UNSW Engineering

Education Specification

1. Program Overview

Program Title: Bachelor of Engineering (Honours)

Award Title: Bachelor of Engineering (Honours) (Nuclear Engineering)

Engineering Discipline: Nuclear Engineering

UNSW Bachelor of Engineering (Honours) (Nuclear Engineering) is a four-year, full-time degree delivered by the School of Mechanical and Manufacturing Engineering. The degree is AQF level 8 and provides graduates with advanced knowledge and skills for professional or highly skilled work and/or further learning.

The Nuclear Engineering specialisation covers the analysis, design, operation and maintenance of nuclear systems and instils a nuclear mindset, essential to Australia's growing nuclear sector. Graduates will have a deep technical understanding of the physics within a reactor, radiation interactions with matter, and the cradle-to-grave of nuclear fuel cycles, alongside the essential regulatory, ethical, and risk management frameworks that govern nuclear environments.

2. Career Alignment

Students in the Nuclear Engineering specialisation study a range of nuclear technologies that are in commercial use, in particular the design, maintenance and operation of pressurised water reactors. Students are taught the fundamentals of engineering a nuclear power reactor: radiation physics, nuclear thermohydraulic, behaviour of materials in nuclear environments, the nuclear fuel cycle, control systems, engineering design, nuclear safety management, and the regulatory frameworks that govern these technologies. These technical skills are directly relevant to the global nuclear power industry, the stewardship of ANSTO's nuclear reactor, and stewardship of the AUKUS nuclear powered submarines. They are also relevant for adjacent sectors, such as nuclear medicine production and the emerging fusion energy industry, which require very similar skill sets. Most importantly, students will graduate with a Nuclear Mindset, fast-tracking them to embody the Australian nuclear industry cultural expectations and competencies, as laid out by the federal government's Australian Submarine Agency. The program sets our students up for a multitude of safety critical industry roles.

3. Specialisation Framework

The Specialisation Learning Outcomes (SLOs) for this stream were drafted by the Nuclear Engineering Teaching team. The drafts were developed considering: consultation and feedback from industry partners; alignment with the Nuclear Mindset principles developed by the Australian Submarine

Agency[1] which is shaping Australia's nuclear industry, and expectations of graduate outcomes aligned with EA Stage 1 competencies.

The draft SLOs were reviewed and aligned by Engineering Faculty Education team before being presented to Faculty Education Committee for endorsement.

The SLOs align with the Engineers Australia expectations for a graduate engineer, but are articulated in a Nuclear Engineering context. Reference is made to both Nuclear specific knowledge and skills.

On successful completion of this stream, graduates will be able to:

1. Apply fundamental principles of physics, mathematics, radiation science, materials chemistry, high-performance computing, and artificial intelligence to solve complex problems in nuclear engineering.
2. Analyse the operation and functionality of nuclear technologies used in energy, medicine, research, defence, and space exploration.
3. Combine engineering tools and methodologies to innovate, design, build, regulate, and operate mission- and safety-critical nuclear systems.
4. Interpret changing sociopolitical constraints around nuclear technology in terms of politics, law, international law, international relations, nuclear security and nuclear safeguards.
5. Assess economic, societal, and environmental impacts of the nuclear fuel cycle to optimise sustainability and productivity.
6. Demonstrate a nuclear safety and security mindset by making professional contributions to safety-critical work with leadership, critical thinking, and continuous improvement.
7. Integrate management of people, safety assessment, root cause analysis, audit processes, and performance indicators to ensure high readiness of nuclear facilities.
8. Critically evaluate technical assumptions and challenge conventional methodologies by applying diverse experiences, personal accountability, and research-driven inquiry.
9. Collaborate with diverse stakeholders, including community, government, industry, and research institutions, demonstrating cultural awareness, to ensure ethical and sustainable nuclear technology applications.
10. Communicate complex nuclear engineering concepts to technical and non-technical audiences.
11. Demonstrate leadership and teamwork in multi-disciplinary environments to achieve safe, ethical, and sustainable nuclear technology outcomes.

