SPREE M1 Report

1. SOLAAH Photovoltaics and Solar Energy Engineering

1.1. INTRODUCTION

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 stream 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 report illustrates how the SOLAAH stream fosters the Engineers Australia (EA) Stage 1 Competencies for Professional Engineers in its students. In the following sections the aims and stream 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.

1.2. AIMS OF THE STREAM

The specific objective of the PVSE stream is to educate engineers for the full range of needs of the solar PV and related renewable energy industries. These needs include technology development, manufacturing, systems engineering for applications, maintenance, reliability and lifecycle analysis, marketing and policy.

This stream simultaneously provides students with the opportunity to choose a second area of specialisation (strand) in an area considered to complement the needs of the PV industry. Currently strands are provided in Computing, Electronics, Mathematics, Mechanical engineering, Civil engineering, Physics, Chemical engineering, and Architecture. Students may also formulate their own strands.

1.3. STREAM PLAN

	Term 1	**Term 2**	**Term 3**
Year 1	DESN1000 Introduction to Engineering Design and Innovation ENGG1811 Computing for Engineers MATH1131 Mathematics 1A or MATH1141 Higher Mathematics 1A	PHYS1121 Physics 1A or PHYS1131 Higher Physics 1A First Year Elective (Recommended SOLA1070 Sustainable Energy)	PHYS1221 Physics 1B or PHYS1231 Higher Physics 1B MATS1101 Engineering Materials and Chemistry MATH1231 Mathematics 1B or MATH1241 Higher Mathematics 1B
Year 2	SOLA2060 Introduction to Electronic Devices First Year Elective (Recommended ELEC1111 Electrical Circuit Fundamental) STRAND	SOLA2051 Project in Photovoltaics and Renewable Energy MATH2089 Numerical Methods and Statistics	SOLA2540 Applied Photovoltaics DESN2000 Engineering Design and Professional Practice MATH2018 Engineering Mathematics 2D[1]
Year 3	SOLA3507 Solar Cells STRAND General Education	SOLA3010 Low Energy Buildings and Photovoltaics SOLA3020 Photovoltaic Technology and Manufacturing	ELECTIVE STRAND General Education

[1] Students taking Electric Energy Strand should substitute MATH2018 with MATH2069.

Year 4	SOLA4951 Research Thesis A ELEC4122 Strategic Leadership and Ethics ELECTIVE	SOLA4952 Research Thesis B SOLA4012 Photovoltaic Systems Design SOLA5057 Energy Efficiency	SOLA4953 Research Thesis C ELECTIVE ELECTIVE

1.4. STREAM LEARNING OUTCOMES

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

Knowledge

SLO1. Show proficiency in the enabling sciences that underpin Photovoltaic and Solar Energy (PVSE) Engineering (physics, mathematics and computer science).

SLO2. 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.

SLO3. 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.

Skills

SLO4. Use appropriate analytical and computational tools to analyse complex problems in PVSE and solve by applying critical thinking and engaging with real world context.

SLO5. Design technically and economically efficient, safe and compliant PVSE systems using knowledge of the functionality and operating principles of systems components, enabling technologies and relevant standards.

Application/ Aptitude

SLO6. Lead and manage PVSE projects, individually or as part of a team, in a systematic and professional manner

SLO7. 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.

SLO8. Communicate professionally and effectively within and outside of PVSE engineering and effectively incorporate feedback.

1.5. DEVELOPMENT OF STREAM LEARNING OUTCOMES

Initial development of the stream Learning Outcomes (SLOs) occurred during a SPREE/ Arizona State University Workshop. In order to make presentation of SLOs consistent across the Engineering Faculty, SLOs were further reviewed by a working party consisting of the Deputy Head of School (Education), Director of Learning and Teaching, Undergraduate Course Coordinator, and two academic representatives. The SPREE Industry Advisory Committee (IAC) has been consulted on the modifications to the SLOs and are satisfied that they are appropriate to address the needs of the Photovoltaic and Solar Energy industry. All teaching academics have also been consulted and the modified SLOs were presented to the School Learning and Teaching Committee (L&T Comm) for further discussion and final endorsement.

1.6. CURRICULUM MAPPING

For the mapping, 168 UOC courses in the stream have been used. The stream consists of 126 UOC core courses, 12 UOC first-year elective, 18 UOC Strand and 12 UOC third-year/fourth-year electives.

It is recommended that students enrol in SOLA1070 and ELEC1111 for first-year electives and almost all students choose these courses and hence these have been used in the mapping.

Electronics is one of the most popular Strands. Students study ELEC2133 Analogue Electronics, ELEC2134 Circuits and Signals and ELEC4614 Power Electronics, so these courses have also been included in the mapping.

Similarly, for the third-year/fourth-year electives, SOLA5050 Renewable Energy Policy and SOLA5056 Sustainable Energy for Developing Countries have been included as they are among the most popular courses selected by the students in this stream.

