School of Electrical Engineering and Telecommunications

Semester 2, 2018
Course Outline

ELEC/ENGG9744
Nuclear Safety, Security and Safeguards

Course Staff

Course Convener:	Dr Edward Obbard, Room 638 (Hilmer Building) e.obbard@unsw.edu.au
Lecturers:	(UNSW) Dr Edward Obbard; (ASNO) Dr Kalman Robertson; (ANSTO) Mr Jarrod Powell, Mr Mark Summerfield.
Location/Times:	Fully online

Consultations

You are encouraged to ask questions on the course material, through the learning platform and the arranged forum discussions in the first instance, rather than via email. ALL email enquiries should be made from your student email address with ENGG9744 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 will be delivered online, with weekly installments and corresponding exercises posted to the learning platform.

Context and Aims

This course is aimed at future leaders and managers of organisations that use nuclear technology and nuclear materials as part of their operations. It is aimed at achieving an advanced level of understanding of the regulatory challenges that face senior professionals in the nuclear industry, as well as those in other safety-critical or highly regulated industries which share similar challenges.

These challenges are summarised as nuclear safety, nuclear security and nuclear safeguards. As such the course is wide in scope, but the common thread through all of this is that safety, security and safeguards are connected by their similarities in terms of the assessment and mitigation of threat and in the application of detailed conceptual and legal frameworks to ensure that these occur.

Students will learn from professionals at the Australian Nuclear Science and Technology Organisation (ANSTO) and from the Australian Safeguards and Non-proliferation Office (ASNO) both how specific nuclear materials and safety- or security-critical systems are regulated in the organisational, national and international context.

The course emphasises both knowledge and application. The assessments include presenting and critiquing safety cases and threat assessments, applying the tools for engineering safety assessments, and planning and communication for a nuclear accident case study. All of these skills will be applicable in a wide range of contexts.

Indicative content schedule

WEEK	Material delivered	Relevant Assignment
Week 1 **23 July-**	Nuclear Safeguards	Safeguards online assignments
Week 2	Materials Accounting	
Week 3		
Week 4	Nuclear safety fundamentals	Safety Case (30%)
Week 5	Safety analysis methodologies	
Week 6		
Week 7		
Week 8	Nuclear licensing	
Week 9	Safety cases due **18 September** Safety cases feedback due **20 September**	
Teaching Recess **24 September**		
Week 10 **2 October-**	Nuclear Security	Threat assessment (10%)
Week 11	Threat Assessments due **12 October**	
Week 12	Incident management & Communication Strategies	Emergency planning and response (10%)
Week 13 **22 October-**	Incidents plans/responses **due 22 October** Incident feedback **22 - 25 October**	

Assessment

Coursework Assignments	50%
Peer review and participation	10%
Final Exam (2 hours)	40%

Course Details

Credits

This is a 6 UoC course and the expected workload is 12 hours per week.

Relationship to Other Courses

This is a postgraduate course convened by the School of Electrical Engineering and Telecommunications. It is a core class on the MEngSci Nuclear Engineering specialization and can be taken as an elective by 3rd or 4th year students from other schools and faculties on the approval of home school and the ENGG9744 course convener.

Pre-requisites and Assumed Knowledge

A pre-requisite for this course is ENGG9741 Introduction to Nuclear Engineering, or equivalent education and professional experience.

Following Courses

None.

Learning outcomes

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

1. Present, critique and defend a safety case for a nuclear (or other safety-critical) activity
2. Formulate threat assessments and specify physical protection measures
3. Prepare operational plans and response for a nuclear safety incident

To achieve these outcomes, the course will teach you to

4. Name the organisations, regulations and standards that influence the operation of nuclear facilities
5. Explain how the operators of nuclear facilities mitigate nuclear proliferation risks
6. Apply nuclear design principles and safety analysis methodologies
7. Assess consequences of radiological contamination

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**. The course provides several competency areas of the IAEA International Nuclear Management Academy guidelines for a masters in Management of Nuclear Technology. These are listed in **Appendix D.**

Syllabus

Learning Outcome	Syllabus
1	Nuclear safety principles and analysis; Nuclear licensing, licensing basis and regulatory processes; Transport of nuclear goods and materials
2	Nuclear security
3	Nuclear incident management, emergency planning and response; Communication strategies for leaders in nuclear
4	International nuclear organizations; National nuclear technology policy, planning and politics; Nuclear standards; Nuclear law
5	Nuclear safeguards; Export controls
6	Nuclear power plant and other facility design principles; Nuclear power plant/facility operational systems
7	Radiological safety and protection

Guest Lecturers

Kalman A Robertson

Kalman A Robertson, PhD is a safeguards officer in the IAEA Safeguards Section of the Australian Safeguards and Non-Proliferation Office (ASNO) in the Department of Foreign Affairs and Trade. ASNO is the regulatory authority responsible for nuclear safeguards and nuclear security in Australia, as well as coordinating collaboration with the IAEA on safeguards technology development. Mr Robertson was previously engaged by the International Capacity-Building Support Office of the Integrated Support Center for Nuclear Nonproliferation and Nuclear Security of the Japan Atomic Energy Agency, where he worked as a researcher and instructor in the fields of nuclear safeguards and nuclear security. In 2015-2016, he was a Stanton Nuclear Security Postdoctoral Fellow in the Project on Managing the Atom

and the International Security Program at the Belfer Center for Science and International Affairs of Harvard University. He holds a PhD in International, Political, and Strategic Studies from the ANU, where he also received the University Medal for Physics and First Class Honours in Law.

