ENEE20001 *Advanced Power System Analysis and Control*
Term 2 - 2024

Profile information current as at 29/07/2024 03:46 pm

General Information

Overview

In this unit, you will learn to work both individually and in teams in the planning, analysis, and design of power systems and their associated control systems using state-of-the-art methods. You will design power systems to incorporate the growing penetration of renewable energy sources. In order to do this, you will develop advanced skills to effectively design, analyse, and augment power systems to maximise reliability, security, and sustainability. Upon successful completion of this unit, you will be able to analyse systems incorporating renewable energy sources both dynamically and in steady-state using industry-standard software such as Power System Simulator for Engineering (PSSE). You will be able to tune control systems to satisfy Australian network standards and you will become competent to meet the challenges and opportunities of 21st-century power systems as they continue to evolve. You will apply skills in ENEE20001 to work towards the United Nations sustainable development goal. Online students are required to attend a residential school.

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

ENEE14005 Capstone Power and Control Design 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 2 - 2024

- Melbourne
- Mixed Mode
- 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).

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 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. **In-class Test(s)**
Weighting: 20%
2. **Project (applied)**
Weighting: 40%
3. **In-class Test(s)**
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 Live lectures

Feedback
Students appreciated the interaction with the Lecturer.

Recommendation
Keep facilitating student involvement during live sessions.

Feedback from Tutorials

Feedback
Students value face-to-face and software support during tutorial sessions.

Recommendation
Develop supporting roles of tutors further.

Unit Learning Outcomes

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

1. Conduct load-flow and fault analyses of complex power systems in order to augment the system to optimise power flows and voltage profiles
2. Model advanced dynamics of complex power systems to determine transient stability limits
3. Perform dynamic stability analysis of complex power systems in order to improve power system damping
4. Model renewable power plants in steady-state and transient situations to quantify their impact on system security
5. Discuss the impact of power system augmentations on economic, social, and environmental sustainability
6. Work autonomously and in teams on complex power engineering projects including providing leadership
7. Document and communicate professional engineering information including computer-based simulations and drawings using appropriate electrical engineering standards, terminology, and symbols.

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
1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. (LO: 1I 2I 3I)
1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 2I 4I 5I)
2.3 Application of systematic engineering synthesis and design processes. (LO: 3I 4I)
3.1 Ethical conduct and professional accountability. (LO: 6I)
3.3 Creative, innovative and pro-active demeanour. (LO: 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 3I)
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 3A 4A 5I)
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline. (LO: 5A)
2.1 Application of established engineering methods to complex engineering problem solving. (LO: 1A 2A 3A)
2.2 Fluent application of engineering techniques, tools and resources. (LO: 1A 2A 3A 4A)
2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 6A)
3.2 Effective oral and written communication in professional and lay domains. (LO: 5I 6I 7A)
3.4 Professional use and management of information. (LO: 1I 3I 6I 7A)
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	7
1 - In-class Test(s) - 20%	•						
2 - In-class Test(s) - 40%		•	•	•			
3 - Project (applied) - 40%	•	•	•	•	•	•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes						
	1	2	3	4	5	6	7
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

ENEE20001

Prescribed

POWER SYSTEM ANALYSIS AND DESIGN, SI Edition
6th Edition (2016)
Authors: J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma
Cengage Learning
Boston , MA , USA
ISBN: 9781305636187
Binding: Other

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 pdf converter
- Computer with Windows OS, headphones & microphone
- The free version of PSS/E software - downloadable from the internet

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 - 08 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of power systems, models of generators, lines, loads, transformers, load flow analysis: methods, reactive compensation, reactors, capacitors, SVCs, Load flow analysis using PSS/E	Glover, Sarma, and Overbye Chapter 3, sections3.1 to 3.6 Chapter 5 Chapter 6 sections 6.1-6.9	

