School of Electrical Engineering & Telecommunications

UNSW Engineering

ELEC9713

Industrial and Commercial Power Systems

Term 1, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Daming Zhang	daming.zhang@unsw.edu.au	Thursday 5pm-8pm; Monday 4pm-5pm.	EET, G17, Room317	02-93854070

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

The aim of the course is to provide practical knowledge on the design and operation of electrical distribution systems in large commercial buildings or industrial sites. Topics covered include: regulatory aspects; switchboards, cabling systems; transformers and switchgear; earthing systems; electrical safety issues including personnel protection and fire protection; protection of electrical systems (including both overcurrent and surge protection) and condition monitoring; lightning protection; electrical lighting systems; communication systems in buildings; emergency systems; energy efficiency and energy management; power quality and effects of voltage and current harmonics; power frequency magnetic fields and their impact in building and industrial sites.

Course Aims

The course aims to provide the student with the fundamentals of electrical power distribution systems: their design, construction, maintenance and operation. In particular, it provides practical and essential knowledge for designing the electrical distribution infrastructure in large commercial buildings or industrial sites. Particular emphasis is on compliance with current practices and regulations within Australia. The course also touches on some aspects of utilisation.

The course coverage will include the following aspects of commercial and industrial electrical systems: regulatory aspects; switchboard design and operation; (HV and LV) cabling systems; distribution transformers and switchgear; earthing; electrical safety issues including personnel protection and fire protection; fault calculation; protection of electrical systems including both over-current and surge protection; lightning protection; electrical lighting systems; industrial heating; energy efficiency and energy management; power factor correction; power quality and the effects of voltage and current harmonics; communication systems in buildings; power frequency magnetic fields and their impact in building and industrial sites. Equipment operation will also be covered, together with condition monitoring aspects of major plant.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Calculation of maximum power demand by a new building	PE1.1, PE3.1
2. Understand switchboard selection and design for a specific applications	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4
3. Understand selection of cable sizes with the consideration of current rating, and voltage drop under different operating conditions, such as different ambient temperature and different bundling etc.	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4

Learning Outcome	EA Stage 1 Competencies
4. Understand and explain selection of distributed transformers	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4
5. Calculate fault current for a three-phase symmetrical fault	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4
6. Understand and explain over current protection for power distribution circuits	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4
7. Understand and explain earthing or grounding system study	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4
8. Understand and explain lightning protection system study	PE1.2, PE1.3, PE1.4, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4, PE3.2
9. Understand and explain power quality and reactive power compensations issues.	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4

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;

Tutorials, which allow for exercises in problem solving and allow time for you to resolve problems in understanding of lecture material.

Learning in this course

You are expected to attend all lectures, tutorials, and mid-term exams in order to maximise learning. In addition to the lecture notes, you should read relevant sections of the recommended text. Reading additional texts 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 face-to-face classes throughout the course.

Tutorial classes

You should attempt all of your problem sheet questions in advance of attending the tutorial classes. The importance of adequate preparation prior to each tutorial cannot be overemphasized, as the effectiveness and usefulness of the tutorial depends to a large extent on this preparation. Group learning is encouraged. Answers for these questions will be discussed during the tutorial class.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Switch Board Selection	5%	16/04/2023 11:58 PM	1, 2, 3, 4, 5, 6, 7, 8, 9
2. Lightning protection	15%	16/04/2023 11:59 PM	1, 2, 3, 4, 5, 6, 7, 8, 9
3. Mid-Term Exam	20%	30/03/2023 07:45 PM	1, 2, 3, 4
4. Final Examination	60%	To be specified.	1, 5, 6, 7, 9

Assessment 1: Switch Board Selection

Start date: 31/03/2023 09:00 AM
Due date: 16/04/2023 11:58 PM

Study on switch board; selection of a switch board for a specific application according to the requirement on insulation, ingress protection, compartmentalization.

This is not a Turnitin assignment

Assessment 2: Lightning protection

Start date: 31/03/2023 09:00 AM
Due date: 16/04/2023 11:59 PM

Design a lightning protection system for a building. The dimensions of the building are given. The students are required to use roll of sphere method and/or other methods to design a lightning protection system with the consideration of the safety of the building and personnel inside the building.

