School of Electrical Engineering and Telecommunications

Semester 1, 2018
Course Outline

ELEC9713
Industrial and Commercial Power System

COURSE STAFF

Course Convener: Dr. ZHANG Daming, Room 650/651, E10, daming.zhang@unsw.edu.au
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Consultations: You are encouraged to ask questions on the course material, after the lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during lectures. ALL email enquiries should be made from your student email address with ELEC9713 in the subject line.

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

The course consists of 3 hours of lectures each week.

Lectures	Day	Time	Location
ELEC9713	Tuesday	6pm – 9pm	Law Th G04

Context and Aims

In the current state of the art in the supply of electrical energy, there is an increasing need to make the overall electrical systems in residential building, large commercial buildings and in industrial sites etc -

- more energy efficient, with better energy management;
- safer in all aspects (including personnel safety, fire and equipment safety);
- of adequate power quality with regard to harmonics and over-voltages;
- able to accommodate modern information technology systems;
- being compliant with the new EMC and EMI regulations for electrical systems;
- providing monitoring systems to assess the condition of the electrical installation.

This course aims to address these issues. To fulfil this purpose, the following contents are arranged: overview on power supply to end users, mainly including industry plants and residential buildings; switchboard selection and design for a specific applications; 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; study on and selection of distribution transformers; Fault current calculation for three-phase symmetrical fault; overcurrent protection for power distribution circuits; earthing or grounding system study; lightning protection system study; power quality and reactive power compensations issues etc.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Overview
Week 2	Overview & Switchboard
Week 3	Switchboard & Cable sizing + **Tutorial 1**
Week 4	Cable sizing
Week 5	Distribution transformers
	Recess week
Week 6	Fault analysis +**Tutorial 2**
Week 7	Fault analysis & Overcurrent protection
Week 8	**Mid-Semester Exam**
Week 9	Overcurrent protection + **Tutorial 3**
Week 10	Earthing or grounding system study and design +**Tutorial 4**
Week 11	Earthing or grounding system study and design
Week 12	Lightning protection system & Power quality and reactive power compensation + **Tutorial 5**
Week 13	Revision + **Tutorial 6**

Assessment

Mid-Semester Exam	25%
Assignment	15%
Final Exam (2 hours)	60%

Course Details

Credits

This is a 6 UoC course.

Relationship to Other Courses

This is a postgraduate course in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed Knowledge

It is essential that you are familiar with basic electrical power engineering knowledge before this course is attempted.

Following Courses

N.A.

Learning outcomes

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

1. Calculation of maximum power demand by a new building;
2. switchboard selection and design for a specific applications;
3. 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;
4. knowledge on selection of distributed transformers;

5. fault current calculation for three-phase symmetrical fault;
6. overcurrent protection for power distribution circuits;
7. earthing or grounding system study;
8. lightning protection system study;
9. power quality and reactive power compensations issues etc.

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 capabilities (listed in ***Appendix B***). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in ***Appendix C***.

Syllabus

Course Content	Hours
1. Overview and calculation of maximum power demand by a new building	5
2. Switchboard	3
3. Cable sizing	5
4. Distribution transformers	4
5. Fault analysis	5
6. Overcurrent protection	5
7. Earthing or grounding system study and design	4
8. Lightning protection system	2
9. Power quality and reactive power compensation	3
Total	36

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-semester 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

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through the mid-semester exam.

Mid-Semester Exam

The mid-session examination is arranged in week 8 during lecture hour. You will be grouped into two groups. Details on which group you are in will be sent to you after the collation of the attendance list. It 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 6. It will definitely contain numerical and analytical questions. Marks will be assigned according to the correctness of the responses.

Assignment

The assignment allows 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.

The assignment report will be due midnight of Friday in week 10. Late reports will attract a penalty of 10% per day. Submission should be via Moodle.

Details on the assignment are distributed separately. Each of you will be notified.

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 in a controlled fashion. Questions may be drawn from any aspect of the course (including laboratory), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses.

Course 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.

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.

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

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 http://www.lc.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://my.unsw.edu.au/student/atoz/ABC.html), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **ten to twelve 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 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 should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**,

not to course or school staff. For more detail, consult https://my.unsw.edu.au/student/atoz/SpecialConsideration.html.

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 myExperience process. 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.

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:

http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures

https://my.unsw.edu.au/student/atoz/ABC.html

APPENDICES

Appendix A: 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.

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. 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 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	✓