BE Electrical Engineering (ELECAH3707)

1. Introduction

This report is in response to Engineers Australia (EA) M1 requirements regarding the curriculum mapping of the ELECAH Electrical Engineering stream of the 3707 Bachelor of Engineering (Honours) program. Firstly, it presents the aims of this stream, its structure and uniqueness. The stream comprises a suite of courses, each plays a role in achieving the overall objectives and this is revealed through the mapping between the Course Learning Outcomes (CLOs) and the Stream Learning Outcomes (SLOs). These SLOs in turn are then mapped to EA Stage 1 Graduate Competencies which completes the CLO/SLO/EA competency chain and from which curriculum mapping from the course level to the EA competencies is obtained. Finally, the strengths and weaknesses of the stream are drawn from these mapping results and an action plan to strengthen the stream is presented.

2. Aims of the stream

The Electrical Engineering stream prepares students with advanced theoretical and technical knowledge, cognitive and communication skills in accordance with AQF level 8, for a broad and creative profession concerned with the design, development, planning and management of systems and devices which underpin modern economics and contribute to the quality of life.

An Electrical Engineer may be responsible for the research, design, development, manufacturing and management of complex hardware and software systems and reliable, cost-effective electrical/electronic devices, many involving the use of new information and computer-intensive technologies. These include computer systems; data telecommunication networks including the internet; mobile communications and wireless networks; integrated electronic systems; control systems, advanced robotics and intelligent machines; video and image processing systems; generation, transmission, distribution and utilisation of electrical power; renewable energy systems and solar energy conversion; biomedical equipment and devices, such as medical imaging scanners, pacemaker implants and hearing aids.

The stream design and delivery put emphasis on rigorous engineering analytical and practical skills, design and innovation, both within and external to the curriculum, to ensure that our graduates have the complete fundamental skill set required for a successful industry career, including at the cutting edge of R&D, innovation and technical leadership. Our innovative and unique final-year Design Proficiency course acts as a form of quality control on students' technical knowledge and skills.

The stream structure and recommended study plan is shown in Table 1. It comprises 26 core courses (8 Level 1, 6 Level 2, 7 Level 3, and 5 Level 4), 5 elective courses (1 Level 3 Breadth elective, and 4 Level 4 Practice electives), 2 General Education courses, and Industrial Training (60 days). Flexibility and choice are maintained throughout the entire structure by providing many elective courses.

Year	Term	Course	Course name
1	1	ELEC1111	Electrical Circuit Fundamentals
		MATH1131	Maths 1A (or MATH1141 Higher Maths 1A)
		DESN1000	Introduction to Engineering Design & Innovation
	2	COMP1511	Intro. to Programming (or COMP1911 Computing 1A)
		MATH1231	Maths 1B (or MATH1241 Higher Maths 1B)
		PHYS1131	Higher Physics 1A
	3	COMP1521	Computer Systems Fundamentals
		MATH2069	Maths 2A
		PHYS1231	Higher Physics 1B
2	1	ELEC2134	Circuits and Signals
		ELEC2141	Digital Circuit Design
		GENxxxx	General Education
	2	ELEC2133	Analogue Electronics
		MATH2099	Maths 2B
		DESN2000	Engineering Design and Professional Practice
	3	ELEC3104	Digital Signal Processing
		L3 elective	choose from L3 elective list
		GENxxxx	General Education
3	1	ELEC3106	Electronics
		ELEC3115	Electromagnetic Engineering
		TELE3113	Analogue & Digital Communications
	2	ELEC3105	Electrical Energy
		ELEC3114	Control Systems
		ELEC3117	Electrical Engineering Design
	3	Industrial Training or International Exchange	
4	1	ELEC4951	Thesis A
		ELEC4122	Strategic Leadership and Ethics
		L4 elective	choose from L4 elective list
	2	ELEC4952	Thesis B
		L4 elective	choose from L4 elective list
		L4 elective	choose from L4 elective list
	3	ELEC4953	Thesis C
		ELEC4123	Electrical Design Proficiency
		L4 elective	choose from L4 elective list

Table 1: ELECAH3707 Stream – Recommended Study Plan

3. Stream Learning Outcomes (SLOs)

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

1. Demonstrate a rigorous understanding of the fundamental principles embodied in Electrical Engineering.
2. Identify, select, and apply specialist in-depth technical knowledge and current research, in electrical energy systems, electronics, control systems, signal processing and communications technology.
3. Think independently, critically, logically and apply analytical procedures and tools to develop complex hardware and software electrical systems.
4. Proficiently apply problem-solving and design skills to demanding, open-ended electrical design challenges and the creation of products.
5. Demonstrate a professional aptitude concerning the role of engineers in society and a well-developed, respectful, responsible ethic including safety, privacy, security, environmental concerns, and human rights.
6. Communicate technical and non-technical concepts fluently and effectively with all stakeholders in document and verbal form, whether as part of a project team or in a leadership context.

4. Development of SLOs

The SLOs were developed through rigorous internal consultations (School and Engineering Faculty). In the first stage at the school level, working groups were formed with members of academic teaching staff from various disciplinary areas to formulate the SLOs. The SLOs were reviewed by the School Academic Executive Committee. External consultations were then sought from the School Industry Advisory Board for their advice and feedback, particularly the expectation of industry with regards to graduate capabilities. The Faculty of Engineering Academic Programs Committee reviewed and approved the SLOs before the final approval by the Faculty Board. The developed SLOs were shared and discussed with all teaching staff in the school through a School Board meeting.

5. Curriculum Mapping

At the course level, the course coordinators develop their course outlines (COs) to articulate the course's context and relevance within the program. Each CO includes details about the course learning outcomes (CLOs) which lists the knowledge, attitudes, skills, and practices that students are expected to acquire and demonstrate after completing that course. Each CO also specifies the various assessments (exam, quiz, lab work, assignment, etc) to validate attainment of the CLOs. UNSW Assessment Policy prescribes that each course can have up to four main assessment components of varying weightings and each component may comprise several sub-components. The assessment weightings and the mapping of the assessments to the CLOs are developed by the course coordinators and provided in the COs for precision and transparency in the course design and assessment. A web-based platform (ACOA) developed by UNSW Engineering Faculty is used for constructing the COs so that CLOs, assessments, and other key course information can be easily found, and in a consistent format across all courses.

The cognitive scales for each CLO in a course are calculated by aggregating the weighted assessment contributions, using a curriculum mapping tool (CMAP) developed by UNSW Engineering Faculty. An example is shown in Table 2 for the ELEC1111 course which has 4 assessment components and 7 CLOs. CLO1 is the most important learning outcome in this course and its cognitive scale indicates the assessments correctly put emphasis on attainment of this CLO.

