ENEM13015 *Design of Machine Elements*
Term 2 - 2022

Profile information current as at 27/04/2024 03:35 am

All details in this unit profile for ENEM13015 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
Design of Machine Elements is aimed at integrating and applying prior knowledge in fundamental design, materials sciences, mechanics of materials, statics and dynamics coupled with design strategies and knowledge of machine elements to design various machine components. These skills and knowledge will help you to design, analyse, synthesise and deliver robust engineering solutions. You will acquire strong analytical knowledge of machine elements, their design and load carriage and power transmission mechanics.

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: MATH11219 Engineering Mathematics AND (ENEM12009 Structural Mechanics OR ENEM14012 Solid Mechanics and Computational 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 - 2022

- 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. **Project (applied)**
Weighting: 50%
3. **Project (applied)**
Weighting: 30%

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

Some students lack fundamental knowledge in Engineering Drawing and CAD

Recommendation

Continue to provide additional material to support such students.

Unit Learning Outcomes

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

1. Develop detailed design of machine components to Australian and International Standards
2. Apply the formal procedures of detailed machine design, including requirements, solutions, modelling and evaluation to solve problems
3. Analyse and design a range of machine elements, explain the physical basis of their design, usage and operational limitations
4. Interpet various design codes and standards
5. Work effectively in teams by: identifying individual roles and responsibility, interacting positively with colleagues, and communicating effectively at group meetings
6. Communicate as professionals through the production of drawings (computer aided) and Bill of Materials, and through written technical reports.

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 4I) 1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline. (LO: 1I 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: 1A 3A) 1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. (LO: 1A) 1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 1I 3A 4A) 1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1I 3I 5A) 2.1 Application of established engineering methods to complex engineering problem solving. (LO: 2A 5A) 2.2 Fluent application of engineering techniques, tools and resources. (LO: 2I 6A) 2.3 Application of systematic engineering synthesis and design processes. (LO: 2A 3A) 2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 5A) 3.1 Ethical conduct and professional accountability. (LO: 5A) 3.2 Effective oral and written communication in professional and lay domains. (LO: 5A 6A) 3.3 Creative, innovative and pro-active demeanour. (LO: 2A) 3.4 Professional use and management of information. (LO: 1A 4A) 3.5 Orderly management of self, and professional conduct. (LO: 6A) 3.6 Effective team membership and team leadership. (LO: 5A)

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 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	6
1 - Written Assessment - 20%		•	•			
2 - Project (applied) - 50%	•	•		•	•	•
3 - Project (applied) - 30%	•		•	•		•

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						

Alignment of Assessment Tasks to Graduate Attributes

Assessment Tasks	Graduate Attributes									
	1	2	3	4	5	6	7	8	9	10
1 - Written Assessment - 20%		•	•							
2 - Project (applied) - 50%	•	•	•	•	•	•	•	•		

Assessment Tasks	Graduate Attributes									
	1	2	3	4	5	6	7	8	9	10
3 - Project (applied) - 30%		•	•	•		•				

Textbooks and Resources

Textbooks

ENEM13015

Prescribed

Shigley's Mechanical Engineering Design
Edition: 11th edn (2021)
Authors: Richard G Budynas and Keith J Nisbett
McGraw Hill
Singapore
ISBN: 9789813158986
Binding: Paperback

Additional Textbook Information
An e-book would also be fine.

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 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 - 11 Jul 2022

Module/Topic	Chapter	Events and Submissions/Topic

1. Introduction to design of machine elements 2. Design Standards and Design Codes 3. Design for Strength & Stiffness - Review of static design methods	Lecture Notes Chapters 1 - 4, Shigley	1. Discussion on Assignments, Major and minor projects. 2. Assignment 1 (Individual): Design Analysis Problems - 20% total weighting 3. Assignment 2 (Group): Group Design Project - 50% total weighting 4. Assignment 3 (Individual): Individual Design Project - 30% total weighting 5. Form Groups **Assignment 2: Group Design Project** - Finalize the selection of group design project and submit a 1 page proposal via the submission link on unit Moodle site. Refer to assignment documentation for further details.

Week 2 - 18 Jul 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Failure Modes and Prevention in Machine Elements 2. Failure Theories and Design for Static Loading	Lecture Notes Chapter 5, Shigley	Design case study, Problem solving

Week 3 - 25 Jul 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design for Variable Loading 2. Fatigue Life Methods - Stress-life & Strain-life Methods 3. Linear Elastic Fracture Mechanics (LEFM) Method	Lecture Notes Chapters 6, Shigley	Design case study, Problem solving

Week 4 - 01 Aug 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design of Shafts – materials, shaft layout, shaft design for stress deflection considerations, critical speeds, limits and fits 2. Design of shaft components - keys and keyways	Lecture Notes Chapter 7, Shigley	Design case study, Problem solving

Week 5 - 08 Aug 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design & Selection of Roller Bearings - Variable loading, Selection of ball, cylinder and tapered roller bearings 2. Design assessment, lubrication, mounting and enclosure design	Lecture Notes Chapter 11, Shigley	Design case study, Problem solving

Vacation Week - 15 Aug 2022

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 22 Aug 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Gears – types of gears, Spur gear terminology, Lewis Bending equation 2. AGMA Stress equations, AGMA Strength equations, dynamic, overload, size, surface condition factors	Lecture Notes Chapter 13, Shigley	Design case study, Problem solving **Problem Solving** Due: Week 6 Friday (26 Aug 2022) 11:59 pm AEST

Week 7 - 29 Aug 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design of Spur & Helical Gears – Load distribution, hardness ratio, stress cycle life, temperature, reliability factors 2. Design of gear trains - calculation of reduction ratios, power transmission	Lecture Notes Chapter 14, Shigley	Design case study, Problem solving

