School of Electrical Engineering and Telecommunications

Semester 2, 2018
Course Outline

ELEC9716
Electrical Safety

COURSE STAFF

Course Convener: Dr. Jayashri Ravishankar, Room #546, Hilmer Building (E10)
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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. You are encouraged to use Moodle discussion forums to post your questions. Active participation in the online discussion forum is expected to provide peer-to-peer support. If an email enquiry becomes necessary, it should be made from your student email address with ELEC9716 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.

COURSE SUMMARY

Contact Hours

The course consists of 3 hours of lectures each week. The course has many assessments based on team activities and there are marks assigned for individual contributions in a team. The teams will be formed on the first day of the lecture.

Lectures	Day	Time	Location
	Thursday	6-9 pm	NS Global theatre (G14)
			TETB G16, G17

Context and Aims

Electrical accidents to personnel and electrically initiated fires cause a considerable loss to industry and the community every year, ranging from death and permanent debilitating injury to property damage amounting to many millions of dollars. The causes of such accidents and fires range from carelessness and/or ignorance, through to unforeseen mal operation of equipment or appliances.

The continual growth of the chemical and petro-chemical engineering industries in recent years implies a corresponding increase in the number of industrial complexes involving hazards from flammable gases, vapours and mists which can produce explosive mixtures with air. At the same time the amount of electrical equipment required on such sites is increasing, so that appropriate steps must be taken to provide the protection against the possibility of gas ignition.

Explosions can cause huge loss of life and plant. In addition to the large disasters which create international news, there are numerous smaller explosions and fires such as those in small paint spraying areas, dry-cleaning premises and the like which can also cause serious injury and/or substantial loss. In many cases the hazards occur in areas frequented by the public, for example petrol service stations. In all of these situations electricity is used.

The importance of this expanding area of technology has been emphasized by a number of IEE international conferences over the years. Despite the increasing importance of electrical safety in hazardous atmospheres it was reported at one of these conferences that there is still a shortage of professional engineers with appreciable knowledge of the subject and that some of the fundamentals of hazardous atmosphere electrical safety had never even been heard of by many factory works engineers.

The course aims to enable students to identify hazards to people and equipment that are present in the electrical environment of a power supply utility, commercial or domestic installation, together with the design principles and working procedures that are implemented to minimise the risk of electrical accidents and fires. The legal processes that can arise as a result of electrical accidents and fires are also discussed.

The course also aims to develop competencies for practice and ability to act and display initiative via thorough analysis of explosion hazards and the various methods of overcoming these hazards.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	General principals of electric safety; Electricity & Human body;
Week 2	Tutorial 1; Earthing;
Week 3	Tutorial 2; Safety against OV, ELV, RV; Safe practices;
Week 4	Mining VR simulation;
Week 5	Mining VR simulation;
Week 6	Hazardous areas, Electrical fires, arc flash; Tutorial 3;
Week 7	OH power line safety, Insulators; Tutorial 4; MCQ due
Week 8	Electrical safety in hospitals; Tutorial 5; Safety issues with emerging energy sources
Week 9	Mid-session test
Break	
Week 10	Industry lectures; VR simulation report due
Week 11	Case study presentation;
Week 12	Case study presentation;
Week 13	Case study presentation; Team evaluation due

Assessment

VR Simulation report	20%
Case study presentation	20%
Team evaluation	5%
Mid-session assessment	20%
Final Exam (2 hours)	35%

COURSE DETAILS

Credits

This is a 6 UoC course and the expected workload is 10–12 hours per week throughout the 13 week semester.

Relationship to Other Courses

This is a postgraduate course in the School of Electrical Engineering and Telecommunications. It is a specialization course in the Energy Systems stream of the postgraduate study.

Pre-requisites and Assumed Knowledge

The assumed knowledge for this course is fundamental concepts of electrical power engineering. Students of other specialisation CANNOT manage this course, without any background in electrical engineering. The subject material is very descriptive and a significant proportion of the assessment (including the assignment) is of a descriptive nature. If your written English is poor, you will need a lot more time to manage the written work in course.

Learning outcomes

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

1. Identify the presence of electrical hazards;
2. Employ investigative techniques for determining the cause of electrical accidents, fires and explosions;
3. Analyse electrical hazards and provide solutions to minimise risks;
4. Communicate electrical safety information in a formal engineering report / presentation / group discussion providing independent conclusions;
5. Gain familiarity with the industry procedures on electrical safety;
6. Gain awareness on electrical safety laws nationally and internationally.

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

This course covers the very broad and important area of electrical safety in domestic and industrial installations. Topic areas include, the effects of electric current passing through the human body; lightning hazards; protection of personnel: earthing and double insulation; protection of personnel: residual current detectors; effects of electric and magnetic fields and electromagnetic radiation; electrosurgical hazards; electrical fires and their investigation; electrical safety and the law including the Australian electricity safety act; electrical safety in hazardous atmospheres: area classification; gas grouping; temperature classification; electrical equipment in hazardous areas; safety issues with emerging energy sources; electrical safety in medical environment; risk assessment procedure.

