UNSW Engineering

Education Specification

1. Program Overview

Program Title: Bachelor of Engineering (Honours)

Award Title: Bachelor of Engineering (Honours) (Photovoltaics and Solar Energy Engineering)

Engineering Discipline: Photovoltaics and Solar Energy Engineering

The SOLAAH Bachelor of Engineering (Honours) in Photovoltaics and Solar Energy (PVSE) is a four-year, full time degree. It is offered by the School of School of Photovoltaic and Renewable Energy Engineering (SPREE) as a specialisation of the UNSW 3707 Bachelor of Engineering (Honours) program. It is an AQF Level 8 qualification and provides graduates with advanced knowledge and skills for professional and/or further learning. This document illustrates how the SOLAAH specialisation fosters the Engineers Australia (EA) Stage 1 Competencies for Professional Engineers in its students. In the following sections the aims and specialisation learning outcomes (SLOs) are presented. This is followed by the curriculum mapping that relates the course learning outcomes of individual courses to SLOs, SLOs to EA Competencies, and finally CLOs of individual courses to EA Competencies.

2. Career Alignment

Photovoltaic engineers contribute across the full PV value chain, from solar cell and module technology development and manufacturing to system design, installation, commissioning, operation and maintenance, reliability and lifecycle analysis. Graduates are prepared for industry roles in PV R&D and production, utility-scale and distributed PV system design and building-integrated photovoltaics and low-energy buildings. Graduates are working with organisation such as manufacturers and equipment suppliers, EPC, developers and asset owners, consultancies and government. Graduates of this degree are at the forefront of the transition to a renewable energy future.

Graduates of this degree can work in a wide range of fields including refining solar cells production technology, grid connection and integration, utility scale developments, photovoltaic system designs an building integrated systems. They could also work on designing and constructing energy efficient buildings.

To support the broad and interdisciplinary nature of the job market, the degree features “strands” which allows students to further specialise in complimentary areas such as computer science, electrical engineering, mathematics, mechanical engineering, civil engineering, physics, chemical engineering, and architecture. Students may also formulate their own strands subject to the approval of the specialisation authority.

Emerging areas, including customer-side energy resources (rooftop PV, batteries, EV integration, virtual power plants and demand response), and data-enabled asset management, are being strengthened through new electives and ongoing integration of data science skills across the curriculum.

3. Specialisation Framework

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

1. Show proficiency in the enabling sciences that underpin Photovoltaic and Solar Energy (PVSE) Engineering (physics, mathematics and computer science).
2. Demonstrate proficiency of PVSE Energy specialist technical knowledge such as operation, design and manufacturing of solar cells and modules, energy efficiency and photovoltaic systems design.
3. Critically evaluate and apply current research to the solution of problems faced in a real world context, in PVSE Energy engineering, by considering technical, economic, social and environmental implications.
4. Use appropriate analytical and computational tools to analyse complex problems in PVSE and solve by applying critical thinking and engaging with real world context.
5. Design PVSE systems using knowledge of the functionality and operating principles of systems components, enabling technologies and relevant standards.
6. Lead and manage PVSE projects, individually or as part of a team, in a systematic and professional manner.
7. Demonstrate a high level of personal autonomy, perseverance, ethical conduct and professional accountability when working as an individual and within diverse multi-cultural and multi-disciplinary team environments.
8. Communicate professionally and effectively within and outside of PVSE engineering and effectively incorporate feedback.

4. Continuous Improvement

The SPREE Program Committee monitors the programs and courses. The committee gathers feedback from the stakeholders including industry, Course Convenors, School and Faculty committees, students and professional bodies. In addition, the School conducts routine course reviews and comprehensive course and program reviews as discussed in Section 5.2. Revision and/or new course/program proposals are presented to the SPREE Learning and Teaching Committee (LTC) for further discussion and endorsement. The approved proposals are presented to the Faculty Academic Committee.

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

Curriculum mapping was undertaken following the methodology established by the Faculty. The mapping was conducted as a two-step process. The assessments in an individual course were mapped with the CLOs, CLOs were mapped with SLOs and SLOs were mapped with relevant Engineers Australian Stage 1 Competency Standards for Professional Engineers (PLOs). Both core and elective courses in the specialisation were considered for the mapping. These mapping are shown in Tables 1 and 2.