Week 8 - 05 Sep 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design of Bevel Gears 2. Design of Worm Gears	Lecture Notes Chapter 15, Shigley	Design case study, Problem solving

Week 9 - 12 Sep 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design of Machine frames & Housings 2. Design of Non-permanent Joints - Threads, Screws and Fasteners	Lecture Notes Chapter 8, Shigley	Design case study, Problem solving **Group Project** Due: Week 9 Friday (16 Sept 2022) 11:59 pm AEST

Week 10 - 19 Sep 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design of Permanent Joints - Static Design of Welds 2. Adhesive Bonding	Lecture Notes Chapter 9, Shigley	Design case study, Problem solving

Week 11 - 26 Sep 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Design of Mechanical Springs	Lecture Notes Chapter 10, Shigley	Design case study, Problem solving

Week 12 - 03 Oct 2022

Module/Topic	Chapter	Events and Submissions/Topic
1. Tribology, Wear & Lubrication of Machine Elements 2. Design & Selection of Journal Bearings	Lecture Notes Chapter 12, Shigley	Design case study, Problem solving **Individual Project** Due: Week 12 Friday (7 Oct 2022) 11:59 pm AEST

Review/Exam Week - 10 Oct 2022

Module/Topic	Chapter	Events and Submissions/Topic

Exam Week - 17 Oct 2022

Module/Topic	Chapter	Events and Submissions/Topic

Assessment Tasks

1 Problem Solving

Assessment Type
Written Assessment

Task Description
This assignment will consist of 6 numerical problems which you will solve and submit during the term. Each problem will be related to a portion of the syllabus covered in the first 6 weeks.

Assessment Due Date
Week 6 Friday (26 Aug 2022) 11:59 pm AEST

Return Date to Students
Week 8 Friday (9 Sept 2022)

Weighting
20%

Minimum mark or grade
50%

Assessment Criteria
The main criteria for assessment are:
1. Development of accurate free body diagrams (FBDs) for the problems
2. Application of relevant theory and design equations to calculate required unknowns
3. Comment on the final results obtained
Refer to the assessment handout for more detailed information.

Referencing Style

- Harvard (author-date)
- Turabian

Submission
Online

Submission Instructions
Submit as a PDF document via the submission link on the unit Moodle page

Learning Outcomes Assessed

- Apply the formal procedures of detailed machine design, including requirements, solutions, modelling and evaluation to solve problems
- Analyse and design a range of machine elements, explain the physical basis of their design, usage and operational limitations

Graduate Attributes

- Problem Solving
- Critical Thinking

2 Group Project

Assessment Type
Project (applied)

Task Description
This assessment will involve the design, drawing, CAD modelling and 3D printing of a machine assembly for a particular application that you will undertake as a part of a 4-member team. You will assess your designs for 3D printability and rescale them for 3D printing. Further detailed instructions are available on the unit Moodle site.

Assessment Due Date
Week 9 Friday (16 Sept 2022) 11:59 pm AEST

Return Date to Students
Week 11 Friday (30 Sept 2022)

Weighting
50%

Minimum mark or grade
50%

Assessment Criteria
The following are the main assessment criteria:
1. Succinct selection and development of the machine assembly including scope, appropriate assumptions, justifications and design limitations
2. Detailed design calculations for all components using established design codes, standards and procedures
3. Detailed and accurately scaled engineering drawing with BOMs, and relevant specifications for 3D printability
4. Comprehensive documentation of the whole design process along with a list of references
Refer to the unit Moodle site for more detailed assessment criteria.

Referencing Style

- Harvard (author-date)
- Turabian

Submission
Online Group

Submission Instructions
Submit the main report as one PDF document and a zip folder of your drawings, solid models and any animations.

Learning Outcomes Assessed

- Develop detailed design of machine components to Australian and International Standards
- Apply the formal procedures of detailed machine design, including requirements, solutions, modelling and evaluation to solve problems
- Interpet various design codes and standards
- Work effectively in teams by: identifying individual roles and responsibility, interacting positively with colleagues, and communicating effectively at group meetings
- Communicate as professionals through the production of drawings (computer aided) and Bill of Materials, and through written technical reports.

Graduate Attributes

- Communication
- Problem Solving
- Critical Thinking
- Information Literacy
- Team Work
- Information Technology Competence
- Cross Cultural Competence
- Ethical practice

3 Individual Project

Assessment Type
Project (applied)

Task Description
In this assignment, you will design an individual machine element as described in the handout.

Assessment Due Date
Week 12 Friday (7 Oct 2022) 11:59 pm AEST

Return Date to Students
Exam Week Friday (21 Oct 2022)

Weighting
30%

Minimum mark or grade
50%

Assessment Criteria
The main assessment criteria will include:
1. Adoption of prescribed design approaches to develop correct FBDs
2. Retrieve correct material data and other design coefficients from tables and charts
3. Apply correct theory and equations to solve for the unknowns
4. Make correct interpretations and comment on the final answers.
5. Develop full scale engineering drawing of the result according to AS1100.101 and 201
Refer to the assessment handout for more detailed information.

Referencing Style

- Harvard (author-date)
- Turabian

Submission
Online

Submission Instructions
Submit as a PDF document

Learning Outcomes Assessed

- Develop detailed design of machine components to Australian and International Standards
- Analyse and design a range of machine elements, explain the physical basis of their design, usage and

operational limitations
- Interpet various design codes and standards
- Communicate as professionals through the production of drawings (computer aided) and Bill of Materials, and through written technical reports.

Graduate Attributes

- Problem Solving
- Critical Thinking
- Information Literacy
- Information Technology Competence

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