4. Continuous Improvement

The Nuclear Engineering program is newly established and seeking provisional accreditation. The program has been designed to meet current industry needs and expectations. The program will be continuously improved through regular reviews of the courses, curriculum, and program structure, which will involve industry consultation, as discussed in Section 5.

[1] https://www.asa.gov.au/sites/default/files/documents/2024-09/Nuclear_mindset_interactive_PDF_3.pdf

The School is piloting models which allow for more individualised (non-exam) assessment, including open-ended projects, portfolios and vivas. The new core Nuclear Engineering courses and assessment structures incorporate these models and have been designed for initial offering based on learnings from other streams for current best practice in improving integrity in a post-COVID and AI environment. Courses and assessments will be reviewed and refined as the program progresses.

The Head of School, the Deputy Head (Education), Associate Head of School (Education), the Deputy Head (Academic) and School Education Committee (SEC) have the overall responsibility for the management of the undergraduate and postgraduate coursework programs within the School. The committee meets regularly to discuss coordination of teaching, program review, designing new courses and revision of existing courses, course organisation and administration, students' feedback on courses, etc.

Proposals for new courses or course revisions relating to a particular discipline are born out of discussion among all staff in that discipline, as well as relevant industry representatives. New proposals for both undergraduate and postgraduate elective courses are typically driven by discipline-specific academic staff and motivated by current industry or research trends. Course changes are first discussed at the SEC and then at the School level during School Management Committee meetings.

To ensure program design is informed by ongoing evaluation of practice, industry needs, and future demand, the School draws on regular input from the Industry Advisory Board and engagement with Industry Partners. The School has active partnerships with industry organisations that provide regular input on current practice and workforce needs, including through engagement with academic staff and guest lectures. In addition, as Australia's top-ranked Mechanical school, many courses are taught by academics who lead internationally recognised research programs. This leadership, together with strong industry links, keeps teaching research-informed and up to date.

5. Review Process

UNSW's Academic Offering Review and Monitoring Procedure outlines a structured approach to maintaining the quality and relevance of academic programs and courses. It includes both program-level and course-level review processes, with defined responsibilities and timelines.

Program Monitoring is conducted annually for all programs and specialisations. A comprehensive program review must occur at least once every five years for accredited programs, and every seven years for others. These reviews include a self-evaluation report (SER), review panel, review event, and a formal response with an implementation plan. Oversight is provided by the Academic Board and University Academic Quality Committee (UAQC), with input from Faculty Education Committees and Deans.

Course Review within UNSW Engineering is managed through a two-tiered process: Routine Course Review and Comprehensive Course Review. Routine reviews are conducted at the end of each term by Schools, using data such as enrolment, assessment outcomes, academic integrity issues, WAM differences, and student feedback (myExperience). Courses flagged through this process are added to the Comprehensive Course Review roster.

Comprehensive Course Reviews are detailed evaluations led by the Course Convenor in collaboration with a Faculty Educational Developer, Nexus Fellow, or Senior Academic. These reviews assess course design, pedagogy, alignment with learning outcomes, and feedback mechanisms. Outcomes are documented in a Course Development Plan and an Evaluation Report following the next course delivery. Schools must review at least 10% of their courses annually.

Stakeholder involvement spans multiple levels, including the Academic Board, UAQC, Faculty and School committees, Course Convenors, and external contributors such as students and professional bodies.

Frequency of updates includes termly course reviews, annual program monitoring, and five-yearly comprehensive reviews for accredited programs.

6. Curriculum Mapping

A curriculum mapping has been carried out for the ENGGFH Nuclear Engineering specialisation. The specialisation covers all the Engineers Australia Stage 1 Graduate Competencies.

SLO 1 (Fundamental Principles): Knowledge in enabling sciences is concentrated in Level 1 and Level 2. First-year courses such as MATH1131/1141, PHYS1121/1131, ENGG1811 (Computing), and MATS1110 (Materials) establish the foundation. Specialised physics is introduced in Level 2 with PHYS2117 (Introduction to Nuclear Physics), alongside MATH2089 and MMAN2700 (Thermodynamics).

