UNSW Course Outline

ELEC9715 Electricity Industry Operation and Control - 2024

Published on the 13 Feb 2024

General Course Information

Course Code : ELEC9715
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Electrical Engineering & Telecommunications
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Gain knowledge and skills on the operation and control of electricity industries with growing levels of variable renewables as well as distributed energy resources. We'll cover the evolving electricity industry drivers of restructuring, technological developments and environmental

concerns, and their impact on electricity industry operation and control. You'll learn conventional approaches and tools for economic dispatch, unit commitment, hydroscheduling, production costing, reliability measures and operations planning in traditional utility industry structures. However we'll also cover operation and control within restructured electricity industries with wholesale spot electricity markets, bilateral trading, forward markets, derivatives and full retail competition.

Course Aims

The purpose of this course is to introduce students to the main issues involved in electricity industry operation and control; that is, decision making approaches and methods to meet industry objectives through appropriate operation of existing, in place, power system equipment. Industry operation and control will be discussed in the context of both traditional monopoly utility run power systems and the restructured market-based industries now becoming more common worldwide.

Thus the course will explore the broader issue of electricity industry operation and control rather than the narrower traditional power system focus. Considerable attention is given to practical implementation and experience to date in Australia, with comments on other countries when appropriate. The integration of variable renewables and distributed energy resources are key focus topics. Students taking this course will therefore gain a critical appreciation of the operation of Australia's restructured industry.

The companion course, ELEC9714 Electricity Industry Planning and Economics explores issues of electricity industry structure, market design and technical, economic and environmental regulation with a particular focus on the investment decision making timescale. These courses can be taken separately or in either sequence.

Relationship to Other Courses

As noted above, ELEC9714 explores electricity industry decision making over longer time frames. The courses are stand-alone but if you are interested in planning and investment for electricity industry transition you should also consider taking this course as well.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the fundamental objectives, constraints and concepts of electricity industry operation and control
CLO2 : Apply basic conventional economic dispatch, unit commitment, hydro-scheduling, production costing, reliability assessment and operation planning techniques to simple electricity industry problems
CLO3 : Describe the implementation of power system operation and control in a restructure industry context including ancillary services, and energy spot and derivative markets
CLO4 : Apply basic models for electricity markets to simple and restructured electricity industry problems
CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which power system operation and control is defined and undertaken
CLO6 : Describe the opportunities and challenges that variable renewables and emerging distributed energy resources pose for future electricity industry operation and control

Course Learning Outcomes	Assessment Item
CLO1 : Explain the fundamental objectives, constraints and concepts of electricity industry operation and control	• Final Exam • Student Participation and Quizzes held in classes • Group Student Project and Group Student Presentation • Individual Student Assignment
CLO2 : Apply basic conventional economic dispatch, unit commitment, hydro-scheduling, production costing, reliability assessment and operation planning techniques to simple electricity industry problems	• Final Exam • Student Participation and Quizzes held in classes • Individual Student Assignment
CLO3 : Describe the implementation of power system operation and control in a restructure industry context including ancillary services, and energy spot and derivative markets	• Group Student Project and Group Student Presentation • Final Exam • Student Participation and Quizzes held in classes • Individual Student Assignment
CLO4 : Apply basic models for electricity markets to simple and restructured electricity industry problems	• Group Student Project and Group Student Presentation • Final Exam • Student Participation and Quizzes held in classes • Individual Student Assignment
CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which power system operation and control is defined and undertaken	• Group Student Project and Group Student Presentation • Final Exam • Student Participation and Quizzes held in classes • Individual Student Assignment
CLO6 : Describe the opportunities and challenges that variable renewables and emerging distributed energy resources pose for future electricity industry operation and control	• Group Student Project and Group Student Presentation • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Learning and Teaching in this course

You are expected to attend the in-person lectures in order to maximise learning. In addition to the lecture slides, you should read relevant sections of any recommended texts and other materials, as discussed in the classes. Reading additional texts and reports will further enhance your learning experience. Group learning is also encouraged. UNSW *assumes* that self-directed study

of this kind is undertaken in addition to attending classes throughout the course.

