ENEC13017 *Advanced Structural Analysis*
Term 2 - 2024

Profile information current as at 23/05/2025 07:05 pm

General Information

Overview
In this unit, you will learn the idealisation and loading of complex structural systems. You will also learn how to calculate deflections in truss, beam, and frame structures using various analytical methods such as the virtual load method. You will be able to analyse indeterminate structures using fundamental techniques/methods e.g., force method, and slope-deflection method. You will be introduced to the fundamentals of structural analysis using the direct stiffness method and you will use industry-relevant software such as SPACE GASS or equivalent to analyse complex structures.

Details
Career Level: *Undergraduate*
Unit Level: *Level 3*
Credit Points: *6*
Student Contribution Band: *8*
Fraction of Full-Time Student Load: *0.125*

Pre-requisites or Co-requisites
Prerequisites: ENEG11006 Engineering Statics and ENEC12012 Stress Analysis
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 2 - 2024

- 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. **Online Quiz(zes)**
Weighting: 20%
2. **Project (applied)**
Weighting: 30%
3. **Project (applied)**
Weighting: 30%
4. **Project (applied)**
Weighting: 20%

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 SUTE

Feedback
Students found that the real-world assignments and industry-based content are beneficial for their learning.

Recommendation
This practice should be continued.

Feedback from SUTE

Feedback
Provide some additional SpaceGass practice.

Recommendation
More 'watch and learn' resources should be provided for learning the software.

Feedback from SUTE

Feedback
Tutorials were helpful though not enough time to go through all the questions.

Recommendation
Tutorials are designed as interactive Q&A sessions with students. It will be communicated to the students that they are expected to review the questions beforehand.

Unit Learning Outcomes

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

1. Apply principles of structural idealisation, and loading (including moving loads) for practical structures
2. Apply fundamental theories to determine deflection in structures
3. Apply analytical methods to solve statically indeterminate structures
4. Perform critical analyses of complex structures using industry-relevant software
5. Demonstrate engineering values including professional communication and sustainable development.

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 2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 1A 4A) 3.4 Professional use and management of information. (LO: 4I 5A) 3.5 Orderly management of self, and professional conduct. (LO: 2N 3N)

Intermediate

1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 1I) 1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 3N) 2.3 Application of systematic engineering synthesis and design processes. (LO: 1I 2I 3I 4A) 3.2 Effective oral and written communication in professional and lay domains. (LO: 5I)

Advanced

1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. (LO: 1I 2I 3I 4A) 1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences underpin the engineering discipline. (LO: 2A 3A) 1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1I 2I 3I 4A) 2.1 Application of established engineering methods to complex engineering problem-solving. (LO: 1A 2A 3A) 2.2 Fluent application of engineering techniques, tools, and resources. (LO: 3A 4A)

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 Engineers Australia's Stage 1 Competency Standard for Professional Engineers and course-level mapping informationhttps://moodle.cqu.edu.au/course/view.php?id=1511

Alignment of Learning Outcomes, Assessment and Graduate Attributes

— N/A Level
• Introductory Level
• Intermediate Level
• Graduate Level
◦ Professional Level
◦ Advanced Level

Alignment of Assessment Tasks to Learning Outcomes

Assessment Tasks	Learning Outcomes				
	1	2	3	4	5
1 - Online Quiz(zes) - 20%	•	•	•		
2 - Project (applied) - 30%	•	•			
3 - Project (applied) - 30%			•		
4 - Project (applied) - 20%				•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes				
	1	2	3	4	5
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

ENEC13017

Prescribed

Structural Analysis in SI Units
Edition: 10th edn (2019)
Authors: Hibbeler, R
Pearson
Harlow , Essex , UK
ISBN: 9781292247137
Binding: Paperback

View textbooks at the CQUniversity Bookshop

IT Resources

You will need access to the following IT resources:

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)
- Structural analysis software SpaceGass

Referencing Style

All submissions for this unit must use the referencing style: Harvard (author-date)
For further information, see the Assessment Tasks.

Teaching Contacts

Hassan Baji Unit Coordinator
h.baji@cqu.edu.au

Schedule

Week 1 - 08 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic
Introduction, Review on Analysis of Determinate Trusses and Beams Determinacy and Stability	Chapter 2: Analysis of Statically Determinate Structures Chapter 3: Analysis of Statically Determinate Trusses Chapter 4: Internal Loadings Developed in Structural Members	

Week 2 - 15 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic
Influence Lines for Beams Qualitative Influence Lines Influence Lines for Floor Girders Influence Lines for Trusses Maximum Influence at a Point due to a Series of Concentrated Loads	Chapter 6: Influence Lines for Statically Determinate Structures	

Week 3 - 22 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic

The Double Integration Method Moment Area Theorems Conjugate-Beam Method	Chapter 7: Deflections	Progressive Test #1: The test opens at 9:00 AM Monday of this week and closes at 9:00 PM Monday of next week.

