School of Electrical Engineering and Telecommunications

Term 2, 2019
Course Outline

ELEC9714
Electricity Industry Planning and Economics

COURSE STAFF

The primary course coordinator and lecturer is:

Dr Iain MacGill
Joint Director (Engineering), Centre for Energy and Environmental Markets (CEEM)
Associate Professor, School of Electrical Engineering and Telecommunications.
Room TETB316 (Tyree Energy Technology Building), i.macgill@unsw.edu.au

Providing joint coordination support, and a number of lectures will be:

Dr Navid Haghdadi
Postdoctoral Research Associate, Centre for Energy and Environmental Markets
School of Electrical Engineering and Telecommunications
Level 3, Tyree Energy Technology Building, n.haghdadi@unsw.edu.au

Several guest lectures will also be arranged with research and industry experts during the term.

Consultations: You are, of course, encouraged to ask questions on the course material during the lectures. There will be a number of discussion forums on the course Moodle for questions regarding logistics, lecture materials and assessment tasks. Please always check these first to see if your questions has already been asked and answered, and post your questions here if you think they are relevant to other students. Please note that Iain and Navid are unlikely to be available for consultations without an appointment first being made by email to Dr MacGill. Scheduled consultation times for the assignments and projects will be advised during lectures, and on the course Moodle. Note that ALL email enquiries must be made from your student email address with ELEC9714 mentioned in the subject line. We will not reply to emails that do not meet these requirements.

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.

COURSE SUMMARY

Contact Hours

This is a 6 UoC course and the expected workload is around 15 hours per week throughout the 10 week term. As noted below, most of this time must be self-directed learning. As a post-graduate offering, the course consists of 4 hours of lectures each week from weeks 1 to 8. The last two weeks of term will involve student seminar presentations in the same room. There are no tutorials or laboratories. However, there may be tutorial like sessions within some of the Thursday 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. Note also that there will be some scheduled consultations for the assignments, and group project discussions. Details will be made available in the lectures and on Moodle.

Lectures	Day	Time	Location
	Monday	4-6pm (weeks 1,3-11)	Webster Theatre B (K-G15-290)
	Thursday	9-11am (weeks 1-10)	Mathews Theatre B (K-D23-203)

Context and Aims

The purpose of this course is to introduce students to the main issues involved in electricity industry planning and economics – that is, decision making approaches and methods to meet longer-term industry objectives. This will be considered in the context of both traditional monopoly utility run power systems, and the restructured market-based industries now becoming more common worldwide. Furthermore, it will also explore the challenges and opportunities that renewables and distributed energy resources bring to these issues.

Indicative Lecture Schedule

WEEK	LECTURE	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	Public holiday Monday – Thursday recorded materials on decision making in planning and investment	Quiz tasks [out] Information on group projects and possible topics
3	Centralised and decentralized decision making frameworks – techniques for integrated resource planning and price setting	Quiz tasks [out] Assignment 1
4	Market prices and financial instruments – their role in the electricity industry for investment.	Quiz tasks Group project topics finalized
5	Australia's restructured electricity industry, National Electricity Market design, performance	Quiz tasks [in] Assignment 1 [out] Assignment 2
6	Network Services and investment	Quiz tasks
7	Renewable energy economics and investment	Quiz tasks [in] Assignment 2
8	Retail Market design and end-user decision making the electricity industry	Project group discussions with course coordinators
9	Sustainable energy futures – future challenges and options for the NEM and electricity industries around the world	Quiz tasks
10	Student group project presentations	Presentation into Moodle before class [out] Exam prep. guidance
11	Course overview and exam discussion makeup lecture for the loss of one lecture due to week 2 holiday	Project group wikis finalized and reports due week 11

Assessment

Assessment activity	Assessment (%)
Group project reports on an agreed topic	15
Group student wikis, project pitch on their report topics	5
Individual student participation in surveys, forums, wikis, quizzes	10
Individual student assignments during the term	20
Final exam (2 hours)	50

COURSE DETAILS

Credits

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10-week term.

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. 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..

Learning outcomes

After successful completion of this course, you should be able to:

1. Understand the fundamental objectives, constraints and concepts of electricity industry planning, economics and investment.
2. apply basic conventional ‘optimal generation mix’ planning techniques to simple electricity industry investment problems
3. describe the implementation of electricity industry planning and investment in a restructured industry context including the role of energy spot and derivative markets
4. apply basic models of electricity markets to simple restructured electricity industry problems involving operation and investment.
5. appreciate 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
6. describe the opportunities and challenges that emerging distributed energy resources pose for future electricity industry planning, economics and investment.

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in ***Appendix A***. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate attributes (listed in ***Appendix B***). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in ***Appendix C***.

Syllabus

The nature of the electricity and gas industries; climate change and the electricity industry; objectives & options for restructuring; insights from electricity pricing theory; wholesale electricity market design; Australia's restructured electricity industry; National Electricity Market design & performance; the role of electricity networks in a restructured electricity industry including market representation, network pricing and network regulation; ancillary services; design & implementation of retail electricity markets; electricity industry regulation.

TEACHING STRATEGIES

Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
- Tutorial style components in some of the lectures which allow for exercises in problem solving;
- Small periodic quizzes to test your understanding, and your views on key issues
- Several video lectures

Learning in this course

You are expected to attend lectures in order to maximise learning. In addition to the lecture notes, you should read relevant sections of any recommended texts and other materials. 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.