Mapping of the assessments to CLOs and CLOs to SLOs were done in consultation with the course convenors, and the mapping of SLOs to PLO was performed in consultation with the program leader.

Curriculum mapping shows that the specialisation provides good coverage of all the Engineers Australia Stage 1 Competencies for Professional Engineers. It is particularly strong in in-depth technical knowledge, application of engineering methods, and engineering design. The SPREE IAC is satisfied that the SLOs and the mapping of competencies appropriately address the needs of the renewable energy industry. Although “Professional and personal attributes” competencies are embedded in the specialisation, some elements of this such as ethics could be better distributed across the specialisation which is an aim of the on-going program review.

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

SLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16
1. Show proficiency in the enabling sciences that underpin Photovoltaic and Solar Energy (PVSE) Engineering (physics, mathematics and computer science).	X	X														
2. Demonstrate proficiency of PVSE Energy specialist technical knowledge such as operation, design and manufacturing of solar cells and modules, energy efficiency and photovoltaic systems design.		X	X		X	X	X	X								
3. Critically evaluate and apply current research to the solution of problems faced in a real world context, in PVSE Energy engineering, by considering technical, economic, social and environmental implications.				X		X					X		X	X		
4. Use appropriate analytical and computational tools to analyse complex problems in PVSE and solve by applying critical thinking and engaging with real world context.					X	X	X	X	X							
5. Design PVSE systems using knowledge of the functionality and operating principles of systems components, enabling technologies and relevant standards					X	X	X	X	X	X						
6. Lead and manage PVSE projects, individually or as part of a team, in a systematic and professional manner.										X						X
7. Demonstrate a high level of personal autonomy, perseverance, ethical conduct and professional accountability when working as an individual and within diverse multi-cultural and multi-disciplinary team environments.											X		X		X	X
8. Communicate professionally and effectively within and outside of PVSE engineering and effectively incorporate feedback.												X		X		

Table 2. Mapping of courses to the specialisation learning outcomes

CLO	1. Show proficiency in the enabling sciences that underpin Photovoltaic and Solar Energy (PVSE) Engineering (physics, mathematics and computer science).	2. Demonstrate proficiency of PVSE Energy specialist technical knowledge such as operation, design and manufacturing of solar cells and modules, energy efficiency and photovoltaic systems design.	3. Critically evaluate and apply current research to the solution of problems faced in a real world context, in PVSE Energy engineering, by considering technical, economic, social and environmental implications.	4. Use appropriate analytical and computational tools to analyse complex problems in PVSE and solve by applying critical thinking and engaging with real world context.	5. Design PVSE systems using knowledge of the functionality and operating principles of systems components, enabling technologies and relevant standards	6. Lead and manage PVSE projects, individually or as part of a team, in a systematic and professional manner.	7. Demonstrate a high level of personal autonomy, perseverance, ethical conduct and professional accountability when working as an individual and within diverse multi-cultural and multi-disciplinary team environments.	8. Communicate professionally and effectively within and outside of PVSE engineering and effectively incorporate feedback.
Level 1 Core Courses								
COMP1511 Programming Fundamentals	Introduced							
COMP1911 Computing 1A	Introduced							