The mapping of the CLOs to the 12 different Assessment types are shown in Table 3. All the core courses together with a representative range of elective courses are shown in the table.

At the stream level, the course coordinators provide the mapping of the CLOs to the SLOs for their courses. The mapping results are shown in Table 4.

The SLOs in turn are mapped to the 16 EA Stage 1 Competencies. This mapping was done by expert working groups in the school with review and final endorsement from the Academic Executive Committee. The SLO/EA mapping is shown in Table 5.

As the stream specifies a quota of electives to be taken, the more popular electives (large enrolment) are included in the mapping to complete the CLO/SLO/EA Competency chain and the overall curriculum mapping results are shown in Table 6.

The final cognitive scale (last row in Table 6) reveals the percentage coverage of the stream for each of the 16 EA Competencies. Table 7 aggregates these and shows the percentage coverage of the stream for each of the 3 competency categories: 53% on Knowledge and skill base (PE1), 24% on Engineering application ability (PE2), and 23% on Professional and personal attributes (PE3).

Core | Learning Outcomes | Assessment | AS→CLO Mapping | CLO→SLO Mapping

AS → CLO Mapping	Learning Outcomes (CLO)						
Assessments (AS)	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
As1 Midterm Exam (20%)	✓	✓	✓	-	-	✓	-
As2 Weekly Online Quizzes (15%)	✓	✓	✓	✓	-	✓	-
As3 Final Exam (45%)	✓	✓	✓	✓	-	✓	-
As4 Laboratory Assessment and Exam (20%)	✓	-	-	✓	✓	-	✓
Cognitive Scale	22.0	17.0	17.0	17.0	5.0	17.0	5.0

Table 2: Mapping from Assessments to CLOs for ELEC1111 course

ELECAH Electrical Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → AT Mapping

Courses (CO)	Assessment Types (AT)												
	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut	
COMP1511	26	-	54	13	-	-	-	-	-	-	7	-	L1 core courses
COMP1521	20	-	60	10	-	-	-	-	-	-	10	-	
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-	
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-	
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-	
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-	
PHYS1131	-	-	50	20	30	-	-	-	-	-	-	-	
PHYS1231	-	-	50	20	30	-	-	-	-	-	-	-	
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-	L2 core courses
ELEC2133	15	-	85	-	-	-	-	-	-	-	-	-	
ELEC2134	-	-	80	20	-	-	-	-	-	-	-	-	
ELEC2141	25	-	55	20	-	-	-	-	-	-	-	-	
MATH2069	-	-	60	-	-	-	-	-	-	-	40	-	
MATH2099	-	-	60	-	18	-	-	-	-	-	23	-	
ELEC3104	-	-	50	-	-	-	-	-	30	-	20	-	L3 core courses
ELEC3105	10	-	65	20	-	-	-	-	-	-	5	-	
ELEC3106	10	-	60	15	-	-	-	-	-	-	15	-	
ELEC3114	-	-	70	20	-	-	-	-	-	-	10	-	
ELEC3115	15	-	55	15	-	-	-	-	-	-	15	-	
ELEC3117	-	-	30	5	-	-	-	25	-	40	-	-	
TELE3113	-	-	60	20	-	-	-	-	-	-	20	-	
ELEC4122	30	-	32	-	-	-	-	14	-	-	24	-	L4 core courses
ELEC4123	-	-	-	46	10	-	-	-	-	15	29	-	
ELEC4951	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4952	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4953	-	-	-	-	-	-	-	-	100	-	-	-	
ENGG2600	-	-	-	-	25	-	-	15	60	-	-	-	L3 Breadth Electives
COMP3211	-	-	40	-	40	-	-	-	-	-	20	-	
COMP3231	40	-	60	-	-	-	-	-	-	-	-	-	
ELEC3111	30	-	50	20	-	-	-	-	-	-	-	-	
ELEC3145	-	-	60	25	-	-	-	-	-	-	15	-	
ENGG3001	-	20	-	-	10	-	-	20	-	50	-	-	
ELEC4445	-	10	40	-	-	-	-	-	-	25	25	-	L4 Practice Electives
ELEC4601	10	-	60	30	-	-	-	-	-	-	-	-	
ELEC4602	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4603	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4604	-	-	60	-	-	-	-	-	-	20	20	-	
ELEC4611	-	-	85	10	-	-	-	-	-	5	-	-	
ELEC4612	-	-	50	20	30	-	-	-	-	-	-	-	
ELEC4613	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4614	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4617	-	-	60	20	-	-	-	-	-	-	20	-	
ELEC4621	-	-	50	30	-	-	-	-	-	-	20	-	
ELEC4622	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4623	-	-	50	20	20	-	-	-	10	-	-	-	
ELEC4631	-	-	76	12	-	-	-	-	-	-	12	-	
ELEC4632	-	-	60	20	-	-	-	-	-	-	20	-	