Lectures will make extensive use of PowerPoint slides and white board work. Summary PowerPoint printouts will be provided on the course Moodle website. Additional information and reading materials will also be progressively made available on Moodle, but they are no substitute for accurate notes, and active student participation through questions and informal exercises during the lectures. It is also intended that you will be provided with access to a number of on-line data sources for the Australian National Electricity Market.

ASSESSMENT >

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Assessment will consist of a group report on an agreed topic related to material covered in the course; a group wiki and project pitch to the class, various class participation activities, class assignments taken individually and the final exam. Satisfactory performance in both the class based assessment and examination is required to pass this course.

Assignments

The assignments allow self-directed study leading to the solution of partly structured problems. Marks will be assigned according to how completely and correctly the problems have been addressed and the understanding of the course material demonstrated by the report.

These assignments must be undertaken by students individually. It is expected that there will be two such assignments during the semester. Provisional dates for assignment distribution and submission are provided in the course syllabus.

Project report and wiki

The project will involve students in an activity suited to their interests and skills in the area of electricity industry planning, economics and investment. Groups of four students are very strongly preferred, although smaller groups may also be permitted if and as appropriate – groups and topics must be approved by the course coordinators. In particular, students undertaking a fourth year engineering thesis or post-graduate research thesis should not choose an elec9714 project topic that closely relates to their other thesis research. Similarly, students are strongly encouraged not to choose a project that closely relates to any other projects that they have undertaken – for example, in elec9715 or other electricity industry related courses.

The intent of these group elec9714 projects is to expose you to electricity industry planning and economics issues other than those you might already have already worked on, or are currently working on. Note also that the large student numbers this year will make smaller groups than 4 students particularly challenging to manage.

Projects will either focus on

- development and testing of a simple software, spreadsheet or Matlab power system modelling and optimisation tool, or
- an in-depth literature survey of some aspect of electricity industry planning, economics and investment (around 5000 words plus tables, diagrams, references etc.).

More information on these projects and suitable topics will be distributed in week 2 and project topics are to be negotiated and finalised by week 5. Details on the formal requirements for the project reports will also be provided at this time. It should contain a significant review of the literature relevant to the topic and a comprehensive bibliography. All source material must be adequately referenced in the body of the report and it is expected that there will be 25 or more scholarly references in a literature survey. It is also required that the project will include some analysis of actual electricity industry economic and/or market data. The report will be assessed on the quality of the content and presentation.

Given student numbers, we will be using group wikis this year. Each group is required to establish a wiki on Moodle and use this to communicate their project work and findings with other students taking the course. It is envisaged that you will post early discussions regarding your topic and host a question forum where other students can come and ask questions or provide comments. You will also need to prepare a slide pack and are invited to undertake additional communication activities such as brief videos. You will also have a chance to do a six to seven minute short seminar of your project in week 10. A computer and projector for PowerPoint presentations will be available for this and you will also be able to run the presentation from your own laptop if that is preferred. All students are required to attend this session and provide a peer mark for each group.

Assessment of the wikis will be based on the quality and comprehensiveness of the materials and discussion with other students in the course, with extra marks for innovative communication strategies. Each student will receive an individual mark according to the quality and extent of engagement in other student group projects through the wikis, as well as other on-line activities over the semester.

More details will be provided on the projects and wikis during the lectures, and on Moodle. *For all of the non-exam assessment tasks in this course, it is essential that you have a complete understanding of the UNSW official position on 'In-class assessment and plagiarism' as outlined below. Please note that there are severe penalties associated with plagiarism offences.*

Final Exam

The exam in this course is a standard closed-book 2 hour written examination, comprising four compulsory questions. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material. Questions may be drawn from any aspect of the course unless specifically indicated otherwise by the lecturer.

Relationship of Assessment Methods to Learning Outcomes *(example below)*

	Learning outcomes					
Assessment	**1**	**2**	**3**	**4**	**5**	**6**
Assignments	✓	✓	✓	✓	✓	
Group project and seminar	✓		✓	✓	✓	✓
Mid-semester exam	✓	✓	✓	✓	✓	
Final exam	✓	✓	✓	✓	✓	✓

COURSE 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 several 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. You should check this site frequently. Materials will include summary pdf versions of the lecture PowerPoints (also provided as printouts prior to each lecture). A range of reports, papers and websites will be uploaded throughout the semester 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 Centre for 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

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

Mailing list

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

OTHER MATTERS *<essential>*

Dates to note

Important Dates available at: https://student.unsw.edu.au/dates

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/guide), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

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.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the "fit to sit/submit" rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see https://student.unsw.edu.au/special-consideration.

Continual Course Improvement

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 online student survey myExperience. 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 continue to evaluate and modify our delivery and assessment methods.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:
https://student.unsw.edu.au/guide
https://www.engineering.unsw.edu.au/electrical-engineering/resources

APPENDICES

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed 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.

Appendix B: 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.
- 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 tutorials.
- 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.

Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

	Program Intended Learning Outcomes	
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	✓
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	✓
	PE1.3 In-depth understanding of specialist bodies of knowledge	✓
	PE1.4 Discernment of knowledge development and research directions	✓
	PE1.5 Knowledge of engineering design practice	✓
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice	✓
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	✓
	PE2.2 Fluent application of engineering techniques, tools and resources	✓
	PE2.3 Application of systematic engineering synthesis and design processes	✓
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects	✓
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	
	PE3.2 Effective oral and written communication (professional and lay domains)	✓
	PE3.3 Creative, innovative and pro-active demeanour	✓
	PE3.4 Professional use and management of information	✓
	PE3.5 Orderly management of self, and professional conduct	
	PE3.6 Effective team membership and team leadership	✓