School of Electrical Engineering and Telecommunications

Term 2, 2019
Course Outline

ELEC9716
Electrical Safety

COURSE STAFF

Course Convener: Dr. Jayashri Ravishankar, Room 122 (G17), jayashri.ravishankar@unsw.edu.au

Course Mentors: Basil Ahmad basil.ahmad@student.unsw.edu.au
Xinyu Liang xinyu.liang@student.unsw.edu.au
Qiaowan Luo qiaowan.luo@student.unsw.edu.au
Arijit Sharma arijit.sharma@student.unsw.edu.au
Minyuan Yang minyuan.yang@student.unsw.edu.au

Consultations: You are encouraged to ask questions on the course material, via Moodle discussion forums and group mentors. Active participation in the online discussion forum is expected to provide peer-to-peer support. For any questions that remain unresolved via the above means, you are encouraged to contact the lecturer after the lecture class times in the first instance, rather than via email. 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
	Friday	6-9 pm	TETB G16, G17

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	Earthing;
Week 3	Risk assessment by Dr Skinner;
Week 4	Virtual Reality (VR) simulation 1 and 2;
Week 5	VR simulation 3 and 4; VR Quiz 1 & 2 due;
Week 6	VR simulation 5; VR Quiz 2 & 3 due;
Week 7	Safety against OV, ELV, RV; Safe practices; Hazardous areas; VR Quiz 5 due;
Week 8	Arc flash; Electrical safety in hospitals & emerging energy sources;
Week 9	Case study presentation; VR Report due;
Week 10	Case study presentation;

Assessment

VR assessment	25%
VR report	20%
Case Study Presentation	20%
Final Exam (2 hours)	35%

Must pass the final exam to pass the course.

COURSE DETAILS

Credits

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10-week term.

Relationship to Other Courses

This is a postgraduate course in the School of Electrical Engineering and Telecommunications. It is an advanced disciplinary elective 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. Being an elective course in energy systems, the course requires a broad understanding of electrical machine theory and power system operation. The subject material is very descriptive and a significant proportion of the assessment 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:

- Flipped mode delivery, which promotes pre-learning and active discussions in the class;
- 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;
- Tutorials, which allow for exercises in problem solving and allow time for you to resolve problems in understanding of lecture material;
- Face-to-face mentoring sessions, that will promote group work and enhance deeper learning of the concepts;
- Virtual Reality (VR) simulations, which allow a 360 degree interactive tour of various scenarios;
- Moodle reading game, which promotes a thorough understanding of the course material;

Learning in this course

You are expected to attend all lectures, tutorials, and VR sessions 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. 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 and the tutor will cover the more complex questions in the tutorial class. In addition, during the tutorial class, 1-2 new questions that are not in your notes may be provided by the tutor, for you to try in class. These questions and solutions may not be made available on the web, so it is worthwhile for you to attend your tutorial classes to gain maximum benefit from this course.

Virtual Reality Simulation

The VR schedule is deliberately designed to provide practical, 360 degree exposure to the concepts conveyed in course. **You are required to attend at least 80% of these sessions**. Attendance WILL be kept, and you MUST attend them to receive grades.

ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the VR simulation sessions, Quizzes and Case Study presentations.

VR Assessment

Virtual reality (VR) simulation of five different scenarios is available in Moodle. They cast 360-degree 3D images and provide several electrical related safety hazards and procedures. The students work together in groups, ably guided by the mentors, to identify the safety hazards, work through the risk assessment questions and provide solutions for rectifying the hazards.

After completing each scenario, your work will be assessed by the mentors. Assessment marks will be awarded according to your preparation, how much of the simulation you were able to complete, your understanding of the scenarios, and your understanding of the topic covered by the simulation.

Each simulation carries 3% making a total of 15% towards the course.

To check that you have achieved the practical learning outcomes for the course via the VR simulations, you will be required to complete the related MCQ Quiz via Moodle, which are due the week after the simulation on Monday 5 pm.

Each quiz carries 2% making a total of 10% towards the course.

VR Simulation Report

This is a group report. Each group may select one VR simulation and make a report which comes in three parts, as below.

I. Report (15%): This is a group report that must include the following:
   1. Brief description of the scenario. Any additional 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) 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. Your individual participation will be monitored by your mentors according to which the group mark will be scaled individually. 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! Only one report per group should be uploaded.

The report will be due on Monday Week 9, 5 pm. *Late reports will attract a penalty of 10% per day* (including weekends).

Case Study Presentation (Weeks 9-10)

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. OH lines
4. UG cables
5. Wind energy
6. Solar energy / battery
7. Medical locations
8. Mining safety
9. Marine environment
10. Arc flash / other PPE

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 VR scenarios) – either a drawing, mind map, block diagram, etc.

Each topic above will be addressed by two groups. The presentations are scheduled in Weeks 9-10. 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 Week 9, Thursday 5 pm.

Final Exam

The exam in this course is a standard closed-book 2 hour written examination. 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. ***Please note that you must pass the final exam in order to pass the course.***

Relationship of Assessment Methods to Learning Outcomes

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

COURSE RESOURCES

Textbooks

Textbooks

Course material compiled by the course coordinator is available online in Moodle via the Moodle book App. The lecture slides and lecture videos 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 **15 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 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.

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.
- 360 degree virtual reality simulations have been added to the course this year.
- More systematic team activities have been added.

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 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	✓