Table 3: Mapping from CLOs to Assessment Types

ELECAH Electrical Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → SLO Mapping	Stream Learning Outcomes (SLOs)						
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	
COMP1511	50.0	0.0	50.0	0.0	0.0	0.0	
COMP1521	63.6	0.0	25.6	10.8	0.0	0.0	
DESN1000	9.2	0.0	15.2	30.4	0.0	45.2	
ELEC1111	80.5	11.0	8.5	0.0	0.0	0.0	L1 core courses
MATH1131	64.4	0.0	23.9	0.0	0.0	11.7	
MATH1231	64.4	0.0	23.9	0.0	0.0	11.7	
PHYS1131	48.3	0.0	48.3	0.0	0.0	3.3	
PHYS1231	48.1	0.0	48.1	0.0	0.0	3.7	
DESN2000	7.5	14.0	7.5	31.0	20.0	20.0	
ELEC2133	38.6	38.6	11.4	11.4	0.0	0.0	
ELEC2134	22.9	35.4	35.4	0.0	0.0	6.2	L2 core courses
ELEC2141	24.6	24.6	24.6	12.1	2.1	12.1	
MATH2069	77.1	0.0	22.9	0.0	0.0	0.0	
MATH2099	71.8	0.0	28.3	0.0	0.0	0.0	
ELEC3104	44.4	8.3	19.4	8.3	0.0	19.4	
ELEC3105	23.8	17.5	23.8	23.8	0.0	11.2	
ELEC3106	63.2	0.0	12.2	12.2	0.0	12.2	
ELEC3114	22.8	32.6	32.6	9.8	2.2	0.0	L3 core courses
ELEC3115	33.3	33.3	33.3	0.0	0.0	0.0	
ELEC3117	13.2	21.9	25.9	25.9	9.2	4.0	
TELE3113	25.0	19.4	19.4	36.1	0.0	0.0	
ELEC4122	0.0	0.0	0.0	0.0	80.0	20.0	
ELEC4123	18.8	18.8	18.8	18.8	12.5	12.5	
ELEC4951	10.0	14.0	24.0	24.0	14.0	14.0	L4 core courses
ELEC4952	10.0	14.0	24.0	24.0	14.0	14.0	
ELEC4953	10.0	14.0	24.0	24.0	14.0	14.0	
ENGG2600	2.9	0.0	16.4	23.7	0.0	57.0	
COMP3211	0.0	31.7	31.7	6.7	0.0	30.0	
COMP3231	0.0	50.0	50.0	0.0	0.0	0.0	
ELEC3111	36.8	14.2	24.5	9.0	0.0	15.5	L3 Breadth Electives
ELEC3145	15.6	28.1	28.1	28.1	0.0	0.0	
ENGG3001	0.0	0.0	0.0	0.0	90.0	10.0	
ELEC4445	0.0	0.0	8.1	12.0	39.9	39.9	
ELEC4601	12.5	37.5	25.0	25.0	0.0	0.0	
ELEC4602	29.6	50.9	7.5	3.1	0.0	8.8	
ELEC4603	37.6	37.6	15.1	0.0	0.0	9.6	
ELEC4604	10.6	26.4	36.9	15.6	0.0	10.6	
ELEC4611	12.1	31.6	19.5	19.5	5.2	12.1	
ELEC4612	17.9	17.9	17.9	10.8	17.9	17.9	
ELEC4613	29.2	29.2	29.2	12.5	0.0	0.0	L4 Practice Electives
ELEC4614	33.3	33.3	33.3	0.0	0.0	0.0	
ELEC4617	24.4	24.4	24.4	24.4	0.0	2.2	
ELEC4621	0.0	47.9	22.9	14.6	0.0	14.6	
ELEC4622	25.8	41.9	16.1	16.1	0.0	0.0	
ELEC4623	11.7	21.7	41.7	5.0	20.0	0.0	
ELEC4631	32.3	32.3	35.3	0.0	0.0	0.0	
ELEC4632	9.9	61.3	8.6	8.6	1.7	9.9	

Table 4: Mapping from CLOs to SLOs

Stream Learning Outcomes (SLOs)	Engineers Australia Stage 1 Competencies															
	1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
	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
1	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-	-
4	-	-	-	-	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓
5	-	-	-	-	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
6	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓

Table 5: Mapping of SLOs to EA Competencies

ELECAH Electrical Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

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
COMP1511	25.0	25.0	-	-	-	-	16.7	16.7	16.7	-	-	-	-	-	-	-
COMP1521	31.8	31.8	-	-	1.2	-	9.7	9.7	9.7	1.2	-	1.2	1.2	1.2	-	1.2
DESN1000	4.6	4.6	-	-	3.4	-	8.4	8.4	8.4	3.4	-	14.7	3.4	14.7	11.3	14.7
ELEC1111	40.2	40.2	3.7	3.7	3.7	-	2.8	2.8	2.8	-	-	-	-	-	-	-
MATH1131	32.2	32.2	-	-	-	-	8.0	8.0	8.0	-	-	2.9	-	2.9	2.9	2.9
MATH1231	32.2	32.2	-	-	-	-	8.0	8.0	8.0	-	-	2.9	-	2.9	2.9	2.9
PHYS1131	24.2	24.2	-	-	-	-	16.1	16.1	16.1	-	-	0.8	-	0.8	0.8	0.8
PHYS1231	24.1	24.1	-	-	-	-	16.0	16.0	16.0	-	-	0.9	-	0.9	0.9	0.9
DESN2000	3.8	3.8	4.7	4.7	8.1	4.0	5.9	5.9	5.9	3.4	4.0	8.4	3.4	12.4	9.0	12.4
ELEC2133	19.3	19.3	12.9	12.9	14.1	-	5.1	5.1	5.1	1.3	-	1.3	1.3	1.3	-	1.3
ELEC2134	11.5	11.5	11.8	11.8	11.8	-	11.8	11.8	11.8	-	-	1.6	-	1.6	1.6	1.6
ELEC2141	12.3	12.3	8.2	8.2	9.5	0.4	9.5	9.5	9.5	1.3	0.4	4.4	1.3	4.8	3.4	4.8
MATH2069	38.5	38.5	-	-	-	-	7.6	7.6	7.6	-	-	-	-	-	-	-
MATH2099	35.9	35.9	-	-	-	-	9.4	9.4	9.4	-	-	-	-	-	-	-
ELEC3104	22.2	22.2	2.8	2.8	3.7	-	7.4	7.4	7.4	0.9	-	5.8	0.9	5.8	4.9	5.8
ELEC3105	11.9	11.9	5.8	5.8	8.5	-	10.6	10.6	10.6	2.6	-	5.5	2.6	5.5	2.8	5.5
ELEC3106	31.6	31.6	-	-	1.4	-	5.4	5.4	5.4	1.4	-	4.4	1.4	4.4	3.1	4.4
ELEC3114	11.4	11.4	10.9	10.9	12.0	0.4	12.0	12.0	12.0	1.1	0.4	1.1	1.1	1.5	0.4	1.5
ELEC3115	16.7	16.7	11.1	11.1	11.1	-	11.1	11.1	11.1	-	-	-	-	-	-	-
ELEC3117	6.6	6.6	7.3	7.3	10.2	1.8	11.5	11.5	11.5	2.9	1.8	3.9	2.9	5.7	2.8	5.7
TELE3113	12.5	12.5	6.5	6.5	10.5	-	10.5	10.5	10.5	4.0	-	4.0	4.0	4.0	-	4.0
ELEC4122	-	-	-	-	-	16.0	-	-	-	-	16.0	5.0	-	21.0	21.0	21.0
ELEC4123	9.4	9.4	6.2	6.2	8.3	2.5	8.3	8.3	8.3	2.1	2.5	5.2	2.1	7.7	5.6	7.7
ELEC4445	-	-	-	-	1.3	8.0	4.0	4.0	4.0	1.3	8.0	11.3	1.3	19.3	18.0	19.3
ELEC4602	14.8	14.8	17.0	17.0	17.3	-	2.9	2.9	2.9	0.3	-	2.6	0.3	2.6	2.2	2.6
ELEC4614	16.7	16.7	11.1	11.1	11.1	-	11.1	11.1	11.1	-	-	-	-	-	-	-
ELEC4617	12.2	12.2	8.1	8.1	10.9	-	10.9	10.9	10.9	2.7	-	3.3	2.7	3.3	0.6	3.3
ELEC4632	5.0	5.0	20.4	20.4	21.4	0.3	3.8	3.8	3.8	1.0	0.3	3.4	1.0	3.8	2.8	3.8
ELEC4951	5.0	5.0	4.7	4.7	7.3	2.8	10.7	10.7	10.7	2.7	2.8	6.2	2.7	9.0	6.3	9.0
ELEC4952	5.0	5.0	4.7	4.7	7.3	2.8	10.7	10.7	10.7	2.7	2.8	6.2	2.7	9.0	6.3	9.0
ELEC4953	5.0	5.0	4.7	4.7	7.3	2.8	10.7	10.7	10.7	2.7	2.8	6.2	2.7	9.0	6.3	9.0
Cognitive Scale	14.6	14.6	7.0	7.0	7.1	3.1	7.5	7.5	7.5	1.7	3.1	3.6	1.7	5.0	4.3	5.0

