ENEE14005 *Capstone Power and Control Design*
Term 1 - 2024

Profile information current as at 29/04/2024 07:11 am

General Information

Overview

In this unit, you will work in a team to analyse and design electrical power and control systems by applying PSSE or equivalent industry software. You will also focus on renewables, promoting the United Nations Sustainable Development Goal 7: Affordable and Clean Energy. On satisfactory completion, you will be able to investigate solutions for contemporary engineering problems, plan and control project work in a team environment, research current practice in this discipline, execute evidence-based decision-making, check and evaluate the validity of information, and prepare professional documentation for a project.

Details

Career Level: *Undergraduate*
Unit Level: *Level 4*
Credit Points: *12*
Student Contribution Band: *8*
Fraction of Full-Time Student Load: *0.25*

Pre-requisites or Co-requisites

Prerequisites: ENEE13021 Power System Analysis and Design AND ENEE13019 Control Systems Analysis and Design
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

- Bundaberg
- Cairns
- Gladstone
- Mackay
- 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).

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 Undergraduate 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 Test**
Weighting: 20%
2. **Online Test**
Weighting: 20%
3. **Portfolio**
Weighting: 60%

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

Feedback
Students appreciated how technically informative this unit is for future job requirements.

Recommendation
This good practice should be maintained.

Feedback from In Class Feedback

Feedback
Students appreciated the use of commercial power system software in this unit.

Recommendation
This good practice should be maintained.

Feedback from Unit Evaluation

Feedback
Students requested introducing a summary for adding each sub-model of synchronous generator in lecture notes.

Recommendation
Effects of each model, e.g., exciter, and governor on power systems should be summarised in future lectures.

Feedback from Unit Coordinator

Feedback
Questions of two online quizzes can be further revised to assess students' knowledge about sub-models of synchronous generators.

Recommendation
Quiz questions should be added or some existing questions should be modified to assess students knowledge about sub-models of synchronous generators.

Unit Learning Outcomes

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

1. Perform advanced load flow, stability, and power quality calculations using commercial software
2. Tune power system controllers to obtain the desired performance
3. Design power transmission infrastructure and renewable generation and storage systems for a reliable power supply
4. Apply the Australian Standards, National Electricity rules and general principles of sustainable development
5. Present design outcomes professionally as a report, short conference paper and presentation
6. 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

1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 1I 2I 3I 4I)

1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1I 2I 3I 4I)

2.2 Fluent application of engineering techniques, tools, and resources. (LO: 1I 2I 3I 4I)

3.3 Creative, innovative, and proactive demeanor. (LO: 5I 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 3A 4I)

1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. (LO: 1A 2A 3A 4A)

1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 1I 2I 3I 4A)

1.6 Understanding of the scope, principles, norms, accountabilities, and bounds of sustainable engineering practice in the specific discipline. (LO: 4A)

2.1 Application of established engineering methods to complex engineering problem-solving. (LO: 1I 2I 3I 4A)

2.3 Application of systematic engineering synthesis and design processes. (LO: 3A 4A)

2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 4A)

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

3.4 Professional use and management of information. (LO: 3A 4A)

3.5 Orderly management of self, and professional conduct. (LO: 4I 5I 6A)

3.6 Effective team membership and team leadership. (LO: 5A 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 Undergraduate Course Moodle site for further information on 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

— 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 Test - 20%	•					
2 - Online Test - 20%		•				
3 - Portfolio - 60%	•	•	•	•	•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes					
	1	2	3	4	5	6
1 - Communication					•	•
2 - Problem Solving	•	•	•	•		•
3 - Critical Thinking	•	•	•	•		
4 - Information Literacy	•	•			•	
5 - Team Work			•	•		
6 - Information Technology Competence	•	•			•	
7 - Cross Cultural Competence						
8 - Ethical practice			•	•		•
9 - Social Innovation						
10 - Aboriginal and Torres Strait Islander Cultures						

