# ELCT4001

## Advanced Electrical Systems

Session 2, Special circumstance 2020

*School of Engineering*

## Contents





**Notice**

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and ot her small group learning activities on campus for the second half-year, while keeping an online ver sion available for those students unable to return or those who choose to continue their studies onli ne.

To check the availability of face-to-face and onlin e activities for your unit, please go to timetable vi ewer. To check detailed information on unit asses sments visit your unit's iLearn space or consult yo ur unit convenor.

# General Information

Unit convenor and teaching staff
Convener and Lecturer
Sara Deilami
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Tuesdays 11am-1pm

Tutor
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Credit points
10

Prerequisites
(ELEC3024 or ELEC324) and (ELCT3005 or ELEC295) and (ELCT3006 or ELEC396)

Corequisites

Co-badged status

Unit description
This unit develops advanced knowledge and skills necessary for designing, analysing, controlling and operating future energy systems containing a substantial proportion of renewable energy sources (i.e. intermittent and distributed generation), energy storage, and new types of loads such as electric vehicles, in "smart grids" monitored and coordinated by modern information and telecommunications technology. Topics covered include; smart grids and micro-grids in electrical energy systems, energy efficiency and energy management strategies (e.g. in energy storage subsystems, and in buildings), electricity network monitoring technologies (e.g. phasor measurement units, smart meters), the IEC61850 power equipment automation standard, electrical subsystems such as flexible AC transmission systems (FACTS), solid state transformers and smart inverters, etc. The choice and impact of telecommunication technologies on the control and security of energy infrastructure will be emphasised, together with economic considerations and the role and impact of electricity markets on electrical energy systems, e.g. in demand management, etc.

## 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 components of smart grid and analyse the differences between a conventional and a smarter grid, demonstrate an understanding of basic concepts, fundamental analysis and design techniques in modern power systems.
**ULO2:** Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, using appropriate telecommunications technologies and control methods.
**ULO3:** Demonstrate and apply knowledge of relevant standards governing the implementation of advanced electrical energy systems.
**ULO4:** Demonstrate knowledge and understanding of commercial, legal and regulatory issues relevant to distributed electrical energy systems.
**ULO5:** Demonstrate and apply knowledge of emerging electrical energy technologies and other influences and trends relevant to the development of modern electrical energy systems.

# General Assessment Information

**Grading and passing requirement for unit:**

In order to pass this unit a student must obtain an overall mark of at least 50% or more for the unit.

For further details about grading, please refer to the policies and procedures section.

**Late submissions and Re-submissions:**

Late submissions will attract a penalty of <2/100, 2%> marks per day. Extenuating circumstances will be considered upon lodgment of an application for special consideration.

Re-submissions of work are not allowed.

**Supplementary Exam:**

If you receive special consideration for the final exam, a supplementary 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 final exam you are declaring yourself available for a resit 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 submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their

supplementary examination.

# Assessment Tasks

| Name | Weighting | Hurdle | Due |
|---|---|---|---|
| Final Exam | 50% | No | TBA |
| Practical Lab | 20% | No | By End of Scheduled Submission Time. |
| Project | 20% | No | Week 13 |
| Problem Solving (Tutorial) | 10% | No | By End of Scheduled Submission Time. |

## Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **TBA**
Weighting: **50%**

Final exam will cover all of the course content. The exam involves short answers and problem solving. The details of the exam will be sent to the students through iLearn closer to the examination date.

On successful completion you will be able to:

- Identify the components of smart grid and analyse the differences between a conventional and a smarter grid, demonstrate an understanding of basic concepts, fundamental analysis and design techniques in modern power systems.
- Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, using appropriate telecommunications technologies and control methods.
- Demonstrate and apply knowledge of relevant standards governing the implementation of advanced electrical energy systems.
- Demonstrate knowledge and understanding of commercial, legal and regulatory issues relevant to distributed electrical energy systems.

## Practical Lab

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 17 hours
Due: **By End of Scheduled Submission Time.**
Weighting: **20%**

There are five laboratory sessions throughout the semester. The laboratory sessions **start on week 3**. The laboratories are strongly recommended; participation, and completion of all the laboratory activities are required in order to satisfactorily complete the course. You are required to record all the laboratory scripts, results and printouts, answer all questions and submit them all in the form of a report by the end of the scheduled submission time.

