3. Explain theories of failure and apply failure analysis to structures and components
4. Describe the nature of engineering assumptions and explain both the approaches used to deal with uncertainty and limitations of the validity of results
5. Prepare professional, technical project documentation showing the evaluation of uncertainties and results obtained
6. Communicate, work and learn independently and collaboratively and communicate in a professional manner.

**The Learning Outcomes for this unit are linked with the Engineers Australia Stage 1 Competency Standards for Professional Engineers in the areas of 1. Knowledge and Skill Base, 2. Engineering Application Ability and 3. Professional and Personal Attributes at the following levels:**

**Introductory 1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1N 3N 4N ) 1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline. (LO: 1N 3N 4N ) 3.5 Orderly management of self, and professional conduct. (LO: 1N 3N 4N )**

**Intermediate 1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. (LO: 1I 2N 3I 4I 5N 6N ) 1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. (LO: 1N 3I 4I 5N ) 1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 1N 3I 4I ) 2.2 Fluent application of engineering techniques, tools and resources. (LO: 1I 2N 3I 4I 5I ) 2.3 Application of systematic engineering synthesis and design processes. (LO: 1I 2N 3I 4I )**

**Advanced 1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 1I 2N 3A 4I 5N ) 2.1 Application of established engineering methods to complex engineering problem-solving. (LO: 1I 2N 3A 4I )**Note: LO refers to the Learning Outcome number(s) which link to the competency and the levels: N - Introductory, I - Intermediate and A - Advanced. Refer to the Engineering Undergraduate Course Moodle site for further information on the Engineers Australia's Stage 1 Competency Standard for Professional Engineers and course level mapping information <https://moodle.cqu.edu.au/course/view.php?id=1511>

## Alignment of Learning Outcomes, Assessment and Graduate Attributes



### Alignment of Assessment Tasks to Learning Outcomes

Assessment Tasks	Learning Outcomes					
	1	2	3	4	5	6
1 - Written Assessment - 20%	•	•				
2 - Written Assessment - 20%			•	•		
3 - Written Assessment - 20%			•		•	•
4 - Written Assessment - 0%				•	•	•
5 - Examination - 40%	•	•				

### Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes					
	1	2	3	4	5	6
1 - Communication	•	•	•	•	•	•
2 - Problem Solving	•	•	•	•		•
3 - Critical Thinking	•	•	•	•		
4 - Information Literacy				•	•	•
5 - Team Work						
6 - Information Technology Competence					•	•
7 - Cross Cultural Competence						
8 - Ethical practice						
9 - Social Innovation						
10 - Aboriginal and Torres Strait Islander Cultures						

## Textbooks and Resources

### Textbooks

ENEM12009

#### Prescribed

##### Mechanics of Materials

Edition: 7th SI (2015)

Authors: Beer and Johnston

McGraw-Hill

New York , NY , USA

ISBN: 978-9-814-59524-7

Binding: Hardcover

#### Additional Textbook Information

Copies can be purchased at the CQUni Bookshop here: <http://bookshop.cqu.edu.au> (search on the Unit code)

[View textbooks at the CQUniversity Bookshop](#)

### IT Resources

#### You will need access to the following IT resources:

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)

## Referencing Style

All submissions for this unit must use the referencing style: [Harvard \(author-date\)](#)

For further information, see the Assessment Tasks.

## Teaching Contacts

**Nirmal Mandal** Unit Coordinator

[n.mandal@cqu.edu.au](mailto:n.mandal@cqu.edu.au)

## Schedule

### Week 1 - 06 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
Lecture - Elastic behaviour - stress, strain and displacement, concept of stresses: axial, bending and torsional stress components, Stress on an oblique plane, design criteria. Tutorial - Four tutorial problems will be supplied during the tutorial.	Chapter 1, Beer	

### Week 2 - 13 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
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Lecture -Mechanical Properties of Materials, stress - strain diagram, Deformation, Hooke's Law (axial force).

Tutorial- Four tutorial problems will be supplied during the session.

Chapter 2, Beer

### Week 3 - 20 Mar 2023

Module/Topic

Chapter

Events and Submissions/Topic

Lecture-: Stress -strain, Poisson's ratio - Generalised Hooke's Law, elastic-plastic deformation, residual stress.  
Tutorial- Four tutorial problems will be supplied during the tutorial.

Chapter 2, Beer

### Week 4 - 27 Mar 2023

Module/Topic

Chapter

Events and Submissions/Topic

Lecture- Torsional stress: Torsion formula, angle of twist, design of transmission shaft.  
Tutorial- Four tutorial problems will be supplied during the tutorial.