Table 6: Mapping of ELECAH3707 courses to EA Competencies

Engineers Australia Stage 1 Competencies																
1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes						
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	
14.6	14.6	7.0	7.0	7.1	3.1	7.5	7.5	7.5	1.7	3.1	3.6	1.7	5.0	4.3	5.0	
53						24				23						

Table 7: Overall mapping of ELECAH3707 stream to EA Competencies

6. Reflection and Future Action

The SLOs were developed specifically for this stream but closely align with the overarching EA Stage 1 Competencies (Table 5). The first 2 SLOs are about acquiring the particular knowledge and skill base which align with the EA PE1 Competencies. The next 2 SLOs are about engineering applications (EA PE2) while the last 2 SLOs address the professional and personal attributes (PE3). The alignment is reflected in similar heatmaps between the stream (Table 4) and program (Table 6) levels.

Overall, as a stream, all the EA competencies are well covered, with a greater emphasis on the Knowledge and Skill Base PE1 competencies, particularly PE1.1 and PE1.2. This is expected given that ELECAH3707 is a fundamental, undergraduate program. The Academic Executive Committee felt that a split of roughly 50% (PE1), 25% (PE2) and 25% (PE3) is a fair reflection of the objectives of the undergraduate program.

Engineering Management Application PE2.4 and Creative/Innovative Attribute PE3.3 appear to be less emphasised in the heatmap. This can be traced back to the SLOs: SLO4 is the only one that links to these two competencies. Furthermore, it can be observed that SLO4 covers a wide range of EA competencies which highlights the importance of embedding design in the curriculum. Note that students actually have more elective choices in the stream that can increase their opportunities for creativity and project management, e.g., Vertically Integrated Projects, Humanitarian Engineering, Student Initiated Projects. These are part of the real-world, project-based multi-disciplinary education initiatives by the Engineering Faculty. Such courses were recently introduced, hence not yet sufficiently popular to be counted as representative electives in the overall curriculum mapping.

Early in the program, many core courses are very much focused on the Knowledge and Skill Base (PE1) but compensated by the Design courses (DESN1000, DESN2000) which put emphasis on Engineering Applications (PE2) and Professional/Personal Attributes (PE3). This is further consolidated by more advanced Design courses (ELEC3117, ELEC4123) later in the program. Final-year electives and thesis tend to develop much a broader mix of competencies, as would be expected.

The heatmap also reflects that since the 2016 Engineers Australia Accreditation, the fractions of competencies within Engineering Applications (PE2) and Professional/Personal Attributes (PE3) have increased, which was a response to industry/alumni feedback shown in the Self-Study report (Appendix H) submitted in 2021.

From Table 3, assessments for most courses rely heavily on exams (mid-term and final). The other forms of assessments include take-home assignments, lab skills assessments and lab reports. Teamwork skills assessments are becoming more popular in recent years as seen in Table 7 (PE3.5). Enquiry-based learning courses include thesis work and design proficiency that have various assessments like seminar presentations, design concept mapping, reports, poster presentation and design showcase.

To ensure academic integrity, all final exam papers are reviewed by another academic with relevant technical knowledge and then a final review of the papers is done by the Director of Academic Studies. Thesis reports are submitted using TurnItIn for checking against plagiarism, and they are blind marked by two academics to ensure consistency. A third assessor is utilised if there is a discrepancy of larger than ten marks. For online written exams, various approaches have been adopted such as personalised exam papers or having a number of different versions. Some courses include an oral assessment as a compulsory component to pass the course. The markers are trained to identify plagiarism in the exams / reports and if anything identified, these are referred to the School Student Integrity Advisor, who meets with students before finalising an outcome. Plagiarism cases found are recorded in the university Plagiarism Register or Misconduct Register, the latter for serious cases.

The curriculum mapping did not take into account the Industrial Training component. The 60-day Industrial Training amounts to 480 hours in total as compared to the standard study load of 150 hours for a course. Thus, it is equivalent to 3 courses targeting mainly on PE2 and PE3 competencies, resulting in a more balanced overall curriculum alignment. The heatmaps (Tables 4 and 6) provide a high-level, strategic view of the stream that will inform all future course and stream revisions.

Among the strengths of the stream is practical learning experience. As noted in the Self-Study report, the laboratory component (every week in every technical course) accounts for 30% of in-class contact hours. The post-pandemic era presents a new education landscape, particularly the shift to online education delivery. To this end, the School has already taken initiatives to migrate laboratory facilities towards network-connected remote-control equipment that has easy-to-use interfaces. Web-enabled laboratory equipment is a crucial aspect of the School's remote laboratory course offerings. The School will continue to expand/enhance the functionalities of the online lab experiments. The growth of educational technology hardware and software resources for experimental purposes could potentially benefit learning and teaching. The School already has a dedicated Learning and Teaching Innovation Laboratory and the aim will be to continue supplying it with the latest technologies for experimentation.

7. Summary

Curriculum mapping of the ELECAH Electrical Engineering stream of the 3707 Bachelor of Engineering (Honours) program has been studied using the UNSW Engineering Faculty mapping tool CMAP. The stream design covers all the EA competencies with a split of 53% on PE1, 24% on PE2 and 23% on PE3. The stream is designed such that students develop in-depth technical competence in Electrical Engineering and all key elements of the total learning experience are covered in balanced proportion. Accordingly, it develops enabling skills and knowledge, in-depth technical competence, problem-solving design and project-based learning, personal and professional practices.

