UNSW Course Outline

ELEC9714 Electricity Industry Planning and Economics - 2024

Published on the 26 May 2024

General Course Information

Course Code : ELEC9714
Year : 2024
Term : Term 2
Teaching Period : T2
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

In this course, you will gain knowledge and skills in planning, economics and investment within electricity industries that are pursuing clean energy transition, including deploying growing levels of variable renewables as well as distributed energy resources. We'll cover the evolving electricity

industry drivers of market restructuring, technological developments and environmental concerns, and their impact on power system planning and investment. You'll learn conventional approaches and tools for characterising electricity industry technology options and solving optimal generation and network investment planning with traditional utility industry structures. However, we'll also cover planning and investment within restructured electricity industries with wholesale spot electricity markets, bilateral trading, derivatives and full retail competition. You'll gain knowledge and skills to help drive clean energy transition in electricity sectors around the world.

Course Aims

The purpose of this course is to introduce students to the key features of a restructured electricity industry. The course gives an Australian perspective, considering issues including: the nature of the electricity industry; objectives and options for restructuring; insights from electricity pricing theory; Australia's restructured electricity industry; National Electricity Market design and performance; the role of electricity networks in a restructured electricity industry including market representation, network pricing and network regulation; ancillary services; design and implementation of retail electricity markets; climate change and the electricity industry; and electricity industry regulation.

Considerable attention is given to practical implementation and experience to date in Australia, with comments on other countries when appropriate. Students taking this course will therefore gain a critical appreciation of economics, planning and investment in Australia's restructured industry. Students taking this course should gain a critical appreciation of planning, economics and investment within Australia's restructured electricity industry. The subject should also provide a basis for further study of this field. The companion course, ELEC9715 Electricity Industry Operation and Control presents decision making approaches and methods to meet industry objectives through appropriate operation of existing, in place, power system equipment. These courses can be taken separately or in either sequence.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the fundamental objectives, constraints and concepts of electricity industry planning, economics and investment
CLO2 : Apply basic conventional 'optimal generation mix' planning techniques to simple electricity industry investment problems
CLO3 : Describe the implementation of electricity industry planning and investment in a restructured industry context including the role of energy spot and derivative markets
CLO4 : Apply basic models of electricity markets to simple restructured electricity industry problems involving operation and investment
CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which electricity industry planning, economics and investment is defined and undertaken.
CLO6 : Describe the opportunities and challenges that emerging distributed energy resources pose for future electricity industry planning, economics and investment

Course Learning Outcomes	Assessment Item
CLO1 : Explain the fundamental objectives, constraints and concepts of electricity industry planning, economics and investment	• Group project • Student Participation and In-class Quizzes • Final Examination
CLO2 : Apply basic conventional 'optimal generation mix' planning techniques to simple electricity industry investment problems	• Course assignments • Student Participation and In-class Quizzes • Final Examination
CLO3 : Describe the implementation of electricity industry planning and investment in a restructured industry context including the role of energy spot and derivative markets	• Group project • Course assignments • Student Participation and In-class Quizzes • Final Examination
CLO4 : Apply basic models of electricity markets to simple restructured electricity industry problems involving operation and investment	• Course assignments • Student Participation and In-class Quizzes • Final Examination
CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which electricity industry planning, economics and investment is defined and undertaken.	• Group project • Course assignments • Final Examination
CLO6 : Describe the opportunities and challenges that emerging distributed energy resources pose for future electricity industry planning, economics and investment	• Group project • Student Participation and In-class Quizzes • Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams | Echo 360

Other Professional Outcomes

The Course Learning Outcomes (CLOs) contribute to the Engineers Australia (National Accreditation Body) Stage I competencies as outlined below

Engineers Australia (EA), Professional Engineer Stage 1 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 1, 2,3,4,5

PE1.3 In-depth understanding of specialist bodies of knowledge: CLO 1, 2, 3, 4

PE1.4 Discernment of knowledge development and research directions: n/a

PE1.5 Knowledge of engineering design practice: CLO 1, 2, 3, 5.

PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice: n/a

PE2: Engineering Application Ability:

PE2.1 Application of established engineering methods to complex problem solving: CLO 1, 3, 4, 5, 6

PE2.2 Fluent application of engineering techniques, tools and resources: CLO 1, 2,3, 4, 5, 6

PE2.3 Application of systematic engineering synthesis and design processes: n/a

PE2.4 Application of systematic approaches to the conduct and management of engineering projects: n/a

PE3: Professional and Personal Attributes:

PE3.1 Ethical conduct and professional accountability: n/a

PE3.2 Effective oral and written communication (professional and lay domains): CLO 5, 6

PE3.3 Creative, innovative and pro-active demeanour: CLO 6

PE3.4 Professional use and management of information: n/a

PE3.5 Orderly management of self, and professional conduct: n/a

PE3.6 Effective team membership and team leadership: n/a

This course is also designed to provide the course learning outcomes which arise from targeted

graduate capabilities. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (also listed below).