Table 1.1: BE (Honours) Photovoltaics and Solar Energy – CLO to SLO mapping

CO → SLO Mapping	Stream Learning Outcomes (SLOs)							
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8
DESN1000	18.3	0.0	8.3	0.0	17.1	19.6	19.6	17.1
ELEC1111	80.5	0.0	11.0	8.5	0.0	0.0	0.0	0.0
ENGG1811	82.5	0.0	0.0	17.5	0.0	0.0	0.0	0.0
MATH1131	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MATH1231	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MATS1101	51.7	0.0	35.8	0.0	0.0	0.0	6.2	6.2
PHYS1121	98.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
PHYS1221	97.8	0.0	2.2	0.0	0.0	0.0	0.0	0.0
SOLA1070	11.2	11.2	30.0	5.0	6.2	6.2	0.0	30.0
DESN2000	5.0	5.0	12.5	5.0	2.7	37.2	12.7	20.0
ELEC2133	0.0	54.5	22.7	0.0	22.7	0.0	0.0	0.0
ELEC2134	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0
MATH2018	36.7	0.0	26.7	36.7	0.0	0.0	0.0	0.0
MATH2089	27.4	60.6	0.0	0.0	0.0	0.0	0.0	12.0
SOLA2051	18.3	18.3	0.0	16.7	0.0	16.7	16.7	13.3
SOLA2060	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
SOLA2540	0.0	61.5	5.6	16.2	8.4	2.8	2.8	2.8
SOLA3010	0.0	30.3	1.5	31.8	31.8	1.5	1.5	1.5
SOLA3020	8.3	8.3	12.5	45.8	0.0	0.0	12.5	12.5
SOLA3507	0.0	50.3	8.4	21.5	2.8	5.7	5.7	5.7
ELEC4122	0.0	0.0	0.0	0.0	0.0	16.7	66.7	16.7
ELEC4614	0.0	55.6	22.2	22.2	0.0	0.0	0.0	0.0
SOLA4012	0.0	24.8	12.4	32.1	22.5	2.8	2.8	2.8
SOLA4951	10.0	5.0	25.0	20.0	5.0	10.0	5.0	20.0
SOLA4952	10.0	10.0	20.0	20.0	20.0	6.7	6.7	6.7
SOLA4953	10.0	10.0	20.0	20.0	20.0	6.7	6.7	6.7
SOLA5050	4.3	15.9	4.3	0.0	11.2	0.0	27.3	36.9
SOLA5056	0.0	10.3	25.0	27.7	10.3	6.0	6.0	14.7
SOLA5057	0.0	30.3	26.3	30.3	0.0	0.0	0.0	13.0

Table 1.2: BE (Honours) Photovoltaics and Solar Energy – Course assessment map.

CO → AT Mapping	Assessment Types (AT)											
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-
ENGG1811	20	-	70	10	-	-	-	-	-	-	-	-
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-
MATS1101	-	-	70	30	-	-	-	-	-	-	-	-
PHYS1121	-	-	50	20	30	-	-	-	-	-	-	-
PHYS1221	-	-	50	20	30	-	-	-	-	-	-	-
SOLA1070	15	-	50	-	-	-	-	-	-	-	35	-
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-
ELEC2133	15	-	85	-	-	-	-	-	-	-	-	-
ELEC2134	-	-	80	20	-	-	-	-	-	-	-	-
MATH2018	-	-	60	-	10	-	-	-	-	-	30	-
MATH2089	-	-	60	-	20	-	-	-	-	-	20	-
SOLA2051	20	-	-	20	20	-	-	-	15	25	-	-
SOLA2060	25	-	50	-	-	-	-	-	-	-	25	-
SOLA2540	-	-	25	20	-	-	-	-	35	-	20	-
SOLA3010	40	-	45	-	-	-	-	-	-	-	15	-
SOLA3020	-	-	40	-	-	-	-	-	-	20	40	-
SOLA3507	-	-	70	-	-	-	-	-	-	30	-	-
ELEC4122	30	-	32	-	-	-	-	14	-	-	24	-
ELEC4614	-	-	70	20	-	-	-	-	-	10	-	-
SOLA4012	-	-	-	-	-	-	-	-	85	-	15	-
SOLA4951	-	-	-	-	-	-	-	-	100	-	-	-
SOLA4952	-	-	-	-	-	-	-	-	100	-	-	-
SOLA4953	-	-	-	-	-	-	-	-	100	-	-	-
SOLA5050	-	-	40	-	-	-	-	20	40	-	-	-
SOLA5056	-	-	-	-	-	-	-	-	100	-	-	-
SOLA5057	40	-	40	12	-	-	-	-	-	-	8	-

Table 1.3: BE (Honours) Photovoltaics and Solar Energy – CLO to EA Stage 1 Competencies for Professional Engineers curriculum mapping.

