ENEM20004 *Finite Element Methods for Engineering Design*
Term 2 - 2021

Profile information current as at 07/05/2024 09:26 am

General Information

Overview

This project-based learning unit will use cutting-edge computational design techniques to solve complex multidisciplinary problems in mechanical, structural and electromechanical engineering. You will formulate innovative design ideas for authentic applications and use latest finite element simulation software to obtain accurate insights into how they will perform in practice. You will be introduced to the variational principles in statics and dynamics of structures and machines, Finite Element Methods and analysis procedures, principles of multivariate analysis, and parametric design optimisation techniques. You will apply these procedures to model and simulate a variety of problems at the interface of mechanical, structural, electrical and mechatronics disciplines. You will achieve hands-on experience in using an industry standard finite element analysis software package.

Details

Career Level: *Postgraduate*
Unit Level: *Level 8*
Credit Points: *12*
Student Contribution Band: *8*
Fraction of Full-Time Student Load: *0.25*

Pre-requisites or Co-requisites

There are no requisites for this unit.
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 - 2021

- Melbourne
- Online
- Perth
- 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 12-credit Postgraduate unit at CQUniversity requires an overall time commitment of an average of 25 hours of study per week, making a total of 300 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. **In-class Test(s)**
Weighting: 20%
2. **Portfolio**
Weighting: 30%
3. **Project (applied)**
Weighting: 50%

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 Have Your Say

Feedback
Unit provides a good balance of theory and practice

Recommendation
This practice will be continued and will be progressively enhanced in subsequent offerings

Feedback from Have Your Say

Feedback
More guidance required in assessments

Recommendation
This issue is being addressed in the current installment. Students will be encouraged to seek clarifications as required.

Feedback from Have Your Say

Feedback
The unit doesn't suit online study

Recommendation
Students who face challenges pursuing this unit online will be offered additional zoom sessions as and when required.

Unit Learning Outcomes

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

1. Apply finite element methods to model advanced multidisciplinary engineering problems
2. Formulate finite element models to solve complex linear and nonlinear engineering problems
3. Critically assess the applicability of advanced non-linear computational design tools and utilise them in several engineering contexts
4. Analyse and solve multidisciplinary problems in structural, thermal, thermomechanical and electromechanical systems using advanced modelling and simulations methods
5. Solve multivariate and parametric design optimisation problems
6. Write and present high quality technical and professional reports that demonstrate information retrieval and processing.

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:
Intermediate
1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 1I 2I 4I)
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline. (LO: 3I)
3.1 Ethical conduct and professional accountability. (LO: 6I)
3.3 Creative, innovative and pro-active demeanour. (LO: 3I 4I)
Advanced
1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. (LO: 3A)
1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. (LO: 1A 2I)
1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 1I 2A 3A 4A)
1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1A 2I 3A 4A)
2.1 Application of established engineering methods to complex engineering problem solving. (LO: 1I 2A 3I 4A 5A)
2.2 Fluent application of engineering techniques, tools and resources. (LO: 3A 4A 5A)
2.3 Application of systematic engineering synthesis and design processes. (LO: 1A 2A 3I 4A 5A)
3.2 Effective oral and written communication in professional and lay domains. (LO: 6A)
3.4 Professional use and management of information. (LO: 6A)
3.5 Orderly management of self, and professional conduct. (LO: 6A)

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 Postgraduate Units 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=11382

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	6
1 - In-class Test(s) - 20%	•					
2 - Portfolio - 30%		•	•	•		•

Assessment Tasks	Learning Outcomes					
	1	2	3	4	5	6
3 - Project (applied) - 50%	•	•	•	•	•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes					
	1	2	3	4	5	6
1 - Knowledge	◦	◦				
2 - Communication						◦
3 - Cognitive, technical and creative skills			◦	◦	◦	
4 - Research		◦		◦		
5 - Self-management						
6 - Ethical and Professional Responsibility						◦
7 - Leadership						
8 - Aboriginal and Torres Strait Islander Cultures						

Alignment of Assessment Tasks to Graduate Attributes

Assessment Tasks	Graduate Attributes							
	1	2	3	4	5	6	7	8
1 - In-class Test(s) - 20%	◦	◦						
2 - Portfolio - 30%		◦	◦	◦		◦		
3 - Project (applied) - 50%	◦	◦	◦	◦	◦	◦		

Textbooks and Resources

Textbooks

There are no required textbooks.