Week 4 - 29 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic
Method of Virtual Work: Trusses	Chapter 8: Deflections Using Energy Methods	

Week 5 - 05 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic
Method of Virtual Work: Beams and Frames	Chapter 8: Deflections Using Energy Methods	Progressive Test #2: The test opens at 9:00 AM Monday of this week and closes at 9:00 PM Monday of next week.

Vacation Week - 12 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 19 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic
Maxwell's Theorem of Reciprocal Force Method of Analysis: Beams Force Method of Analysis: Trusses	Chapter 9: Analysis of Statically Indeterminate Structures by the Force Method	**Project 1** Due: Week 6 Monday (19 Aug 2024) 11:59 pm AEST

Week 7 - 26 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic
Slope-Deflection Equations Analysis of Beams Analysis of Frames: No Sideway Analysis of Frames: Sideway	Chapter 10: Displacement Method of Analysis: Slope-Deflection Equations	Progressive Test #3: The test opens at 9:00 AM Monday of this week and closes at 9:00 PM Monday of next week.

Week 8 - 02 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
Moment Distribution for Beams Stiffness-Factor Modifications Moment Distribution for Frames: No Sideway	Chapter 11: Displacement Method of Analysis: Moment Distribution Method	

Week 9 - 09 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
Moment Distribution for Frames: Sideway Frames	Chapter 11: Displacement Method of Analysis: Moment Distribution Method	

Week 10 - 16 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
Member Stiffness Matrix Displacement and Force Transformation Matrices Member Global Stiffness Matrix Application of the Stiffness Method for Truss Analysis Application of the Stiffness Method for Beam Analysis	Chapter 14: Truss Analysis Using the Stiffness Method Chapter 15: Beam Analysis Using the Stiffness Method	**Project 2** Due: Week 10 Monday (16 Sept 2024) 11:59 pm AEST

Week 11 - 23 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
SpaceGass Training and Project 3 Discussion		

Week 12 - 30 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
SpaceGass Training and Project 3 Discussion		

Review/Exam Week - 07 Oct 2024

Module/Topic	Chapter	Events and Submissions/Topic

Exam Week - 14 Oct 2024

Module/Topic	Chapter	Events and Submissions/Topic
		Project 3 Due: Exam Week Monday (14 Oct 2024) 11:59 pm AEST

Assessment Tasks

1 Progressive Tests

Assessment Type
Online Quiz(zes)

Task Description
This assessment task consists of three "Progressive Tests". First, second and third carries 7%, 7%, and 6% marks, respectively. Each test consists of a number of numerical questions.
Important Notes:

- Each Test is set for 60 minutes. You have 60 minutes from when you start your attempt to submit your answers.
- If you start but leave a test and come back to it later, your 60 min time may have lapsed and you will be scored zero for that attempt.
- You can attempt each test up to three (3) times within the given time frame as specified in the schedule.
- The test will be automatically closed after the end of the given time frame.
- The final mark will be the highest of all the attempts.
- Even though the tests are open for a few days, it is expected that your first attempt would be on the first day.
- The Tests cannot generally be deferred. However, under exceptional circumstances, if you have valid reasons to defer the test(s), please contact the Unit Coordinator with documents of proof before the due date.

Number of Quizzes
3

Frequency of Quizzes
Other

Assessment Due Date

Tests opening and closing details are given on the unit schedule.

Return Date to Students

Immediately after the test completion.

Weighting
20%

Assessment Criteria

- Full marks allocated to a question will be awarded for each correct answer.
- No penalty for wrong answers.

Referencing Style

- Harvard (author-date)

Submission
Online

Learning Outcomes Assessed

- Apply principles of structural idealisation, and loading (including moving loads) for practical structures
- Apply fundamental theories to determine deflection in structures
- Apply analytical methods to solve statically indeterminate structures

2 Project 1

Assessment Type
Project (applied)

Task Description
This assessment consists of three different practical sub-projects. You will need to use the knowledge and skills that you learned in weeks 1 to 5 to find the solution to the problems in these sub-projects.
Sub-project 1-1: Calculation of applied loads and maximum internal forces in a bridge subjected to gravity and moving loads covering materials taught in weeks 1 and 2. This part worth 30% of the total grade for Project 1.
Sub-project 1-2: Calculation of applied loads and deflections in a residential building structure subjected to gravity loads covering materials taught in weeks 1, 3 and 4. This part worth 30% of the total grade for Project 1.
Sub-project 1-3: Calculation of applied loads and deflections in a truss structure subjected to gravity loads covering materials taught in weeks 1, 2 and 4. This part worth 40% of the total grade for Project 1.