Chapter 3, Beer

**Assignment 1** Due: Week 4 Friday (31 Mar 2023) 11:45 pm AEST

### Week 5 - 03 Apr 2023

Module/Topic

Chapter

Events and Submissions/Topic

Lecture- Stresses in bending loadings, analysis of bending stresses in beams.  
Tutorial- Four tutorial problems will be supplied during the tutorial

Chapter 4, Beer

### Vacation Week - 10 Apr 2023

Module/Topic

Chapter

Events and Submissions/Topic

Teaching free week

N/A

### Week 6 - 17 Apr 2023

Module/Topic

Chapter

Events and Submissions/Topic

Lecture - Design of beams for bending: shear force and bending moment diagrams.  
Tutorial- Four tutorial problems will be supplied during the tutorial.

Chapters 5 and 6, Beer

### Week 7 - 24 Apr 2023

Module/Topic

Chapter

Events and Submissions/Topic

Lecture- Transformations of stresses and strains: principal stresses, combined loadings.  
Tutorial- Four tutorial problems will be supplied during the tutorial.

Chapters 7 and 8, Beer

**Week 8 - 01 May 2023**

Module/Topic	Chapter	Events and Submissions/Topic
Lecture- Deflections of beams, measurement methods and analysis Tutorial- a few problems will be given during the tutorial	Chapter 9, Beer	<b>Assignment 2</b> Due: Week 8 Friday (5 May 2023) 11:45 pm AEST

**Week 9 - 08 May 2023**

Module/Topic	Chapter	Events and Submissions/Topic
Lecture- Linear elastic buckling Tutorial- a few problems will be given during the tutorial	Chapter 10, Beer	

**Week 10 - 15 May 2023**

Module/Topic	Chapter	Events and Submissions/Topic
Lecture Failure theories of structural elements, Energy method Tutorial - a few problems will be given during the tutorial	Chapters 7 and 11, Beer	

**Week 11 - 22 May 2023**

Module/Topic	Chapter	Events and Submissions/Topic
Lecture- Fatigue and Fatigue life Tutorial- a few problems will be given during the tutorial	Lecturer notes	<b>Assignment 3</b> Due: Week 11 Friday (26 May 2023) 11:45 pm AEST

**Week 12 - 29 May 2023**

Module/Topic	Chapter	Events and Submissions/Topic
Lecture: Discussion on FEA and Review of unit Tutorial: Review tutorial problems	All Chapters	<b>Workbook</b> Due: Week 12 Friday (2 June 2023) 11:45 pm AEST

**Review/Exam Week - 05 Jun 2023**

Module/Topic	Chapter	Events and Submissions/Topic

**Exam Week - 12 Jun 2023**

Module/Topic	Chapter	Events and Submissions/Topic

## Assessment Tasks

### 1 Assignment 1

**Assessment Type**

Written Assessment

**Task Description**

This assignment assesses contents from week 1 to week 4 of this unit. The assignment questions will be available in the Moodle site at the beginning of Week 1

**Assessment Due Date**

Week 4 Friday (31 Mar 2023) 11:45 pm AEST

Compulsory submission

**Return Date to Students**

Week 6 Friday (21 Apr 2023)

After two working weeks of submission date

**Weighting**

20%

**Minimum mark or grade**

50%

**Assessment Criteria**

It will be graded based on presentation, correct process and result, appropriate explanation, neat diagram, correct units, interpretation of results and analysis etc.

**Referencing Style**

- [Harvard \(author-date\)](#)

**Submission**

Online

**Submission Instructions**

It is not expected that students will type up calculations. Students should scan hand calculation for online submissions

**Learning Outcomes Assessed**

- Analyse the elastic behaviour of engineering structures and components and determine stresses, principal stresses, strains and deflections and the effects of impact loads
- Analyse stress and strain using theoretical methods

## 2 Assignment 2

**Assessment Type**

Written Assessment

**Task Description**

This assignment assesses contents from week 5 to week 8 of this unit. The assignment questions will be available on the Moodle site at the beginning of Week 5

**Assessment Due Date**

Week 8 Friday (5 May 2023) 11:45 pm AEST

Compulsory submission

**Return Date to Students**

Week 10 Friday (19 May 2023)

After two weeks of submission date

**Weighting**

20%

**Minimum mark or grade**

50%

**Assessment Criteria**

It will be graded based on presentation, correct processes and result, appropriate explanation, neat diagram, correct units, interpretation of results and analysis etc.

**Referencing Style**

- [Harvard \(author-date\)](#)

**Submission**

Online

**Submission Instructions**

It is not expected that students will type up calculations. Students should scan hand calculation for online submissions

**Learning Outcomes Assessed**

- Explain theories of failure and apply failure analysis to structures and components
- Describe the nature of engineering assumptions and explain both the approaches used to deal with uncertainty and limitations of the validity of results



## 3 Assignment 3

### Assessment Type

Written Assessment

### Task Description

This assignment assesses contents from week 9 to week 11 of this unit. The assignment questions will be available on the Moodle site at the beginning of Week 9

### Assessment Due Date

Week 11 Friday (26 May 2023) 11:45 pm AEST

Compulsory submission

### Return Date to Students

Review/Exam Week Friday (9 June 2023)

After two week of submission sate

### Weighting

20%

### Minimum mark or grade

50%

### Assessment Criteria

It will be graded based on presentation, correct process and result, appropriate explanation, neat diagram, correct units, interpretation of results and analysis etc.