BE Telecommunications (TELEAH3707)

1. Introduction

This report is in response to Engineers Australia (EA) M1 requirements regarding the curriculum mapping of the TELEAH Telecommunications stream of the 3707 Bachelor of Engineering (Honours) program. Firstly, it presents the aims of this stream, its structure and uniqueness. The stream comprises a suite of courses, each plays a role in achieving the overall objectives and this is revealed through the mapping between the Course Learning Outcomes (CLOs) and the Stream Learning Outcomes (SLOs). These SLOs in turn are then mapped to EA Stage 1 Graduate Competencies which completes the CLO/SLO/EA competency chain and from which curriculum mapping from the course level to the EA competencies is obtained. Finally, the strengths and weaknesses of the stream are drawn from these mapping results and an action plan to strengthen the stream is presented.

2. Aims of the stream

The Telecommunications stream prepares students with advanced theoretical and technical knowledge, cognitive and communication skills in accordance with AQF level 8, for a broad and creative profession concerned with the design, development, planning and management of systems and devices which underpin modern economics and contribute to the quality of life.

Telecommunications engineering is concerned with communicating information at a distance. It is strongly associated with data communications, largely because of the need to encode, compress and encrypt all information, and because of the growing importance of digital and wireless (e.g., mobile telephony) networks. It is designed to equip students who are interested in the following fields: satellite communications; signal and image processing; optical fibres and photonics; optical and microwave communications; mobile satellite communications; data networks; software systems including e-commerce; microelectronic devices and systems; data coding, compression, encryption and transmission; real-time embedded systems; quantum telecommunications.

The stream design and delivery put emphasis on rigorous engineering analytical and practical skills, design and innovation, both within and external to the curriculum, to ensure that our graduates have the complete fundamental skillset required for a successful industry career, including at the cutting edge of R&D, innovation and technical leadership. Our innovative and unique final-year Design Proficiency course acts as a form of quality control on students' technical knowledge and skills.

The stream structure and recommended study plan is shown in Table 1. It comprises 27 core courses (8 Level 1, 6 Level 2, 8 Level 3, and 5 Level 4), 4 elective courses (1 Level 3 Breadth elective, and 3 Level 4 Discipline electives), 2 General Education courses, and Industrial Training (60 days). Flexibility and choice are maintained throughout the entire structure by providing many elective courses.

Year	Term	Course	Course name
1	1	ELEC1111	Electrical Circuit Fundamentals
		MATH1131	Maths 1A (or MATH1141 Higher Maths 1A)
		DESN1000	Introduction to Engineering Design & Innovation
	2	COMP1511	Intro. to Programming (or COMP1911 Computing 1A)
		MATH1231	Maths 1B (or MATH1241 Higher Maths 1B)
		PHYS1131	Higher Physics 1A
	3	COMP1521	Computer Systems Fundamentals
		MATH2069	Maths 2A
		PHYS1231	Higher Physics 1B
2	1	ELEC2134	Circuits and Signals
		ELEC2141	Digital Circuit Design
		GENxxxx	General Education
	2	ELEC2133	Analogue Electronics
		MATH2099	Maths 2B
		DESN2000	Engineering Design and Professional Practice
	3	ELEC3104	Digital Signal Processing
		TELE3118	Network Technologies
		GENxxxx	General Education
3	1	ELEC3106	Electronics
		ELEC3115	Electromagnetic Engineering
		TELE3113	Analogue & Digital Communications
	2	L3/L4 elective	choose from L3 or L4 elective list
		ELEC3114	Control Systems
		ELEC3117	Electrical Engineering Design
	3	Industrial Training or International Exchange	
4	1	ELEC4951	Thesis A
		ELEC4122	Strategic Leadership and Ethics
		L4 elective	choose from L4 elective list
	2	ELEC4952	Thesis B
		L4 elective	choose from L4 elective list
		L4 elective	choose from L4 elective list
	3	ELEC4953	Thesis C
		TELE3119	Trusted Networks
		ELEC4123	Electrical Design Proficiency

Table 1: TELEAH3707 Stream – Recommended Study Plan

3. Stream Learning Outcomes (SLOs)

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

1. Demonstrate a rigorous understanding of the fundamental principles embodied in Telecommunications Engineering.
2. Identify, select, and apply specialist in-depth technical knowledge and current research, in electronics, signal processing, telecommunications and networking technology.
3. Think independently, critically, logically and apply analytical procedures and tools to develop complex hardware and software telecommunications systems and network protocols.
4. Proficiently apply problem-solving and design skills to demanding, open-ended telecommunications design challenges and the creation of products.
5. Demonstrate a professional aptitude concerning the role of engineers in society and a well-developed, respectful, responsible ethic including safety, privacy, security, environmental concerns, and human rights.
6. Communicate technical and non-technical concepts fluently and effectively with all stakeholders in document and verbal form, whether as part of a project team or in a leadership context.

4. Development of SLOs

The SLOs were developed through rigorous internal consultations (School and Engineering Faculty). In the first stage at the school level, working groups were formed with members of academic teaching staff from various disciplinary areas to formulate the SLOs. The SLOs were reviewed by the School Academic Executive Committee. External consultations were then sought from the School Industry Advisory Board for their advice and feedback, particularly the expectation of industry with regards to graduate capabilities. The Faculty of Engineering Academic Programs Committee reviewed and approved the SLOs before the final approval by the Faculty Board. The developed SLOs were shared and discussed with all teaching staff in the school through a School Board meeting.

5. Curriculum Mapping

At the course level, the course coordinators develop their course outlines (COs) to articulate the course's context and relevance within the program. Each CO includes details about the course learning outcomes (CLOs) which lists the knowledge, attitudes, skills, and practices that students are expected to acquire and demonstrate after completing that course. Each CO also specifies the various assessments (exam, quiz, lab work, assignment, etc) to validate attainment of the CLOs. UNSW Assessment Policy prescribes that each course can have up to four main assessment components of varying weightings and each component may comprise several sub-components. The assessment weightings and the mapping of the assessments to the CLOs are developed by the course coordinators and provided in the COs for precision and transparency in the course design and assessment. A web-based platform (ACOA) developed by UNSW Engineering Faculty is used for constructing the COs so that CLOs, assessments, and other key course information can be easily found, and in a consistent format across all courses.

The cognitive scales for each CLO in a course are calculated by aggregating the weighted assessment contributions, using a curriculum mapping tool (CMAP) developed by UNSW Engineering Faculty. An example is shown in Table 2 for the ELEC1111 course which has 4 assessment components and 7 CLOs. CLO1 is the most important learning outcome in this course and its cognitive scale indicates the assessments correctly put emphasis on attainment of this CLO.