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
DESN1000	9.2	9.2	4.9	4.9	4.9	6.0	2.8	-	2.8	6.8	3.9	17.1	7.8	7.8	7.8	3.9
ELEC1111	40.2	40.2	4.5	2.8	4.5	2.8	1.7	1.7	1.7	-	-	-	-	-	-	-
ENGG1811	41.2	41.2	3.5	-	3.5	-	3.5	3.5	3.5	-	-	-	-	-	-	-
MATH1131	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MATH1231	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MATS1101	25.8	25.8	9.0	9.0	9.0	10.2	-	-	-	-	1.2	6.2	1.2	1.2	1.2	-
PHYS1121	49.0	49.0	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-
PHYS1221	48.9	48.9	0.6	0.6	0.6	0.6	-	-	-	-	-	-	-	-	-	-
SOLA1070	9.4	9.4	13.3	8.5	9.5	7.5	2.0	1.0	2.0	2.3	-	30.0	1.2	1.2	1.2	1.2
DESN2000	4.2	4.2	6.2	3.6	4.6	5.7	1.4	1.0	1.4	7.9	2.5	20.0	10.0	10.0	10.0	7.4
ELEC2133	18.2	18.2	27.7	9.5	9.5	5.7	3.8	-	3.8	3.8	-	-	-	-	-	-
ELEC2134	16.7	16.7	29.2	12.5	12.5	12.5	-	-	-	-	-	-	-	-	-	-
MATH2018	18.3	18.3	14.0	6.7	14.0	6.7	7.3	7.3	7.3	-	-	-	-	-	-	-
MATH2089	33.9	33.9	20.2	-	-	-	-	-	-	-	-	12.0	-	-	-	-
SOLA2051	15.3	15.3	9.4	-	3.3	3.3	3.3	3.3	3.3	3.3	3.3	13.3	6.7	6.7	6.7	3.3
SOLA2060	41.7	41.7	16.7	-	-	-	-	-	-	-	-	-	-	-	-	-
SOLA2540	20.5	20.5	26.5	2.8	6.0	2.0	4.6	3.2	4.6	2.0	0.6	2.8	1.1	1.1	1.1	0.6
SOLA3010	10.1	10.1	22.2	5.7	12.0	0.7	11.7	6.4	11.7	5.6	0.3	1.5	0.6	0.6	0.6	0.3
SOLA3020	6.9	6.9	15.1	3.1	12.3	5.6	9.2	9.2	9.2	-	2.5	12.5	2.5	2.5	2.5	-
SOLA3507	16.8	16.8	23.6	2.6	6.9	3.2	4.8	4.3	4.8	1.6	1.1	5.7	2.3	2.3	2.3	1.1
ELEC4122	-	-	-	-	-	13.3	-	-	-	3.3	13.3	16.7	16.7	16.7	16.7	3.3
ELEC4614	18.5	18.5	28.5	5.6	10.0	5.6	4.4	4.4	4.4	-	-	-	-	-	-	-
SOLA4012	8.2	8.2	21.5	6.8	13.3	3.6	10.2	6.4	10.2	4.3	0.6	2.8	1.1	1.1	1.1	0.6
SOLA4951	6.7	6.7	12.8	7.1	11.1	7.2	4.8	4.0	4.8	2.8	1.0	20.0	3.0	3.0	3.0	2.0
SOLA4952	8.3	8.3	15.7	8.3	12.3	6.3	7.3	4.0	7.3	4.7	1.3	6.7	2.7	2.7	2.7	1.3
SOLA4953	8.3	8.3	15.7	8.3	12.3	6.3	7.3	4.0	7.3	4.7	1.3	6.7	2.7	2.7	2.7	1.3
SOLA5050	7.5	7.5	8.3	2.9	2.9	6.5	1.9	-	1.9	1.9	5.5	36.9	5.5	5.5	5.5	-
SOLA5056	3.4	3.4	17.0	8.0	13.5	7.5	7.3	5.5	7.3	2.9	1.2	14.7	2.4	2.4	2.4	1.2
SOLA5057	10.1	10.1	22.8	6.6	12.7	6.6	6.1	6.1	6.1	-	-	13.0	-	-	-	-
Cognitive Scale	16.8	16.8	11.8	4.5	6.6	4.5	4.2	3.5	4.2	3.1	2.0	10.5	3.3	3.3	3.3	1.7

1.7. REFLECTION ON STRENGTHS WEAKNESSES AND FUTURE ACTION

Strengths

From Table 1.3 it is evident that the SOLAAH steam provides good coverage of all the Engineers Australia Stage 1 Competencies for Professional Engineers. The Cognitive Scale for “Knowledge and skills base”, “Engineering application ability” and “Professional and personal attributes” are 61%, 15% and 24%, respectively. The stream is particularly strong in engineering fundamentals, in-depth technical knowledge (1.1, 1.2. 1.3) and effective communication (3.2). The SPREE IAC is satisfied that these SLOs and the mapping of competencies appropriately address the needs of the photovoltaic and solar energy industry.

Weaknesses

Overall the stream appear to have less weighting to “Engineering Application ability”. In terms of

individual competencies, the stream seems to have a relatively lower focus on ethics (3.1) and team leadership (3.6). These skills are often developed with other skills such as communication and management. This may have resulted in low Cognitive Scale score as the Cognitive Scale is shared with other skills.

Future Action

The School is in the process of reviewing degrees offered by the School. It has recently completed the review of the BE Renewable Energy Engineering. In the review of this stream, a particular focus will be given to assessing curriculum mapping and further embedding competencies in the area of engineering application, ethics and team leadership if necessary.

1.8. ASSESSMENT AND ACADEMIC INTEGRITY

A wide variety of assessments is used. It can be seen from the course assessment map (Table 1.2) that overall 48% of the assessments are in the form of quizzes and exams, 42% are in the form of laboratory activities, projects, and assignments; and the rest are in the form of other assessments. For the second year and higher level third year and fourth year courses, which cover Steam specific technical knowledge and skills, 45% of the assessments are in the form of quizzes and exams, and 50% are in the form of laboratory activities, projects, and assignments and the rest are in the form of other assessments

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.
- Due to COVID-19, all exams have been moved to online. 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.
- In some courses viva-style oral exam has also been used. The school is considering whether oral exam can be implemented more widely.
- Assignments are submitted in electronic format and are submitted through TurnItIn, which detects plagiarism or collusion.
- 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.

1.9. SUMMARY

Curriculum mapping shows that the stream provides good coverage of all the Engineers Australia Stage 1 Competencies for Professional Engineers. It is particularly strong in specialist engineering fundamentals, in-depth technical knowledge and effective communication. The SPREE IAC is satisfied that the SLOs and the mapping of competencies appropriately address the needs of the photovoltaic and solar energy industry. Although "Engineering application ability" competencies are widely embedded in the stream, overall its weighting is lower that the "Knowledge and skills base" and "Professional and personal attributes" competencies. Future directions for the stream involve working on embedding "Engineering application ability" competencies, ethics and team leadership more widely throughout the stream.

2. SOLABH Renewable Energy Engineering

2.1. INTRODUCTION

The SOLABH Bachelor of Engineering (Honours) in Renewable Energy (RE) is a four-year, full time degree. It is offered by SPREE as a stream 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 report illustrates how the SOLABH stream fosters the Engineers Australia (EA) Stage 1 Competencies for Professional Engineers in its students. In the following sections aims and stream 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.

2.2. AIMS OF THE STREAM

The specific objective of the Renewable Energy program is to educate engineers for the full range of needs of the RE and related industries. The areas include energy efficiency, photovoltaics, wind power generation, and renewable energy policy. It is a core objective of the program to produce graduates having a strong technical knowledge, skills and attributes enabling them to practice as professional engineers. In addition, graduates should be independent investigators, self-motivated, critical thinkers and problem solvers, life-long learners, good communicators, team players, effective managers as well as economically, environmentally and socially aware members of the global community.

