ENEX13002 *Power Electronics*
Term 1 - 2019

Profile information current as at 15/05/2024 02:48 am

All details in this unit profile for ENEX13002 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
This unit is based on your knowledge on electronics you previously studied. In this unit you will learn about power semiconductors such as Diacs, silicon controlled rectifiers (SCR), metal oxide silicon field effect transistors (MOSFET), isolated gate bipolar junction transistors (IGBT), their symbols and theory of operation and limitations. You will also learn to calculate thermal dissipation requirements of power semiconductors and to choose suitable heat sinks. You will be introduced to the concepts of alternating current (AC) to direct current (DC), DC to DC, and DC to AC circuits, pulse width modulation (PWM) control, and chopper circuits. You will also learn about different types of motors and their control including DC motor control, AC motor control and stepper motor control schemes. You will learn to simulate power electronic circuits and develop power electronics solutions industrial problems. Students enrolled in distance mode are required to attend a compulsory Residential School.

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: ENEX12002 Introductory Electronics OR (ENEE13018 Analogue Electronics and ENEE13020 Digital Electronics) AND (ENEX12001 Electrical Power and Machines OR ENEE12015 Electrical Power 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 - 2019

- Mackay
- Mixed Mode

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).

Residential Schools
This unit has a Compulsory Residential School for distance mode students and the details are:
Click here to see your Residential School Timetable.

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: 15%
2. **Written Assessment**
Weighting: 15%
3. **Practical and Written Assessment**
Weighting: 15%
4. **Practical and Written Assessment**
Weighting: 15%
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 Have your say survey

Feedback
The students say unit providing a solid introduction and gave understanding of power electronics.

Recommendation
The existing unit learning material on power electronics will remain the same and further supporting material will be provided as applicable in the future.

Feedback from Have your say survey

Feedback
The students found the tutorial solutions were useful for learning.

Recommendation
Will continue to provide tutorial solutions in the future.

Feedback from Have your say survey

Feedback
Some of the students found the mathematics used in the lectures was hard to understand.

Recommendation
The unit coordinator checked with the mathematics lecturers and found that all the mathematical formulae and methods used in this unit have been covered by the students in the foundation levels. Unfortunately, the time does not permit to teach mathematics within this unit and it is clearly mentioned to the students that they need to go through their Year 1 and 2 mathematics lecture notes. The unit coordinator will develop a list of recommended topics in mathematics of what they have learnt earlier.

Feedback from Have your say survey

Feedback
The Distance students requested tutorial sessions after 5:00pm with Zoom access.

Recommendation
The unit coordinator will try to accommodate this request as much as possible.

Feedback from Have your say survey

Feedback
Students struggled to interpret the assessment criteria.

Recommendation
Assessment criteria will be reviewed and simplified.

Feedback from Self reflection

Feedback
The high level of mathematical nature of the textbook made it harder for some students to understand.

Recommendation
The textbook will be reviewed.

Unit Learning Outcomes

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

1. Explain power semiconductors and their principles of operation
2. Analyse and model the operation of alternating current (AC) to direct current (DC), DC to DC, DC to AC power converters and inverters
3. Analyse single phase and three phase rectifier circuits, inverter circuits, and different motor control schemes
4. Compare and select power electronics drive components for a mechatronic system
5. Design variable speed motor controllers for different types of electric motors and evaluate their performances
6. Solve real life problems and communicate professionally using power electronic terminology
7. Work collaboratively and autonomously and communicate professionally in presenting your solutions

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	7
1 - Written Assessment - 15%	•	•	•				
2 - Written Assessment - 15%	•	•	•				
3 - Practical and Written Assessment - 15%	•	•	•	•	•	•	•
4 - Practical and Written Assessment - 15%	•		•	•		•	•
5 - Examination - 40%	•	•	•				

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes						
	1	2	3	4	5	6	7
1 - Communication	•	•	•	•		•	•
2 - Problem Solving			•		•	•	•
3 - Critical Thinking	•	•	•	•	•	•	
4 - Information Literacy							
5 - Team Work					•		•
6 - Information Technology Competence	•	•	•	•	•	•	