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 Capabilities

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 rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.
- 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 activitie

Additional Course Information

Relationship to Other Courses

This is a postgraduate course in the School of Electrical Engineering and Telecommunications. The course is available in the following programs: Master of Engineering Science; Doctor of Philosophy in Engineering, Master of Engineering and Bachelor of Engineering (4th Year Elective substitution). Students undertaking other courses may also be permitted subject to agreement with the School of Electrical Engineering and Telecommunications, and the Course Coordinator.

The companion course, ELEC9715 Electricity Industry Operation and Control explores presents decision making approaches and methods to meet shorter-term industry objectives through appropriate operation and control of existing, in place, power system equipment. These courses can be taken separately, or in either sequence. This course replaces the old ELEC9201 Power System Planning and Economics.

Pre-requisites and Assumed Knowledge

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).

Following Courses

The course is not a pre-requisite for other courses at UNSW. However, it does have close links to its companion course, ELEC9715 Electricity Industry Operation and Control, 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.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Group project Assessment Format: Group	25%	
Student Participation and In-class Quizzes Assessment Format: Individual	10%	
Course assignments Assessment Format: Individual	25%	
Final Examination Assessment Format: Individual	40%	

Assessment Details

Group project

Assessment Overview

Students will be able to choose their groups and topics (from a list of around 50 possible topics) in coordination with the course coordinator. The projects will focus on either the development and testing of a simple software or an in-depth literature survey of some aspects of electricity industry planning, economics, and investment (around 5000 words plus tables, diagrams, references, etc.). Apart from the report, students will deliver a short seminar at the end of the term. Assessments will be based on the quality of the content (literature review, quantitative analysis) and presentation.

Course Learning Outcomes

- CLO1 : Explain the fundamental objectives, constraints and concepts of electricity industry planning, economics and investment
- CLO3 : Describe the implementation of electricity industry planning and investment in a restructured industry context including the role of energy spot and derivative markets
- CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which electricity industry planning, economics and investment is defined and undertaken.
- CLO6 : Describe the opportunities and challenges that emerging distributed energy resources pose for future electricity industry planning, economics and investment

Assignment submission Turnitin type

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

Student Participation and In-class Quizzes

Assessment Overview

Each student will receive an individual mark according to the quality and extent of their engagement in the lectures through the various activities with a focus on small quizzes held during the class.

Course Learning Outcomes

- CLO1 : Explain the fundamental objectives, constraints and concepts of electricity industry planning, economics and investment
- CLO2 : Apply basic conventional 'optimal generation mix' planning techniques to simple electricity industry investment problems
- CLO3 : Describe the implementation of electricity industry planning and investment in a restructured industry context including the role of energy spot and derivative markets
- CLO4 : Apply basic models of electricity markets to simple restructured electricity industry problems involving operation and investment
- CLO6 : Describe the opportunities and challenges that emerging distributed energy resources pose for future electricity industry planning, economics and investment

Course assignments

Assessment Overview

The assignments allow self-directed study leading to the solution of partly structured problems. There are two assignments over the course, each of equal weighting, and worth in total 25% of the final course mark. Marks will be assigned according to how completely and correctly the problems have been addressed. These assignments must be undertaken by students individually.

Course Learning Outcomes

- CLO2 : Apply basic conventional 'optimal generation mix' planning techniques to simple electricity industry investment problems
- CLO3 : Describe the implementation of electricity industry planning and investment in a restructured industry context including the role of energy spot and derivative markets
- CLO4 : Apply basic models of electricity markets to simple restructured electricity industry problems involving operation and investment
- CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which electricity industry planning, economics and investment is defined and undertaken.

Assessment Length

Assessed over the 10 weeks of the course

Final Examination

Assessment Overview

This will be a 2-hour closed-book written examination comprising four compulsory questions. The questions test your knowledge of the materials and assess the skills that you gained over the course.

Course Learning Outcomes

- CLO1 : Explain the fundamental objectives, constraints and concepts of electricity industry planning, economics and investment
- CLO2 : Apply basic conventional 'optimal generation mix' planning techniques to simple electricity industry investment problems
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- CLO4 : Apply basic models of electricity markets to simple restructured electricity industry problems involving operation and investment
- CLO5 : Recognise how electricity industry restructuring, technology development and environmental concerns are changing the way in which electricity industry planning, economics and investment is defined and undertaken.
- CLO6 : Describe the opportunities and challenges that emerging distributed energy resources pose for future electricity industry planning, economics and investment

Hurdle rules

Note that adequate performance in the exam is required to pass the course.