A unique feature of this program is that from Year 2, students can select a set of 'Strand elective' courses in one of three areas to develop depth and focus to their education in Renewable Energy. These courses are available in Humanitarian and Sustainability, Low Energy Systems, and Renewable Energy Systems.

2.3. STREAM PLAN

	Term 1	**Term 2**	**Term 3**
Year 1	DESN1000 Introduction to Engineering Design and Innovation ENGG1811 Computing for Engineers MATH1131 Mathematics 1A or MATH1141 Higher Mathematics 1A	PHYS1121 Physics 1A or PHYS1131 Higher Physics 1A MATH1231 Mathematics 1B or MATH1241 Higher Mathematics 1B SOLA1070 Sustainable Energy	PHYS1221 Physics 1B or PHYS1231 Higher Physics 1B ELEC1111 Electrical Circuit Fundamental
Year 2	MATH2018 Engineering Mathematics 2D MMAN2700 Thermodynamics General Education	SOLA2051 Project in Photovoltaics and Renewable Energy MATH2089 Numerical Methods and Statistics	SOLA2540 Applied Photovoltaics DESN2000 Engineering Design and Professional Practice ENGG2500 Fluid Mechanics for Engineers
Year 3	SOLA5050 Renewable Energy Policy SOLA5053 Wind Energy Converters General Education	MECH3610 Advanced Thermofluids SOLA3010 Low Energy Buildings and Photovoltaics ELECTIVE	ELEC2911 Power Engineering for Renewable Energy ELECTIVE

Year 4	SOLA4951 Research Thesis A ELEC4122 Strategic Leadership and Ethics ELECTIVE	SOLA4952 Research Thesis B SOLA4012 Photovoltaic Systems Design SOLA5057 Energy Efficiency	SOLA4953 Research Thesis C ELECTIVE ELECTIVE

2.4. STREAM LEARNING OUTCOMES

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

Knowledge

SLO1. Show proficiency in the enabling sciences that underpin Renewable Energy (physics, mathematics and computer science), sustainability and climate change, quantify the impact of human activities on environmental systems and propose engineering solutions.

SLO2. Demonstrate proficiency of Renewable Energy specialist technical knowledge including quantifying the magnitude, variability and uncertainty of the resources underpinning renewable energy and energy systems, analysing the impact on system design, operation, performance and integration within the broader energy system.

SLO3. Critically evaluate and apply current research to the solution of problems faced in a real world context, in Renewable Energy engineering, by considering technical, economic, social and environmental implications.

Skills

SLO4. Use appropriate analytical and computational tools to analyse complex problems in renewable energy and solve by applying critical thinking and engaging with real world context.

SLO5. Design technically and economically efficient, safe and compliant renewable energy systems using knowledge of the functionality and operating principles of systems components, enabling technologies and relevant standards.

SLO6. Use plant and electricity industry data to analyse the operation and impacts of renewable and distributed energy systems and design and implement solutions to improve their performance and integration into electricity systems.

Application

SLO7. Lead and manage renewable energy projects, individually or as part of a team, in a systematic and professional manner.

SLO8. 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.

SLO9. Communicate professionally and effectively within and outside of renewable energy engineering and effectively incorporate feedback.

2.5. DEVELOPMENT OF STREAM LEARNING OUTCOMES

The development of the stream Learning Outcomes (SLOs) occurred during the review of this stream by the SPREE Program Committee consisting of the Deputy Head of School (Education), Undergraduate Course Coordinator, stream Coordinators, two academic representatives, and Director of Learning and Teaching. Another outcome of this review was the introduction of three Strands (in Humanitarian and Sustainability, Low Energy Systems, and Renewable Energy Systems). All teaching academics, students and Industry Advisory Committee (IAC) were consulted on the revision of the stream structure and their feedback was incorporated. In order to make presentation of SLOs consistent across the Engineering Faculty, SLOs were further reviewed by a working party consisting of the Deputy Head of School (Education), Director of Learning and Teaching, Undergraduate Course Coordinator, and two academic representatives. The IAC has been consulted on the modifications to

the SLOs and are satisfied that they are appropriate to address the needs of the renewable energy industry. All teaching academics have also been consulted and the modified SLOs were presented to the School Learning and Teaching Committee (L&T Comm) for further discussion and final endorsement.

2.6. CURRICULUM MAPPING

For the mapping 168 UOC courses in the stream have been used. The stream consists of 132 UOC core courses, 18 UOC Strand and 18 UOC third-year/fourth-year electives.

For the mapping the Low Energy Systems Stand has been chosen. Students take ENGG2500, MECH3610 and SOLA3010 to complete this Strand.

Similarly, for the third-year/fourth-year electives, SOLA5050 Renewable Energy Policy, SOLA5051 Life Cycle Assessment and MECH9720 Solar Thermal Energy courses have been included as they are among the most popular courses selected by the students in this stream.