The mapping of the CLOs to the 12 different Assessment types are shown in Table 3. All the core courses together with a representative range of elective courses are shown in the table.

At the stream level, the course coordinators provide the mapping of the CLOs to the SLOs for their courses. The mapping results are shown in Table 4.

The SLOs in turn are mapped to the 16 EA Stage 1 Competencies. This mapping was done by expert working groups in the school with review and final endorsement from the Academic Executive Committee. The SLO/EA mapping is shown in Table 5.

As the stream specifies a quota of electives to be taken, the more popular electives (large enrolment) are included in the mapping to complete the CLO/SLO/EA Competency chain and the overall curriculum mapping results are shown in Table 6.

The final cognitive scale (last row in Table 6) reveals the percentage coverage of the stream for each of the 16 EA Competencies. Table 7 aggregates these and shows the percentage coverage of the stream for each of the 3 competency categories: 52% on Knowledge and skill base (PE1), 26% on Engineering application ability (PE2), and 22% on Professional and personal attributes (PE3).

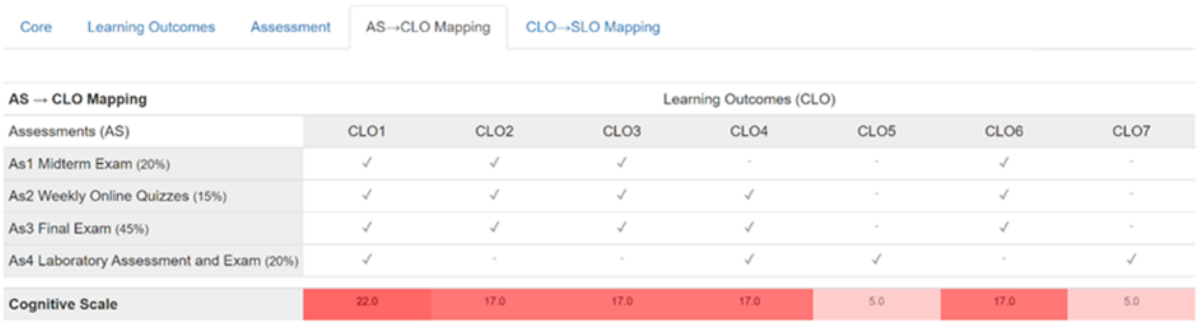

Table 2: Mapping from Assessments to CLOs for ELEC1111 course

TELEAH Telecommunications

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → AT Mapping

	Assessment Types (AT)												
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut	
COMP1511	26	-	54	13	-	-	-	-	-	-	7	-	L1 core courses
COMP1521	20	-	60	10	-	-	-	-	-	-	10	-	
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-	
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-	
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-	
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-	
PHYS1131	-	-	50	20	30	-	-	-	-	-	-	-	
PHYS1231	-	-	50	20	30	-	-	-	-	-	-	-	
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-	L2 core courses
ELEC2133	15	-	85	-	-	-	-	-	-	-	-	-	
ELEC2134	-	-	80	20	-	-	-	-	-	-	-	-	
ELEC2141	25	-	55	20	-	-	-	-	-	-	-	-	
MATH2069	-	-	60	-	-	-	-	-	-	-	40	-	
MATH2099	-	-	60	-	18	-	-	-	-	-	23	-	
ELEC3104	-	-	50	-	-	-	-	-	30	-	20	-	L3 core courses
ELEC3106	10	-	60	15	-	-	-	-	-	-	15	-	
ELEC3114	-	-	70	20	-	-	-	-	-	-	10	-	
ELEC3115	15	-	55	15	-	-	-	-	-	-	15	-	
ELEC3117	-	-	30	5	-	-	-	25	-	40	-	-	
TELE3113	-	-	60	20	-	-	-	-	-	-	20	-	
TELE3118	-	-	70	20	-	-	-	-	10	-	-	-	
TELE3119	-	-	70	20	-	-	-	-	-	-	10	-	
ELEC4122	30	-	32	-	-	-	-	14	-	-	24	-	L4 core courses
ELEC4123	-	-	-	46	10	-	-	-	-	15	29	-	
ELEC4951	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4952	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4953	-	-	-	-	-	-	-	-	100	-	-	-	
ENGG2600	-	-	-	-	25	-	-	15	60	-	-	-	L3 Breadth Electives
COMP3211	-	-	40	-	40	-	-	-	-	-	20	-	
COMP3231	40	-	60	-	-	-	-	-	-	-	-	-	
ELEC3145	-	-	60	25	-	-	-	-	-	-	15	-	
ENGG3001	-	20	-	-	10	-	-	20	-	50	-	-	
MATH3411	-	-	60	-	-	-	-	-	-	-	40	-	
ELEC4445	-	10	40	-	-	-	-	-	-	25	25	-	L4 Practice Electives
ELEC4601	10	-	60	30	-	-	-	-	-	-	-	-	
ELEC4602	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4603	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4604	-	-	60	-	-	-	-	-	-	20	20	-	
ELEC4621	-	-	50	30	-	-	-	-	-	-	20	-	
ELEC4622	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4631	-	-	76	12	-	-	-	-	-	-	12	-	
ELEC4632	-	-	60	20	-	-	-	-	-	-	20	-	
PHTN4661	-	-	75	-	-	-	-	-	-	25	-	-	
PHTN4662	-	-	70	20	-	-	-	-	-	10	-	-	
TELE4642	-	-	70	30	-	-	-	-	-	-	-	-	
TELE4651	-	-	50	40	-	-	-	-	-	10	-	-	
TELE4652	-	-	55	20	-	-	-	-	-	20	5	-	
TELE4653	-	-	-	-	100	-	-	-	-	-	-	-	

Table 3: Mapping from CLOs to Assessment Types

TELEAH Telecommunications

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → SLO Mapping — Stream Learning Outcomes (SLOs)

Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	
COMP1511	50.0	0.0	50.0	0.0	0.0	0.0	
COMP1521	63.6	0.0	25.6	10.8	0.0	0.0	
DESN1000	0.0	0.0	15.2	39.6	0.0	45.2	
ELEC1111	80.5	11.0	8.5	0.0	0.0	0.0	L1 core courses
MATH1131	64.4	23.9	0.0	0.0	0.0	11.7	
MATH1231	64.4	0.0	23.9	0.0	0.0	11.7	
PHYS1131	48.3	0.0	48.3	0.0	0.0	3.3	
PHYS1231	48.1	0.0	48.1	0.0	0.0	3.7	
DESN2000	7.5	14.0	7.5	31.0	20.0	20.0	
ELEC2133	38.6	38.6	11.4	11.4	0.0	0.0	
ELEC2134	25.0	33.3	33.3	0.0	0.0	8.3	L2 core courses
ELEC2141	24.6	24.6	24.6	12.1	2.1	12.1	
MATH2069	77.1	0.0	22.9	0.0	0.0	0.0	
MATH2099	71.8	0.0	28.3	0.0	0.0	0.0	
ELEC3104	44.4	8.3	19.4	8.3	0.0	19.4	
ELEC3106	63.2	0.0	12.2	12.2	0.0	12.2	
ELEC3114	22.8	32.6	32.6	9.8	2.2	0.0	
ELEC3115	33.3	33.3	33.3	0.0	0.0	0.0	L3 core courses
ELEC3117	13.2	21.9	25.9	25.9	9.2	4.0	
TELE3113	25.0	19.4	19.4	36.1	0.0	0.0	
TELE3118	34.4	20.0	6.7	22.2	14.4	2.2	
TELE3119	16.4	16.4	33.6	17.1	0.0	16.4	
ELEC4122	0.0	0.0	0.0	0.0	80.0	20.0	
ELEC4123	18.8	18.8	18.8	18.8	12.5	12.5	
ELEC4951	10.0	14.0	24.0	24.0	14.0	14.0	L4 core courses
ELEC4952	10.0	14.0	24.0	24.0	14.0	14.0	
ELEC4953	10.0	14.0	24.0	24.0	14.0	14.0	
ENGG2600	2.9	0.0	16.4	23.7	0.0	57.0	
COMP3211	0.0	31.7	31.7	6.7	0.0	30.0	
COMP3231	0.0	50.0	50.0	0.0	0.0	0.0	L3 Breadth Electives
ELEC3145	15.6	28.1	28.1	28.1	0.0	0.0	
ENGG3001	0.0	0.0	0.0	0.0	90.0	10.0	
MATH3411	0.0	50.0	50.0	0.0	0.0	0.0	
ELEC4445	0.0	0.0	8.1	12.0	39.9	39.9	
ELEC4601	12.5	37.5	25.0	25.0	0.0	0.0	
ELEC4602	29.6	50.9	7.5	3.1	0.0	8.8	
ELEC4603	41.9	41.9	5.1	0.0	0.0	11.1	
ELEC4604	10.6	26.4	36.9	15.6	0.0	10.6	
ELEC4621	0.0	70.8	0.0	8.3	0.0	20.8	
ELEC4622	25.8	41.9	16.1	16.1	0.0	0.0	L4 Practice Electives
ELEC4631	32.3	32.3	35.3	0.0	0.0	0.0	
ELEC4632	9.9	61.3	8.6	8.6	1.7	9.9	
PHTN4661	14.0	24.0	12.3	17.3	8.3	24.0	
PHTN4662	24.3	24.3	14.0	18.4	6.5	12.6	
TELE4642	43.8	10.4	18.8	18.8	4.2	4.2	
TELE4651	21.2	28.8	10.0	25.0	7.5	7.5	
TELE4652	24.3	24.3	20.8	18.0	6.3	6.3	
TELE4653	11.1	22.2	22.2	22.2	11.1	11.1	

Table 4: Mapping from CLOs to SLOs

Stream Learning Outcomes (SLOs)	Engineers Australia Stage 1 Competencies															
	1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
	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
1	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-	-
4	-	-	-	-	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓
5	-	-	-	-	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
6	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓

Table 5: Mapping of SLOs to EA Stage 1 Competencies

TELEAH Telecommunications

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

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
COMP1511	25.0	25.0	-	-	-	-	16.7	16.7	16.7	-	-	-	-	-	-	-
COMP1521	31.8	31.8	-	-	1.2	-	9.7	9.7	9.7	1.2	-	1.2	1.2	1.2	-	1.2
DESN1000	-	-	-	-	4.4	-	9.5	9.5	9.5	4.4	-	15.7	4.4	15.7	11.3	15.7
ELEC1111	40.2	40.2	3.7	3.7	3.7	-	2.8	2.8	2.8	-	-	-	-	-	-	-
MATH1131	32.2	32.2	8.0	8.0	8.0	-	-	-	-	-	-	2.9	-	2.9	2.9	2.9
MATH1231	32.2	32.2	-	-	-	-	8.0	8.0	8.0	-	-	2.9	-	2.9	2.9	2.9
PHYS1131	24.2	24.2	-	-	-	-	16.1	16.1	16.1	-	-	0.8	-	0.8	0.8	0.8
PHYS1231	24.1	24.1	-	-	-	-	16.0	16.0	16.0	-	-	0.9	-	0.9	0.9	0.9
DESN2000	3.8	3.8	4.7	4.7	8.1	4.0	5.9	5.9	5.9	3.4	4.0	8.4	3.4	12.4	9.0	12.4
ELEC2133	19.3	19.3	12.9	12.9	14.1	-	5.1	5.1	5.1	1.3	-	1.3	1.3	1.3	-	1.3
ELEC2134	12.5	12.5	11.1	11.1	11.1	-	11.1	11.1	11.1	-	-	2.1	-	2.1	2.1	2.1
ELEC2141	12.3	12.3	8.2	8.2	9.5	0.4	9.5	9.5	9.5	1.3	0.4	4.4	1.3	4.8	3.4	4.8
MATH2069	38.5	38.5	-	-	-	-	7.6	7.6	7.6	-	-	-	-	-	-	-
MATH2099	35.9	35.9	-	-	-	-	9.4	9.4	9.4	-	-	-	-	-	-	-
ELEC3104	22.2	22.2	2.8	2.8	3.7	-	7.4	7.4	7.4	0.9	-	5.8	0.9	5.8	4.9	5.8
ELEC3106	31.6	31.6	-	-	1.4	-	5.4	5.4	5.4	1.4	-	4.4	1.4	4.4	3.1	4.4
ELEC3114	11.4	11.4	10.9	10.9	12.0	0.4	12.0	12.0	12.0	1.1	0.4	1.1	1.1	1.5	0.4	1.5
ELEC3115	16.7	16.7	11.1	11.1	11.1	-	11.1	11.1	11.1	-	-	-	-	-	-	-
ELEC3117	6.6	6.6	7.3	7.3	10.2	1.8	11.5	11.5	11.5	2.9	1.8	3.9	2.9	5.7	2.8	5.7
TELE3113	12.5	12.5	6.5	6.5	10.5	-	10.5	10.5	10.5	4.0	-	4.0	4.0	4.0	-	4.0
TELE3118	17.2	17.2	6.7	6.7	9.1	2.9	4.7	4.7	4.7	2.5	2.9	3.0	2.5	5.9	3.4	5.9
TELE3119	8.2	8.2	5.5	5.5	7.4	-	13.1	13.1	13.1	1.9	-	6.0	1.9	6.0	4.1	6.0
ELEC4122	-	-	-	-	-	16.0	-	-	-	-	16.0	5.0	-	21.0	21.0	21.0
ELEC4123	9.4	9.4	6.2	6.2	8.3	2.5	8.3	8.3	8.3	2.1	2.5	5.2	2.1	7.7	5.6	7.7
ELEC4951	5.0	5.0	4.7	4.7	7.3	2.8	10.7	10.7	10.7	2.7	2.8	6.2	2.7	9.0	6.3	9.0
ELEC4952	5.0	5.0	4.7	4.7	7.3	2.8	10.7	10.7	10.7	2.7	2.8	6.2	2.7	9.0	6.3	9.0
ELEC4953	5.0	5.0	4.7	4.7	7.3	2.8	10.7	10.7	10.7	2.7	2.8	6.2	2.7	9.0	6.3	9.0
TELE4642	21.9	21.9	3.5	3.5	5.6	0.8	8.3	8.3	8.3	2.1	0.8	3.1	2.1	4.0	1.9	4.0
TELE4651	10.6	10.6	9.6	9.6	12.4	1.5	6.1	6.1	6.1	2.8	1.5	4.7	2.8	6.2	3.4	6.2
TELE4652	12.2	12.2	8.1	8.1	10.1	1.3	8.9	8.9	8.9	2.0	1.3	3.6	2.0	4.8	2.8	4.8
TELE4653	5.6	5.6	7.4	7.4	9.9	2.2	9.9	9.9	9.9	2.5	2.2	5.2	2.5	7.5	5.0	7.5
Cognitive Scale	15.4	15.4	5.9	5.9	6.8	2.5	8.0	8.0	8.0	1.9	2.5	3.7	1.9	5.0	4.0	5.0

