# ENEM13015 *Design of Machine Elements*
## Term 2 - 2017

Profile information current as at 17/05/2024 06:08 pm



## 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, synthesize 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 - 2017

- Bundaberg
- Cairns
- Distance
- Gladstone
- Mackay
- 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. **Group Work**
Weighting: 50%
3. **Practical Assessment**
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.

## 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
3. Analyse and design a range of machine elements, 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

Learning outcomes are linked to Engineers Australia Stage 1 Competencies and also discipline capabilities. You can find the mapping for this on the Engineering Undergraduate Course website.

## 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 - Group Work - 50% | • | • | • | | • | • |
| 3 - Practical Assessment - 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 | | | | • | • | • |

| Graduate Attributes | Learning Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 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 - Group Work - 50% | • | • | • | • | • | • | • | • | | |
| 3 - Practical Assessment - 30% | • | • | • | • | • | • | • | • | | |

# Textbooks and Resources

## Textbooks

ENEM13015

**Prescribed**

**Shigley's Mechanical Engineering Design**
Edition: 10th (2015)
Authors: Budynas, R.G., and Nisbett, J.K.
McGraw Hill
New York , New York , USA
ISBN: 978-981-4595-28-5
Binding: Hardcover

**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

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

## Schedule

**Week 1 - 10 Jul 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Introduction to design of machine elements<br>Design Standards and Design Codes<br>Design for Strength & Stiffness - Review of static design methods | Lecture Notes<br>Chapters 1 - 4, Shigley | Example problems<br>Discussion on Assignments, Major and minor projects.<br>Assignment 1: Problem solving (3 Sets)<br>Assignment 2: Gearbox Project<br>Assignment 3: Gearbox Housing Project |

**Week 2 - 17 Jul 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Failure of Machine Elements and Prevention<br>Design for variable loading - Fatigue loading<br>Failure Theories | Lecture Notes<br>Chapters 5,6 Shigley | Solved example problems, Design case study<br>**N.B. Assignment 1 will consist of 3 problem sets that you will solve and submit. Check submission dates for each problem set.**<br>**Assignment 2: Gearbox Design Project - Selection of application for the design of a multi-stage gearbox.** One page write up on your proposed application. Refer to unit Moodle site for more details. |

**Week 3 - 24 Jul 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Part 1: Design of Shafts – materials, shaft layout, shaft design for stress deflection considerations, critical speeds, limits and fits<br>Part 2: Design of shaft components - keys and keyways | Lecture Notes<br>Chapters 7 Shigley | Solved example problems, Design case study<br>Gearbox design activity - Finalization of functional design parameters for gearbox, power requirements, operational conditions, sizing, concept generation, shaft layout consideration and related design calculations<br>**Documentation of design activity**<br>**Submission (S1): Brief Proposal of your gearbox project** |

**Week 4 - 31 Jul 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Design & Selection of Roller Bearings - Variable loading, Selection of ball, cylinder and tapered roller bearings, design assessment, lubrication, mounting and enclosure design | Lecture Notes<br>Chapters 11 Shigley | Solved example problems, Design case study<br>Gearbox design activity - concept generation, bearing selection for shafts and related design calculations<br>**Documentation of design activity continues**<br>**Submission (S2): Assignment 1, Problem Set 1** |

**Week 5 - 07 Aug 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Design & Selection of Journal Bearings | Lecture Notes<br>Chapters 12 Shigley | Solved example problems, Design case study<br>Gearbox design activity - recheck all calculations and confirm bearing selection, development of drawings<br>**Documentation of design activity continues** |

**Vacation Week - 14 Aug 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|

**Week 6 - 21 Aug 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Part 1: Gears – types of gears, Spur gear terminology, Lewis Bending equation, AGMA Stress equations, AGMA Strength equations, dynamic, overload, size, surface condition factors | Lecture Notes<br>Chapters 13 Shigley | Solved example problems, Design case study<br>Gearbox design activity - concept generation, gear selection and related design calculation, drawing activity continues<br>**Documentation of design activity continues** |

**Week 7 - 28 Aug 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Part 1: Design of Spur & Helical Gears – Load distribution, hardness ratio, stress cycle life, temperature, reliability factors, design of gear trains - calculation of reduction ratios, power transmission<br>Part 2: Design of Bevel & Helical gears | Lecture Notes<br>Chapters 14,15 Shigley | Solved example problems, Design case study<br>Gearbox design activity - concept generation, gear selection and related design calculation, drawing activity continues<br>**Documentation of design activity continues**<br>**Submission (S3): Assignment 1, Problem Set 2** |

**Week 8 - 04 Sep 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Design of Machine frames & Housings<br>Design of Flexible Machine Elements - belt and rope drives | Lecture Notes<br>Chapter 17 Shigley | Solved example problems, Design case study<br>Gearbox Project - all design finalization, recheck calculations, transmission ratios, tramission stage design recheck etc., develop accurate drawings for CAD models.<br>Rescale models to suit 3D printability and finalize all drawings, CAD data.<br>**Documentation of design activity continues** |

**Week 9 - 11 Sep 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Design of Flexible Machine Elements - chain drives<br>Design of Non-permanent Joints - threads | Lecture Notes<br>Chapter 17 Shigley<br>Chapter 8 Shigley | Solved example problems, Design case study<br>Gearbox Housing design - establish IP rating for the housing, developing dimensioning, materials, fastening mechanisms.<br>**Submission (S4): Assignment 2 Gearbox Project**<br>**CAD files to be submitted for 3D printing.**<br>**Project 1** Due: Week 9 Friday (15 Sept 2017) 11:45 pm AEST |