Table 2.1: BE (Honours) Renewable Energy – CLO to SLO mapping

CO → SLO Mapping	Stream Learning Outcomes (SLOs)								
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8	SLO9
DESN1000	18.3	0.0	8.3	0.0	17.1	0.0	19.6	19.6	17.1
ELEC1111	80.5	0.0	11.0	8.5	0.0	0.0	0.0	0.0	0.0
ENGG1811	82.5	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0
MATH1131	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MATH1231	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PHYS1121	98.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
PHYS1221	86.7	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0
SOLA1070	13.3	13.3	23.8	5.0	6.2	0.0	6.2	0.0	32.1
DESN2000	5.0	5.0	12.5	5.0	2.7	0.0	28.7	21.2	20.0
ELEC2911	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGG2500	11.9	59.6	0.0	15.9	0.0	0.0	12.6	0.0	0.0
MATH2018	36.7	0.0	26.7	36.7	0.0	0.0	0.0	0.0	0.0
MATH2089	27.4	60.6	0.0	0.0	0.0	0.0	0.0	0.0	12.0
MMAN2700	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOLA2051	18.3	18.3	0.0	16.7	0.0	0.0	16.7	16.7	13.3
SOLA2540	0.0	61.5	5.6	16.2	8.4	0.0	2.8	2.8	2.8
MECH3610	0.0	50.0	0.0	37.5	0.0	0.0	0.0	12.5	0.0
SOLA3010	0.0	30.3	1.3	24.0	24.0	16.5	1.3	1.3	1.3
ELEC4122	0.0	0.0	0.0	0.0	0.0	0.0	16.7	66.7	16.7
SOLA4012	0.0	19.8	12.4	24.8	21.9	14.6	2.2	2.2	2.2
SOLA4951	10.0	6.7	26.7	20.0	6.7	0.0	10.0	0.0	20.0
SOLA4952	10.0	10.0	20.0	20.0	20.0	0.0	6.7	6.7	6.7
SOLA4953	6.7	20.0	26.7	16.7	10.0	0.0	6.7	6.7	6.7
SOLA5050	2.9	7.6	13.7	9.7	0.0	2.9	9.7	21.2	32.3
SOLA5051	0.0	47.3	18.7	18.7	0.0	0.0	0.0	15.3	0.0
SOLA5052	3.0	16.1	19.1	14.5	8.5	19.1	7.6	7.6	4.6
SOLA5053	27.1	40.9	13.9	3.0	3.0	3.0	3.0	3.0	3.0
SOLA5057	0.0	30.3	6.5	30.3	0.0	0.0	0.0	0.0	6.5
MECH9720	0.0	58.3	0.0	0.0	25.0	0.0	8.3	0.0	8.3

Table 2.2: BE (Honours) Renewable Energy – Course assessment map.

CO → AT Mapping	Assessment Types (AT)											
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-
ENGG1811	20	-	70	10	-	-	-	-	-	-	-	-
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-
PHYS1121	-	-	50	20	30	-	-	-	-	-	-	-
PHYS1221	-	-	50	20	30	-	-	-	-	-	-	-
SOLA1070	15	-	50	-	-	-	-	-	-	-	35	-
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-
ELEC2911	25	-	40	20	-	-	-	-	-	-	15	-
ENGG2500	20	-	80	-	-	-	-	-	-	-	-	-
MATH2018	-	-	60	-	10	-	-	-	-	-	30	-
MATH2089	-	-	60	-	20	-	-	-	-	-	20	-
MMAN2700	15	-	40	20	-	-	-	-	-	-	25	-
SOLA2051	20	-	-	20	20	-	-	-	15	25	-	-
SOLA2540	-	-	25	20	-	-	-	-	35	-	20	-
MECH3610	15	-	40	15	-	-	-	-	-	-	30	-
SOLA3010	40	-	45	-	-	-	-	-	-	-	15	-
ELEC4122	30	-	32	-	-	-	-	14	-	-	24	-
SOLA4012	-	-	-	-	-	-	-	-	85	-	15	-
SOLA4951	-	-	-	-	-	-	-	-	100	-	-	-
SOLA4952	-	-	-	-	-	-	-	-	100	-	-	-
SOLA4953	-	-	-	-	-	-	-	-	100	-	-	-
SOLA5050	-	-	40	-	-	-	-	20	40	-	-	-
SOLA5051	15	-	35	-	10	-	-	-	-	40	-	-
SOLA5052	-	-	50	10	-	-	-	-	-	20	20	-
SOLA5053	-	-	45	-	-	-	-	5	-	50	-	-
SOLA5057	40	-	40	12	-	-	-	-	-	-	8	-
MECH9720	-	-	40	-	-	-	-	-	-	50	10	-

Table 2.3: BE (Honours) Renewable Energy – CLO to EA Stage 1 Competencies for Professional Engineers curriculum mapping.