### Referencing Style

- [Harvard \(author-date\)](#)

### Submission

Online

### Submission Instructions

It is not expected that students will type up calculations. Students should scan hand calculation for online submissions

### Learning Outcomes Assessed

- Explain theories of failure and apply failure analysis to structures and components
- Prepare professional, technical project documentation showing the evaluation of uncertainties and results obtained
- Communicate, work and learn independently and collaboratively and communicate in a professional manner.

## 4 Workbook

### Assessment Type

Written Assessment

### Task Description

This assignment assesses contents from week 1 to week 12 of this unit.

The workbook is graded as a pass/fail based on the satisfactory performance of the criteria. You have to put solutions to problems in tutorials and lectures (if any) given on a weekly basis.

### Assessment Due Date

Week 12 Friday (2 June 2023) 11:45 pm AEST

Compulsory submission

### Return Date to Students

Exam Week Friday (16 June 2023)

After two weeks of submission date: A general e-mail on workbook assessment will be sent to the students through Moodle

### Weighting

Pass/Fail

### Minimum mark or grade

Students should obtain a Pass grade

### Assessment Criteria

The criteria and associated weightings are given below. The allocations are as follows:

10% Presentation and layout - includes written appearance of the document, quality of arrangement in records, use of title sections, legality, etc.

90% Content - demonstrates the application of knowledge, adequate personal study and application of unit materials.

There should be evidence of application and analysis relating to each unit topic.

**Referencing Style**

- [Harvard \(author-date\)](#)

**Submission**

Online

**Submission Instructions**

It is not expected that students will type up calculations. Students should scan hand calculation for online submissions

**Learning Outcomes Assessed**

- Describe the nature of engineering assumptions and explain both the approaches used to deal with uncertainty and limitations of the validity of results
- Prepare professional, technical project documentation showing the evaluation of uncertainties and results obtained
- Communicate, work and learn independently and collaboratively and communicate in a professional manner.

## Examination

**Outline**

Complete an invigilated examination.

**Date**

During the examination period at a CQUniversity examination centre.

**Weighting**

40%

**Length**

180 minutes

**Minimum mark or grade**

50%

**Exam Conditions**

Closed Book.

**Materials**

Dictionary - non-electronic, concise, direct translation only (dictionary must not contain any notes or comments).

Calculator - non-programmable, no text retrieval, silent only

## Academic Integrity Statement

As a CQUniversity student you are expected to act honestly in all aspects of your academic work.

Any assessable work undertaken or submitted for review or assessment must be your own work. Assessable work is any type of work you do to meet the assessment requirements in the unit, including draft work submitted for review and feedback and final work to be assessed.

When you use the ideas, words or data of others in your assessment, you must thoroughly and clearly acknowledge the source of this information by using the correct referencing style for your unit. Using others' work without proper acknowledgement may be considered a form of intellectual dishonesty.

Participating honestly, respectfully, responsibly, and fairly in your university study ensures the CQUniversity qualification you earn will be valued as a true indication of your individual academic achievement and will continue to receive the respect and recognition it deserves.

As a student, you are responsible for reading and following CQUniversity's policies, including the [Student Academic Integrity Policy and Procedure](#). This policy sets out CQUniversity's expectations of you to act with integrity, examples of academic integrity breaches to avoid, the processes used to address alleged breaches of academic integrity, and potential penalties.

### What is a breach of academic integrity?

A breach of academic integrity includes but is not limited to plagiarism, self-plagiarism, collusion, cheating, contract cheating, and academic misconduct. The Student Academic Integrity Policy and Procedure defines what these terms mean and gives examples.

### Why is academic integrity important?

A breach of academic integrity may result in one or more penalties, including suspension or even expulsion from the University. It can also have negative implications for student visas and future enrolment at CQUniversity or elsewhere. Students who engage in contract cheating also risk being blackmailed by contract cheating services.

### Where can I get assistance?

For academic advice and guidance, the [Academic Learning Centre \(ALC\)](#) can support you in becoming confident in completing assessments with integrity and of high standard.

### What can you do to act with integrity?



#### Be Honest

If your assessment task is done by someone else, it would be dishonest of you to claim it as your own



#### Seek Help

If you are not sure about how to cite or reference in essays, reports etc, then seek help from your lecturer, the library or the Academic Learning Centre (ALC)



#### Produce Original Work

Originality comes from your ability to read widely, think critically, and apply your gained knowledge to address a question or problem