**Week 10 - 18 Sep 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|

| | | |
|---|---|---|
| Design of Non-permanent Joints - Screws and fasteners | Lecture Notes<br>Chapter 8 Shigley | Solved example problems, Design case study<br>Gearbox Housing design activity continues - finalization of all design parameters. Commence drawings for development of CAD models.<br>Rescale models to suit 3D printability and finalize all drawings, CAD data. |

**Week 11 - 25 Sep 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Design of Permanent Joints - welds (static design), adhesive bonding | Lecture Notes<br>Chapter 9 Shigley | **Submission (S5): Assignment 3 Gearbox Housing Project**<br><br>**Project 2** Due: Week 11 Friday (29 Sept 2017) 11:45 pm AEST |

**Week 12 - 02 Oct 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|
| Design of Seals for static, dynamic and reciprocating applications<br>Design of Springs | Lecture Notes<br>Chapter 10 Shigley | **Submission (S6): Assignment 1, Problem Set 3**<br><br>**Written Assessment** Due: Week 12 Friday (6 Oct 2017) 11:45 pm AEST |

**Review/Exam Week - 09 Oct 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|

**Exam Week - 16 Oct 2017**

| Module/Topic | Chapter | Events and Submissions/Topic |
|---|---|---|

## Term Specific Information

ENEM13015 Design of Machine Elements is a new unit that will be delivered for the first time to both internal and distance students enrolled in CC31 and CC32 as part of the new engineering program. Drawing upon the knowledge gained in ENEM12009 Strucural Mechanics and ENEG11008 Materials for Engineers, the unit will introduce students to the design of various machine elements and assemblies for variable loading taking into consideration fatigue and endurance. It will introduce various failure criteria for the basis of such approaches and also introduce relevant design codes and standards used. Students will involve themselves in solving typical design problems, partake design and drawing activities to produce 3D printable gearbox and a gearbox housing.

## Assessment Tasks

### 1 Written Assessment

**Assessment Type**
Written Assessment

**Task Description**
This assignment will consist of 3 problem sets (4 or 5 design problems per set) which you will progressively submit during the term. Each problem set will be related to a portion of the syllabus covered in some weeks and will be an extension of the solved examples and tutorial problems you will encounter in the unit.

**Assessment Due Date**
Week 12 Friday (6 Oct 2017) 11:45 pm AEST

**Return Date to Students**
Exam Week Friday (20 Oct 2017)

**Weighting**
20%

**Minimum mark or grade**
50%

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

**Referencing Style**

- Harvard (author-date)

**Submission**
Online

**Submission Instructions**
Submit a PDF document with a clearly labelled coverpage.

**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
- Interpet various design codes and standards

**Graduate Attributes**

- Communication
- Problem Solving
- Critical Thinking
- Information Literacy
- Information Technology Competence
- Ethical practice

## 2 Project 1

**Assessment Type**
Group Work

**Task Description**
Project 1 will consist of the design and drawing of a gearbox for a particular application you will chose. This is a group assignment with a maximum of 4 team members. Please refer to the unit Moodle site for more information.

**Assessment Due Date**
Week 9 Friday (15 Sept 2017) 11:45 pm AEST

**Return Date to Students**
Week 11 Friday (29 Sept 2017)

**Weighting**
50%

**Minimum mark or grade**
50%

**Assessment Criteria**
The following are the main assessment criteria for the gearbox assignment:
1. Succinct development of a case for the gearbox
2. Complete design of the various stages along with appropriate assumptions, justifications and reflections on the scope and limitations of the design.
3. Detailed design calculations for all components such as shafts, bearings, keys, keyways, gears (including number of stages)
4. Detailed, accurate and scaled engineering drawings with BOMs and all relevant specifications according to AS standards, for 3D printability
5. Comprehensive documentation of the design procedure with a list of references.
See the unit Moodle site for more detailed information.

**Referencing Style**

- Harvard (author-date)

**Submission**
Online

**Submission Instructions**
Submit a PDF document with a clearly labelled coverpage. CAD files have to be uploaded separately.

**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
- Analyse and design a range of machine elements, the physical basis of their design, usage and operational limitations
- 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 Project 2

**Assessment Type**
Practical Assessment

**Task Description**
Project 2 relates to the design and drawing of a housing for the gearbox designed in Assignment 2. This is a group assignment and will be executed by the same team members as in Assignment 1. Please see the unit Moodle site for detailed information on the task description.

**Assessment Due Date**
Week 11 Friday (29 Sept 2017) 11:45 pm AEST

**Return Date to Students**
Exam Week Friday (20 Oct 2017)

**Weighting**
30%

**Minimum mark or grade**
50%

**Assessment Criteria**
The following are the main assessment criteria for the gearbox housing assignment:
1. Succinct development of a case for the gearbox housing with comment on the selected IP rating for the housing.
2. Complete design of the housing including top and bottom cover and fastening mechanisms
3. Detailed design calculations for all components top cover, bottom cover, bolts, screws and seals
4. Detailed, accurate and scaled engineering drawings with BOMs and all relevant specifications according to AS standards, for 3D printability
5. Comprehensive documentation of the design procedure with a list of references.
See the unit Moodle site for more detailed information.

**Referencing Style**

- Harvard (author-date)

**Submission**
Online

**Submission Instructions**
Submit a PDF document with a clearly labelled coverpage. CAD files have to be uploaded separately.

**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
- Analyse and design a range of machine elements, the physical basis of their design, usage and operational limitations
- 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

## 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