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
DESN1000	9.2	9.2	4.9	4.9	4.9	6.0	2.8	-	2.8	6.8	3.9	17.1	7.8	7.8	7.8	3.9
ELEC1111	40.2	40.2	4.5	2.8	4.5	2.8	1.7	1.7	1.7	-	-	-	-	-	-	-
ENGG1811	41.2	41.2	3.5	-	3.5	-	3.5	3.5	3.5	-	-	-	-	-	-	-
MATH1131	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MATH1231	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHYS1121	49.0	49.0	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-
PHYS1221	43.3	43.3	0.6	0.6	0.6	0.6	-	-	-	-	-	-	-	-	-	-
SOLA1070	11.1	11.1	12.4	7.0	8.0	5.9	2.0	1.0	2.0	2.3	-	32.1	1.2	1.2	1.2	1.2
DESN2000	4.2	4.2	6.2	3.6	4.6	7.4	1.4	1.0	1.4	6.2	4.2	20.0	10.0	10.0	10.0	5.7
ELEC2911	33.3	33.3	33.3	-	-	-	-	-	-	-	-	-	-	-	-	-
ENGG2500	25.8	25.8	23.1	-	3.2	-	3.2	3.2	3.2	2.5	-	-	2.5	2.5	2.5	2.5
MATH2018	18.3	18.3	14.0	6.7	14.0	6.7	7.3	7.3	7.3	-	-	-	-	-	-	-
MATH2089	33.9	33.9	20.2	-	-	-	-	-	-	-	-	12.0	-	-	-	-
MMAN2700	41.7	41.7	16.7	-	-	-	-	-	-	-	-	-	-	-	-	-
SOLA2051	15.3	15.3	9.4	-	3.3	3.3	3.3	3.3	3.3	3.3	3.3	13.3	6.7	6.7	6.7	3.3
SOLA2540	20.5	20.5	26.5	2.8	6.0	2.0	4.6	3.2	4.6	2.0	0.6	2.8	1.1	1.1	1.1	0.6
MECH3610	16.7	16.7	24.2	-	7.5	2.5	7.5	7.5	7.5	-	2.5	-	2.5	2.5	2.5	-
SOLA3010	10.1	10.1	22.5	4.3	9.1	3.9	12.1	4.8	12.1	7.6	0.3	1.3	0.5	0.5	0.5	0.3
ELEC4122	-	-	-	-	-	13.3	-	-	-	3.3	13.3	16.7	16.7	16.7	16.7	3.3
SOLA4012	6.6	6.6	21.2	6.8	11.7	6.4	11.5	5.0	11.5	7.0	0.4	2.2	0.9	0.9	0.9	0.4
SOLA4951	7.2	7.2	14.0	7.8	11.8	6.7	5.1	4.0	5.1	3.1	-	20.0	2.0	2.0	2.0	2.0
SOLA4952	8.3	8.3	15.7	8.3	12.3	6.3	7.3	4.0	7.3	4.7	1.3	6.7	2.7	2.7	2.7	1.3
SOLA4953	10.0	10.0	18.3	8.3	11.7	8.0	5.0	3.3	5.0	3.0	1.3	6.7	2.7	2.7	2.7	1.3
SOLA5050	4.0	4.0	8.5	3.4	5.4	8.2	2.5	1.9	2.5	2.5	4.2	32.3	6.2	6.2	6.2	1.9
SOLA5051	15.8	15.8	24.2	4.7	8.4	7.7	3.7	3.7	3.7	-	3.1	-	3.1	3.1	3.1	-
SOLA5052	6.9	6.9	18.3	6.2	9.1	10.1	8.1	2.9	8.1	6.7	1.5	4.6	3.0	3.0	3.0	1.5
SOLA5053	27.2	27.2	18.8	4.0	4.6	4.7	1.7	0.6	1.7	1.7	0.6	3.0	1.2	1.2	1.2	0.6
SOLA5057	10.1	10.1	17.8	1.6	7.7	1.6	6.1	6.1	6.1	-	-	6.5	-	-	-	-
MECH9720	19.4	19.4	23.6	4.2	4.2	-	4.2	-	4.2	5.8	-	8.3	1.7	1.7	1.7	1.7
Cognitive Scale	18.1	18.1	12.5	3.7	5.5	4.4	4.0	2.9	4.0	3.5	2.3	9.7	3.2	3.2	3.2	1.6

2.7. REFLECTION ON STRENGTHS WEAKNESSES AND FUTURE ACTION

Strengths

From Table 2.3 it is evident that the SOLABH steam provides good coverage of all the Engineers Australia Stage 1 Competencies for Professional Engineers. The Cognitive Scale for “Knowledge and skills base”, “Engineering application ability” and “Professional and personal attributes” are 62.3%, 14.4% and 23.2%, respectively. The stream is particularly strong in engineering fundamentals, in-depth technical knowledge (1.1, 1.2. 1.3) and effective communication (3.2). The SPREE IAC is satisfied that these SLOs and the mapping of competencies appropriately address the needs of the renewable energy industry.

Weaknesses

Overall the stream appears to have a lower weighting to “Engineering Application ability”. In terms of

individual competencies, the stream seems to have a relatively lower focus on ethics (3.1) and team leadership (3.6). These skills are often developed with other skills such as communication and management. This may have resulted in low Cognitive Scale score as the Cognitive Scale is shared with other skills.

Future Action

As stated earlier, the School is in the process of reviewing degrees offered by the School. In the review of this stream, a particular focus will be given to assessing curriculum mapping and further embedding competencies in the area of engineering application, ethics and team leadership if necessary.

2.8. ASSESSMENT AND ACADEMIC INTEGRITY

A wide variety of assessments is used. It can be seen from the course assessment map (Table 2.2) that overall 46% of the assessments are in the form of quizzes and exams, 43% are in the form of laboratory activities, projects, and assignments; and the rest are in the form of other assessments. For the second year and higher level third year and fourth year courses, which cover Steam specific technical knowledge and skills, 43% of the assessments are in the form of quizzes and exams, and 51% are in the form of laboratory activities, projects, and assignments and the rest are in the form of other assessments.

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.
- Due to COVID-19, all exams have been moved to online. 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.
- In some courses viva-style oral exam has also been used. The school is considering whether oral exam can be implemented more widely.
- Assignments are submitted in electronic format and are submitted through TurnItIn, which detects plagiarism or collusion.
- 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.

2.9. SUMMARY

Curriculum mapping shows that the stream provides good coverage of all the Engineers Australia Stage 1 Competencies for Professional Engineers. It is particularly strong in specialist engineering fundamentals, in-depth technical knowledge and effective communication. The SPREE IAC is satisfied that the SLOs and the mapping of competencies appropriately address the needs of the renewable energy industry. Although "Engineering application ability" competencies are widely embedded in the stream, overall its weighting is lower that the "Knowledge and skills base" and "Professional and personal attributes" competencies. Future direction for the stream involves working on embedding "Engineering application ability" competencies, ethics and team leadership more widely throughout the stream.

3. SOLAGS Renewable Energy Engineering

3.1. INTRODUCTION

The SOLAGS Master of Engineering in Renewable Energy (RE) is a two-year, full time degree. It is offered by SPREE as a stream of the UNSW 8621 Master of Engineering program. It is an AQF Level 9 qualification and provides graduates with specialist knowledge and skills for professional and/ or further learning. This report illustrates how the SOLAGS stream fosters the Engineers Australia (EA) Stage 1 Competencies for Professional Engineers in its students. In the following sections aims and stream 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.

3.2. AIMS OF THE STREAM

The Master of Engineering in Renewable Energy enables students to specialise and gain in-depth knowledge in areas related to renewable energy technologies, systems engineering, and energy efficiency.