Assessment Due Date
Week 6 Monday (19 Aug 2024) 11:59 pm AEST

Return Date to Students
Week 8 Monday (2 Sept 2024)

Feedback will be returned in two weeks following the assessment due date.

Weighting
30%

Minimum mark or grade
25%

Assessment Criteria
In this assessment, you are required to provide a detailed explanation of the procedure you use to solve each problem. Your explanations need to be detailed enough to convince the marker that you really know and understand what you are doing. Correct answer and explanation of the correct approach both are important in this course. A substantial part of the marks in your assessment are for evidence of how you thought about the problem. Each question in the assignment will be assessed against the following criteria.
Part 1: Statement of the Problem (20 % of the Marks)
· Model the structure with sound idealisation assumptions.
· Draw accurate sign convention, Free-Body and other diagrams as required for the solution
· State key information that are provided.
Part 2: Development of the Problem and Results (80%)
· Show your calculations in detail
· State your answers with magnitude, unit, and direction as appropriate
· For marking purpose, this part will be sub-divided by two or more milestones of the calculations with appropriate weights

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Submit a single PDF file.

Learning Outcomes Assessed

- Apply principles of structural idealisation, and loading (including moving loads) for practical structures
- Apply fundamental theories to determine deflection in structures

3 Project 2

Assessment Type
Project (applied)

Task Description
In this project, you will analyse a structural frame. You will need to use the knowledge and skills that you learned in weeks 6 to 9 to find the solution to the problems in this project.
Project 2-1: Calculation of applied loads and internal forces/reactions in a frame structure using the force method covering materials taught in week 6. This part worth 40% of the total grade for Project 2.
Project 2-2: Calculation of nodal displacement in a frame structure using the slope-deflection method covering materials taught in week 7. This part worth 30% of the total grade for Project 2.
Project 2-3: Calculation of internal bending moment in a frame structure using the moment-distribution method covering materials taught in week 8. This part worth 30% of the total grade for Project 2.

Assessment Due Date
Week 10 Monday (16 Sept 2024) 11:59 pm AEST

Return Date to Students
Week 12 Monday (30 Sept 2024)

Feedback will be returned in two weeks following the assessment due date.

Weighting
30%

Minimum mark or grade
25%

Assessment Criteria
In this assessment, you are required to provide a detailed explanation of the procedure you use to solve each problem. Your explanations need to be detailed enough to convince the marker that you really know and understand what you are doing. Correct answer and explanation of the correct approach both are important in this course. A substantial part of the marks in your assessment are for evidence of how you thought about the problem. Each question in the assignment will be assessed against the following criteria.
Part 1: Statement of the Problem (20 % of the Marks)
· Model the structure with sound idealisation assumptions
· Draw accurate sign convention, Free-Body and other diagrams as required for the solution
· State key information that are provided.
Part 2: Development of the Problem and Results (80%)
· Show your calculations in detail
· State your answers with magnitude, unit, and direction as appropriate
· For marking purpose, this part will be sub-divided by two or more milestones of the calculations with appropriate weights

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Submit a single PDF file.

Learning Outcomes Assessed

- Apply analytical methods to solve statically indeterminate structures

4 Project 3

Assessment Type
Project (applied)

Task Description
In this project, you will model and analyse a structure in SpaceGass software. You will need to use the knowledge and skills that you learned in weeks 10 to 12 to find the solution to the problems in this project. Major steps of modelling that should be followed are:
Loading: Based on the given geometry and loads, load the structural.
Idealisation: Given the structural information, and based on sound idealisation assumptions, prepare a simplified

structural model.
Software modelling: Create geometry, define support conditions, cross-sections, materials, loading, set analysis parameters and run analysis in SpaceGass
Model verification: Provide simple calculations to verify some of the software outputs
Extract results: Extract some major outputs e.g., nodal displacement, reactions, internal forces, etc.
Prepare calculation report: Present your results in a professional technical report

Assessment Due Date
Exam Week Monday (14 Oct 2024) 11:59 pm AEST

Return Date to Students

Feedback will be returned in two weeks following the assessment due date.

Weighting
20%

Minimum mark or grade
50%

Assessment Criteria
In this assessment, you are required to provide a detailed SpaceGass model. Using the created model, the requested structural output should be presented in a technical report following a professional standard.
Part 1: SpaceGass (50 % of the Marks)
· All key information that are provided are clearly stated
· Model has sound idealisation assumptions
· SpaceGass model is accurate
Part 2: Development of the Problem and Results (50%)
· Proper verification showing model accuracy is conducted
·All relevant results are properly extracted
· Results are presented in an integrated report with high professional standard

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Submit a PDF report file and a SpaceGass model file.

Learning Outcomes Assessed

- Perform critical analyses of complex structures using industry-relevant software
- Demonstrate engineering values including professional communication and sustainable development.

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