ENEE20002 *Advanced Electrical Machines and Drives*
Term 1 - 2024

Profile information current as at 28/04/2024 05:40 pm

General Information

Overview

The objective of this unit is to introduce you to advanced electrical machines, drives and their control. You will learn about dynamic modelling of various types of DC and AC electrical machines. The unit will also introduce you to space vector theory associated with dynamic modelling of AC electrical machines. You will also learn about DC and AC motor drives. The unit will enable you to apply vector control fundamentals in electrical machine control. You will also learn some advanced topics such as speed-sensorless control of electrical machines. You will be required to successfully complete an electrical machines and drives design team project. Online students will be required to attend a compulsory residential school in order to complete the laboratory experiments. Prior knowledge of the fundamental concepts of electrical circuit analysis and electrical power engineering is assumed.

Details

Career Level: *Postgraduate*
Unit Level: *Level 9*
Credit Points: *12*
Student Contribution Band: *8*
Fraction of Full-Time Student Load: *0.25*

Pre-requisites or Co-requisites

ENEE14007 Electrical Machines and Drives Applications is an Anti-Requisite 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 1 - 2024

- Melbourne
- 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 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. **Online Quiz(zes)**
Weighting: Pass/Fail
2. **Written Assessment**
Weighting: 10%
3. **Practical Assessment**
Weighting: 15%
4. **Portfolio**
Weighting: 30%
5. **Online Test**
Weighting: 45%

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 Unit Evaluation Report

Feedback
Students indicated that they got useful learning resources (as PDF documents)

Recommendation
The use of industry-relevant resources should be continued in the next offering.

Feedback from Unit Evaluation Report

Feedback
Students highlighted that they are happy with the clarity and support for the unit

Recommendation
Industry-relevant resources should be provided for better understanding in the next offering.

Feedback from Unit Evaluation Report

Feedback
Student expected further clarification on few topics.

Recommendation
More detail explanations should be provided with real life examples.

Unit Learning Outcomes

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

1. Evaluate various types of DC and AC electrical machines using dynamic modelling principles
2. Model and control AC electrical machines using space vector theory
3. Apply vector control fundamentals in advanced electrical machine control
4. Analyse and design DC and AC motor drives considering stakeholder requirements
5. Document and communicate professional engineering information, including computer-based simulations and drawings using appropriate electrical engineering standards, terminology, and symbols
6. Scope, plan, manage and successfully complete engineering projects autonomously and in teams with a responsible, ethical, and professional attitude regarding the role of engineers.

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

1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline. (LO: 4I)
2.3 Application of systematic engineering synthesis and design processes. (LO: 2I 4I)
3.1 Ethical conduct and professional accountability. (LO: 6I)
3.3 Creative, innovative and pro-active demeanour. (LO: 2I 4I)
3.5 Orderly management of self, and professional conduct. (LO: 6I)

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 2A)
1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. (LO: 1A 2A 3A)
1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 1A 2A 3A 4A)
1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 1A 2A 4A)
1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1I 2I 4A)
2.1 Application of established engineering methods to complex engineering problem solving. (LO: 2A 3A 4A)
2.2 Fluent application of engineering techniques, tools and resources. (LO: 1A 2I 3I 4A 5A)
2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 4A 5A 6A)
3.2 Effective oral and written communication in professional and lay domains. (LO: 4I 5A)
3.4 Professional use and management of information. (LO: 4I 5A 6A)
3.6 Effective team membership and team leadership. (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 - Online Quiz(zes) - 0%	•	•				
2 - Written Assessment - 10%	•	•		•		
3 - Practical Assessment - 15%			•	•	•	•
4 - Portfolio - 30%			•		•	•
5 - Online Test - 45%	•	•	•			

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						

Textbooks and Resources

Textbooks

ENEE20002

Supplementary

Power Electronics Circuit Devices and Applications
Edition: 4th Ed. (2014)
Authors: Muhammad H. Rasid
ISBN: 0273769081
Binding: Paperback
ENEE20002

Supplementary

Power System Stability and Control
(2009)
Authors: Prabha Kundur
McGraw-Hill, Inc
ISBN: 0-07-035958-x
Binding: Paperback

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

Narottam Das Unit Coordinator
n.das@cqu.edu.au

Schedule

Week 1 - 04 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
1. Basics of AC System 2. Fundamentals of Electrical Machines	Lecture Slides & Study guide	