Assessment 3: Mid-Term Exam

Start date: 30/03/2023 05:00 PM
Due date: 30/03/2023 07:45 PM

Mid-term examination will cover the contents taught to one week before the mid-term examination.

Assessment 4: Final Examination

Start date: To be specified.
Due date: To be specified.

Final Examination

Attendance Requirements

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

Course Schedule

View class timetable

Timetable

Date	Type	Content
O-Week: 6 February - 10 February		
Week 1: 13 February - 17 February	Lecture	Overview
Week 2: 20 February - 24 February	Lecture	Cable sizing
Week 3: 27 February - 3 March	Blended	Cable sizing + tutorial 1
Week 4: 6 March - 10 March	Lecture	Distribution transformers
Week 5: 13 March - 17 March	Blended	Fault analysis + tutorial 2
Week 6: 20 March - 24 March	Lecture	Fault analysis & Overcurrent protection
Week 7: 27 March - 31 March	Blended	Overcurrent protection + tutorial 3 (Mid-term examination is in this week)
	Assessment	Mid-Term Exam
Week 8: 3 April - 7 April	Blended	Earthing or grounding system study and design + tutorial 4
Week 9: 10 April - 14 April	Blended	Earthing or grounding system study and design + tutorial 5
Week 10: 17 April - 21 April	Blended	Power quality and reactive power compensation + tutorial 6

Resources

Prescribed Resources

On-line resources

Moodle

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

Recommended Resources

Reference

1. AS/NZS 3000:2007 Wiring Rules
2. AS/NZS 3017:2007 Electrical installations – Verification guidelines
3. AS/NZS 3019:2007 Electrical installations – Periodic verification
4. AS/NZS 4836:2001 Safe working on low-voltage electrical installations
5. AS/NZS 3018:2001 Electrical installations – Domestic installations
6. AS3439.1-2002 Low Voltage Switchgear and Controlgear Assemblies – Part 1: Type-tested and partially type-tested assemblies
7. AS/NZS 3439.2:2002 - Particular requirements for busbar trunking systems (busways)
8. AS/NZS 3439.3:2002 - Particular requirements for low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access for their use - Distribution boards (IEC 60439-3:1990, MOD)
9. AS 2067-2008 - Substations and high voltage installations exceeding 1 kV a.c.
10. AS/NZS 3008.1.1:1998 Electrical Installations - Selection of Cables Part 1.1: Cables for alternating voltages up to and including 0.6/1 kV – Typical Australian installation conditions
11. AS/NZS 5000.1:1999 Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1 kV
12. AS/NZS 3198:1996 Approval and test specification - Electric cables - XLPE insulated - For working voltages up to and including 0.6/1 kV (superseded)
13. AS/NZS 1429.1:2000 Electric cables - Polymeric insulated - For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV
14. BS 7671: 2008, IET Wiring Regulations
15. AS60076.1-2005: Power transformers – General
16. AS2374.7-1997: Power transformers - Loading guide for oil-immersed power transformers
17. AS2374.8-2000: Power transformers - Application guide
18. AS60076.11-2006: Power transformers - Dry-type transformers
19. AS3953-1996: Loading guide for dry-type power transformers
20. AS60044.2-2003: Instrument transformers - Voltage transformers
21. AS/NZS 60479.1:2002 : Effects of current on human beings and livestock - General aspects; and AS/NZS 60479.2:2002 : Special aspects.
22. IEEE-Standard.#80-1986, Guide for Safety in Substation Grounding
23. IEEE Green Book John Wiley(1986).
24. IEEE Standard #141: Recommended Practice for Electric Power Distribution for Industrial Plants. (IEEE Red Book). IEEE/Wiley (1986).
25. IEEE Standard #242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems. (IEEE Buff Book). IEEE/Wiley (1986).

26. AS/NZS 1768:2007 Lightning Protection.

Course Evaluation and Development

Students can raise their questions during lectures and tutorials, which are addressed immediately;

Students can send their questions through emails to the lecturer which will be handled in a timely manner;

Students can apply for online meetings via Teams which will be accommodated;

Face-to-face meetings can also be arranged to address students' doubts and questions on the course materials.

Laboratory Workshop Information

N.A.

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. **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.unsw.edu.au/engineering/our-schools/electrical-engineering-telecommunications/student-life/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	