



# ENEE13016 Power System Protection

## Term 1 - 2023

Profile information current as at 26/03/2023 09:57 pm

All details in this unit profile for ENEE13016 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

In this unit, you will analyse and design devices and schemes to protect electrical power apparatus and systems. You will explain the philosophy, principles, concepts and practices, the codes, standards and refer to manuals that guide the design and operation of protection schemes. You will also analyse protection schemes, solve protection problems and correct faults. You will identify requirements, analyse and design protection for power system networks and for apparatus in electrical power systems. You will develop fluency in the technical language of power systems protection and develop the professional skills needed to communicate, learn and work alone and collaboratively to solve problems and document the solution process.

#### 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

ENEE12015 Electrical Power Engineering or ENEE12004 Introduction to Power Systems or ENTE12005 Electrical Power Systems.

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 - 2023

- 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: 30%

#### 2. **Online Quiz(zes)**

Weighting: 30%

#### 3. **Online Test**

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 Unit survey

**Feedback**

The lectures and tutorials from current lecturer were informative and relevant to the subject criteria. The inclusion of previous lecturer's lectures are also very helpful and provide a different perspective.

**Recommendation**

Continue this good practice.

#### Feedback from Unit survey

**Feedback**

Possibly supplying a previous students report will provide an example for the future students

**Recommendation**

Provide exemplars for the substation protection design project

#### Feedback from Unit survey

**Feedback**

Having Multiple small assignments will allow students to continue to practice the subject throughout the term rather than assigning everything to be completed within the last few weeks.

**Recommendation**

Introduce some interactive progress review mechanisms to monitor the gradual progression of the students with the project.

## Unit Learning Outcomes

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

1. Analyse and design power system protection schemes to solve operational problems and correct faults
2. Apply codes, standards, guidelines in manuals to design power system protection schemes for given operational scenarios
3. Design protection schemes for power networks, including determining the type and nature of suitable protection for apparatus that needs protection
4. Document solutions effectively using electrical power systems protection terminology, symbols and diagrams to present the information in a professional manner
5. Communicate, work and learn both individually and in teams, in a professional manner.

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

1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1I 2I 3I)

2.3 Application of systematic engineering synthesis and design processes. (LO: 3I)

2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 3I)

3.2 Effective oral and written communication in professional and lay domains. (LO: 4I 5I)

3.6 Effective team membership and team leadership. (LO: 5I)

#### 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 3A)

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)

1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 1A 2A 3A)

1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline. (LO: 1I 2I 3A)

2.1 Application of established engineering methods to complex engineering problem solving. (LO: 1A 2I 3A)

*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 information

<https://moodle.cqu.edu.au/course/view.php?id=1511>

## Alignment of Learning Outcomes, Assessment and Graduate Attributes



### Alignment of Assessment Tasks to Learning Outcomes

Assessment Tasks	Learning Outcomes				
	1	2	3	4	5
1 - Written Assessment - 30%	•	•	•	•	•
2 - Online Quiz(zes) - 30%	•	•			
3 - Online Test - 40%			•	•	•

### Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes				
	1	2	3	4	5
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					

## Textbooks and Resources

### Textbooks

**There are no required textbooks.**

### IT Resources

**You will need access to the following IT resources:**

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)

## Referencing Style

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

## Teaching Contacts

**Shaminda De Silva** Unit Coordinator  
[s.desilva@cqu.edu.au](mailto:s.desilva@cqu.edu.au)

## Schedule

### Week 1 - 06 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
Protection system fundamentals	NPAG Chapter 2; Reading Topic 1	

### Week 2 - 13 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
Current transformers	NPAG Chapter 6 sections 6.4.1 to 6.4.9; Reading Topic 2	

### Week 3 - 20 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
Over current protection	NPAG Chapter 9 sections 9.1 to 9.9; Reading Topic 3 pages 3-1 to 3-9.	

### Week 4 - 27 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
Over current protection	NPAG Chapter 9 sections 9.10 to 9.18; Reading Topic 3 pages 3-10 to 3-19.	

