

ELEC9713

Industrial and Commercial Power Systems



UNSW

THE UNIVERSITY OF NEW SOUTH WALES

School of Electrical Engineering
and Telecommunications

COURSE OUTLINES - Session 1, 2009

1. Course Staff

Course convener: Dr. Toan Phung, room EE107, toan.phung@unsw.edu.au

2. Course Details

Credits: This is a 6 UoC course; expected workload is 10-12 hours per week throughout the 12 week session.

Contact hours: The course consists of 2.5 hours of lectures per week, and 1 hour of tutorials per fortnight:

Lectures:	Mondays,	18-21,	room ChemSc M14
Tutorials:	Mondays,	20-21,	room ChemSc M14

Consultations: Students are encouraged to use the open consultation hour (Mon-Fri 2-3pm) rather than contact by email. Students may seek consultation with the course convener at other times by appointment.

3. Course Information

Context: Power Engineering is concerned with the generation, transmission, distribution and utilization of electrical energy. Low-voltage distribution systems and their components form an important part which required specific considerations in their design and operation to provide high reliability (minimum power interruption), quality (in terms of voltage regulation) and safety (of personnel and equipment). Distribution networks can spread over a very large area and handled by a power utility or on a smaller scale within a customer's installation (buildings, industrial plants).

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; (HC 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.

Relation to other courses: This is one of the specialisation courses for a Master degree in Engineering Science (Energy Systems) at the University of New South Wales. Some of the topics covered in this course are expanded in more details in a post-graduate course ELEC9712, High Voltage Systems.

Assumed knowledge: It is assumed that the students have completed all the core courses required in the first 3 years of a BEE degree, and in particular the ELEC3105 (Electrical Energy) course.

Old courses: The course replaces a previous course ELEC9226 (Electrical Services in Buildings).

4. Learning outcomes

After the successful completion of the course, the student will be able to:

- Have detailed knowledge in designing the electrical distribution systems at up to 11kV.
- Understand the relevant standards, rules and regulations.
- Apply appropriate measures to evaluate and improve energy efficiency.
- Apply appropriate diagnostic techniques to monitor conditions of the equipment in the installation.

The course delivery methods and course content address a number of core UNSW *graduate attributes*; these include:

- Development of in-depth knowledge and understanding in the discipline.
- Development of analytical and critical thinking, which is addressed by the tutorial exercises and class tests.
- Information literacy - the skills to appropriately locate, evaluate and use relevant information.
- The ability to engage in independent and reflective learning (via project assignment).
- Development of effective communication (oral presentation and written report).
- Team and collaborative working skills (via group project assignment).

Please refer to <http://www.ltu.unsw.edu.au/content/userDocs/GradAttrEng.pdf> for more information about graduate attributes.

5. Teaching strategies

The course consists of the following elements: lectures, home work, and tutorials:

Lectures:

Students are expected to attend the lectures and prepare themselves for them. The lectures provide the students with a focus on the core material in the course. Generic features and functions of various components required in a typical low voltage distribution network are explained. This is further explored with practical case studies and consideration to regulatory requirements and

Australia Standards. Mathematical tools and computer-aided analysis are then used to convey a qualitative understanding of critical issues affecting the safe and reliable operation of the distribution system. The basic principles covering the testing and condition monitoring of distribution equipment are presented and then illustrated by examining a wide array of diagnostic devices that are currently being used in the industry.

Tutorials:

The tutorial sessions provide personal assistance to students in solving problems. A total of 5 problem sets will be presented throughout the semester and some of these will be worked through during the tutorials. The tutorials take the student through all critical course topics and aim to exercise the students' analytical and critical thinking skills. Students are strongly encouraged to complete all the tutorial problems as these help to develop in-depth quantitative understanding of the course materials. During tutorials, students will also be invited to raise any concepts or topics covered in lectures with which they are experiencing difficulty and required another explanation. Tutorials are also opportunities for interactive discussion on any questions, issues or topics relevant to the course.

Home work:

The class lectures can only cover the course material to a certain depth; students must down-load the lecture notes (from the course web site) and reflect on its content as preparation for the lectures to fully appreciate the course material. Further research and reading from the recommended list of text/reference books are also required. The ability to read the literature, identify relevant parts and extract critical information with the aid of the lectures is regarded as an essential component of this course. Also, a significant component of home work is preparation for tutorials, and researching on a group project assignment.

6. Assessment details

There are three components of the assessment in this course:

Quizzes:	20% overall weight
Group project assignment:	10% overall weight
Final examination:	70% overall weight

Assessment task due dates are given in the course schedule. Note that there are no marks awarded for tutorial work.

Quizzes: There are two quizzes, each is of one hour duration and closed-book, held during the lecture time through the semester. They are provided in order to get early feedback on student performance. The quizzes test the students general understanding of the course material covered in the previous 4-5 lectures. Assessment is a graded mark according to the correct fraction of answers to the questions.

Assignment: This is a group project whereby each group is to carry out a literature survey or a real-life case study on a topic relevant to this course, and in the end give an oral presentation and submit a detailed written report. The assessment criteria equally address your research and communication skills. The report is due on the due date by 5pm. Late submissions carry a 50% penalty for the first week and will not be accepted beyond one week delay. Delays on medical grounds are accepted. The reports should be dropped into the school assignment box next to room EEG12A.