Week 2 - 11 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
Fundamentals of DC Motor	Lecture Slides & Study guide	**PRE-TEST** Due: Week 2 Friday (15 Mar 2024) 5:00 pm AEST

Week 3 - 18 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
DC Motor Drives	Lecture Slides & Study guide	

Week 4 - 25 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
Space Vector Theory	Lecture Slides & Study guide	

Week 5 - 01 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Modelling of Permanent Magnet Synchronous Motor	Lecture Slides & Study guide	

Vacation Week - 08 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
	Lecture Slides & Study guide	

Week 6 - 15 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Modelling of Induction Motor	Lecture Slides & Study guide	

Week 7 - 22 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Vector Control Fundamentals	Lecture Slides & Study guide	

Week 8 - 29 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Vector Control of Permanent Magnet Synchronous Motor	Lecture Slides & Study guide	

Week 9 - 06 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Vector Control of Induction Motor	Lecture Slides & Study guide	**LAB EXPERIMENTS REPORT** Due: Week 9 Monday (6 May 2024) 11:45 pm AEST

Week 10 - 13 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Fundamentals of Power Electronic Converters	Lecture Slides & Study guide	

Week 11 - 20 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Power Electronic Converters: VSC & LCC	Lecture Slides & Study guide	**THEORY ASSIGNMENT** Due: Week 11 Monday (20 May 2024) 11:55 pm AEST

Week 12 - 27 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Generation of Harmonics and Harmonic Filters	Lecture Slides & Study guide	

Review/Exam Week - 03 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic
	Lecture Slides & Study guide	**PROJECT PORTFOLIO** Due: Review/Exam Week Monday (3 June 2024) 11:55 pm AEST

Exam Week - 10 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic
		ONLINE TEST Date and time will be announced in due course.

Assessment Tasks

1 PRE-TEST

Assessment Type
Online Quiz(zes)

Task Description
This assessment is designed to give the lecturer as well as the students a good understanding of the fundamental electrical machines knowledge that students have, coming into this unit. While there is no minimum pass mark for anyone to be able to continue studying the unit, the students who score lower marks in this assessment will be issued additional work to bring their fundamental knowledge up to par with the expectations of this unit. The content tested will be the electrical machines fundamental knowledge students must have acquired during their undergraduate studies. The test date will be announced in advanced and will be within Week 02 of the term. This is a pass/fail assessment and hence no marks will be added to the unit total. However, non-completion would cause a fail mark and would thus block the student from completing the unit.

Number of Quizzes

Frequency of Quizzes
Other

Assessment Due Date
Week 2 Friday (15 Mar 2024) 5:00 pm AEST

Return Date to Students

Weighting
Pass/Fail

Assessment Criteria
This will be an online quiz with every question formulated as a multiple choice question. Each question will carry equal marks.

Referencing Style

- Harvard (author-date)

Submission
Online

Learning Outcomes Assessed

- Evaluate various types of DC and AC electrical machines using dynamic modelling principles
- Model and control AC electrical machines using space vector theory

2 THEORY ASSIGNMENT

Assessment Type
Written Assessment

Task Description
This assignment is designed to assess the learning outcomes 1, 2 and 3 of this unit. The assignment will involve problems associated with dynamic modelling and control of DC and AC electrical machines and modeling and control of AC electrical machines using space vector theory. Students will work individually and make individual submissions.

Assessment Due Date
Week 11 Monday (20 May 2024) 11:55 pm AEST

Return Date to Students

We strive to return assessments within 2 weeks of the submission deadline.

Weighting
10%

Minimum mark or grade
In order to pass the unit, students must score at least 50% for this assessment.

Assessment Criteria
Marks will be allocated for the following:
1. Application of theoretical fundamentals and justification thereof.

2. Correct theory or method deployed to analyse and/or design machine-drive systems where applicable.
3. Correct and tidy circuit diagrams/schematics and relevant input/output waveforms.
4. Correct mathematical working and correct answers. Evidence of checking of the results and interpretation of results.
5. All work and intermediate steps must be shown with justification of steps taken.
6. Assignments must be tidy and legible with good English and grammar.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Make your team submission to the link provided in Moodle as one PDF file which contains all the information and necessary attachments.

Learning Outcomes Assessed

- Evaluate various types of DC and AC electrical machines using dynamic modelling principles
- Model and control AC electrical machines using space vector theory
- Analyse and design DC and AC motor drives considering stakeholder requirements

3 LAB EXPERIMENTS REPORT

Assessment Type
Practical Assessment

Task Description
This compulsory assessment item covers the laboratory experiment component of the unit. On-campus students will carry out the experiments during laboratory experiment sessions scheduled each week (attendance is compulsory). Students will be formed into teams and each team must submit separate professional technical laboratory reports on each experiment. The details of the experiments will be notified to students through the unit Website. Please also refer to assessment criteria for more details.