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 styles below:

- Harvard (author-date)
- Turabian

For further information, see the Assessment Tasks.

Teaching Contacts

Prasad Gudimetla Unit Coordinator
p.gudimetla@cqu.edu.au

Schedule

Week 1 - 12 Jul 2021

Module/Topic	Chapter	Events and Submissions/Topic
1. Introduction to the unit 2. Introduction to Finite Element Analysis	Lecture Notes	1. Computer lab: Introduction to ANSYS Workbench - Overview + Basic Stress Analysis 2. Computer workshop: motor cover

Week 2 - 19 Jul 2021

Module/Topic	Chapter	Events and Submissions/Topic
Introduction to Linear Stress Analysis	Lecture notes	Computer Lab: Linear Stress analysis workshop

Week 3 - 26 Jul 2021

Module/Topic	Chapter	Events and Submissions/Topic
Review of Structural Mechanics - Displacement, Stress and Strain Relationships	Lecture notes	Computer Lab: 2D and 3D Static Structural stress analysis

Week 4 - 02 Aug 2021

Module/Topic	Chapter	Events and Submissions/Topic
1. Shape Functions for Elements and Interpolation 2. Analysis of 1D, 2D and Beam Elements	Lecture Notes	Computer Lab: Modelling with beam elements, 2D heat transfer problem - steady state thermal analysis Workshop: Pump housing - thermal analysis

Week 5 - 09 Aug 2021

Module/Topic	Chapter	Events and Submissions/Topic
1. Element Technology in ANSYS Workbench 2. Meshing - Guidelines and Rules for Accuracy	Lecture Notes	Computer Lab: Meshing basics, global and local mesh controls, meshing methods Computer workshop: Shell Pressure Vessel

Vacation Week - 16 Aug 2021

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 23 Aug 2021

Module/Topic	Chapter	Events and Submissions/Topic

Review of Mechanical Vibrations & Structural Dynamics Free vibration/modal analysis, Prestressed analysis, forced vibrational analysis,	Lecture Notes	Computer workshops: Modal analysis of a frame, Gantry crane, Eigenvalue Buckling of a Pipe **In-class Test** Due: Week 6 Friday (27 Aug 2021) 11:59 pm AEST

Week 7 - 30 Aug 2021

Module/Topic	Chapter	Events and Submissions/Topic
Nonlinear Modelling & Simulation 1 - Large scale deformations, metal plasticity	Lecture Notes	Computer Lab: Large scale deformation, Metal plasticity, localised yielding

Week 8 - 06 Sep 2021

Module/Topic	Chapter	Events and Submissions/Topic
Nonlinear Modelling & Simulation 2 - Contact modelling	Lecture Notes	Computer Lab: Contact stiffness, symmetric v asymmetric, interface treatment, contact with friction

Week 9 - 13 Sep 2021

Module/Topic	Chapter	Events and Submissions/Topic
Nonlinear Modelling & Simulation 3 - Advanced Contact + contact diagnostics	Lecture Notes	Computer workshops: Bolted Flange, nonlinear gasket **Portfolio** Due: Week 9 Friday (17 Sept 2021) 11:59 pm AEST

Week 10 - 20 Sep 2021

Module/Topic	Chapter	Events and Submissions/Topic
Rigid body Dynamic Analysis, Flexible Dynamic analysis	Lecture Notes	Computer workshops: Landing gear - rigid and flexible dynamic analysis

Week 11 - 27 Sep 2021

Module/Topic	Chapter	Events and Submissions/Topic
Fatigue Analysis - Theory and approach	Lecture Notes	Computer Lab: Stress based Fatigue Analysis

Week 12 - 04 Oct 2021

Module/Topic	Chapter	Events and Submissions/Topic
Parametric Modelling and Design Optimization	Lecture Notes	Computer workshop: Design optimization of a crane hook

Review/Exam Week - 11 Oct 2021

Module/Topic	Chapter	Events and Submissions/Topic

Exam Week - 18 Oct 2021

Module/Topic	Chapter	Events and Submissions/Topic
		Individual Applied Project Due: Exam Week Friday (22 Oct 2021) 11:59 pm AEST

Assessment Tasks

1 In-class Test

Assessment Type
In-class Test(s)

Task Description
This in-class test will be held in Week 6. It will comprise of 25 short answer and multiple choice questions based on the

content delivered in the first 5 weeks of the term. The test will run for 2 hours. Refer to the unit Moodle site for more information.