Textbooks and Resources

Textbooks

ENEE14005

Supplementary

Control Systems Engineering
Edition: 8th edn (2019)
Authors: Norman S. Nise
Wiley
Hoboken , NJ , USA
ISBN: 9781119561880
Binding: Paperback
ENEE14005

Supplementary

Power System Analysis and Design
7th SI Edition (2022)
Authors: J. Duncan Glover, Mulukutla Sarma, Thomas Overbye, Adam B. Birchfield
Cengage Learning
Boston , MA , USA
ISBN: 9780357676196
Binding: Paperback

IT Resources

You will need access to the following IT resources:

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)
- MATLAB and Simulink Suite Software (For students without access to a CQUni campus), see the Textbook and Resources section for more information
- PSS/E Xplore Link for download supplied on Moodle and in project specification

Referencing Style

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

Teaching Contacts

Kianoush Emami Unit Coordinator
k.emami@cqu.edu.au

Schedule

Week 1 - 04 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of Load Flow and fault calculations, models of power system components review of PSS/E	Chapters 6-9, of Glover, Sarma, and Overbye	

Week 2 - 11 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic

Power system dynamics, classical machine model, swing equation, critical clearing time, detailed machine models,, simulation using PSSE	Chapter 11 of Glover, Sarma and Overbye	

Week 3 - 18 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of Control Theory, transfer functions, Linear State space models, exciters and governors, modelling of exciters and governors, in PSSE, AEMO Specifications for damping	Refer to ENEE13019 notes on transfer functions and linear modelling, Nise chapters 2,3 , Glover et al chapters 11 and 12 and PSSE Models document	**Online test 1** Due: Week 3 Friday (22 Mar 2024) 11:45 pm AEST

Week 4 - 25 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of Compensator design, modelling of voltage response of synchronous machine, exciter tuning, effect of fast exciters on dynamic stability	Refer to ENEE13019 notes on root locus design.and time domain response. See Nise chapters 4,8 and 9	

Week 5 - 01 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Modelling of Solar PV and Wind, effect on system performance, AS4777 Effects of low system inertia, storage options, low voltage ride through issues	PSS/E models document and AS4777	

Vacation Week - 08 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 15 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Power System Quality, harmonics, sources effects and modelling	AS/NZS 61000.3.2:2003	

Week 7 - 22 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Other aspects of power quality - flicker and negative sequence, estimation, effect of and on renewable generation	National Electricity Rules (NER) chapter 5 AS/NZS61000.3.7:2001	**Project Progress Report (15% of Portfolio) Due:** Week 7 Friday (26 April 2024) 11:55 pm AEST

Week 8 - 29 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
Introduction to the NER clauses for connection, NER clauses S5.2.5.1 - S5.2.5.6	NER chapter 5	

Week 9 - 06 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Introduction to the NER clauses for connection, NER clauses S5.2.5.7 - S5.2.5.14 and S5.2.6.1, S5.2.6.2		

Week 10 - 13 May 2024

Module/Topic	Chapter	Events and Submissions/Topic

Introduction to the Australian electricity market, market impact of renewables, Sustainability triple bottom line		**Online Test 2** Due: Week 10 Friday (17 May 2024) 11:45 pm AEST

Week 11 - 20 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Review of unit and portfolio requeirements		

Week 12 - 27 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Question and Answer session regarding project		

Review/Exam Week - 03 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic
		Portfolio-Updated Progress Report(15%), Presentation(15%) and Final Report(30%) Due: Review/Exam Week Friday (7 June 2024) 11:55 pm AEST

Exam Week - 10 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic

Assessment Tasks

1 Online test 1

Assessment Type
Online Test

Task Description
Questions covering load flow analysis, reactive compensation, transmission line modelling, basic power system stability including the swing equation and critical clearing times, operation of PSS/E

Assessment Due Date
Week 3 Friday (22 Mar 2024) 11:45 pm AEST

Return Date to Students

Feedback will be accessible immediately after the quiz is completed.

Weighting
20%

Minimum mark or grade
To pass this assessment, students must achieve a minimum score of 50% of the maximum grade.