Final examination: The exam in this course is a standard closed-book 3 hours written examination, covering all aspects of the course that have been presented in the lectures and tutorials. The exam format will be similar to the previous years' examinations. Some questions are of a descriptive nature (e.g. explaining a concept) and the rest are problem-solving. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Assessment is a graded mark according to the correct fraction of answers to the exam questions. A satisfactory performance (50% or greater) in the final exam is a necessary requirement to pass this course, irrespective of the marks obtained in the other components.

7. Course Schedule

Wk 1:	Course overview Topic 1: Overall perspective of LV distribution, Installations, Equipment, Coordination, Regulations, Power supply, Substation, Switchboards.
Wk 2:	Topic 1 (cont.) Topic 2: Cabling systems, capacity, voltage drop, regulation.
Wk 3:	Topic 2 (cont.) Tutorial 1.
Wk 4:	Topic 3: Transformers: oil and dry types, efficiency and protection.
Wk 5:	Topic 4: Fault calculations in industrial systems. Tutorial 2; QUIZ 1
Wk 6:	Topic 5: Overcurrent protection methods, Discrimination.
Wk 7:	Topic 6: Power quality. Tutorial 3.
Wk 8:	Topic 7: Lightning and surge protection. Earthing.
Wk 9:	Topic 8: Lighting systems: illumination levels and efficiency. Tutorial 4.
Wk 10:	Topic 9: Industrial heating. Topic 10: Emergency and communications systems. QUIZ 2
Wk 11:	Topic 11: Equipment testing and requirements, monitoring for condition assessment. Tutorial 5.
Wk 12	Revision. Project oral presentations; Assignment report due (5 June 09).

Note that the above schedule (this version dated 16/2/09) is provisional at this stage and may be updated during the session. Students should attend lectures and regularly check the course website for possible updates.

8. Resources for Students

Textbooks:

There are no prescribed textbooks for the course. A comprehensive set of lecture notes developed by the convener will be made available for download from the course web site.

Reference books:

The following references will each cover parts of the course only. They are listed in no particular order of importance although the ones in **bold** are perhaps those most relevant:

1. Standards Australia, *AS/NZS 3000:2007 Electrical installations* (known as the Australian/New Zealand Wiring Rules)
2. NSW Government, Department of Water and Energy, *Service and Installation Rules of New South Wales: the Electricity Industry Standard of Best Practice for Customer Connection Services and Installations*, 2009.
3. F.S. Prabhakara et al, *Industrial & Commercial Power Systems Handbook*, McGrawHill, 1996.
4. IEEE Gray Book: *Recommended Practice for Electric Power Systems in Commercial Buildings*, IEEE Press/Wiley.
5. E.A. Reeves, *Handbook of Electrical Installations*, Granada.
6. B. Rigby, *Design of Electrical Services for Buildings*, 4th ed., Spon Press, 2005.
7. R.B. Standler, *Protection of Electronic Circuits from Overvoltages*, John Wiley.
8. W. Rudolph, *Safety of Electrical Installations*, VDE Verlag.
9. J.C. Whitaker, *AC Power Systems Handbook*, 2nd ed., CRC Press, 1998.
10. Standards Australia, *AS1768-2007: Lightning Protection*.
11. K. Pethebridge & I. Neeson, *Electrical Wiring Practice*, 6th ed., McGraw-Hill, 2002.
12. J.R. Coaton and A.M. Marsden (Ed), *Lamps and Lighting*, 4th ed., Arnold, 1997.
13. Standards Australia, *AS/NZS1680.1-2006: Interior Lighting*.
14. IEEE Buff Book: *Recommended Practice for Protection and Coordination of Industrial and Commercial Systems*.
15. P. Hasse, *Overvoltage protection of LV systems*, 2nd ed., IEE Press, 2000.
16. T. Davies, *Protection of Industrial Power Systems*, Pergamon Press, 1989.
17. T. Gonen, *Electric Power Distribution System Engineering*, McGraw-Hill, 1986.
18. P. Gill, *Electrical Power Equipment Maintenance and Testing*, Dekker, 1998.
19. E.W.G. Bungay and D. McAllister, *Electric Cables Handbook*, BSP Professional, 1990.
20. M.J. Heathcote, *The J & P Transformer Book: a Practical Technology of the Power Transformer*, 12th ed., Newnes, 1998.

On-line resources:

The web site for this course is: <https://subjects.ee.unsw.edu.au/elec9713/>. It contains lecture notes, tutorials, laboratory materials, past ELEC9226 exam papers, as well as other relevant information and announcements about this course.

9. 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 serious offence by the University and severe penalties may apply. For more information about plagiarism, please refer to <http://www.lc.unsw.edu.au/plagiarism>.

All submitted reports and assignments must have an attached cover-sheet that declares that the work detailed in the report/assignment is entirely that of the named student(s) only. The form is available from the EE&T School web site.

Continual Course Improvement

Students are advised that the course is under constant revision in order to improve the learning outcomes of its students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process.

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 policies, see <http://scoff.ee.unsw.edu.au/>