Graduate Attributes	Learning Outcomes						
	1	2	3	4	5	6	7
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 - 15%	•	•	•			•				
2 - Written Assessment - 15%	•	•	•			•				
3 - Practical and Written Assessment - 15%	•	•	•			•		•		
4 - Practical and Written Assessment - 15%	•	•	•		•	•		•		
5 - Examination - 40%	•	•	•			•				

Textbooks and Resources

Textbooks

ENEX13002

Prescribed

Power Electronics Devices, Circuits, and Applications
4th Edition (International) (2014)
Authors: Muhammad H. Rashid
Pearson Education Ltd.
Harlaw , Essex , England
ISBN: 978-0-273-76908-8
Binding: Paperback

Additional Textbook Information
Paper copies can be purchased from the CQUni Bookshop here: http://bookshop.cqu.edu.au (search on the Unit code)
If you prefer an eBook, it can be purchased at the publisher website here: http://www.pearson.com.au/9780273785149

View textbooks at the CQUniversity Bookshop

IT Resources

You will need access to the following IT resources:

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)
- Access to a document scanner and a software that can create pdf documents.
- A computer with Windows 7 or later with Admin authority to install NI-Multisim software.
- Multisim 14.0 Education Edition or later (CQU will provide the licence key to install it on student computers).

Referencing Style

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

Teaching Contacts

Piet Janse Van Rensburg Unit Coordinator
p.jansevanrensburg@cqu.edu.au

Schedule

Week 1 - 11 Mar 2019

Module/Topic	Chapter	Events and Submissions/Topic
• Introduction to Power Electronics • Power Diodes and LRC Circuits	Chapters 1 & 2	

Week 2 - 18 Mar 2019

Module/Topic	Chapter	Events and Submissions/Topic
• Diode Rectifiers • Power Transistors	Chapters 3 & 4	

Week 3 - 25 Mar 2019

Module/Topic	Chapter	Events and Submissions/Topic
• DC - DC Conversions	Chapter 5	

Week 4 - 01 Apr 2019

Module/Topic	Chapter	Events and Submissions/Topic
• DC - AC Converters	Chapter 6	

Week 5 - 08 Apr 2019

Module/Topic	Chapter	Events and Submissions/Topic
• Resonant Pulse Inverters	Chapters 7	

Vacation Week - 15 Apr 2019

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 22 Apr 2019

Module/Topic	Chapter	Events and Submissions/Topic
• Multilevel Inverters	Chapter 8	**Assignment 1** Due: Week 6 Wednesday (24 Apr 2019) 10:00 pm AEST

Week 7 - 29 Apr 2019

Module/Topic	Chapter	Events and Submissions/Topic
• Thyristors	Chapter 9	

Week 8 - 06 May 2019

Module/Topic	Chapter	Events and Submissions/Topic
• Controlled Rectifiers	Chapter 10	Design and Build **Draft Report** Due: Week 8, Wednesday 10:00 pm AEST

Week 9 - 13 May 2019

Module/Topic	Chapter	Events and Submissions/Topic
• AC Voltage Controllers	Chapter 11	
Week 10 - 20 May 2019		
Module/Topic	**Chapter**	**Events and Submissions/Topic**
• DC Drives	Chapter 14	**Assignment 2** Due: Week 10 Wednesday (22 May 2019) 10:00 pm AEST
Week 11 - 27 May 2019		
Module/Topic	**Chapter**	**Events and Submissions/Topic**
• AC Drives	Chapter 15	**Residential School** - Compulsory for all Distance / Flex students - **29 - 31 May** 2019, **Mackay Ooralea Campus**, Engineering Building 24, 08:30 - 16:30.
Week 12 - 03 Jun 2019		
Module/Topic	**Chapter**	**Events and Submissions/Topic**
• Introduction to Renewable Energy	Chapter 16	**Laboratory Experiments** Due: Week 12 Wednesday (5 June 2019) 10:00 pm AEST
Review/Exam Week - 10 Jun 2019		
Module/Topic	**Chapter**	**Events and Submissions/Topic**
		Design and Build Exercise Due: Review/Exam Week Wednesday (12 June 2019) 10:00 pm AEST
Exam Week - 17 Jun 2019		
Module/Topic	**Chapter**	**Events and Submissions/Topic**

Term Specific Information

There is a **residential school** for this unit (**compulsory for all non-Mackay campus students**). Please confirm the correct dates using the online CQU handbook. Campus: **Mackay Ooralea Campus**, Building 24 (Engineering).