Assessment Criteria
Accuracy and correctness of answers

Referencing Style

- Harvard (author-date)

Submission
Online

Learning Outcomes Assessed

- Perform advanced load flow, stability, and power quality calculations using commercial software

2 Online Test 2

Assessment Type
Online Test

Task Description
Questions on modelling of detailed synchronous machines, exciters, power system stabilisers, and renewable generation, use of PSS/E in modelling the aforementioned, power system quality

Assessment Due Date
Week 10 Friday (17 May 2024) 11:45 pm AEST

Return Date to Students

Feedback will be accessible immediately after the quiz is completed.

Weighting
20%

Minimum mark or grade
To pass this assessment, students must achieve a minimum score of 50% of the maximum grade.

Assessment Criteria
Accuracy and correctness of answers

Referencing Style

- Harvard (author-date)

Submission
Online

Learning Outcomes Assessed

- Tune power system controllers to obtain the desired performance

3 Portfolio-Updated Progress Report(15%), Presentation(15%) and Final Report(30%)

Assessment Type
Portfolio

Task Description
Portfolio consists of a progress report due at 11:55 pm AEST on the Friday of week 7, and a final report and recorded group presentation all due at 11:55 pm AEST on the Friday of week 13. Grading criteria for these tasks will be provided on Moodle. These are group submissions however the marks will be individualised based on self and peer assessment of your contribution in the case of the reports and individual performance in the case of the presentation. The self and peer assessment is done through the university Self and Peer assessment (SPA) system. Details of this will be given on Moodle.
Weightings of these component in respect of the term totals are as follows
Progress report : 15%
Presentation : 15%
Final Report: 30% including 5% from self and peer assessment
making a total of 60% for the entire portfolio.

Assessment Due Date
Review/Exam Week Friday (7 June 2024) 11:55 pm AEST
Progress Report due 11:55 PM 26 April 2024 (week 7), Final Report and recorded presentation due 11:55 pm 7 June 2024 (week 13)

Return Date to Students

Within two weeks of due date

Weighting
60%

Minimum mark or grade
To pass this assessment, students must achieve a minimum score of 50% of the maximum grade.

Assessment Criteria
Progress Report

1. Technical accuracy in
    (a) load flow based analysis and design
    (b) detailed machine modelling
    (c) modelling of exciters and PSS's and Critical clearing time calculations
    (d) tuning of exciters
2. statement of issues and evidence of intra and inter team communication, team charter and self and peer assessments
3. plan for future work including Gantt chart
4. succinctness, correct grammar, spelling formatting etc

Final Report
1. Technical accuracy in the topics mentioned under progress report plus
    (a) Estimation of harmonic issues that may arise from installation of solar plant
    (b) Estimation of other power quality issues such as flicker and phase unbalance
    (c) Sizing of storage.
    (d) modelling of renewables in PSS/E
    (e) assessment of impact of solar on system stability and discussion of mitigation measures
    (f) sustainability report across triple bottom line
    (g) assessment of NER clauses
    (h) impact on the electricity market
    (i) addressing Progress Report feedback in a separate section
2. statement of issues and evidence of intra and inter team communication, team charter and modification thereof where necessary as well as self and peer assessments
3. Risk assessment
4. succinctness, correct grammar, spelling formatting etc
5. recommendations

Presentation
1. Technical aspects with respect to those mentioned under final report including sustainability and risk assessment and recommendations
2. Clarity and succinctness of slides
3. Presentation being ten minutes or less
4. Participation of all members of team and individual performance

Referencing Style

- Harvard (author-date)

Submission
Online Group

Submission Instructions
Submit via links provided on Moodle

Learning Outcomes Assessed

- Perform advanced load flow, stability, and power quality calculations using commercial software
- Tune power system controllers to obtain the desired performance
- Design power transmission infrastructure and renewable generation and storage systems for a reliable power supply
- Apply the Australian Standards, National Electricity rules and general principles of sustainable development
- Present design outcomes professionally as a report, short conference paper and presentation
- 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