Assessment Due Date
Week 9 Monday (6 May 2024) 11:45 pm AEST

Return Date to Students

We strive to provide feedback within 2 weeks of the submission due date.

Weighting
15%

Minimum mark or grade
In order to pass the unit, students must score at least 50% for this assessment.

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
Make your team submission to the link provided in Moodle as one PDF file which contains all the information and necessary attachments.

Learning Outcomes Assessed

- Apply vector control fundamentals in advanced electrical machine control
- Analyse and design DC and AC motor drives considering stakeholder requirements
- Document and communicate professional engineering information, including computer-based simulations and drawings using appropriate electrical engineering standards, terminology, and symbols
- Scope, plan, manage and successfully complete engineering projects autonomously and in teams with a responsible, ethical, and professional attitude regarding the role of engineers.

4 PROJECT PORTFOLIO

Assessment Type
Portfolio

Task Description
This compulsory assessment item is the project component of the unit. Students will work in teams. Complete details of an electrical machines and drive system design project will be provided on the unit Moodle website at the beginning of the term. Teams will be working on their project throughout the term and submit a professional, typed team report. The project is carried out by the teams to mimic team work that consulting engineers would do. It requires the student teams to submit an expression of interest before a specified deadline communicated to the students through Moodle at the early stages of the term. Later, the teams are supposed to attend a debriefing meeting mid-way through the project. Final reports must be prepared as one submission per team are to be submitted before the deadline specified below.

Assessment Due Date
Review/Exam Week Monday (3 June 2024) 11:55 pm AEST

Return Date to Students

We strive to return assessments within 2 weeks of the submission deadline.

Weighting
30%

Minimum mark or grade
In order to pass the unit, students must score at least 50% for this assessment.

Assessment Criteria
Marks for the project will be given out of 100 based on the quality of each project activity; i.e.:
Expression of Interest (12%)
Debriefing Meeting (8%)
Project Report (70%)
Peer Assessment (10%).
The marking schemes for each of those will be published on the Moodle site.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Make your team submission to the link provided in Moodle as one PDF file which contains all the information and necessary attachments.

Learning Outcomes Assessed

- Apply vector control fundamentals in advanced electrical machine control
- Document and communicate professional engineering information, including computer-based simulations and drawings using appropriate electrical engineering standards, terminology, and symbols
- Scope, plan, manage and successfully complete engineering projects autonomously and in teams with a responsible, ethical, and professional attitude regarding the role of engineers.

5 ONLINE TEST

Assessment Type
Online Test

Task Description
This online test will be monitored through Zoom and students will have to provide written answers to some questions.
1. Online test will be time scheduled and will take place for everyone at the same time.
2. Each student stays home with a device (preferably a laptop).
3. The online test paper will be loaded to the Moodle site so that students only can access it during the online test

period.
4. The student uses blank A4 papers (single side) to write answers.
5. At the end of the online test, he/she first takes photos of all written pages and email invigilator.
6. Later he/she scan the pages and upload to Moodle within a specified time at the end of online test.
7. Online test date and time will be within the standard examination period for Term 1-2024.

Assessment Due Date

This will be held during the examination week. The exact date and time of the examination will be released on Moodle in due course.

Return Date to Students

Outcomes will be published with the grade certification.

Weighting
45%

Minimum mark or grade
In order to pass the unit, students must score at least 50% for this assessment.

Assessment Criteria
Marks will be allocated for the following:
1. Application of theoretical fundamentals and justification thereof.
2. Correct theory or method deployed to analyse and/or design machine-drive systems where applicable.
3. Correct and tidy circuit diagrams/schematics and relevant input/output waveforms.
4. Correct mathematical working and correct answers. Evidence of checking of the results and interpretation of results.
5. All work and intermediate steps must be shown with justification of steps taken.
6. Submissions must be tidy and legible with good English and grammar.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Make your individual submission to the link provided in Moodle as one PDF file which contains all the information and necessary attachments.

Learning Outcomes Assessed

- Evaluate various types of DC and AC electrical machines using dynamic modelling principles
- Model and control AC electrical machines using space vector theory
- Apply vector control fundamentals in advanced electrical machine control

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