SLO 2 (Nuclear Technologies): Students begin analysing nuclear technologies in ATOM2000 (Introduction to Atomic Energy) in Year 2. This is deepened in Level 3 through ATOM3001 (Nuclear Reactor Coolants), ATOM3002 (Neutronics), and ATOM3003 (Nuclear Reactor Degradation), ensuring comprehensive technical expertise.

SLO 3 (Design & Innovation): The design stream progresses from DESN1000 and DESN2000 to DESN3000 (Strategic Design Innovation). It culminates in ATOM4100 (Nuclear Engineering Design), where students combine engineering tools to design mission-critical nuclear systems.

SLO 4 (Sociopolitical Constraints) & SLO 5 (Impact Assessment): These competencies are uniquely addressed in ARTS3100 (Ethics and the Nuclear Age) and ENGG9744 (Nuclear Safety, Security and Safeguards). Students interpret political, legal, and international frameworks (SLO 4) and assess the societal and environmental impacts of the fuel cycle (SLO 5).

SLO 6 (Safety Mindset) & SLO 7 (Management): A "Nuclear Mindset" is instilled early in ATOM2000 and rigorously developed in ENGG9744 and ATOM4001 (Reactor Engineering and Control). These courses require students to integrate safety assessments, root cause analysis, and audit processes.

SLO 8, 9, 10, 11 (Professional Skills): Critical evaluation, collaboration, and communication are scaffolded throughout the degree, particularly in the design spine and the capstone Research Thesis (MMAN4951/4952/4953). ATOM4100 and ATOM4001 specifically assess leadership and teamwork in multi-disciplinary, safety-critical environments

Course learning outcomes in the Nuclear Engineering stream (ENGGFH) map well to EA Stage 1 Competencies, through the SLO map.

There is evidently more weight applied to the first order knowledge and application competencies. The curriculum map indicates that much of this enhanced weighting comes from our foundational science/maths/computing courses in the first two years of the degree and technical courses in later years. Significant weighting is also placed on critical thinking, discernment and being pro-active throughout all courses due to the emphasis on pro-active nuclear safety and informed decision-making skills.

Although the weighting of category 3 competencies is relatively lower than some other categories, they are disproportionately developed in year 3 and 4 of the plan, most strongly by thesis and design courses. There is a reasonable argument that these capstone experiences have a greater influence on the graduate engineer than foundational studies, so there is perhaps a need to include a weighting factor for coursework based on the year-level of study.

Table 1. Mapping of the stream learning outcomes to the Engineers Australia Stage 1

SLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14.	PLO15	PLO16
1. Apply fundamental principles of physics, mathematics, radiation science, materials chemistry, high-performance computing, and artificial intelligence to solve complex problems in nuclear engineering.	x	x														
2. Analyse the operation and functionality of nuclear technologies used in energy, medicine, research, defence, and space exploration.			x													
3. Combine engineering tools and methodologies to innovate, design, build, regulate, and operate mission- and safety-critical nuclear systems.					x		x	x	x							
4. Interpret changing sociopolitical constraints around nuclear technology in terms of politics, law, international law, international relations, nuclear security and nuclear safeguards.					x	x					x					
5. Assess economic, societal, and environmental impacts of the nuclear fuel cycle to optimise sustainability and productivity.						x				x						
6. Demonstrate a nuclear safety and security mindset by making professional contributions to safety-critical work with leadership, critical thinking, and continuous improvement.															x	
7. Integrate management of people, safety assessment, root cause analysis, audit processes, and performance indicators to ensure high readiness of nuclear facilities.							x			x						
8. Critically evaluate technical assumptions and challenge conventional methodologies by applying diverse experiences, personal accountability, and research-driven inquiry.				x									x			
9. Collaborate with diverse stakeholders, including community, government, industry, and research institutions, demonstrating cultural awareness, to ensure ethical and sustainable nuclear technology applications.						x					x	x		x		x
10. Communicate complex nuclear engineering concepts to technical and non-technical audiences.												x				
11. Demonstrate leadership and teamwork in multi-disciplinary environments to achieve safe, ethical, and sustainable nuclear technology outcomes.																x