Assessment Tasks

1 Assignment 1

Assessment Type
Written Assessment

Task Description
This **individual** assignment together with feedback, helps to prepare you for the final exam.
The unit content from **Weeks 1 to 4** will be tested in Assignment 1.Questions will be largely analysis based.
Individual work is mandatory - this is a take-home test. None of your steps or solutions may be discussed or divulged to a fellow student.
Please refer to the CQU plagiarism policy - a **signed cover page declaring individual work** is required.
The assignment questions will be released on the unit website at least 2 weeks before the assignment is due to be submitted.

To prevent electronic plagiarism, **typed submissions are not acceptable**. Students should scan clear and legible hand written work for online submission as a **PDF** file.

Assessment Due Date
Week 6 Wednesday (24 Apr 2019) 10:00 pm AEST

Return Date to Students

We strive to return assessments to students within 2 weeks.

Weighting
15%

Minimum mark or grade
A minimum of 30% must be attained for Assignment 1 in order to pass the unit.

Assessment Criteria
Marks will be allocated for the followings:

1. Application of theoretical fundamentals
2. Explanation of reasons to apply specific theory or method to solve a given problem where applicable
3. Correct circuit diagrams/schematics and relevant input/output waveforms
4. Correct mathematical working and correct answers
5. All working and intermediate steps must be shown with justification of steps taken
6. Assignments must be tidy and legible

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
1) Plagiarism statement and 2) complete hand-written assignment scanned in together as a single .pdf file

Learning Outcomes Assessed

- Explain power semiconductors and their principles of operation
- Analyse and model the operation of alternating current (AC) to direct current (DC), DC to DC, DC to AC power converters and inverters
- Analyse single phase and three phase rectifier circuits, inverter circuits, and different motor control schemes

Graduate Attributes

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

2 Assignment 2

Assessment Type
Written Assessment

Task Description
This **individual** analysis and design based assignment helps to prepare you for the final exam.
The unit content from **Weeks 5 to 9** will be tested in Assignment 2.
Individual work is mandatory - this is a take-home test. None of your steps or solutions may be discussed or divulged to a fellow student.
Please refer to the CQU plagiarism policy - a **signed cover page declaring individual work** is required.
The assignment questions will be released on the unit website at least 2 weeks before the assignment is due to be submitted.
To prevent electronic plagiarism, **typed submissions are not acceptable**. Students should scan clear and legible hand written work for online submission as a **PDF** file.

Assessment Due Date
Week 10 Wednesday (22 May 2019) 10:00 pm AEST

Return Date to Students

We strive to return assessments to students within 2 weeks.

Weighting
15%

Minimum mark or grade
A minimum of 40% must be attained for Assignment 2 in order to pass the unit.

Assessment Criteria
Marks will be allocated for the followings:

1. Application of theoretical fundamentals
2. Correct theory or method deployed to analyse and/or design power electronic circuitry where applicable
3. Correct circuit diagrams/schematics and relevant input/output waveforms
4. Correct mathematical working and correct answers
5. All working and intermediate steps must be shown with justification of steps taken
6. Assignments must be tidy and legible

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
1) Plagiarism statement, 2) complete hand-written assignment and 3) screen shot of Multisim circuit and results - all scanned in together as a single .pdf file

Learning Outcomes Assessed

- Explain power semiconductors and their principles of operation
- Analyse and model the operation of alternating current (AC) to direct current (DC), DC to DC, DC to AC power converters and inverters
- Analyse single phase and three phase rectifier circuits, inverter circuits, and different motor control schemes

Graduate Attributes

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

3 Laboratory Experiments

Assessment Type
Practical and Written Assessment

Task Description
This assessment item consists of a series of laboratory experiments on plug-and-play power electronic circuits and drives.
Teams of 2 students should be formed, however **only ONE combined report** needs to be submitted by BOTH students. Each student should submit a personal **signed cover page declaring the team work done**, specifying the other team member's name.
Team reports must be **professional and typed**, including references.
Photographic evidence is required to prove that the various circuits were constructed and measurements were obtained - for this reason it is required that a team member's hand or fingers be included in all your photographs as a 'signature'.
Laboratory sessions will be held at various times, as directed by the unit website, through the semester or in the case of distance students at the residential school.
Laboratories are compulsory and all students must attend and pass all laboratory assessments in order to pass the unit.
Detailed explanations of these experiments and how to carry them out will be posted on the unit website at the start of the term.