Mark Summerfield

Mr Summerfield is the Leader, Technical Support Group within ANSTO's Nuclear Operations division with responsibility for licensing and regulation specific to the OPAL reactor. He is also responsible for QA and configuration management, training, IT support and environmental management. He is Chair of the Reactor Assessment Committee (the equivalent of the internal reactor safety committee) and sits on the ANSTO Safety Assurance Committee (SAC) that overseas all safety across the whole of ANSTO.

Mr Summerfield has a BSc (Hons) degree in Nuclear Engineering from the University of Manchester. After near 19 years in the UK and European nuclear power industry, principally as a Systems Safety Engineer, he emigrated to Australia in 1998 to join ANSTO to work on the OPAL reactor project. Here he has played a major role in design and implementation and now management of all regulatory aspects of its highly successful and world-renowned operational performance.

Jarrod Powell

Mr Powell has a BA (Hons) from UNSW majoring in in Politics & International Relations and a BSc majoring in Psychology. He works as an Advisor in Government and International Affairs in the Nuclear Security, Government and International Affairs division of the Australian Nuclear Science and Technology Organisation (ANSTO). In this role he manages both government and international affairs for Australia's primary federal nuclear agency and coordinates its interactions with all levels of government. From September 2018 he assumes the role of Counsellor Nuclear at the Australian Embassy in Vienna, providing expert support to the Australian Permanent Mission to the International Atomic Energy Agency (IAEA).

Teaching Strategies

Delivery Mode

Fully online. This course is UNSW digital uplift content, which is taught online through the learning platform.

Learning in this course

You are expected to view all the learning materials, and attempt all exercises, 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 the mandated exercises on the learning platform.

Online exercises

Learning materials and graded assessments will be paced throughout the duration of the course. The group of students will complete the course together and at the same pace. Therefore it is essential that you effectively manage your time in this course to view the material and complete the assignments on time. Some assignments are peer reviewed by the course learning community, and thus it is doubly important to stay up to date with work to avoid impacting your fellow students.

Assignments

The assignments allow self-directed study leading to the solution of partly structured problems, essays and presentations. Marks will be assigned according to how completely and correctly the assignments have been addressed, and the understanding of the course material demonstrated by the report. All the assignments contribute to a structured, cumulative coursework project that enables students to demonstrate their learning and integrates the many aspects of the very diverse course material.

The three most advanced learning outcomes (1-3) each correspond to an online, multimedia assignment that is marked both by student peers and by the course directors. The reason for this peer review is to teach the essential function of a safety/security case for licensing - which is for it to be openly criticised. Therefore to advocate for one's own assessments, as well as giving and receiving objective criticism, are essential skills for all levels of professional in safety-critical industries, and are assessed in this course.

Final Exam

The exam in this course is a standard closed-book 2 hour written examination. 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, unless specifically indicated otherwise. 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.

Course Resources

Textbooks

1. Websites: IAEA, ASNO, ARPANSA, WNA, and others recommended in learning materials.

2. Nuclear Safeguards, Security and Nonproliferation: Achieving Security with Technology and Policy
Author: James Doyle
ISBN 978-0750686730
Year Published 2008
Publisher Heinemann-Butterworth

3. Three Mile Island: A Nuclear Crisis in Historical Perspective
Author: J. Samuel Walker
ISBN 978-0520246836
Year Published 2006

4. Complete guide to the three worst nuclear power plant accidents: Fukushima 2011, Three Mile Island 1979, and Chernobyl 1986 – Authoritative Coverage of Radiation Releases and Effects – Kindle version.

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

Students need to actively manage their workload. It is typically expected that you will spend at least **ten to fifteen hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both online materials 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 attendance on the learning platform is expected. UNSW regulations state that if students attend less than 80% of scheduled classes (or online learning activities) 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 Course and Teaching Evaluation and Improvement 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. To enable this process, all students are requested to complete the course UNSW MyExperience survey, which will be open 8 October - 1 November 2018.

In response to comments about integration of the very diverse course material the coursework assignments have been redesigned for the 2018 course. The construction of a safety case and presentation to a class has always been a fundamental component of learning and assessment in this course. With the digital uplift of the course to an online platform, the safety case presentations have been redesigned to a multimedia presentation exercise. The learning outcomes have been refined and restructured to conform to the more stringent requirements of online course development and the UNSW 3+ academic calendar. The syllabus and the learning outcomes have been aligned with the IAEA International Nuclear Management Academy competency areas for masters' courses in Management of Nuclear Technology. Increasing emphasis has been moved to the interactive assignment exercises, over the previously greater emphasis on a much longer, 3 hour exam.

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

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 interactive checkpoint assignments and exams.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.

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	

Appendix D: IAEA International Nuclear Management Academy (INMA) learning outcomes for masters' level course in Nuclear Technology Management

INMA Competency Area*	**INMA Competency Level**
1.2 International nuclear organizations	**1**
1.3 National nuclear technology policy, planning and politics	**1**
1.4 Nuclear standards	**1**
1.5 Nuclear law	**1**
1.8 Nuclear licensing, licensing basis and regulatory processes	**2**
1.9 Nuclear security	**2**
1.10 Nuclear safeguards	**2**
1.11 Transport of nuclear goods and materials	**1**
2.1 Nuclear power plant and other facility design principles	**1**
2.2 Nuclear power plant/facility operational systems	**1**
2.6 Nuclear safety principles and analysis	**3**
2.7 Radiological safety and protection	**3**
3.13 Nuclear incident management, emergency planning and response	**2**
4.3 Communication strategies for leaders in nuclear	**2**

*Grosbois, J. de, F. Adachi, and H. Hirose. 2017. "International Nuclear Management Academy Master's Programmes in Nuclear Technology Management." IAEA.