Table 2. Mapping of courses to the stream learning outcomes

CLO	1. Apply fundamental principles of physics, mathematics, radiation science, materials chemistry, high-performance computing, and artificial intelligence to solve complex problems in nuclear engineering.	2. Analyse the operation and functionality of nuclear technologies used in energy, medicine, research, defence, and space exploration.	3. Combine engineering tools and methodologies to innovate, design, build, regulate, and operate mission- and safety-critical nuclear systems.	4. Interpret changing sociopolitical constraints around nuclear technology in terms of politics, law, international law, international relations, nuclear security and nuclear safeguards.	5. Assess economic, societal, and environmental impacts of the nuclear fuel cycle to optimise sustainability and productivity.	6. Demonstrate a nuclear safety and security mindset by making professional contributions to safety-critical work with leadership, critical thinking, and continuous improvement.	7. Integrate management of people, safety assessment, root cause analysis, audit processes, and performance indicators to ensure high readiness of nuclear facilities.	8. Critically evaluate technical assumptions and challenge conventional methodologies by applying diverse experiences, personal accountability, and research-driven inquiry.	9. Collaborate with diverse stakeholders, including community, government, industry, and research institutions, demonstrating cultural awareness, to ensure ethical and sustainable nuclear technology applications.	10. Communicate complex nuclear engineering concepts to technical and non-technical audiences.	11. Demonstrate leadership and teamwork in multi-disciplinary environments to achieve safe, ethical, and sustainable nuclear technology outcomes.
Level 1 Core Courses											
DESN1000 Introduction to Engineering Design and Innovation	Introduced	Introduced	Introduced	no alignment	no alignment	no alignment	Introduced	Introduced	Introduced	Introduced	Introduced
ENGG1811 Computing for Engineers	Introduced		Introduced								
MMAN1130 Design and Manufacturing	Introduced	Introduced	Introduced		Introduced	Introduced					
MATS1101 Engineering Materials and Chemistry	Introduced	Introduced			Introduced	Introduced					
MATH1131 Mathematics 1A	Introduced	Introduced									
MATH1141 Higher Mathematics 1A	Introduced	Introduced									
MATH1231 Mathematics 1B	Introduced	Introduced									

MATH1241 Higher Mathematics 1B	Introduced	Introduced									
PHYS1121 Physics 1A	Introduced	Introduced	Introduced			Introduced		Introduced			
PHYS1131 Higher Physics 1A	Introduced		Introduced			Introduced		Introduced			
Level 2 Core Courses											
ATOM2000 Introduction to Atomic Energy	Introduced	Developed		Introduced	Developed	Introduced		Introduced	Introduced	Introduced	Introduced
DESN2000 Engineering Design and Professional Practice	Developed	Developed	Developed			Developed	Developed	Developed	Developed	Developed	Developed
ENGG2500 Fluid Mechanics for Engineers	Developed	Developed						Developed			
MATH2019 Engineering Mathematics 2E	Developed		Developed					Developed			
MATH2089 Numerical Methods and Statistics	Developed	Developed	Developed					Developed			
MMAN2700 Thermodynamics	Developed	Developed						Developed			
PHYS2XXX Introduction to Nuclear Physics	Developed										
Level 3 Core Courses											
ATOM3001 Nuclear Reactor Coolants		Developed	Developed				Developed				
ATOM3002 Neutron Physics	Developed	Developed	Developed					Developed			
ATOM3003 Nuclear Materials Chemistry	Developed	Developed		Developed	Mastered			Developed	Developed		
ARTS3100 Science, Technology and Responsibility: Ethics and the Nuclear Age				Developed	Developed	Developed		Developed	Developed		
DESN3000 Strategic Design Innovation			Mastered	Mastered		Developed	Developed		Mastered	Mastered	Mastered