DESN1000 Introduction to Engineering Design and Innovation		Introduced		Introduced	Introduced	Introduced	Introduced	Introduced
ELEC1111 Electrical Circuit Fundamentals	Introduced	Introduced		Introduced		Introduced		
ENGG1811 Computing for Engineers	Introduced			Introduced				
MATH1131 Mathematics 1A	Introduced							
MATH1141 Higher Mathematics 1A	Introduced							
MATH1231 Mathematics 1B	Introduced							
MATH1241 Higher Mathematics 1B	Introduced							
PHYS1121 Physics 1A	Introduced							
PHYS1131 Higher Physics 1A	Introduced							
PHYS1221 Physics 1B	Introduced							
PHYS1231 Higher Physics 1B	Introduced							
SOLA1070 Sustainable Energy	Introduced	Introduced	Introduced	Introduced	Introduced		Introduced	Introduced
Level 2 Core Courses								
DESN2000 Engineering Design and Professional Practice		Introduced		Introduced	Developed	Developed	Introduced	Developed
MATH2018 Engineering Mathematics 2D	Developed			Introduced				
MATH2019 Engineering Mathematics 2E	Developed			Introduced				
MATH2089 Numerical Methods and Statistics	Proficient	Developed						
SOLA2051 Project in Photovoltaics and Renewable Energy	Developed	Developed		Developed	Developed	Introduced	Developed	
SOLA2060 Introduction to Electronic Devices	Developed	Developed		Developed	Proficient	Introduced	Introduced	Developed
SOLA2540 Applied Photovoltaics	Developed	Developed			Proficient	Introduced	Introduced	Developed
Level 3 Core Courses								
SOLA3010 Low Energy Buildings and Photovoltaics	Developed	Proficient	Developed	Proficient	Proficient	Developed	Developed	Developed
SOLA3020 Photovoltaic Technology and Manufacturing	Developed	Proficient	Developed	Developed	Developed	Developed	Developed	Developed
SOLA3507 Solar Cells		Proficient		Developed	Developed	Developed	Developed	Developed
Level 4 Core Courses								

ELEC4122 Strategic Leadership and Ethics						Developed	Developed	Developed
SOLA4012 Photovoltaic Systems Design	Proficient	Proficient	Introduced	Proficient	Proficient			
SOLA4951 Research Thesis A	Proficient	Developed	Developed	Developed	Developed	Developed	Developed	Developed
SOLA4952 Research Thesis B	Proficient	Proficient	Developed	Proficient	Proficient	Proficient	Proficient	Proficient
SOLA4953 Research Thesis C	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
SOLA5057 Energy Efficiency	Developed	Developed		Developed		Introduced	Developed	Developed
Strand Electives								
ARCH1361 Architectural Science and Building Environment 2	Introduced	Introduced	Introduced		Introduced			Introduced
BENV1072 Design for Energy Efficiency								
CEIC2000 Material and Energy Systems	Developed	Developed		Introduced	Introduced			
CEIC2001 Fluid and Particle Mechanics	Developed	Developed		Developed	Developed	Developed	Developed	Developed
CEIC2002 Heat and Mass Transfer	Developed	Developed		Developed	Developed	Developed	Developed	Developed
CODE2170 Building Information Modelling	Developed	Developed		Developed	Developed	Developed	Developed	Developed
COMP2041 Software Construction: Techniques and Tools	Developed	Developed		Developed	Introduced			Developed
ELEC2133 Analogue Electronics		Developed			Introduced			
ELEC2134 Circuits and Signals	Proficient			Proficient				
ELEC3104 Digital Signal Processing	Developed	Proficient		Proficient	Developed			
ELEC3105 Electrical Energy		Proficient		Proficient				
ELEC3106 Electronics	Proficient	Proficient			Proficient			
ELEC3114 Control Systems	Proficient	Proficient						
ELEC3115 Electromagnetic Engineering		Proficient	Proficient	Proficient				
ELEC3117 Electrical Engineering Design					Developed	Developed	Developed	Developed
ELEC4614 Power Electronics	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MATH2011 Several Variable Calculus	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MATH2121 Theory and Applications of Differential Equations	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MATH3041 Mathematical Modelling for Real World Systems	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient

MATH3101 Computational Mathematics for Science and Engineering	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MATH3121 Mathematical Methods and Partial Differential Equations	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MATH3261 Fluids, Oceans and Climate	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MECH3610 Advanced Thermofluids	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MECH4620 Computational Fluid Dynamics	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MECH9720 Solar Thermal Energy Design	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MMAN2600 Fluid Mechanics	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
MMAN2700 Thermodynamics	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
PHYS2111 Quantum Physics	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
PHYS3111 Quantum Mechanics	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
PHYS3113 Thermal Physics and Statistical Mechanics	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
PHYS3118 Quantum Physics of Solids and Devices	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
TELE3113 Analogue and Digital Communications	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
Discipline (Depth) Electives								
ENGG2600 Engineering Vertically Integrated Project	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
ENGG3001 Fundamentals of Humanitarian Engineering	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
ENGG3600 Engineering Vertically Integrated Project	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
ENGG4102 Humanitarian Engineering Project	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
ENGG4111 Energy Storage	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
ENGG4600 Engineering Vertically Integrated Project	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
SOLA5050 Renewable Energy Industry and Policy	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
SOLA5051 Life Cycle Assessment	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient

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SOLA5052 Bioenergy and Renewable Fuels	Developed	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
SOLA5053 Wind Energy Converters	Developed	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Proficient
SOLA5056 Sustainable Energy for Developing Countries		Proficient	Proficient	Proficient	Proficient	Proficient	Proficient	Developed
SOLA9101 Advanced Photovoltaics		Proficient	Proficient	Proficient	Proficient	Developed	Developed	Developed
SOLA9102 Advanced Solar Cell Characterisation		Proficient	Proficient	Proficient	Proficient			

7. Assessments

A wide variety of assessments is used. It can be seen from the course assessment map (Tables 3–5) that, overall, 44% of assessments are tests and examinations (Test 23%; Examination 21%), 39% are laboratory activities, projects, presentations and assignments (Lab work 11%; Project 7%; Presentation 5%; Assignment 16%), and the remainder comprise reports (10%), tutorial work (2%), and smaller components such as essays (1%) and portfolios (≤1%). In the core courses, which develop specialisation-specific technical knowledge and skills, 41% of assessments are tests and examinations (Test 25%; Examination 16%) and 43% are laboratory activities, projects, presentations and assignments (Lab work 11%; Project 9%; Presentation 6%; Assignment 17%), with the remainder including reports (5%) and tutorial work (4%). In the elective courses, 46% of assessments are tests and examinations (Test 22%; Examination 24%) and 37% are laboratory activities, projects, presentations and assignments (Lab work 11%; Project 6%; Presentation 5%; Assignment 15%), with the remainder including reports (13%), tutorial work (1%), and smaller components such as essays and portfolios (each about 1%).

The School has reviewed the alignment of assessment types across the specialisation, with fewer than 30% of courses retaining a final exam, and many replacing it with problem- or project-based assessment. In courses involving design and report writing, assessment is often staged so students receive feedback as the course progresses. Presentations, posters and oral exams are also used to build communication skills and support academic integrity. Overall, this assessment design prioritises authenticity while ensuring students develop AI literacy and self-regulation as part of professional practice (i.e., preparing them for the world “out there”).

In team-based assessments, individual team members are peer-assessed. We are also increasingly implementing viva-style oral examination in team-based assessment as well as in project-based assessments. Viva-style components also support assessment integrity in an environment where generative AI can otherwise obscure individual contribution and disciplinary reasoning.

SPREE’s approach to use of generative AI and assessment integrity

The School has implemented many processes to ensure that academic integrity is maintained:

- All exam papers are reviewed by another academic. New questions are written for each exam.
- Online exams use as much randomisation as practically possible. This includes use of question banks and use of STACK questions which allows randomised questions, were developed for numerical questions. In most courses open ended questions are used in exams to assess students’ comprehension. Exams also start at a set time so that student need to focus on their exams which reduces collusion.
- Viva-style oral exams are used in several courses and are often linked to preceding take-home tasks, helping to ensure take-home tasks are used primarily for learning rather than being treated as end-point assessment or completed using generative AI.
- Assignments are submitted in electronic format and are submitted through TurnItIn, which detects plagiarism, collusion and use of AI.
- Thesis literature review and final thesis have two markers to ensure consistency. If there is a mark difference of greater than 10, a third marker is used.
- Several courses (stage-gate courses in-terms of competency development at the program level) have hurdles where student much achieve certain performance level to pass the course.

In addition, the School is shifting from “policing” AI to redesigning tasks so that AI use is explicit and supports learning rather than completion. In particular, we (i) design tasks so the assessable product is clearly tied to disciplinary process (drafting, iteration, justification, and reflection), (ii) use vivas/oral checks and staged submissions to validate authorship, reasoning, and individual contribution, and (iii) make AI use transparent and pedagogically purposeful, for example, through in-house course-context chatbots that promote “AI for learning”, such as the Scout bot used in SOLA2540.

