ELCT4001

Smart Power Grids

Session 2, In person-scheduled-weekday, North Ryde 2024

School of Engineering

Contents

General Information

Unit convenor and teaching staff
Unit Convener/Lecturer
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Credit points
10

Prerequisites
(ELEC2005 or ELCT2005 or ELEC 295) and (ELCT4004 or ELEC 494)

Corequisites

Co-badged status
The unit is co-badged with ELEC8202.

Unit description
This unit provides students with knowledge and necessary skills for designing, analysing, controlling and operating future energy systems containing a large- scale renewable energy sources (i.e. intermittent and distributed generation), energy storage, and new types of loads such as electric vehicles, in "smart grids". It will also provide strong foundation in classical methods and modern protection schemes and engineering practices to protect the safety of the public, personnel and the system by detecting, isolating, and clearing the electric fault, and restore the system. Topics covered include smart grids in electrical energy systems, renewable energy resources, grid and micro- grid connections, energy efficiency and energy management strategies, smart grid protection, electricity network monitoring technologies and the IEC61850 power equipment automation standard.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are

available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

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

ULO1: Identify the operational characteristics of power grid networks including conventional and smarter power grids, the components of the power networks, renewable energy resources and nonrenewable energy resources.
ULO2: Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, and Electric Vehicles.
ULO3: Analyse and apply the knowledge of the stability, power quality of smart power grid and smart power system protection.
ULO4: Demonstrate knowledge and understanding of of energy management systems, including monitoring control and protection of smart power systems and microgrids.
ULO5: Work effectively in teams by: identifying individual roles and responsibilities, sharing knowledge through peer-led learning, writing technical reports and logbooks, and effective communications.

General Assessment Information

Grading and Passing Requirement for Unit

- In order to pass this Unit a student must obtain a mark of 50 or more for the Unit (i.e. obtain a passing grade P, CR, D, or HD).
- For further details about grading, please refer below in the policies and procedures section.
- If you receive special consideration for the oral presentation and demonstration of the Project, a supplementary conventional exam will be scheduled by the faculty during a supplementary exam period, typically about 3 to 4 weeks after the normal exam period. By making a special consideration application for the oral presentation and demonstration of the Project you are declaring yourself available for a conventional exam during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to applying. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration.

Assessments where Late Submissions will be accepted

In this unit, late submissions will be accepted as follows:

Practical Assignment – YES, Standard Late Penalty applies

Pre-Class Quiz & Mid-Term Quiz - NO, unless Special Consideration is Granted

Project Assessment – YES, Standard Late Penalty applies

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Project	50%	No	Week 13 & 14
Class Quiz (Lectorials)	20%	No	Week 8
Pre- Class Quiz (Lectorial)	10%	No	Week 2-7
Practical Lab	20%	No	Week 3-7

Project

Assessment Type [1]: Project
Indicative Time on Task [2]: 20 hours
Due: **Week 13 & 14**
Weighting: **50%**

This is the major assessment of this Unit. It will consist of 3 individual assessments and 1 team

assessment, as follows:

- Individual assessments:
    - Oral presentation and demonstration of the project;
    - Peer assessment regarding the actual contribution of each team member;
    - Evaluation of project logbook of each team member.
- Team assessment:
    - Project report to be submitted in iLearn by each team.

On successful completion you will be able to:

- Identify the operational characteristics of power grid networks including conventional and smarter power grids, the components of the power networks, renewable energy resources and nonrenewable energy resources.
- Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, and Electric Vehicles.
- Analyse and apply the knowledge of the stability, power quality of smart power grid and smart power system protection.
- Demonstrate knowledge and understanding of of energy management systems, including monitoring control and protection of smart power systems and microgrids.
- Work effectively in teams by: identifying individual roles and responsibilities, sharing knowledge through peer-led learning, writing technical reports and logbooks, and effective communications.

Class Quiz (Lectorials)

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 9 hours
Due: **Week 8**
Weighting: **20%**

A quiz is scheduled right after the midsemester break. The quiz will assess both factual knowledge and problem solving.

On successful completion you will be able to:

- Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, and Electric Vehicles.
- Analyse and apply the knowledge of the stability, power quality of smart power grid and smart power system protection.
- Demonstrate knowledge and understanding of of energy management systems, including monitoring control and protection of smart power systems and microgrids.

Pre- Class Quiz (Lectorial)

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 6 hours
Due: **Week 2-7**
Weighting: **10%**

Students are expected to go through the iLearn content, understand the theory and attempt the online quiz every week prior to in class activities (lectorials).

On successful completion you will be able to:

- Identify the operational characteristics of power grid networks including conventional and smarter power grids, the components of the power networks, renewable energy resources and nonrenewable energy resources.
- Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, and Electric Vehicles.
- Analyse and apply the knowledge of the stability, power quality of smart power grid and smart power system protection.