Level 4 Core Courses											
ATOM4001 Reactor Engineering and Control	Mastered	Mastered				Mastered	Mastered	Mastered			
ATOM4100 Nuclear Engineering Design	Mastered	Mastered	Mastered			Mastered	Mastered	Mastered	Mastered	Mastered	
ENGG9744 Nuclear Safety, Security and Safeguards			Mastered	Mastered	Mastered	Mastered	Mastered	Mastered	Developed		
Thesis Courses											
MMAN4951 Thesis A	Mastered	Mastered	Mastered					Mastered		Mastered	
MMAN4952 Thesis B	Mastered	Mastered	Mastered					Mastered		Mastered	
MMAN4953 Thesis C	Mastered	Mastered	Mastered					Mastered		Mastered	
Discipline Electives											
AERO9500 Space Systems Architectures and Orbits	Developed	Developed	Developed								
AERO9610 The Space Segment		Developed	Developed								
ENGG2600 Engineering Vertically Integrated Project	Developed						Developed	Developed		Developed	Developed
ENGG3600 Engineering Vertically Integrated Project	Developed						Developed	Developed		Developed	Developed
ENGG4600 Engineering Vertically Integrated Project	Mastered						Mastered	Mastered		Mastered	Mastered
ENGG4841 Systems Engineering Fundamentals		Developed	Developed				Developed			Developed	
MANF4430 Reliability and Maintenance Engineering	Mastered	Developed	Developed		Developed	Developed	Developed				
MANF4611 Process Modelling and Simulation	Mastered		Mastered					Mastered			
MANF6860 Strategic Manufacturing Management		Mastered			Developed		Developed				

MANF9400 Industrial Management			Developed			Developed	Developed	Developed	Developed		
MANF9420 Operations and Supply Chain Management in Engineering	Developed		Developed		Mastered	Mastered			Developed		
MANF9472 Production Planning and Control			Developed		Developed						
MECH4770 Fundamentals and Design of Electrochemical Energy Storage Systems	Developed	Developed	Developed			Developed		Developed			
MMAN4200 Additive Manufacturing			Developed			Developed		Developed			
MMAN4400 Engineering Management		Developed	Developed		Developed	Developed		Developed			
MMAN9350 Digital and Artificial Intelligence Technologies for Engineering Applications	Mastered		Developed								
SOLA5052 Bioenergy and Renewable Fuels					Developed						
SOLA5053 Wind Energy Converters			Developed		Developed					Developed	
SOLA5056 Sustainable Energy for Developing Countries			Developed		Mastered					Developed	Mastered
SOLA5057 Energy Efficiency			Developed		Mastered		Mastered			Developed	

7. Assessments

A review of assessment distribution indicates that the stream has an emphasis on examination and quizzes. Technical engineering science subjects place an emphasis on written tests/exams, while more conceptual subjects such as the capstone design course utilise viva-style oral-examinations.

The remainder of the assessment is usually in the form of assignments/reports, most commonly associated with lab work or extended analysis calculations. Assignments are mostly associated with elective courses. For design courses, thesis and other professional engineering courses, there is a far greater spread of other assessment types, including major works and portfolios. The School has implemented many processes to ensure that academic integrity is maintained:

- All exam papers are reviewed by another academic, along with worked solutions.
- Online exams use as much randomisation as practically possible for the question type (question banks, numerical input randomisation and in some cases multiple parallel versions of questions with slightly different solution paths). Post-COVID online assessments are generally discouraged throughout all courses in the school to guarantee academic integrity.
- For many exam-style assessments, pen and paper answers are uploaded to Moodle via an ExamScan process managed by faculty. This improves marking procedures, especially when done at scale in large courses.
- In-person lab activities have been centre stage in our program and have been increased substantially as our programs have moved back to in-person face-to-face delivery modes.
- Academics are encouraged to include open-ended elements in all their examination questions, with students answering short essay-style questions. This enables the marker to check the alignment between simple answers and comprehension.
- Reports are submitted using TurnItIn, which ensures that students are not plagiarising or colluding, but does not deter some forms of contract cheating.
- Model report/assignment rubrics have been provided to reward open-ended and creative solutions by students to discourage collusion and contract cheating. These have shown some initial promise, but much more evaluation and testing are required.
- Important works, such as thesis, have two (or three) markers to ensure consistency.
- Some courses have taken on viva-style assessments for all students, but these have proved challenging at scale without centralised support for scheduling.

