

ELEC9781

Special Topics in Electrical Engineering 1

Term 3, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Dr Chaojie Li	chaojie.li@unsw.edu.au	MS Teams Friday 2:00pm-5:00pm	G17 Room 301	041098443 0

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](#)

[Engineering Student Support Services](#)

[Engineering Industrial Training](#)

[UNSW Study Abroad and Exchange](#) (for inbound students)

[UNSW Future Students](#)

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)

Email

[Engineering Student Support Services](#) – current student enquiries

- e.g. enrolment, progression, 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

Course Details

Units of Credit 6

Summary of the Course

This is an elective course at the graduate level, covering some special or advanced topics in electrical engineering of particular interests or needs at the time. The course content varies with the changing topics.

Course Aims

The course aims to expose students to some selected topics of special interest such as new emerging areas of technological advances or industry practices in the field of electrical engineering.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Model the integration of energy storage system into power system.	PE1.1, PE1.5, PE2.1, PE3.2
2. Explain the concept of convex optimisation and its modelling approach	PE1.1, PE1.2, PE2.1, PE3.2, PE3.3
3. Perform time series prediction of renewable energy.	PE1.1, PE1.6, PE2.2
4. Calculate the optimal operation of battery in a power system.	PE1.1, PE1.5, PE2.1, PE2.3
5. Determine the optimal planning of EV charging station.	PE1.1, PE1.3, PE2.3

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.

Teaching Strategies

The teaching in this course aims at establishing an advanced understanding of the areas covered. The course delivery is primarily built on the formal lectures, some lectures involve student participation by giving them topics to research and present.

Additional Course Information

Relationship to Other Courses

The course is a postgraduate course with a special topic of energy storage systems offered to students following a ME (ELEC) course at UNSW. The course gives the introduction for integration of energy storage systems and renewable energy resources into power system network; the course would normally be taken concurrently with thesis work in the energy systems area.

Pre-requisites and Assumed Knowledge

This is one of the special topic courses for Master of Engineering Science and Master of Engineering programs in Electrical Engineering where two industry guest lectures will be delivered. It is assumed that the students have good computer literacy, i.e., MATLAB and mathematical skills.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Essay A and B	40%	Not Applicable	1, 2, 3, 4
2. Quiz	20%	Not Applicable	1, 2, 3, 4, 5
3. Midterm Exam	15%	Not Applicable	1, 2, 3
4. Final Exam	25%	Not Applicable	1, 2, 3, 5

Assessment 1: Essay A and B

Assessment length: 2500

Essay A is required to have a comprehensive literature review on energy storage systems technology. It should be but is not limited to:

1. The background of the energy storage system.
2. The state-of-art of research on energy storage system technology.
3. The future vision of energy storage systems toward net-zero emission by 2050.
4. The conclusion of the literature review.

Essay B is required to design a home PV system with a battery for improving renewable energy usage. The following questions should be answered but not limited to:

1. The background of the home battery system.
2. How to predict that renewable energy will be generated by the home PV system?
3. Given the size of the PV system in a house, what's the optimal size of the battery?
4. What is the likely payback period on this solar system plus the battery?

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

Assessment criteria

The marking criteria for essay A are as below.

- understanding/knowledge of the concept - 10 marks
- completion of the literature review - 15 marks

- report submission (2500 words) - 5 marks

TOTAL: 30 marks that will be scaled to 15% towards the course.

The marking criteria for essay B are as below.

- understanding the engineering practice - 5 marks

- completion of the Project Design - 20 marks

- report submission (2500 words)- 5 marks

TOTAL: 30 marks that will be scaled to 25% towards the course.

Additional details

Essay A will start from 16/09/2022 12:00 AM and is due by 16/10/2022 11:59 PM.

Essay B will start from 22/10/2022 12:00 AM and is due by 26/11/2022 11:59 PM.

Assessment 2: Quiz

There will be four online quizzes on various topics contributing to 10% towards the course. These quizzes will be via Moodle. The quizzes will aid in understanding the material. The quizzes should be submitted online before Sunday 8:00 pm of the allocated weeks. Detailed course material and all lecture videos are available in Teams. To ensure that you use the materials effectively, a mark of 5% is allocated to the progress bar monitor in Teams. Additionally, to apply the concepts learned in the course to the energy storage system, you are encouraged to complete Essay B with a system design, which is worth 25%. Your attendance and engagement during these lectures. You will have to attend 8 out of the 10 sessions to get a total of $8 \times 5 = 40$ marks, which will be scaled to 5% contribution towards the course.