General Assessment Information

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 20 May - 26 May	Activity	Moodle quizes
Week 1 : 27 May - 2 June	Presentation	Introduction to electricity industry restructuring and planning and economics, data and tools
Week 2 : 3 June - 9 June	Online Activity	Decision making in planning and investment Centralised and decentralized decision making frameworks - techniques for integrated resource planning and price setting Information on group projects and possible topics
Week 3 : 10 June - 16 June	Presentation	Market prices and financial instruments - their role in the electricity industry for investment. Assignment 1 released
Week 4 : 17 June - 23 June	Presentation	Australia's restructured electricity industry, National Electricity Market design, performance. Group project topics finalized
Week 5 : 24 June - 30 June	Presentation	Network economics, planning and investment. Assignment 1 due
Week 6 : 1 July - 7 July	Group Work	Flexibility week Project Consultations and revision. Assignment 2 release
Week 7 : 8 July - 14 July	Presentation	Renewables investment
Week 8 : 15 July - 21 July	Presentation	Distributed energy resources. Assignment 2 due.
Week 9 : 22 July - 28 July	Presentation	Possible electricity industry futures
Week 10 : 29 July - 4 August	Seminar	Group project seminars
Week 11 : 5 August - 11 August	Other	Exam guidance and consultations
Week 12 : 12 August - 18 August	Other	

Attendance Requirements

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

General Schedule Information

As a post-graduate offering, the course consists of 4 hours of lectures and workshops each week from weeks 1 to 9. The last week of term will involve student seminar presentations. There are no formal tutorials or laboratories. However, there may be workshop like sessions within some of the lecture slots. Consultation periods prior to the submission of assignments will be offered - further details will be provided over the term. The provisional syllabus of these weekly lectures is outlined below. Lectures will be in-person and simultaneously in MS Teams, running over two hours on Wednesdays and Thursdayss. Note that there maybe several occasions where the lectures will be run at different times or only online. These changed times will be advised via Moodle. All the lectures will be recorded.

The indicative lecture schedule is as follows (noting that this may change over the term)

WEEK ON-LINE LECTURES Class tasks 1 Introduction to the electricity industry and electricity industry restructuring. Introduction to key data sources, data tools, modelling and analysis tools Student surveys and quiz tasks. 2 Decision making in planning and investment Centralised and decentralized decision making frameworks - techniques for integrated resource planning and

price setting Quiz tasks [out] Information on group projects and possible topics 3 Market prices and financial instruments - their role in the electricity industry for investment. Quiz tasks [out] Assignment 1 4 Australia's restructured electricity industry, National Electricity Market design, performance Quiz tasks Group project topics finalized 5 Network economics, planning and investment Quiz tasks [in] Assignment 1 6 Flexibility week Project Consultations and revision [out] Assignment 2 7 Renewable energy economics and investment Quiz tasks 8 Retail Market design and end-user decision making the electricity industry [in] Assignment 2 9 Sustainable energy futures - future challenges and options for the NEM and electricity industries around the world Quiz tasks 10 Student group project presentations - presented in MS Teams Presentation into Moodle before seminars [out] Exam prep. guidance 11 Project group reports finalised at start week 11.

Course Resources

Prescribed Resources

The course Moodle and MS Teams group will be the key source of resources for this course.

Recommended Resources

Textbooks

There is no assigned textbook for this subject. The more recent concepts relevant to electricity industry planning and economics in restructured industries are not easily found in textbooks. The UNSW library has a number of power system planning books dating from the 1960s to 1990s. Some of these have useful descriptions of traditional optimal generation mix techniques. However, they generally have very little to say about planning, economics and investment in restructured industries. There are several more recent books on electricity industry economics and markets including, notably, Stoft, 2002. Unfortunately it is rather US centric, as are most of the other books.

On-line resources

Instead of an assigned text book, regular updates and course materials will be added to the course Moodle website and MS Teams group. You should check both these sits frequently. Materials will include summary pdf versions of the lecture PowerPoints (also provided as printouts prior to each on-line lecture). A range of reports, papers and websites will be uploaded throughout the term to provide more background on electricity industry planning, economics and investment 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

Moodle and MS Teams

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

Announcements concerning course information will be given in the on-line lectures and/or on Moodle and/or via email (which will be sent to your student email address).

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 by email, MS Teams or in-person as apprropriate. You can also use teh formal the Course and Teaching Evaluation and Improvement Process. 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		TETB Rm 316	+612 9385 4920	By prior arrangement via email or MS Teams	No	Yes

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