Practical Lab

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 14 hours
Due: **Week 3-7**
Weighting: **20%**

Laboratory sessions and submission of lab reprot by the end of each session. Students will be assessed based on thier attendance, participation, performance, and their ability to perform analysis, modeling and implementation of the practical experiment as well as software tools . There is no laboratory session in week **1**. Students need to record all the laboratory results (and

printouts) and submit a report for each experiment.

On successful completion you will be able to:

- Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, and Electric Vehicles.
- Demonstrate knowledge and understanding of of energy management systems, including monitoring control and protection of smart power systems and microgrids.
- Work effectively in teams by: identifying individual roles and responsibilities, sharing knowledge through peer-led learning, writing technical reports and logbooks, and effective communications.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

UNIT WEBSITE

- The iLearn website for this unit can be found at: https://ilearn.mq.edu.au/login/
  - Note! All information and communications relevant to this Unit will be via the iLearn website.

TEXTBOOK

- Design of Smart Power Grid Renewable Energy Systems, 3rd Edition, , by A. Keyhani, Wiley, 2019. (Digital).
- Protection of Electricity Distribution Networks, 3nd edition, by Juan M. Gers, Edward J. Holmes, IET Power and Energy Series 47, 2011, (Digital).
- Remark: All students are expected to have access to both textbooks.

LECTORIALS

Unit guide ELCT4001 Smart Power Grids

Lectorials are a combination of traditional lecture and tutorial teaching modes and are designed

to improve student engagement.

The Lectorials are organised in a flipped classroom fashion.

- Prior to Lectorials
    - Links to reading materials, brief videos and/or lecture notes are posted in iLearn each week.
    - Students are expected to read any posted notes or materials, try to solve any given examples, and watch any videos prior to attending the Lectorials.
    - 'pre-class' mini quizzes to assess the basic understanding of fundamental principles in power system analysis and design.
- During Lectorials
    - brief discussion sessions on fundamental principles.
    - plenty of practical examples.
    - interactive problem solving involving students.

LABORATORIES

- Practical activities take place once a week (Weeks 3-7) according to the Unit schedule.
    - *Note! Students must enrol in one of the available weekly Lab sessions.*
- Interactive Practicals use FESTO equipment, and DigSilent Power Factory software platform to assist with the Lab experiments.

On-campus activities commence in Week 2. Students should contact the Unit convenor as soon as possible if they are unable to get back to campus in time.

PROJECTS

- Project activities take place once a week (Weeks 8-13) according to the Unit schedule.
    - *Note! Teams must enrol in one of the available weekly Project sessions.*
- The team Project is the core component of this Unit. The Projects cover practical aspects of smart power grids.
- Students are required to form teams and work on the given project topic.
    - *Note! When forming teams, students should agree in which weekly Project session they want to enrol.*
    - *All Project activities are performed in teams;*

TECHNOLOGY

- The laboratory work will rely on the use of FESTO equipment, and DigSilent Power Factory software platform.

- The software platform are available through Web browser and/or Faculty Lab PCs.
- The Project work will rely on the use of DigSilent Power Factory software platform.
    - The software can be used on dedicated Lab PCs.

COMMUNICATIONS

- Students are reminded the University will communicate all official notices by email to official MQ student's account. Students should read their @student.mq.edu.au email regularly or forward it to an account they check regularly.
- All announcements and other communications regarding this Unit will be via iLearn platform.

WEB RESOURCES

- **DigSilent Power Factory support:**
    - https://www.digsilent.de/en/

Unit Schedule

For details, please refer to the Unit Schedule on the ELCT4001 iLearn webpage.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study

- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Engineers Australia Competency Mapping

EA Competency Standard		Unit Learning Outcomes
Knowledge and Skill Base	1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.	ULO1, ULO2,ULO3
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	ULO1,ULO3,ULO4
	1.3 In-depth understanding of specialist bodies of knowledge	ULO1,ULO2,ULO3,ULO4
	1.4 Discernment of knowledge development and research directions	ULO1,ULO2,ULO4
	1.5 Knowledge of engineering design practice	ULO1,ULO2,ULO3,ULO4
	1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.	ULO1,ULO2,ULO3,ULO4,ULO5
Engineering Application Ability	2.1 Application of established engineering methods to complex problem solving	ULO3,ULO4
	2.2 Fluent application of engineering techniques, tools and resources.	ULO1,ULO2,ULO3,ULO4
	2.3 Application of systematic engineering synthesis and design processes.	ULO1,ULO2
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	ULO3,ULO4
Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	ULO5
	3.2 Effective oral and written communication in professional and lay domains.	ULO5
	3.3 Creative, innovative and pro-active demeanour.	ULO1,ULO2,ULO4,ULO5

	3.4 Professional use and management of information.	ULO1,ULO4,ULO5
	3.5 Orderly management of self, and professional conduct.	ULO3,ULO4
	3.6 Effective team membership and team leadership	ULO5

Unit information based on version 2024.03 of the Handbook