ENGG9744 Nuclear Safety, Security and Safeguards

Course Outline – Semester 2, 2016

Never Stand Still | Faculty of Engineering | School of Electrical Engineering and Telecommunications

Course Staff

Course Convener:	Prof. John Fletcher, Room 131, john.fletcher@unsw.edu.au
Lecturers:	(ANSTO) Dr Jarrod Powell, Mr Mark Summerfield, Mr Sam Batty; (UNSW) Dr Edward Obbard
Location/Times:	Quadrangle G025 (K-E15-G025) Thursdays 18:00 – 21:00

Consultations: You are encouraged to ask questions on the course material, after the lecture class times 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 on Thursday evenings, 6-9pm, in G3 of the Electrical Engineering building. The subject will be supported by tutorial sheets and coursework assignments with staff support from the School of Electrical Engineering and Telecommunications.

Context and Aims

The primary audience for this course is the MEngSci in Nuclear Engineering. Appropriate safety process is a vital aspect of nuclear engineering processes and this course aims to define and detail current nuclear practices. This course will introduce the current state-of-play with regards to nuclear licensing and global policies and their impacts on non-proliferation. It will describe the need for regulatory principles in the nuclear sector and will review international policies, regulations and authorities. Students will learn from practitioners at ANSTO on how a licensed site is operated, the safety culture in place, and risk management strategies in use in all areas of operations.

The course will cover standards and regulatory frameworks, the assessment and management of risk, radiological safety and protection, the overlap between safety, security and safeguards, and will use case studies to demonstrate the principles.

Assessment

Coursework Assignment	30%
Final Exam (3 hours)	70%

Course Details

Credits

This is a 6 UoC course and the expected workload is 10 hours per week.

Relationship to Other Courses

This is a postgraduate course convened by 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. It is essential that you are familiar with basic engineering principles and mathematical skills before this course is attempted. Prior understanding of nuclear fission is useful as is a grounding in chemistry and physics.

Following Courses

None.

Learning outcomes

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

1. Explain the challenges facing safety, security and safeguards professionals and their effective integration.

2. Demonstrate in-depth knowledge of all aspects of current nuclear regulatory frameworks and licensing conditions.

3. Explain the key elements in support of a safe and secure nuclear facility.

4. Conduct threat assessments and apply physical protection measures to mitigate design basis threats.

5. Articulate the merit in developing effective risk management processes and describe their application.

6. Calculate and assess radiological consequences and risks.

7. Calculate the requirements for safe transport of radioactive and toxic materials.

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

1. Laboratory and operational practices at nuclear facilities

2. International standards and national regulatory frameworks, governance and licensing
3. Preventing nuclear terrorism - threat reduction programmes and international initiatives
4. Security risk management, threat assessments and physical protection
5. Nuclear material accountancy and control
6. Radiological Safety and Risk Perception
7. Nuclear safety
8. HAZOPS, systems reliability, safety cases and analysis
9. Safety (probabilistic and deterministic) risk assessment
10. Emergency preparedness and response
11. The overlap between safety security and safeguards
12. Transport of radioactive and toxic materials

Guest Lecturers

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. He is responsible for ANSTO's participation in energy, defence and national security policy issues, and for its international relations with Northeast and South Asia. He is one of two Australian Representatives to the Generation IV International Forum (GIF) Policy Group.

Prior to May 2014 he was seconded to the ANSTO Office of the CEO as a Strategic Business Intelligence Analyst. In this role he was lead researcher, analyst and author for several ANSTO policy submissions to federal government including ANSTO's Energy White Paper submission.

Sam Batty
Mr. Batty has a BEng in Materials Engineering from UNSW. In his current role at ANSTO he works within Nuclear Operations as the Operational Readiness Manager and Client Lead for the first-of-a-kind Synroc Waste Facility that is currently in the design and construction phase. In this role he is responsible for delivering all operational aspects of the facility that will convert the Intermediate Level Liquid Waste generated from radiopharmaceutical production into the "Australian developed" and "world-leading" Synroc wasteform.

He has previously worked within Defence, the Steel Industry and within the Nuclear Science, Technology and Landmark Infrastructure (NSTLI) Group at ANSTO.

During his time in NSTLI he worked primarily within areas that researched the Advanced Nuclear Fuel Cycle, Next Generation Reactor Systems, Advanced Nuclear Wasteforms and Nuclear Security. He primarily held roles pertaining to the management of research facilities associated with nuclear based research and the assurance of appropriate Nuclear Safety, Security and Safeguards. He was also the Facility Officer for a Prescribed Radiation Facility and the Licencing Officer for a total of 11 active facilities and laboratories.

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.

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;
- Online resources via the UNSW moodle site

Learning in this course

You are expected to attend all lectures, and tutorials 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/coursework 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.

Assessment

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

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 into an industry relevant case study. Accompanying the written submission, this is presented in the format of a presentation to a regulatory review panel.

Assignment deadlines will be confirmed during the semester.

Final Exam

The exam in this course is a standard closed-book 3 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 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**	**7**
Assignments	✓	✓		✓	✓	-	-
Final exam	✓	✓	✓	✓	✓	✓	✓

Course Resources

Textbooks

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: WNA, ANS, NEI, WINS

5. 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.

On-line resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials. 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

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 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://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.

In response to comments about integration of the very diverse course material and about providing opportunities for students to demonstrate their learning, the coursework assignment has been redesigned for the 2016 course. By developing, justifying, and applying constructive criticism to a regulatory case to support a variety of nuclear operations students will have the increased opportunity to both integrate and demonstrate their learning in this course.

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	