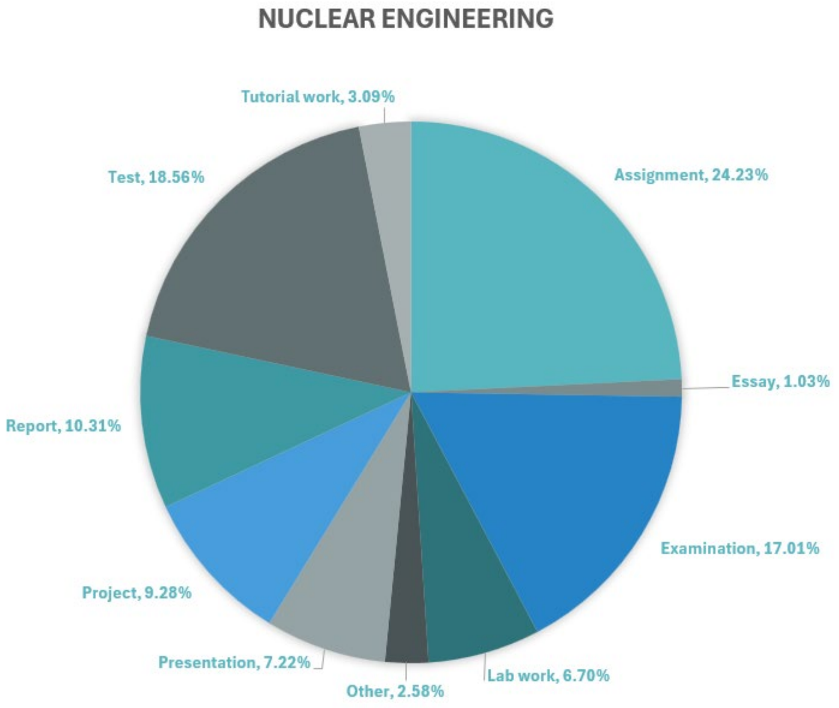

Figure 1. Percentage of assessment types used within the specialisation.

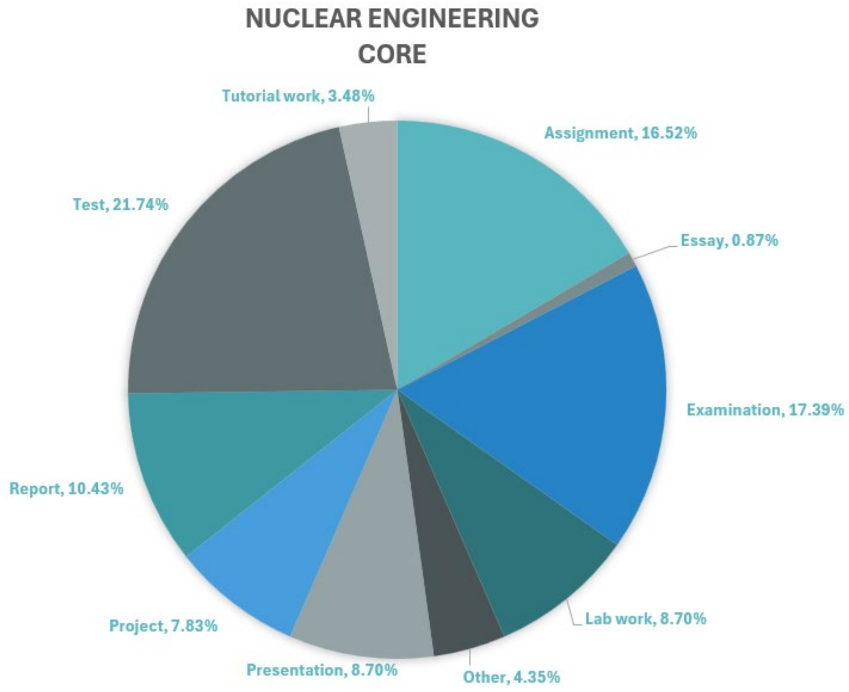

Figure 2. Percentage of assessment types used within the core of the specialisation.