Assessment Due Date
Week 6 Friday (27 Aug 2021) 11:59 pm AEST
Online Submission

Return Date to Students
Week 8 Monday (6 Sept 2021)
Online

Weighting
20%

Assessment Criteria
Refer to the detailed criteria referenced assessment sheets provided on the unit Moodle site.

Referencing Style

- Harvard (author-date)
- Turabian

Submission
Online

Learning Outcomes Assessed

- Apply finite element methods to model advanced multidisciplinary engineering problems

Graduate Attributes

- Knowledge
- Communication

2 Portfolio

Assessment Type
Portfolio

Task Description
You will compile a portfolio of selected workshops and showcase your skills in using ANSYS Workbench. The portfolio will comprise of 6 workshops each worth 5%.

Assessment Due Date
Week 9 Friday (17 Sept 2021) 11:59 pm AEST
Online submission

Return Date to Students
Week 11 Monday (27 Sept 2021)

Weighting
30%

Minimum mark or grade
50%

Assessment Criteria
Refer to the unit moodle site for more details and criteria referenced assessment sheets.

Referencing Style

- Harvard (author-date)
- Turabian

Submission
Online

Learning Outcomes Assessed

- Formulate finite element models to solve complex linear and nonlinear engineering problems
- Critically assess the applicability of advanced non-linear computational design tools and utilise them in several engineering contexts
- Analyse and solve multidisciplinary problems in structural, thermal, thermomechanical and electromechanical systems using advanced modelling and simulations methods

- Write and present high quality technical and professional reports that demonstrate information retrieval and processing.

Graduate Attributes

- Communication
- Cognitive, technical and creative skills
- Research
- Ethical and Professional Responsibility

3 Individual Applied Project

Assessment Type
Project (applied)

Task Description
This is an individual assessment where you will select two problems from a list that will be provided to you via the unit Moodle site. You will apply your engineering and finite element skills to model and simulate the problems, and verify and validate your solutions.

Assessment Due Date
Exam Week Friday (22 Oct 2021) 11:59 pm AEST
Online submission

Return Date to Students

Weighting
50%

Minimum mark or grade
50%

Assessment Criteria
The following assessment criteria shall apply:
1. The problem will be clearly interpreted using relevant theory
2. You will state all the assumptions you have made and the scope of your solution methodology
3. You will clearly specify your modelling approach with appropriate and relevant figures of the meshing, boundary conditions and loads
4. You will postprocess your results and present them in a logical fashion
5. You will discuss all your results and draw appropriate comparison with relevant analytical calculations and provide valid conclusions
6. Your entire body of work will be properly formatted and referenced in Harvard/Turabian style
Refer to the assessment handout for more specific details on the assessment criteria

Referencing Style

- Harvard (author-date)
- Turabian

Submission
Online

Submission Instructions
Submit one PDF and any model files separately via the appropriate submission link

Learning Outcomes Assessed

- Apply finite element methods to model advanced multidisciplinary engineering problems
- Formulate finite element models to solve complex linear and nonlinear engineering problems
- Critically assess the applicability of advanced non-linear computational design tools and utilise them in several engineering contexts
- Analyse and solve multidisciplinary problems in structural, thermal, thermomechanical and electromechanical systems using advanced modelling and simulations methods
- Solve multivariate and parametric design optimisation problems
- Write and present high quality technical and professional reports that demonstrate information retrieval and processing.

Graduate Attributes

- Knowledge
- Communication

- Cognitive, technical and creative skills
- Research
- Self-management
- Ethical and Professional Responsibility

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