3.3. STREAM PLAN

	Term 1	**Term 2**	**Term 3**
Year 1	SOLA9001 Photovoltaics SOLA5053 Wind Energy Converters Disciplinary Course (SOLA5050)	SOLA4012 Photovoltaic Systems Design GSOE9017 Managing Energy Efficiency	SOLA5051 Life Cycle Assessment Disciplinary Course (SOLA5052) Advanced disciplinary Course (SOLA9104)
Year 2	SOLA9451 Master Project A Advanced disciplinary Course (ELEC9715) Technical Management (GSOE9510 Ethics and Leadership in Engineering)	SOLA9452 Master Project B SOLA9103 Renewable Energy System Modelling & Analysis Technical Management (GSOE9820 Engineering Project Management)	SOLA9453 Master Project C SOLA9105 Renewable Energy System Design GSOE9111 Energy Storage

3.4. STREAM LEARNING OUTCOMES

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

Knowledge

SLO1. Demonstrate proficiency of Renewable Energy specialist technical knowledge including quantifying the magnitude, variability and uncertainty of the resources underpinning renewable energy and energy systems.

SLO2. Critically evaluate and apply current research to the solution of problems in a real world context in Renewable Energy engineering by considering technical, economic, social and environmental implications.

Skills

SLO3. Apply appropriate analytical and computational tools to analyse complex problems in renewable energy and solve by applying critical thinking and engaging with real world context.

SLO4. Design and evaluate technically and economically efficient, safe and compliant renewable energy systems using knowledge of the functionality and operating principles of systems components, enabling technologies and relevant standards.

Application

SLO5. Lead and manage renewable energy projects, individually or as part of a team, in a systematic and professional manner.

SLO6. 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.

SLO7. Communicate professionally and effectively within and outside of renewable energy engineering and effectively incorporate feedback.

3.5. DEVELOPMENT OF STREAM LEARNING OUTCOMES

Initial development of the SLOs occurred during the development of this stream. SLOs have been recently reviewed by a working group consisting of the Deputy Head of School (Education), Director of Learning and Teaching, Undergraduate Course Coordinator, and two academic representatives. The IAC has been consulted on the modifications to the SLOs and are satisfied that they are appropriate to address the needs of the renewable energy industry. All teaching academics have also been consulted and the modified SLOs were presented to the School Learning and Teaching Committee (L&T Comm) for further discussion and final endorsement.

3.6. CURRICULUM MAPPING

The SOLAGS stream consists of 96 UOC courses (2-year full time equivalent) comprising of 60 UOC core courses. Besides students select 12 UOC Disciplinary, 12 UOC Advanced Disciplinary and 12 UOC Technical and Management courses for the given list of courses.

For the mapping, SOLA5050 Renewable Energy Policy and SOLA5052 Bioenergy and Renewable Fuels for Disciplinary; ELEC9715 Electricity Industry Operation and Control and SOLA9104 Hybrid Renewable Energy System for Advanced Disciplinary; and GSOE9510 Ethics and Leadership in Engineering and GSOE9820 Engineering Project Management for Technical and Management have been included as they are among the most popular courses selected by the students in this stream.

Table 3.1: ME Renewable Energy – CLO to SLO mapping

CO → SLO Mapping	Stream Learning Outcomes (SLOs)						
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7
SOLA4012	32.1	12.4	24.8	22.5	2.8	2.8	2.8
SOLA5050	4.3	15.9	13.4	0.0	11.2	27.3	27.8
SOLA5051	47.3	18.7	18.7	0.0	0.0	15.3	0.0
SOLA5052	20.4	24.6	19.1	11.0	9.7	9.7	5.5
SOLA5053	27.1	41.9	14.9	4.0	4.0	4.0	4.0
ELEC9715	27.9	23.8	20.8	0.0	0.0	18.3	9.2
GSOE9017	30.3	26.3	30.3	0.0	0.0	0.0	13.0
GSOE9111	21.9	21.9	0.0	21.2	13.1	0.0	21.9
GSOE9510	0.0	0.0	0.0	0.0	33.3	33.3	33.3
GSOE9820	0.0	16.1	8.6	0.0	54.9	12.9	7.5
SOLA9001	38.0	14.0	19.0	2.5	2.5	2.5	2.5
SOLA9103	36.7	10.0	16.7	0.0	0.0	0.0	6.7
SOLA9104	54.0	11.5	3.0	28.5	0.0	3.0	0.0
SOLA9105	0.0	10.3	25.7	15.4	5.4	5.4	37.8
SOLA9451	33.3	0.0	33.3	0.0	0.0	0.0	33.3
SOLA9452	33.3	0.0	16.7	16.7	11.1	11.1	11.1
SOLA9453	33.3	0.0	16.7	16.7	11.1	11.1	11.1

Table 3.2: ME Renewable Energy – Course assessment map.

CO → AT Mapping	Assessment Types (AT)											
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut
SOLA4012	-	-	-	-	-	-	-	-	85	-	15	-
SOLA5050	-	-	40	-	-	-	-	20	40	-	-	-
SOLA5051	15	-	35	-	10	-	-	-	-	40	-	-
SOLA5052	-	-	50	10	-	-	-	-	-	20	20	-
SOLA5053	-	-	45	-	-	-	-	5	-	50	-	-
ELEC9715	-	-	50	-	15	-	-	-	25	-	10	-
GSOE9017	40	-	40	12	-	-	-	-	-	-	8	-
GSOE9111	-	-	-	-	-	-	-	40	-	45	15	-
GSOE9510	-	-	50	-	50	-	-	-	-	-	-	-
GSOE9820	50	-	40	-	-	-	-	-	-	-	10	-
SOLA9001	-	-	25	20	-	-	-	-	35	-	20	-
SOLA9103	10	-	40	-	-	-	-	-	-	50	-	-
SOLA9104	40	-	-	-	-	-	-	-	60	-	-	-
SOLA9105	-	-	-	-	-	-	-	-	90	-	10	-
SOLA9451	-	-	-	-	-	-	-	-	100	-	-	-
SOLA9452	-	-	-	-	-	-	-	-	100	-	-	-
SOLA9453	-	-	-	-	-	-	-	-	100	-	-	-

Table 3.3: ME Renewable Energy – CLO to EA Stage 1 Competencies for Professional Engineers curriculum mapping.