### Week 5 - 03 Apr 2023

Module/Topic	Chapter	Events and Submissions/Topic
Transformer protection	NPAG Chapter 16 sections 16.1 to 16.8	Progressive Test 1: Due Week 5

### Vacation Week - 10 Apr 2023

Module/Topic	Chapter	Events and Submissions/Topic
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### Week 6 - 17 Apr 2023

Module/Topic	Chapter	Events and Submissions/Topic
Transformer protection	NPAG Chapter 16 sections 16.9 to 16.16; Reading Topic 6.	Assignment feedback opportunity 1
<b>Week 7 - 24 Apr 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
Distance (impedance ) protection	NPAG Chapter 11 sections 11.1 to 11.8; Reading Topic 5 pages 5-1 to 5-9.	Progressive Test 2: Due Week 7
<b>Week 8 - 01 May 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
Distance (impedance ) protection	NPAG Chapter 11 sections 11.9 to 11.13; Chapter 12. Reading Topic 5 pages 5-20 to 5-33.	Assignment feedback opportunity 2
<b>Week 9 - 08 May 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
Motor/Generator protection	NPAG Chapters 17 and 19; Reading Topic 6.	
<b>Week 10 - 15 May 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
Feeder protection	NPAG Chapter 9 sections 9.19 to 9.21; Chapter 10.	Progressive Test 3: Due Week 10 Assignment feedback opportunity 3
<b>Week 11 - 22 May 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
The digital substation	NPAG Chapters 24 and 25.	<b>Substation Protection Assignment</b> Due: Week 11 Friday (26 May 2023) 11:55 pm AEST
<b>Week 12 - 29 May 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
Review		
<b>Review/Exam Week - 05 Jun 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
		End of Term Online Test may be scheduled in REVIEW / EXAM WEEK.
<b>Exam Week - 12 Jun 2023</b>		
Module/Topic	Chapter	Events and Submissions/Topic
		Online Test

## Assessment Tasks

### 1 Substation Protection Assignment

#### Assessment Type

Written Assessment

#### Task Description

Review and analyze selected features of an integrated substation protection system. The major technical deliverables are: A simplified protection diagram; The identification of suitable protection zones; Determining suitable protection schemes within each zone; Identifying suitable commercial equipment; Demonstrating that the actions of the protection schemes are coordinated; Determining specified key parameters for protection equipment. Students will present an engineering report that includes a Simplified Protection Diagram; A Design Summary and a Main Body. Page limits apply. Three optional formative feedback opportunities on specific assignment tasks are available in weeks six, eight and ten.

This is a team based assessment. The preferred team size is two. Where circumstances exist, the team size can vary. Teams can self-select their members and must advise the lecturer of the team membership via email before the end of week two. For team based assignments will be submitted with a written statement outlining the contribution of each team member.

The full assignment document is available through Moodle before the start of the term.

### **Assessment Due Date**

Week 11 Friday (26 May 2023) 11:55 pm AEST

Submitted through unit Moodle site as a PDF file.

### **Return Date to Students**

Review/Exam Week Friday (9 June 2023)

Returned through unit Moodle site. We strive to release the assessment marks in 2 weeks after due date.

### **Weighting**

30%

### **Minimum mark or grade**

Students must score at least 50% of the allocated marks

### **Assessment Criteria**

#### **The Simplified Protection Diagram**

It is acceptable to hand draw the diagram (CAD can take time). The diagram should show clearly:

- The primary plant - transformers, breakers and busbars
- The CT and VT locations
- The protection relays with a single line connection to their inputs (generally CTs and VTs) and outputs (circuit breaker operating coils). Show the IEEE device numbers on the relays.

To achieve clarity of presentation the simplified drawing can omit:

- Interconnections between the relays;
- The relay tables;
- Details of the housekeeping power supplies.

### **Design Summary**

The design summary would be expected to refer to the protection diagram. It should:

1. Identify the protection zones;
2. For each protection zone specify:
  - a. The protection schemes to be applied;
  - b. How backup protection is achieved;
  - c. The placement of CTs and VTs;
  - d. Provide the basic ratings for CTs and VTs;
  - e. For overcurrent protection schemes only, give suitable relay settings.

### **Main Body**

Provide an overview of the protection zones and protection schemes;

1. For each protection zone your plan will specify:
  - a. Provide a brief rationale for the selection of the scheme(s);
  - b. Provide a brief rationale the placement of CTs and VTs;
  - c. Outline the calculations for the ratings of CTs and VTs;
  - d. Outline the calculations for overcurrent relay settings;
  - e. Provide recommendations for suitable commercial relays.
2. For each protection zone, give at least two examples of how the protection system will safely and reliably detect and isolate faults within the protection zone. One fault will be a earth fault, one fault will be a line to line fault;
3. For each protection zone, give at least one example of how the protection system will discriminate against a fault outside of the protection zone.