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;
- In-class discussions, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
- Face-to-face mentoring sessions that will promote group work and enhance deeper learning of the concepts;
- Video recording of lectures from industries enumerating different case studies;

- Gaming activities that will involve hazard identification and solution;
- Virtual Reality (VR) simulation of underground mining environment;
- Moodle reading game for thorough understanding of the course material;

Learning in this course

You are expected to attend all lectures, tutorials, labs, and mid-semester exams in order to maximise learning. In addition to the lecture notes/video, you should read relevant sections of the recommended text. Reading additional texts will further enhance your learning experience. The course strongly supports group learning via various team activities. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the semester.

VR simulation report (Due Friday Week 10, 12 noon)

VR simulation of underground mining environment should be undertaken on Weeks 4 and 5. Please note that it is part of the assessment and no alternative dates are available, even if you have any special circumstances. This is an Advanced Visualisation and Interaction Environment (AVIE) that casts 360-degree 3D images of mining environment and provides several electrical related safety hazards and procedures. The students work together to travel around the mine environment and spot the safety hazards, work through the risk assessment questions and rectify the hazard. The related assessment has two parts, as below.

I. Report (15%): This is a group report that must include the following:
    1. Introduction of mining environment and importance of electrical safety in confined spaces. Any links to YouTube videos will fetch maximum mark (5%),
    2. Related work in this area (minimum three references) – references need to be cited in relevant places and listed as per IEEE or Harvard referencing system – highlight key learning points from the references (3%),
    3. Details of the safety hazards involved (as seen in the VR simulation – you may choose one scenario) and suggestions for improving electrical safety highlighting all the three measures, namely engineering, administration and personal protection (7%).
    4. Approximately 10 pages.
    5. The report submission is online through Moodle as a pdf file. The file name should be team id.pdf.

II. Report Turnitin check (5%): Plagiarism is considered a form of academic misconduct, and the University has set very strict rules with severe penalties including course failure. You can check your report using the Turnitin facility in Moodle before actual submission. The similarity index should be well below 15% to be considered acceptable. Note that Turnitin may take up to 2 days to get the similarity result, so be early. You will not be given special consideration for not undertaking the Turnitin check. In case it is greater than 15%, it will result in zero marks for the entire report assessment.

The above mark applies to the team only, which will be individualised based on each of your contribution. More information will be available in the course website. If you are not able to attend the VR simulation, your mark for this assessment will be zero. Please note that there are two submissions of the same report in Moodle!

Case study presentation (Weeks 11-13)

This is a team activity. Each team will present a case study on one of the following topics related to safety:

1. Earthing
2. Lightning
3. Arc flash
4. OH / UG cable
5. Medical locations
6. Wind energy
7. Solar energy
8. LV batteries
9. DC safety
10. Marine environment

The presentation should have the following slides (strictly 5 slides only):

1) Explanation of the incident and identify issue
2) Related law/standards
3) Offer solution – engineering
4) Offer solution – administrative & PPE
5) Make a story line (similar to the gaming activities in the course) – either a drawing, mind map, block diagram, etc. Details should include the explanation of the case study scenario and what the hazards are. This will be discussed further before the break.

Each topic above will be addressed by two groups. The presentations are scheduled in Weeks 11-13. The schedule will be made available in the Moodle closer to the time. This will be marked by the course coordinator and/or external industry assessors. The above mark applies to the team only, which will be individualised based on each of your contribution. The power point presentation should be uploaded in the Moodle on or before 10 Oct 2018.

Team evaluation

As part of EA stage 1 competencies, a self-evaluation and peer evaluation should be completed respectively before Week 3 and Week 13. Each will correspond to 2.5%, contributing to a total of 5% towards the course. These will be setup in Moodle.

Mid-session assessments

This has two parts:

1) Mid-session test (10%) **(Week 9)**

This is an online exam comprising of short answers on all the concepts covered until week 8.

2) Industry lectures (10%) **(Week 10)**

This is an in-class activity. The course has five videos from various industry guests. The jigsaw cooperative learning strategy will be applied. Note that if you are absent for this in-class activity your marks will be zero for this activity.

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 VR simulation and industry videos), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses. ***Please note that you must pass the final exam to pass the course.***

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes					
Assessment	**1**	**2**	**3**	**4**	**5**	**6**
VR simulation report	✓	✓	✓	✓	✓	✓
Case study assessment	✓	✓	✓	✓	✓	✓
Individual ongoing assessments	-	✓	✓	-	✓	✓
Final exam	-	✓	✓	✓	✓	✓

COURSE RESOURCES

Textbooks

Course material compiled by the course coordinator is available online in Moodle. The lecture slides will be made available in Moodle as well, with links to numerous online videos.

Reference books

- Massimo A.G. Mitolo, “Electrical Safety of Low-Voltage Systems”, Mc Graw Hill, 2009.
- John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, "Electrical Safety Handbook", 3rd edition, McGraw-Hill, 2006.
- J. Maxwell Adams, “ELECTRICAL SAFETY - a guide to the causes and prevention of electrical hazards”, The Institution of Electrical Engineers, 1994.
- W. Fordham Cooper, "Electrical Safety Engineering", second edition, Butterworth & Co., 1986.
- D.C. Winburn, "Practical Electrical Safety", Marcel Dekker Inc., 1988.
- Handbook of International Electrical Safety Practices, Princeton energy Resources International, 2010, Scrivener Publishing, USA.

On-line resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials, host forums and occasionally quizzes. 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

Dates to note

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

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.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/guide), 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 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://student.unsw.edu.au/special-consideration.

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 online student survey 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.

Several formative assessments have been included to ensure a continuous learning culture.

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

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 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	✓