On successful completion you will be able to:

- Identify the components of smart grid and analyse the differences between a conventional and a smarter grid, demonstrate an understanding of basic concepts, fundamental analysis and design techniques in modern power systems.
- Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, using appropriate telecommunications technologies and control methods.
- Demonstrate knowledge and understanding of commercial, legal and regulatory issues relevant to distributed electrical energy systems.

## Project

Assessment Type [1]: Project
Indicative Time on Task [2]: 37 hours
Due: **Week 13**
Weighting: **20%**

A project will be defined for the students to gain knowledge and skills by investigating and responding to an engaging subject. The aim of Project is to work on the solution to a problem both analytically and via software implementation, and students are expected to work on the project throughout the course. Students can work in groups on the project but submissions are individually. There are two assessments involved. One assessment is a presentation to be given during week 12. it will be done individually during tutorial and laboratory sessions. The other assessment is the project report that summarizes the project works and the associate findings.The individual submissions of the reports will be announced later through iLearn. Each item accounts for half of the weighting of Project. All the project materials are required to be

packed in one folder and submitted by the end of week 13.

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, using appropriate telecommunications technologies and control methods.
- Demonstrate and apply knowledge of relevant standards governing the implementation of advanced electrical energy systems.
- Demonstrate knowledge and understanding of commercial, legal and regulatory issues relevant to distributed electrical energy systems.
- Demonstrate and apply knowledge of emerging electrical energy technologies and other influences and trends relevant to the development of modern electrical energy systems.

## Problem Solving (Tutorial)

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 15 hours
Due: **By End of Scheduled Submission Time.**
Weighting: **10%**

Tutorial sessions start from week 2. Each tutorial will have several problem-solving questions. A few questions will be solved in the scheduled tutorial. The problems will be designed to enhance students' understanding of the topics covered in lectures and provide them with an opportunity to apply the knowledge they have learned from lectures to solving practical problems. In each session, there will be a tutorial assessment test (online assessment through iLearn) to examine students' learning achievements at different stages of the course. The marks will also be counted towards the weighting of the problem solving assessment task.

On successful completion you will be able to:

- Identify the components of smart grid and analyse the differences between a conventional and a smarter grid, demonstrate an understanding of basic concepts, fundamental analysis and design techniques in modern power systems.
- Analyse, simulate, design and operate electrical energy systems incorporating distributed and intermittent (e.g. renewable) energy resources, including energy storage, using appropriate telecommunications technologies and control methods.
- Demonstrate and apply knowledge of relevant standards governing the implementation

of advanced electrical energy systems.

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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

The recommended text book and resources for this course are listed below:

1: **Main text - book:** A. Keyhani, Design of Smart Power Grid Renewable Energy Systems, Wiley, 2011,Third Edition, available online.

2- Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheble, Power Generation, Operation and Control, Wiley, 2013, 3rd Edition,.

3- J. Ekanayake, K. Liyanage, J.Wu, A. Yokoyama, and N. Jenkins, Smart Grid: Technology and Applications, Wiley, 2012.

4- J. Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, IEEE Press, 2012.

5- A. F. Zobaa, and R. C. Bansal, Handbook of Renewable Energy Technology. World

Scientific, 2011.

6- N. Hatziargyriou, H. Asano, R. Iravani, and C. Marnay, “Microgrids”, IEEE Power and Energy Magazine, Vol.: 5, No: 4, pp. 78-94, 2007.

7- H. Gharavi, and R. Ghafurian, “Smart Grid: The Electric Energy System of the Future [Scanning the Issue]”, Proceedings of the IEEE, Vol: 99, No: 6, pp. 917-921, 2011.

8- F. Bouhafs, M. Mackay, and M. Merabti, “Links to the Future: Communication

Requirements and Challenges in the Smart Grid”, IEEE Power and Energy Magazine, Vol: 10, No: 1, pp. 24-32, 2012.

# 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://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). 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
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

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

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/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

# Student Support

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

## Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- 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

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

## 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.

# Changes from Previous Offering

The lecture notes, lab-sheets and tutorials  have been updated.