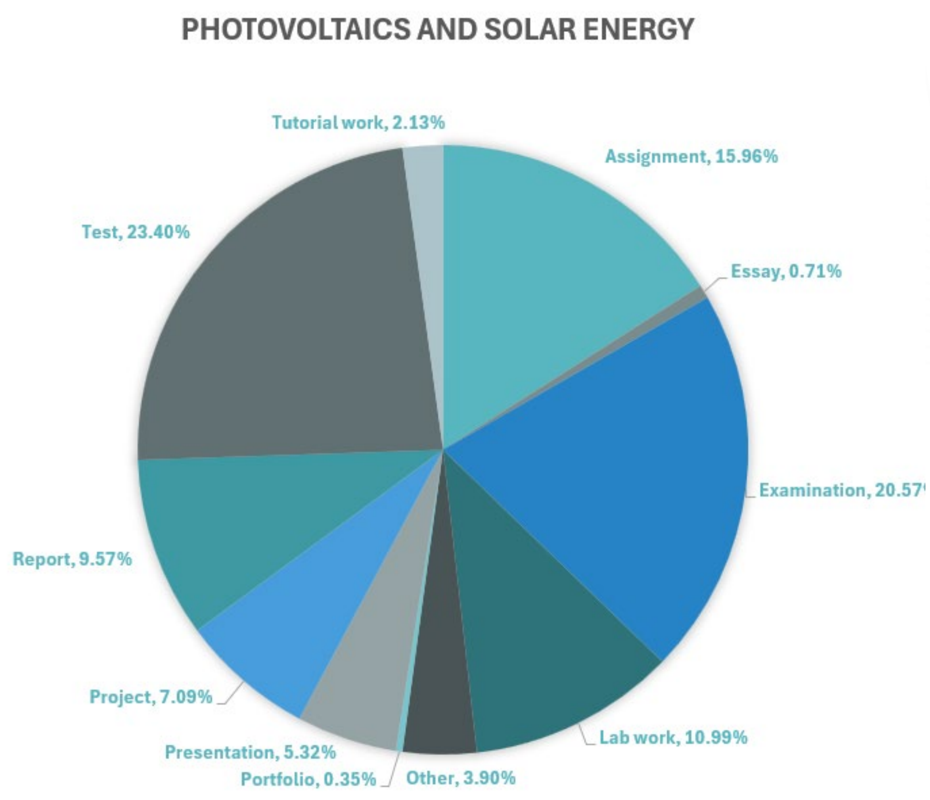

Figure 1. Percentage of assessment types used within the specialisation.

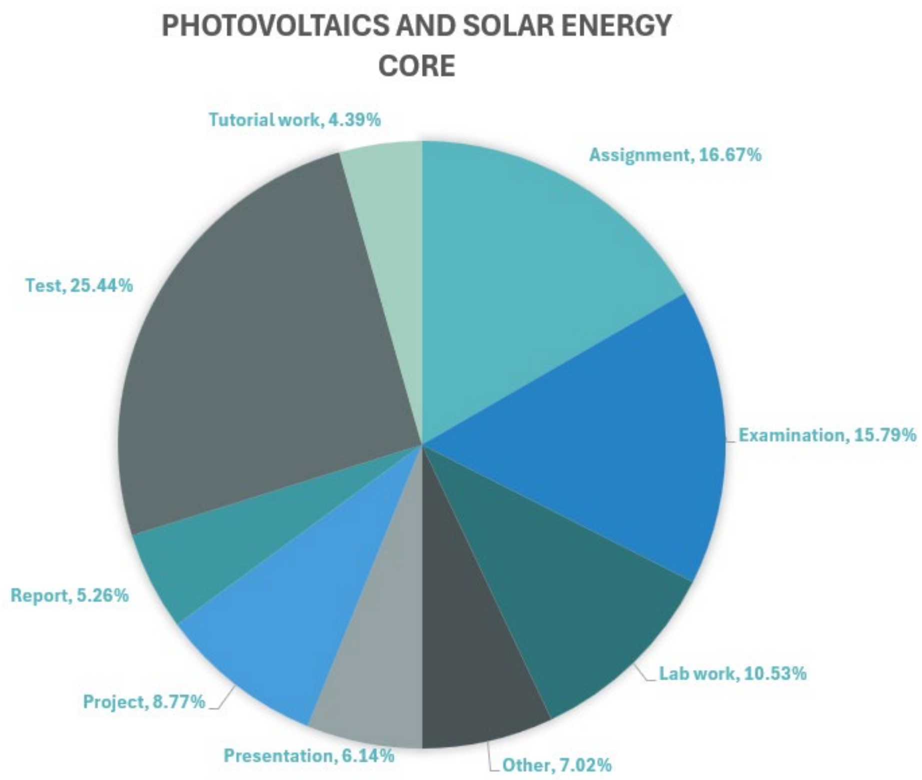

Figure 2. Percentage of assessment types used within the core of the specialisation.

