



Mechanical and Manufacturing Engineering

# Course Outline

Term 2 2020

**ENGG9744**

## **Nuclear Safety, Security and Safeguards**

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# 1. Staff contact details

## Contact details and consultation times for course convenor

Name: Name: Dr Edward Obbard  
Office location: Room 402G, Ainsworth building (J17)  
Email: [e.obbard@unsw.edu.au](mailto:e.obbard@unsw.edu.au)

Please contact me any time about this course. The MS Team created for this course is preferable to Moodle for informal communication and is much more likely to be answered quickly.

Nominally scheduled tutorial or group work time is Wednesdays 18:00 – 20:00. The course does not require all these weekly 2hr appointments, however it is suggested that we use this time to meet for a weekly check-in, or to schedule longer meetings, as required.

Please post all content related questions and chat in public channels, so that everyone has the benefit of the discussion. I might not reply to private messages asking questions about assignments or course content.

## 2. Important links

- [Moodle](#)
- [Lab Access](#)
- [Health and Safety](#)
- [Computing Facilities](#)
- [Student Resources](#)
- [Course Outlines](#)
- [Engineering Student Support Services Centre](#)
- [Makerspace](#)
- [UNSW Timetable](#)
- [UNSW Handbook](#)
- [UNSW Mechanical and Manufacturing Engineering](#)

## 3. Course details

### Credit points

This is a 6 unit-of-credit (UoC) course and involves up to 2 hours per week (h/w) of scheduled online contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 15 h/w on this course. The additional time should be spent in

making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

### Contact hours

The course will be delivered online, with weekly instalments and corresponding exercises posted to the learning platform.

	Day	Time	Delivery Mode
Lectures	N/A	2 hrs/wk	Moodle Recorded Lectures
Weekly check-in	Wednesday	1800-1830	Teams videoconference
Tutorials, group work, presentations	Wednesdays (as required)	1800-2000	Teams videoconference
Nuclear incident exercise	19 <sup>th</sup> -29 <sup>th</sup> June	As announced.	Instructions by email.

All classes in T2 2020 will be online. Please consult this course's Moodle module for details about delivery.

### Summary and Aims of the course

This is a postgraduate course convened by the School of Mechanical and Manufacturing Engineering. 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.

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 localised nuclear

accident case study. All of these skills will be applicable in a wide range of contexts.

### Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		EA Stage 1 Competencies
1.	Present, critique and defend a safety case for a nuclear (or other safety-critical) activity.	PE1.2, PE1.6, PE2.1, PE2.3, PE2.4, PE3.1, PE3.2, PE3.4, PE3.5
2.	Formulate threat assessments to specify physical protection measures.	PE2.4, PE3.6,
3.	Prepare operational plans and response for a nuclear emergency.	PE3.2, PE3.3
4.	Name the organisations, regulations and standards that influence the operation of nuclear facilities.	PE1.1, PE1.3
5.	Explain how the operators of nuclear facilities mitigate nuclear proliferation risks.	PE1.3
6.	Apply nuclear design principles and safety analysis Methodologies.	PE1.5, PE1.6, PE2.1, PE2.2
7.	Assess consequences of radiological contamination.	PE2.2

This course also provides several competency areas of the IAEA International Nuclear Management Academy (INMA) learning outcomes for masters' level course in Nuclear Technology Management (see Appendix B).

## 4. Teaching strategies

### Delivery Mode

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

## **Teleconferences**

We make use of teleconferences for our online meetings. Some of these are mandatory, such as the safety case presentations. Others are scheduled to promote group discussion and work on group assignments and, while not mandatory, it is strongly recommended that you attend, or that you schedule other appropriate times to meet with your group members. Scheduled teleconferences use MS Teams.

## **Guest Lecturers**

**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. Dr 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.

**Dr. Kath Smith**, at the time of recording her lecture materials with us (2019), was the Senior Advisor in Nuclear Security Sciences in the Security and Safeguards division of ANSTO. In this role she assists in coordinating national security activities and research across ANSTO, and facilitates the relationships between ANSTO and its national and international stakeholders. From 2016 to 2018 (inclusive) she served as Australian Resident Representative to the IAEA at the Australian Embassy in Vienna, Austria. From Dec 1987 to Feb 2008, Kath was Principal Research Scientist and Group Leader in the Institute of Materials Engineering at ANSTO, where she undertook research in radiation damage effects and had oversight of various research groups, including those working in: nuclear forensics, radiation detectors and materials characterisation. From Jan 1984 to Dec 1987, Kath lectured in Applied Physics at the University of Technology Sydney then the New South Wales Institute of Technology) and undertook research in crystallography and mineralogy. Kath has a Doctorate of Philosophy (Physics) and Bachelor of Science (Hons) from Monash University.