Other Professional Outcomes

Engineers Australia (EA), Professional Engineer Stage 1 Competencies

The Course Learning Outcomes (CLOs) contribute to your development of the following EA competencies:

PE1: Knowledge and Skill Base:

PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals: CLO 1, 2, 3, 4, 5
PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing: CLO 2, 3, 4, 5, 6
PE1.3 In-depth understanding of specialist bodies of knowledge: CLO 1, 2, 3, 4, 5, 6
PE1.4 Discernment of knowledge development and research directions: CLO 5, 6
PE1.5 Knowledge of engineering design practice: CLO 3, 6
PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice: 1, 5, 6

PE2: Engineering Application Ability:

PE2.1 Application of established engineering methods to complex problem solving: CLO 2, 4
PE2.2 Fluent application of engineering techniques, tools and resources: CLO 1, 2, 5
PE2.3 Application of systematic engineering synthesis and design processes: CLO 2
PE2.4 Application of systematic approaches to the conduct and management of engineering projects: CLO 4, 6

PE3: Professional and Personal Attributes:

PE3.1 Ethical conduct and professional accountability: CLO 1, 5
PE3.2 Effective oral and written communication (professional and lay domains): CLO 1, 2, 5
PE3.3 Creative, innovative and pro-active demeanour: CLO 5
PE3.4 Professional use and management of information: CLO 1, 4, 5
PE3.5 Orderly management of self, and professional conduct:
PE3.6 Effective team membership and team leadership: CLO 5, 6

Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

UNSW Graduate Attributes

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing capable independent and collaborative enquiry, through a series of tutorial exercises spanning the duration of the course.
- Developing digital and information literacy and lifelong learning skills through assignment work.
- Developing ethical practitioners who are collaborative and effective team workers, through group activities, seminars and technical reports.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.
- Developing citizens who can apply their discipline in other contexts, are culturally aware and environmentally responsible, through interdisciplinary tasks, seminars and group activities.

Additional Course Information

Pre-requisites: Although this subject has no formal prerequisites, it is assumed that each student has a basic working knowledge of power systems, and the electricity industry more generally. A

number of texts are available for students whose undergraduate training did not include this type of material, or who feel that they require revision. Please contact the lecturer to discuss if you have questions regarding this matter. It is further assumed that students are familiar with Standard Office software tools including Excel, Word and Powerpoint (or equivalents). If you are not, then this course will provide an excellent opportunity to improve your skills in using these key productivity tools.

The course is not a pre-requisite for other courses at UNSW. However, it does have close links to its companion course, ELEC9714 Electricity Industry Planning and Economics, as detailed above. There is some cross-over between the two courses but they are also carefully designed to complement each other whilst not requiring that you take them in sequence, or take both of them. ELEC9714 Electricity Industry Planning and Economics explores issues of electricity industry structure, market design and technical, economic and environmental regulation with a particular focus on the investment decision making timescale.

Workload: It is expected that you will spend around 12-15 hours per week studying a 6 UoC course, from Week 1 until the final assessment, including face-to-face classes where these run, online lectures and tutorials and independent, self-directed study. In periods where you need to need to complete assignments or prepare for examinations, the workload will be greater. Over-commitment is a common challenge for students. You should take the required course workload into account when planning how to balance study with employment and other activities.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Final Exam Assessment Format: Individual	40%	
Student Participation and Quizzes held in classes Assessment Format: Individual	10%	
Group Student Project and Group Student Presentation Assessment Format: Group	25%	
Individual Student Assignment Assessment Format: Individual	25%	

Assessment Details

Final Exam

Assessment Overview

2-hour closed book written examination comprising four compulsory questions covering both the knowledge and skills that you gained over the course.

Course Learning Outcomes

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- CLO4 : Apply basic models for electricity markets to simple and restructured electricity industry problems
- CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which power system operation and control is defined and undertaken
- CLO6 : Describe the opportunities and challenges that variable renewables and emerging distributed energy resources pose for future electricity industry operation and control

Assessment Length

2 hours

Assessment information

	Learning outcomes				Assessment
1	2	3	4	5	6
Assignments			P	P	P
P	P				
Group project, seminar and wiki		P			P
P	P	P			Class participation
P	P	P	P	P	Final exam
P		P	P	P	P
P	P				

Student Participation and Quizzes held in classes

Assessment Overview

This will be assessed according to the student's participation in the lectures, with a focus on small quizzes held during the class.

Course Learning Outcomes

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- CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which power system operation and control is defined and undertaken

Group Student Project and Group Student Presentation

Assessment Overview

Group Project Report and Seminar - projects will focus on the development and testing of simple software or in-depth literature review of some aspect of electricity industry operation and control. Students will be able to choose their groups and topics (from a list of around 50 possible topics) in coordination with the course coordinator.