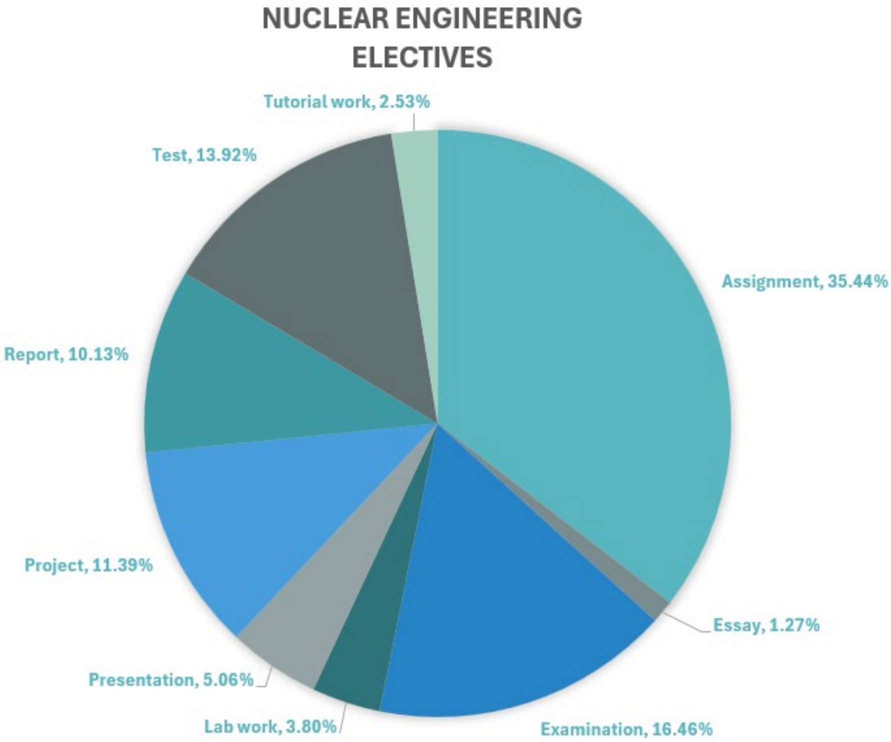

Figure 3. Percentage of assessment types used within the electives of the specialisation.

8. Specialisation Progression Plan

The progression plan the Nuclear Engineering specialisation is shown below. The plan is based on a default student progression. Course codes and names are shown in the tables, including a list of elective options. The progression plan enables students to track their progress towards completion of the degree and how their graduate capabilities have developed over time through attainment of the course learning outcomes. Used in conjunction with the core course prerequisite mapping shown in the flow diagram, the progression plan supports students reflection on how the knowledge and skills obtained at each stage of the program connect to the remaining courses and development of their graduate attributes.

Students develop their graduate capability through different level courses throughout their degree which are tracked by the progression plan. Students in the Nuclear Engineering program first complete level 1 general engineering science subjects, common across Engineering streams, to introduce fundamental maths/physics/coding/materials knowledge. These course feed into more technical level 2 courses that develop more complex engineering physics concepts relevant to nuclear engineering. Level 3 core courses provide material specific to nuclear engineering. These courses are followed by level 4 core course where students build on and demonstrate proficiency of nuclear engineering content, cumulating in a capstone Nuclear Engineering Design Course and Thesis. Students must also complete 60 days of industrial training (ENGG4999).

