School of Electrical Engineering & Telecommunications

UNSW Engineering

ELEC3111

Distributed Energy Generation

Term 3, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Chaojie Li	Chaojie.li@unsw.edu.au	Friday 2:00pm-4:00pm	Room 301, Electrical Engineering Building (G17)	0410984430

Lecturers

Name	Email	Availability	Location	Phone
Yuchen Zhang	yuchen.zhang@unsw.edu.au	Friday 2:00pm-4:00pm	Room 301, Electrical Engineering Building (G17)	

Tutors

Name	Email	Availability	Location	Phone
Minyang Wang	minyang.wang@unsw.edu.au	Monday 2:00pm-4:00pm	Room 301,Electrical Engineering Building (G17)	0431305643

Lab Staff

Name	Email	Availability	Location	Phone
Chai Hua	hua.chai@unsw.edu.au		Electrical Engineering Building (G17)	

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

Distributed energy generation is developing into a significant market in the generation, distribution and utilisation of electrical energy. It includes local fossil fuel-derived energy sources, for example, co-generation from LNG, renewable energy sources, such as wind and hydro, and low-carbon hybrid energy systems that combine energy sources from more than one energy source, whether renewable or fossil-fuelled. This course will equip you with the fundamental technical and economic processes and drivers at play in the electrical power industry.

Issues that will be covered include the basics of distribution network modelling, the different types of distributed energy sources utilised (Co-generation/CHP, wind, hydro, photovoltaics) and who they are integrated onto the electrical grid, the impact of the integration of such sources on the fundamental operation of the distribution and transmission networks, and how distributed generation is impacting on the development and operation of market frameworks.

The material will be presented by a team of leading researchers in each of the cognate areas.

Course Aims

Distributed energy generation is developing into a significant market in the generation, distribution and utilisation of electrical energy. It includes local fossil-fuel derived energy sources, for example, co-generation from LNG, renewable energy sources, such as wind and hydro, and low-carbon hybrid energy systems that combine energy sources from more than one energy source, whether renewable or fossil-fuelled. This course will equip you with the fundamental technical and economic processes and drivers at play in the electrical power industry.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Identify emerging challenges in modern electricity distribution networks resulting from distributed energy sources and compare with traditional distribution systems.	PE1.1, PE1.3, PE1.5
2. Review and summarise Australian standards and grid codes for distributed energy sources	PE1.1, PE1.6
3. Explain the operation principles of photovoltaics, wind, and energy storage systems.	PE1.1, PE1.2, PE1.5, PE2.3
4. Explain the operation of a power electronics inverter and its interface to an electrical network.	PE1.3, PE1.4, PE1.5
5. Formulate phasor diagrams to analyse the impacts of distributed energy sources on the operation of electricity	PE1.3, PE1.5, PE2.1, PE2.2, PE2.3

Learning Outcome	EA Stage 1 Competencies
distribution networks.	
6. Explain how microgrid manages distributed energy sources within an electricity distribution system.	PE1.1, PE1.3, PE1.5, PE2.2, PE2.3, PE3.2
7. Apply appropriate mathematical models of distributed energy sources to analyse microgrid operation problems.	PE2.1, PE2.2, PE2.3, PE2.4, PE3.3

Teaching Strategies

The course will be taught using face-to-face lectures with web supported delivery. Tutorial sheets will be used for formative assessment of student abilities. The course content will be delivered by experts in their fields. This is viewed as offering the best method of learning for the material presented. Suggested and recommended texts will be provided to support student learning outcomes. Summative examinations will be used as a component of assessment.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Lab reports	20%	Not Applicable	1, 3, 4, 5, 6, 7
2. Assignments	30%	Not Applicable	1, 3, 4, 5, 6, 7
3. Final exam	50%	Not Applicable	1, 2, 3, 4, 5, 6, 7

Assessment 1: Lab reports

1. Week 07: Modelling of distributed solar PV generation

2. Week 08 Modelling of distributed wind generation

3. Week 09 Modelling of battery storage system

4. Week 10 Lab oral exam

Additional details

1. The student shall actively engage in the lab experiment, complete the task enthusiastically, and initiate critical thinking to overcome various challenges.

2. The report should be based on the student's lab experiment activities or measurement records.

3. Unless with a valid reason (such as a medical certificate) late submission will be penalized by 20% for each day late for up to a maximum 60%. Late submission after the 3rd day will not be accepted.

Assessment 2: Assignments

1. Assignment 01: Load Modelling

2.Assignment 02: Equivalent Circuit

3.Assignment 03: Equivalent Circuit and Distributed Generation Impact

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

Assessment 3: Final exam

The final exam will be required to cover all lecture materials and the date of the final exam will be announced by the University.

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 modern electric power distribution systems
Week 2: 19 September - 23 September	Lecture	Overview of distributed generation technologies and applications
Week 3: 26 September - 30 September	Lecture	Modelling and analysis power distribution systems
	Tutorial	
Week 4: 3 October - 7 October	Lecture	Active network and system integration of variable generation
	Tutorial	
Week 5: 10 October - 14 October	Lecture	Modelling and analysis of distributed solar PV generation
	Laboratory	Self-paced lab induction (No attendance required)
	Tutorial	
Week 6: 17 October - 21 October	Tutorial	
	Topic	Flexibility week
Week 7: 24 October - 28 October	Lecture	Energy storage technologies, integration and applications
	Laboratory	Modelling of distributed solar PV generation
	Tutorial	
Week 8: 31 October - 4 November	Lecture	Modelling and analysis of distributed wind generation
	Tutorial	
	Laboratory	Modelling of distributed wind generation
Week 9: 7 November - 11 November	Lecture	Design concepts of microgrids
	Tutorial	

	Laboratory	Modelling of battery storage system
Week 10: 14 November - 18 November	Lecture	Big data analytics in electric power distribution systems
	Tutorial	
	Laboratory	Community Microgrid with multiple distributed generations

Resources

Prescribed Resources

Textbooks

Reference books: The following textbooks are recommended reading:

- Ned Mohan, Tore M. Undeland, William P. Robbins, ‘Power Electronics: Converters, Applications, and Design’, Wiley, 3rd Edition, 2002.
- Turan Gönen, ‘Electric Power Distribution Engineering’, 3rd Edition, CRC Press, 2014.
- William H. Kersting, ‘Distribution System Modelling and Analysis’, 4th Edition, CRC Press, 2017.

On-line resources

As a part of the teaching component, the online teaching and learning management system known as Moodle will be used to disseminate teaching materials, host forums and quizzes. As the course progresses, students’ marks from assessments such as labs and the quizzes are available for personal viewing on this website:

https://moodle.telt.unsw.edu.au/login/index.php.

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	