Assessment 3: Midterm Exam

Start date: 28/10/2022 03:00 PM

The mid-term examination tests your general understanding of the course material and is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any course material up to the end of week 4 (topics include up to AI technique-based operation of energy storage system). Marks will be assigned according to the correctness of the responses. The test will be online via Moodle STACK questionnaire, held during Week 7 Friday 15:00-17:00 pm.

Assessment 4: Final Exam

The final exam in this course will cover the aspects of the course from week 5. Note that the material previous to week 5 cannot be completely ignored, although there may not be specific questions from those topics that are already covered in the mid-term exam. Thorough knowledge of these topics is

essential to answer the exam questions. The exam format will be announced closer to the time. The examination tests analytical and critical thinking and a general understanding of the course material in a controlled fashion.

The date of the final exam will be notified in the future according to the requirement of the school.

Attendance Requirements

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

Course Schedule

[View class timetable](#)

Timetable

Date	Type	Content
Week 1: 12 September - 16 September	Lecture	Introduction to Energy Storage Technology : 1. Energy storage technology 2.The role of energy storage system in power system
Week 2: 19 September - 23 September	Homework	Quiz
	Lecture	Solving optimization problems of energy storage system operation 1. Convex optimisation 2. Matlab for solving optimization problems in operation of energy storage system
Week 3: 26 September - 30 September	Lecture	AI techniques for energy storage operation 1. Python Programming for time series prediction 2. Forecasting technique for coordinating renewables with battery
Week 4: 3 October - 7 October	Tutorial	Convex optimisation technique for the battery operation
	Lecture	Energy storage management system 1. Charging methodologies 1. SoC estimation techniques

	Homework	Quiz
Week 5: 10 October - 14 October	Lecture	Energy storage operation 1. Energy storage system for FCAS market 2. Autobidder
Week 6: 17 October - 21 October	Lecture	1. Smart home battery system design : Machine learning technique for optimal operation of energy storage system 2. Industry Guest Lecture (Energy storage system in the Australian power grid)
	Homework	Quiz
	Tutorial	Time series analysis
Week 7: 24 October - 28 October	Lecture	Planning of energy storage systems to renewable energy 1. Sizing and localising issues of energy storage system in distribution network 2. Case study----the three-phase rebalance problem
	Tutorial	Midterm revision (online only) Consultation Thu 19:30-21:00 pm
	Assessment	Mid-exam on Friday 18:00pm-20:00pm
Week 8: 31 October - 4 November	Homework	Quiz
	Lecture	Mobile energy storage in the electrification of transportations 1. Land-Marine-Space vehicle electrification 2. Charging/discharging management
Week 9: 7 November - 11 November	Lecture	Charging station planning for EV in urban area 1. The planning approach and solution of EV charging station

		2.Case study---EV charging infrastructure planning in Sydney
Week 10: 14 November - 18 November	Tutorial	Final exam revision
	Lecture	Industry Guest Lecture : National Electricity Market Operation and Community battery design

Resources

Prescribed Resources

[1] M., Sterner and I. Stadler (Eds.). (2019). *Handbook of energy storage: Demand, technologies, integration*. Springer.

Recommended Resources

[2] Asian Development Bank, Handbook on Battery Energy Storage System, 2018.

[3] M. Hannan, S. Wali, P. Ker, M. Abd Rahman, M. Mansor, V. Ramachandramurthy, K. Muttaqi, T. Mahlia, Z. Dong,
Battery energy storage system: A review of technologies, optimization objectives, constraints, approaches, and outstanding issues, *Journal of Energy Storage*, Volume 42, 2021, 103023.

[4] C. Li, Z. Dong, G. Chen, B. Zhou, J. Zhang and X. Yu, "Data-Driven Planning of Electric Vehicle Charging Infrastructure: A Case Study of Sydney, Australia," in *IEEE Transactions on Smart Grid*, vol. 12, no. 4, pp. 3289-3304, July 2021, doi: 10.1109/TSG.2021.3054763.

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 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 have continued to evaluate and modify our delivery and assessment methods.

Academic Honesty and Plagiarism

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>.

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.

Academic Information

COVID19 - Important Health Related Notice

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by [NSW health](#) or government authorities. Current alerts and a list of hotspots can be found [here](#). **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the [Nucleus: Student Hub](#). If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for [special consideration](#) through the [Special Consideration portal](#). To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this [form](#).

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the [Safe Return to Campus](#) guide for students for more information on safe practices.

Dates to note

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

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see <https://student.unsw.edu.au/policy>), 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 formal classes and *independent, self-directed study*. In periods where you 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.

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>.

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>

Disclaimer

This Course Outline sets out 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 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 (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Synergies in Sound 2016

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in 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	