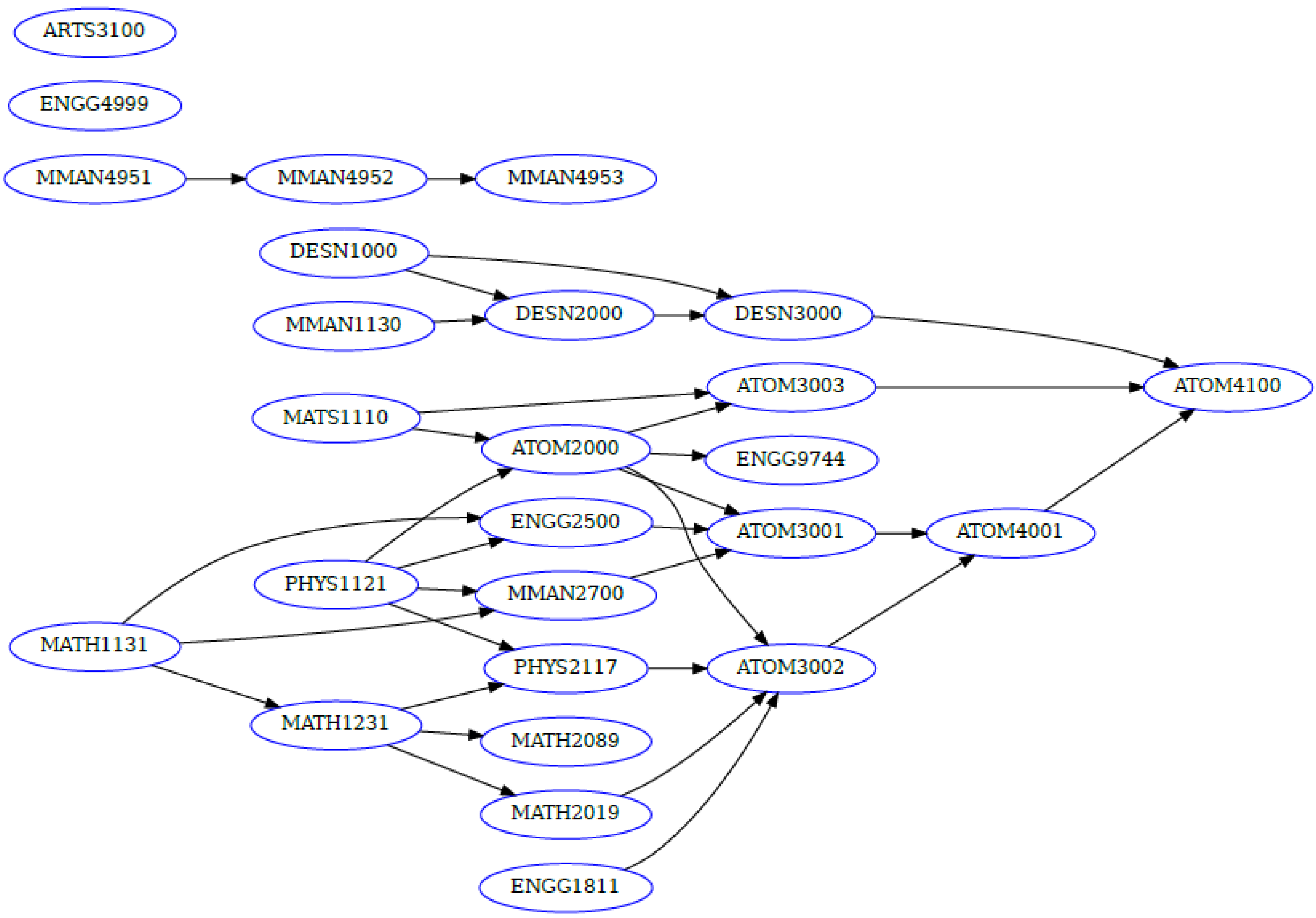

Figure 5: Core course prerequisite chains for BE (Hons) Nuclear Engineering (2026 Version)

Students can track their progression through the "myPlan" checker tool.

[myPlan | Current Students - UNSW Sydney]

A progression checklist and/or study plan is also available for students for the single degree and the double degree offerings.

[Progression checksheets & study plans | Engineering - UNSW Sydney]