Week 2 - 15 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic
Load flow planning studies, modelling with symmetrical components, balanced and unbalanced fault analysis, analysis of unbalanced systems, negative sequence operating limits, hand calculations	Glover, Sarma and Overbye Chapter 8 Chapter 9	

Week 3 - 22 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic
Use of PSS/E in fault modelling and calculation, comparison with hand calculations.	Refer to Lecture Notes	

Week 4 - 29 Jul 2024

Module/Topic	Chapter	Events and Submissions/Topic
Introduction to power system stability, machine inertia, and the swing equation. Classical machine models. Single machine infinite bus stability, equal area criterion, numerical integration of the swing equation, multi-machine systems, modelling in PSS/E	Glover, Sarma and Overbye Chapter 11, sections 11.1- 11.5	

Week 5 - 05 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic
Detailed machine models, exciters, and governors, modelling in PSS/E. Case Studies. Modelling of wind, solar, PV, and solar Thermal.	Glover, Sarma and Overbye Chapter 11, section 11.6' Chapter 12, Sections 12.1, 12.2	**In-Class Test** Due: Week 5 Monday (5 Aug 2024) 1:00 pm AEST

Vacation Week - 12 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 19 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of linear control theory, transfer functions, poles and zeros, open-loop and closed-loop systems, root locus, design of compensators using root locus, Bode plots	Refer to Lecture Notes	**Progress Report** Due: Week 6 Friday (23 Aug. 2024) 11:59 pm AEST

Week 7 - 26 Aug 2024

Module/Topic	Chapter	Events and Submissions/Topic
Linear state-space models, significance of eigenvalues, transfer function to state space conversions, small signal state-space model of a power system. Effect of high gain exciter on damping, Power system stabilisers.	Refer to Lecture Notes	

Week 8 - 02 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
Effect of high gain exciter on damping, Power System Stabilisers. Tuning of exciters using root locus techniques. General review of PSS tuning methods.	Refer to Lecture Notes	

Week 9 - 09 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of the Australian Electricity market, the role of renewables, sustainability and the triple bottom line, issues related to high penetration of renewables.	Refer to Lecture Notes	

Week 10 - 16 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic

Transmission Line Design and Protection	Refer to Lecture Notes	

Week 11 - 23 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of the unit, requirements of portfolio submission, practice presentations, feedback on progress reports.	Refer to Lecture Notes	

Week 12 - 30 Sep 2024

Module/Topic	Chapter	Events and Submissions/Topic
Consultation		**Portfolio** Due: Week 12 Friday (4 Oct 2024) 11:59 pm AEST

Review/Exam Week - 07 Oct 2024

Module/Topic	Chapter	Events and Submissions/Topic
		End-of-Term In-Class Test - date and time to be confirmed by Week 9, and published on Moodle.

Exam Week - 14 Oct 2024

Module/Topic	Chapter	Events and Submissions/Topic

Term Specific Information

Students require the **PSS®E,** often written as **PSS/E (Power System Simulator for Engineering)** software in order to complete Assignment#2 (Project Portfolio). The **PSS®E** software can be installed free of charge by logging into SIEMENS website through an account created using the CQUni email ID.

=== Important Information =====
Online Test: This unit ENEE20001 has no formal Examination. It has "In-Class Test (Mid-Semester Test)" in week 5 and an End of Term "Online Test" between Week 13 and 14 (Examination Weeks). The date and time for the test will be announced in due course.

Assessment Tasks

1 In-Class Test

Assessment Type
In-class Test(s)

Task Description

- This is an open-book test covering all the lectures and tutorials up to the end of week 4.
- The test will be held during the Week 5 lecture time and the duration will be 60 min.
- The test will be monitored through a Zoom session and students will have to provide written answers to the test questions.
- Each student stays home with a device (preferably a laptop) essentially having a camera through which the student will be invigilated in a Zoom session during the test.
- The test paper will be loaded to Moodle.
- The student uses blank A4 papers (single side) to write answers.
- At the end of the test, each student first takes photos of all written pages and emails them to the invigilator.
- Later students scan the pages and upload them to Moodle by the due time specified in Due Date Information section.