Course Learning Outcomes

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- CLO6 : Describe the opportunities and challenges that variable renewables and emerging distributed energy resources pose for future electricity industry operation and control

Individual Student Assignment

Assessment Overview

There are two assignments over the course, each of equal weighting, and worth in total 25% of the final course mark.

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Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

General Assessment Information

Grading Basis

Standard

Course Schedule

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

Indicative Lecture Schedule (subject to change)

Wk: 1

Topics:

Introduction; important features and attributes of the electricity industry; definition of the key problems and challenges of industry operation and control.

Key technologies for generation, networks, loads and their control capabilities

Activities: Student surveys and quiz tasks.

Wk: 2

Topics:

Generation technology operational characteristics

Decision making tools

Economic dispatch (utilisation of operating generators & loads)

Activities:

Quiz tasks

[out] Information on group
projects and possible topics

Wk: 3

Topics:

Continuous voltage and frequency control

Contingencies and their management

Activities:

Quiz tasks

[out] Assignment 1

Wk: 4

Topics:

Unit commitment (selection of generators & loads to operate)

Activities:

Quiz tasks

Group project topics finalized
by end week 4

Wk: 5

Topics:

Energy constraints: hydro, fuel management and maintenance scheduling

Activities:

Quiz tasks

[in] Assignment 1

Wk: 6

Topics:

Flexibility week

Activities:

Consultations and revision if and as requested by students

[out] Assignment 2

Wk: 7

Topics:

Practical electricity industry arrangements for operation and control

Activities:

Quiz tasks

Project group discussions with course coordinator

Wk: 8

Topics:

Operation and control issues associated with variable and only partially controllable generation

Activities:

Quiz tasks

[in] Assignment 2

Wk: 9

Topics:

The operational challenges of distributed energy resources

Electricity industry operation in a ‘smart grid’ low carbon future

Activities:

[out] Exam prep. guidance
and sample questions

Wk: 10

Student group project presentations

Wk: 11

Optional course review and exam guidance session

Project group wikis finalized
and reports due week 11

Course Resources

Prescribed Resources

More recent concepts relevant to electricity industry operation and control in restructured industries are not easily found in textbooks. Instead, regular updates and course materials will be added to the course Moodle. Materials will include pdf versions of the lecture PowerPoints (also provided prior to each lecture). A range of reports, papers and websites will be uploaded throughout the term to provide more background on electricity industry operation and control within the restructured Australian electricity industry, as well as internationally. Another useful website is that of the UNSW Collaboration on Energy and Environmental Markets (CEEM) found at www.ceem.unsw.edu.au. It contains useful papers and presentations covering many of the topics that are explored during the course.

As a part of the teaching component, *Moodle* and MS Teams will be used to disseminate teaching materials, host forums and weekly quizzes. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Recommended Resources

Textbooks

There is no assigned textbook for this subject. The following book is a useful reference on the traditional, monopoly utility, approach to many of the topics covered in this course, and the third edition also has some useful materials on electricity restructuring:

Allen J Wood, Bruce F Wollenberg and Gerard Sheble, Power Generation, Operation and Control, Wiley, 3rd Edition, 2014.

The UNSW library has this book available as an e-book.

On-line resources

More recent concepts relevant to electricity industry operation and control in restructured industries are not easily found in textbooks. Instead, regular updates and course materials will be added to the course Moodle. Materials will include pdf versions of the lecture PowerPoints (also provided prior to each lecture). A range of reports, papers and websites will be uploaded throughout the term to provide more background on electricity industry operation and control within the restructured Australian electricity industry, as well as internationally. Another useful

website is that of the UNSW Collaboration on Energy and Environmental Markets (CEEM) found at www.ceem.unsw.edu.au. It contains useful papers and presentations covering many of the topics that are explored during the course.

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Course Evaluation and Development

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Iain MacGill		Tyree Energy Technology Building, Rm 316	via MS Teams	By appointment, or in scheduled course lectures	No	Yes
	Iain Macgill					No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary

assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic

integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly

indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Use of AI for assessments

Your work must be your own. If you use AI in the writing of your assessment, you must acknowledge this and your submission must be substantially your own work. More information can be found on this website.

Workplace Health & Safety (WHS)

WHS for students and staff is of utmost priority. Most courses involve laboratory work. You must follow the rules about conduct in the laboratory. About COVID-19, advice can be found on this website.

School Contact Information

Consultations: Lecturer consultation times will be advised during the first lecture. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with ELEC/TELExxxx in the subject line; otherwise they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Student Support Enquiries

For enrolment and progression enquiries please contact Student Services

Web

Electrical Engineering Homepage