**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 oversees 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 immigrated 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.

## 5. Course schedule

<b>WEEK</b>	<b>Material delivered</b>	<b>Relevant Assignment &amp; hand in date(s)</b>
Week 1	Nuclear Safeguards	Safeguards revision questions (Exam assessed)
Week 2	Materials Accounting	
Week 3	Radiation Safety	Emergency scenario (15%) 19th - 29th June staged responses
Week 4	Incident management	
Week 5	Nuclear Security	Threat assessment (15%) Report on 8 <sup>th</sup> July
Week 6	Nuclear safety fundamentals	Safety Case (30%) Check-in 28 <sup>th</sup> July Report on 3 <sup>rd</sup> August Presentations on 5 <sup>th</sup> August
Week 7	The safety case	
Week 8	Safety Assessment	
Week 9	Safety Analysis	
Week 10	Safety Case Presentations	

# 6. Assessment

## Assessment overview

Assessment	Group Project? (# Students per group)	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Emergency Scenario	No	Max. 500 words, 5 min video	15%	3, 6 and 7	Knowledge of radiation protection; appropriate responses; effective communication	Staged submissions 19-29 <sup>th</sup> June	23:59 1 <sup>st</sup> July	Friday 3 <sup>rd</sup> July
Design Basis Threat Assessment	Yes (3?)	n/a (spreadsheet workbook)	15%	2, 4	Threat assessment; screening the threats; translating and modifying threats; document presentation.	8 <sup>th</sup> July	23:59 10 <sup>th</sup> July	Friday 10 <sup>th</sup> July
Safety Case	No	Max 20 pages	30%	1, 4, 6 and 7	Safety case structure and argument, safety assessment, safety analysis, peer review and presentation	Check-in 28 <sup>th</sup> July Report on 3 <sup>rd</sup> Aug. Presentations on 5 <sup>th</sup> August	18:00 5 <sup>th</sup> August	12 <sup>th</sup> August
Final exam	No	2 hours	40%	4, 5, 6, and 7	All course content from weeks 1-10 inclusive.	Exam period, date TBC	N/A	Upon release of final results



## Assignments

The assignments allow self-directed study leading to the solution of partly structured problems, reports 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. The safety case assignment 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 critiqued. Therefore advocating for one's own assessments, as well as giving and receiving objective criticism, are essential skills for all levels of professionalism in safety-critical industries, and are assessed in this course.

### *Presentation*

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

### *Submission*

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

- a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
- b. Online quizzes where answers are released to students on completion, or
- c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
- d. Pass/Fail assessment tasks.

## Marking

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

## Examinations

You must be available for all quizzes, tests and examinations.

Final examinations for each course are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates.

For further information on exams, please see the [Exams](#) webpage.

## Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

**Please note** that UNSW now has a [Fit to Sit / Submit rule](#), which means that if you attempt an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's [Special Consideration page](#).

## 7. Expected resources for students

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

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

3. Ablaze (The Story of the Heroes and Victims of Chernobyl)  
Author: Piers Paul Read

ISBN 978-0679408192  
Publisher Random House

4. Websites: Particularly IAEA documents (provided in the course materials). Also: WNA, ANS, NEI, WINS

UNSW Library website: <https://www.library.unsw.edu.au/>  
Moodle: <https://moodle.telt.unsw.edu.au/login/index.php>

## 8. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include the coursework assignments have been redesigned for the 2020 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.

## 9. Academic honesty and plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: [student.unsw.edu.au/plagiarism](http://student.unsw.edu.au/plagiarism). The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:

[www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf](http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf)

## 10. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and policies. In particular, students should be familiar with the following:

- [Attendance](#)
- [UNSW Email Address](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)
- [Academic Honesty and Plagiarism](#)
- [Equitable Learning Services](#)

# Appendix A: Engineers Australia (EA) Competencies

## Stage 1 Competencies for Professional Engineers

	<b>Program Intended Learning Outcomes</b>
<b>PE1: Knowledge and Skill Base</b>	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
<b>PE2: Engineering Application Ability</b>	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
<b>PE3: Professional and Personal Attributes</b>	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 B: IAEA International Nuclear Management Academy (INMA) Learning Outcomes for Masters' Level Course in Nuclear Technology Management

<b>INMA Competency Area*</b>	<b>INMA Competency Level</b>
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	1
4.3 Communication strategies for leaders in nuclear	1

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