Assessment Due Date
Week 12 Wednesday (5 June 2019) 10:00 pm AEST

Return Date to Students

We strive to return assessments to students within 2 weeks.

Weighting
15%

Minimum mark or grade
A minimum of 50% must be attained for the Laboratory Exercises report in order to pass the unit.

Assessment Criteria
Laboratory Exercise Reports will be graded using the following criteria:

- Correct description of laboratory concepts and procedures;
- Correct calculations, analysis and thinking;
- Photographic evidence that circuits were constructed by the team;
- Correct measurements, answers and units;
- Photographic and other evidence that correct results / measurements were obtained by the team;
- Discussion and understanding of laboratory results;
- **Team reports** must be **professional and typed**, including references;
- All laboratory exercises must be attempted.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Submit as a single pdf file

Learning Outcomes Assessed

- Explain power semiconductors and their principles of operation
- Analyse single phase and three phase rectifier circuits, inverter circuits, and different motor control schemes
- Compare and select power electronics drive components for a mechatronic system
- Solve real life problems and communicate professionally using power electronic terminology
- Work collaboratively and autonomously and communicate professionally in presenting your solutions

Graduate Attributes

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

4 Design and Build Exercise

Assessment Type
Practical and Written Assessment

Task Description
In this assessment you will design two kinds of DC-DC power converters to a given specification.
You need to submit a **Draft Design Report** showing both designs before coming to the lab session/ residential school.
The Draft Report will carry a weight of 8 marks (out of 15) and will be assessed **individually**.
In the lab you will form groups of 2 and compare your designs. One design of each student is to be constructed and evaluated.
The **Final Design and Build Report** includes the testing results and is again assessed **individually**.
Each student is to report on his own circuit as tested by the team of 2. This part carries 7 marks (out of 15) allocated for this assessment item.
Detailed design criteria will be released on the unit website.

Assessment Due Date
Review/Exam Week Wednesday (12 June 2019) 10:00 pm AEST

Return Date to Students

We strive to return assessments to students within 2 weeks.

Weighting
15%

Minimum mark or grade
A minimum of 50% must be attained for the Design and Build exercises in order to pass the unit.

Assessment Criteria
Design and Build Reports will be graded using the following criteria:

- Correct description of laboratory concepts and procedures;
- Correct calculations, design steps and thinking displayed;
- Photographic evidence that circuits were constructed by the team;
- Correct measurements, answers and units;
- Photographic and other evidence that correct results / measurements were obtained by the team;
- Discussion and understanding of test results;
- **Individual reports** must be **professional and typed**, including references;
- Two designs and one 'build' must be submitted by each student.

More information will be released on the unit website.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Submit part I of the design report as a single pdf and submit all Multisim or LTspice files first. Submit part II of the design as design test and evaluation report (as a single pdf file).

Learning Outcomes Assessed

- Explain power semiconductors and their principles of operation
- Analyse and model the operation of alternating current (AC) to direct current (DC), DC to DC, DC to AC power converters and inverters
- Analyse single phase and three phase rectifier circuits, inverter circuits, and different motor control schemes
- Compare and select power electronics drive components for a mechatronic system
- Design variable speed motor controllers for different types of electric motors and evaluate their performances
- Solve real life problems and communicate professionally using power electronic terminology
- Work collaboratively and autonomously and communicate professionally in presenting your solutions

Graduate Attributes

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

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
A minimum of 50% must be attained for the examination in order to pass the unit.

Exam Conditions
Open Book.

Materials
Dictionary - non-electronic, concise, direct translation only (dictionary must not contain any notes or comments).
Calculator - all non-communicable calculators, including scientific, programmable and graphics calculators are

authorised

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