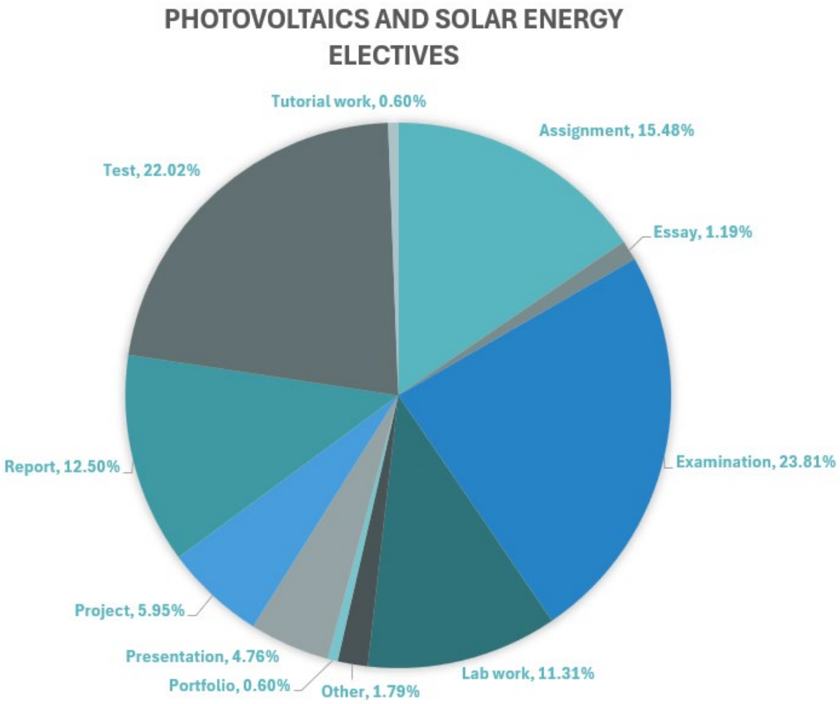

Figure 3. Percentage of assessment types used within the electives of the specialisation.

A wide variety of assessments is used. It can be seen from the course assessment map (Figure 1) that overall 44% of the assessments are in the form of quizzes and exams, 52% are in the form of laboratory activities, projects, presentations, and assignments; and the rest are in the form of other assessments. In the core courses, which cover specialisation specific technical knowledge and skills, 41% of the assessments are in the form of quizzes and exams, and 52% are in the form of laboratory activities, projects, presentations and assignments and the rest are in the form of other assessments (Figure 2). In the elective courses, the distribution of the assignments is similar to in the core courses i.e. 46% of the assessments are in the form of quizzes and exams, and 43% are in the form of laboratory activities, projects, presentations and assignments and the rest are in the form of other assessments (Figure 3).

In the courses which involve design and report writing, work is often split into sections in which students get feedback as the course progresses. Assessments such as presentations, posters, and oral exams are also used to improve student communication skills and increase academic integrity.

The School has implemented many processes to ensure that academic integrity is maintained:

- All exam papers are reviewed by another academic. New questions are written for each exam.
- Online exams use as much randomisation as practically possible. This includes use of question banks and use of STACK questions which allows randomised questions, were developed for numerical questions. In most courses open ended questions are used in exams to assess students' comprehension. Exams also start at a set time so that student need to focus on their exams which reduces collusion.
- Viva-style oral exam are used in a number of courses.
- Assignments are submitted in electronic format and are submitted through TurnItIn, which detects plagiarism, collusion and use of AI.

- Thesis literature review and final thesis have two markers to ensure consistency. If there is a mark difference of greater than 10, a third marker is used.
- In a number of courses have hurdles where student much achieve certain performance level to pass the course.

8. Specialisation Progression Plan

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