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
SOLA4012	10.7	10.7	22.5	6.8	11.8	3.6	8.7	5.0	8.7	4.3	0.6	2.8	1.1	1.1	1.1	0.6
SOLA5050	1.4	1.4	8.1	4.0	6.7	9.4	2.7	2.7	2.7	2.2	5.5	27.8	7.7	7.7	7.7	2.2
SOLA5051	15.8	15.8	24.2	4.7	8.4	7.7	3.7	3.7	3.7	-	3.1	-	3.1	3.1	3.1	-
SOLA5052	6.8	6.8	18.6	8.0	11.8	8.1	5.7	3.8	5.7	3.8	1.9	5.5	3.9	3.9	3.9	1.9
SOLA5053	9.0	9.0	23.2	11.2	14.1	11.3	3.6	3.0	3.6	1.5	0.8	4.0	1.6	1.6	1.6	0.8
ELEC9715	9.3	9.3	19.4	5.9	10.1	9.6	4.2	4.2	4.2	-	3.7	9.2	3.7	3.7	3.7	-
GSOE9017	10.1	10.1	22.8	6.6	12.7	6.6	6.1	6.1	6.1	-	-	13.0	-	-	-	-
GSOE9111	7.3	7.3	16.3	9.0	9.0	5.5	3.5	-	3.5	6.2	-	21.9	2.6	2.6	2.6	2.6
GSOE9510	-	-	-	-	-	6.7	-	-	-	6.7	6.7	33.3	13.3	13.3	13.3	6.7
GSOE9820	-	-	5.7	4.0	5.7	6.6	1.7	1.7	1.7	11.0	2.6	7.5	13.6	13.6	13.6	11.0
SOLA9001	12.7	12.7	20.4	3.9	7.7	4.0	4.2	3.8	4.2	0.9	0.5	2.5	1.0	1.0	1.0	0.5
SOLA9103	12.2	12.2	18.1	2.5	5.8	2.5	3.3	3.3	3.3	-	-	6.7	-	-	-	-
SOLA9104	18.0	18.0	26.2	7.6	8.2	3.5	5.3	0.6	5.3	4.8	0.6	-	0.6	0.6	0.6	-
SOLA9105	-	-	10.3	5.1	10.3	3.7	7.7	5.1	7.7	3.7	1.1	37.8	2.2	2.2	2.2	1.1
SOLA9451	11.1	11.1	17.8	-	6.7	-	6.7	6.7	6.7	-	-	33.3	-	-	-	-
SOLA9452	11.1	11.1	17.2	2.8	6.1	2.2	6.1	3.3	6.1	5.0	2.2	11.1	4.4	4.4	4.4	2.2
SOLA9453	11.1	11.1	17.2	2.8	6.1	2.2	6.1	3.3	6.1	5.0	2.2	11.1	4.4	4.4	4.4	2.2
Cognitive Scale	9.4	9.4	16.1	5.1	7.9	5.2	4.5	3.4	4.5	4.1	2.2	13.6	4.0	4.0	4.0	2.6

3.7. REFLECTION ON STRENGTHS WEAKNESSES AND FUTURE ACTION

Strengths

From Table 3.3 it is evident that the SOLAGS steam provides good coverage of all the Engineers Australia Stage 1 Competencies for Professional Engineers. The Cognitive Scale for "Knowledge and skills base", "Engineering application ability" and "Professional and personal attributes" are 53.1%, 13.5% and 30.4%, respectively. The stream is particularly strong in engineering fundamentals, in-depth technical knowledge (1.1, 1.2. 1.3) and effective communication (3.2). The SPREE IAC is satisfied that these SLOs and the mapping of competencies appropriately address the needs of the renewable energy industry.

Weaknesses

Overall the SOLAGS stream appear to have less weighting for "Engineering Application ability". In terms of individual competencies, the stream seems to have relatively lower focus on ethics (3.1) and team leadership (3.6). These skills are often developed with other skills such as communication and management. This may have resulted in low Cognitive Scale score as the Cognitive Scale is shared with other skills.

Future Action

As stated earlier, the School is in the process of process of reviewing degrees offered by the School. In the review of this stream, a particular focus will be given to assessing curriculum mapping and further embedding competencies in the area of engineering application, ethics and team leadership if necessary.

3.8. ASSESSMENT AND ACADEMIC INTEGRITY

A wide variety of assessments is used. It can be seen from the course assessment map (Table 3.2) that overall 31% of the assessments are in the form of quizzes and exams, 65% are in the form of laboratory activities, projects, and assignments; and the rest are in the form of other assessments. 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.
- Due to COVID-19, all exams have been moved to online. 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.
- In some courses viva-style oral exam has also been used. The school is considering whether oral exam can be implemented more widely.
- Assignments are submitted in electronic format and are submitted through TurnItIn, which detects plagiarism or collusion.
- 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.

3.9. SUMMARY

Curriculum mapping shows that the stream provides good coverage of all the Engineers Australia Stage 1 Competencies for Professional Engineers. It is strong in competencies related to the "Knowledge and skills base" and "Professional and personal attributes", particularly engineering fundamentals, in-depth technical knowledge and effective communication. The SPREE IAC is satisfied that the SLOs and the mapping of competencies appropriately address the needs of the renewable energy industry. Although "Engineering application ability" competencies are widely embedded in the

stream, overall its weighting is lower that the “Knowledge and skills base” and “Professional and personal attributes” competencies. Future direction for the stream involves working on embedding “Engineering application ability” competencies, ethics and team leadership more widely throughout the stream.