This is a team based assignment.

### **Referencing Style**

- [Harvard \(author-date\)](#)

### **Submission**

Online

### **Submission Instructions**

Submitted through unit Moodle site as a PDF file.



## Learning Outcomes Assessed

- Analyse and design power system protection schemes to solve operational problems and correct faults
- Apply codes, standards, guidelines in manuals to design power system protection schemes for given operational scenarios
- Design protection schemes for power networks, including determining the type and nature of suitable protection for apparatus that needs protection
- Document solutions effectively using electrical power systems protection terminology, symbols and diagrams to present the information in a professional manner
- Communicate, work and learn both individually and in teams, in a professional manner.

## 2 Progressive Tests

### Assessment Type

Online Quiz(zes)

### Task Description

This assessment item is a set of online quizzes that can be accessed via the unit Moodle site.

- Progressive tests are an integral part of the study to test the concepts of each week.
- There will be three Progressive tests covering weeks 1-4, 5-6 and 7-9 topics respectively.
- Most questions are multiple choice and most questions require some calculations to select a correct answer.
- Each Progressive test will be available for up to 2 weeks to allow students who cannot find the time each week to study. For example, Progressive test 1 will open in Week 3 and close at the end of week 5.
- Each Progressive test can be attempted 3 times, at each attempt new (but similar) questions are presented. Progressive tests contain between ten and twenty questions. Most students will require less than one hour to complete a progressive test attempt.
- The score for Progressive test mark will be your highest attempt.
- The correct answer for the Progressive test questions will be available immediately after you submit your answer.
- If you encounter any network access issues during the Progressive test, the unit coordinator should be notified at your earliest convenience.
- Details of the assessment can be found on the unit Moodle site at the beginning of the term.

### Number of Quizzes

3

### Frequency of Quizzes

Other

### Assessment Due Date

As stated in the weekly schedule (Week 5, Week 7, Week 10).

### Return Date to Students

Immediate feedback. Marks will be available in the Moodle on completion of the quiz.

### Weighting

30%

### Minimum mark or grade

Students must score at least 25% of the allocated marks

### Assessment Criteria

No Assessment Criteria

### Referencing Style

- [Harvard \(author-date\)](#)

### Submission

Online

### Submission Instructions

Complete the quizzes online through relevant links in unit Moodle site.

### Learning Outcomes Assessed

- Analyse and design power system protection schemes to solve operational problems and correct faults
- Apply codes, standards, guidelines in manuals to design power system protection schemes for given operational scenarios

## 3 End of Term Online Test

### Assessment Type

Online Test

### Task Description

This online test may cover all topics from weeks 1 to 12 and may consist of a mix 4-6 numerical as well as descriptive answer questions.

This online test will be held during the University exam period (Week 13 or 14). The exact date and time will be confirmed by the end of week 9. This online test has a duration of 3 hrs. You will be provided with an additional 30 minutes to read the paper, scan and upload the answer scripts. The Moodle submission link will become inactive 3.5 hrs after the start time. You are encouraged to sit the test from a location with a good Internet connection and where you have access to a scanner. If you are unable to find a scanner, you can use your mobile phone to scan and upload the answer scripts. Please find a list of Camera Scan apps below that is suitable for this.

- a. Adobe Scan (DC) <https://adobescan.app.link/d/1n1NntFHTkb>
- b. Microsoft Lens <https://apps.apple.com/au/app/microsoft-lens-pdf-scanner/id975925059>
- c. SwiftScan <https://swiftscan.app/en/index.html>
- d. CamScanner <https://www.camscanner.com/>
- e. ClearScan <https://clearscanapp.com/>

### Assessment Due Date

Submitted through unit Moodle site as a PDF file.

### Return Date to Students

Returned through unit Moodle site

### Weighting

40%

### Minimum mark or grade

Students must score at least 50% of the allocated marks

### Assessment Criteria

No Assessment Criteria

### Referencing Style

- [Harvard \(author-date\)](#)

### Submission

Online

### Submission Instructions

Submitted through unit Moodle site as a PDF file.

### Learning Outcomes Assessed

- Design protection schemes for power networks, including determining the type and nature of suitable protection for apparatus that needs protection
- Document solutions effectively using electrical power systems protection terminology, symbols and diagrams to present the information in a professional manner
- Communicate, work and learn both individually and in teams, in a professional manner.

## 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