Assessment Due Date
Week 5 Monday (5 Aug 2024) 1:00 pm AEST

Return Date to Students

We strive to return assessments to students within 2 weeks.

Weighting
20%

Minimum mark or grade
A minimum of 50% must be attained for the In-Class Test in order to pass the unit.

Assessment Criteria
A total of 100 marks is allocated to this assessment. Students are assessed on the accuracy of calculated results and the correctness of the method used.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Submit to the link in the Assessment tile of the unit website in Moodle as a PDF file.

Learning Outcomes Assessed

- Conduct load-flow and fault analyses of complex power systems in order to augment the system to optimise power flows and voltage profiles

2 Portfolio

Assessment Type
Project (applied)

Task Description
For this assessment, you will design a specified power system for which the analysis will be mainly done using PSS/E simulations. The project description will be available in the Moodle link of the unit.

Assessment Due Date
Week 12 Friday (4 Oct 2024) 11:59 pm AEST
This will be the due date for the final report and the recorded presentation.

Return Date to Students

We strive to return assessments to students within 2 weeks.

Weighting
40%

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

Assessment Criteria
A total of 100 marks is allocated to this assessment. Students are assessed on the accuracy of calculated results and the correctness of the method used. Below is the contribution of each assessment item to the final mark of this assessment:

- Total progress report (30%)
- Presentation (25%)
- Final Report (45%)

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Final report and recorded presentation to be submitted through the appropriate link on the Moodle Website by the due date and time.

Learning Outcomes Assessed

- Conduct load-flow and fault analyses of complex power systems in order to augment the system to optimise

power flows and voltage profiles
- Model advanced dynamics of complex power systems to determine transient stability limits
- Perform dynamic stability analysis of complex power systems in order to improve power system damping
- Model renewable power plants in steady-state and transient situations to quantify their impact on system security
- Discuss the impact of power system augmentations on economic, social, and environmental sustainability
- Work autonomously and in teams on complex power engineering projects including providing leadership
- Document and communicate professional engineering information including computer-based simulations and drawings using appropriate electrical engineering standards, terminology, and symbols.

3 End-of-Term In-Class Test

Assessment Type
In-class Test(s)

Task Description

- The students are to solve four problems on the associated topics covering all the lectures and tutorials up to the end of week 8.
- The test duration will be 150 min.
- The end-of-term test will be monitored through a Zoom session and students will have to provide written answers to the exam questions.
- The test will be time scheduled and will take place for everyone at the same time.
- Each student will perform the test with a device (preferably a laptop) essentially having a camera through which the student will be invigilated in a Zoom session during the examination.
- The test paper will be uploaded to Moodle.
- The student uses blank A4 papers (single side) to write answers.
- At the end of the test, each student first takes photos of all written pages and emails them to the invigilator.
- Later, students scan the pages and upload them to Moodle by the due time specified in the Due Date Information section.

Assessment Due Date

The End-of-Term In-Class Test will be conducted during the CQU exam period. The exact date and time will be confirmed by Week 9 and published in Moodle.

Return Date to Students

We strive to return assessments to students within 2 weeks.

Weighting
40%

Minimum mark or grade
A minimum of 50% must be attained for the End-of-Term In-Class Test in order to pass the unit.

Assessment Criteria
A total of 100 marks is allocated to this assessment. Students are assessed on the accuracy of calculated results and the correctness of the method used.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Submit to the link in the Assessment tile of the unit website in Moodle as a PDF file.

Learning Outcomes Assessed

- Model advanced dynamics of complex power systems to determine transient stability limits
- Perform dynamic stability analysis of complex power systems in order to improve power system damping
- Model renewable power plants in steady-state and transient situations to quantify their impact on system security

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