Table 6: Mapping of TELEAH3707 courses to EA Competencies

Engineers Australia Stage 1 Competencies																
1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
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
15.4	15.4	5.9	5.9	6.8	2.5	8.0	8.0	8.0	1.9	2.5	3.7	1.9	5.0	4.0	5.0
52						26				22					

Table 7: Overall mapping of TELEAH3707 stream to EA Competencies

6. Reflection and Future Action

The SLOs were developed specifically for this stream but closely align with the overarching EA Stage 1 Competencies (Table 5). The first 2 SLOs are about acquiring the particular knowledge and skill base which align with the EA PE1 Competencies. The next 2 SLOs are about engineering applications (EA PE2) while the last 2 SLOs address the professional and personal attributes (PE3). The alignment is reflected in similar heatmaps between the stream (Table 4) and program (Table 6) levels.

Overall, as a stream, all the EA competencies are well covered, with a greater emphasis on the Knowledge and Skill Base PE1 competencies, particularly PE1.1 and PE1.2. This is expected given that TELEAH3707 is a fundamental, undergraduate program. The Academic Executive Committee felt that a split of roughly 50% (PE1), 25% (PE2) and 25% (PE3) is a fair reflection of the objectives of the undergraduate program.

Engineering Management Application PE2.4 and Creative/Innovative Attribute PE3.3 appear to be less emphasised in the heatmap. This can be traced back to the SLOs: SLO4 is the only one that links to these two competencies. Furthermore, it can be observed that SLO4 covers a wide range of EA competencies which highlights the importance of embedding design in the curriculum. Note that students actually have elective choices in the stream that can increase their opportunities for creativity and project management, e.g., Vertically Integrated Projects, Humanitarian Engineering, Student Initiated Projects. These are part of the real-world, project-based multi-disciplinary education initiatives by the Engineering Faculty. Such courses were recently introduced, hence not yet sufficiently popular to be counted as representative electives in the overall curriculum mapping.

Early in the program, many core courses are very much focused on the Knowledge and Skill Base (PE1) but compensated by the Design courses (DESN1000, DESN2000) which put emphasis on Engineering Applications (PE2) and Professional/Personal Attributes (PE3). This is further consolidated by more advanced Design courses (ELEC3117, ELEC4123) later in the program. Final-year electives and thesis tend to develop much a broader mix of competencies, as would be expected.

The heatmap also reflects that since the 2016 Engineers Australia Accreditation, the fractions of competencies within Engineering Applications (PE2) and Professional/Personal Attributes (PE3) have increased, which was a response to industry/alumni feedback shown in the Self-Study report (Appendix H) submitted in 2021.

From Table 3, assessments for most courses rely heavily on exams (mid-term and final). The other forms of assessments include take-home assignments, lab skills assessments and lab reports. Teamwork skills assessments are becoming more popular in recent years as seen in Table 7 (PE3.5). Enquiry-based learning courses include thesis work and design proficiency that have various assessments like seminar presentations, design concept mapping, reports, poster presentation and design showcase.

To ensure academic integrity, all final exam papers are reviewed by another academic with relevant technical knowledge and then a final review of the papers is done by the Director of Academic Studies. Thesis reports are submitted using TurnItIn for checking against plagiarism, and they are blind marked by two academics to ensure consistency. A third assessor is utilised if there is a discrepancy of larger than ten marks. For online written exams, various approaches have been adopted such as personalised exam papers or having a number of different versions. Some courses include an oral assessment as a compulsory component to pass the course. The markers are trained to identify plagiarism in the exams / reports and if anything identified, these are referred to the School Student Integrity Advisor, who meets with students before finalising an outcome. Plagiarism cases found are recorded in the university Plagiarism Register or Misconduct Register, the latter for serious cases.

The curriculum mapping did not take into account the Industrial Training component. The 60-day Industrial Training amounts to 480 hours in total as compared to the standard study load of 150 hours for a course. Thus, it is equivalent to 3 courses targeting mainly on PE2 and PE3 competencies, resulting in a more balanced overall curriculum alignment. The heatmaps (Tables 4 and 6) provide a high-level, strategic view of the stream that will inform all future course and stream revisions.

Among the strengths of the stream is practical learning experience. As noted in the Self-Study report, the laboratory component (every week in every technical course) accounts for 30% of in-class contact hours. The post-pandemic era presents a new education landscape, particularly the shift to online education delivery. To this end, the School has already taken initiatives to migrate laboratory facilities towards network-connected remote-control equipment that has easy-to-use interfaces. Web-enabled laboratory equipment is a crucial aspect of the School's remote laboratory course offerings. The School will continue to expand/enhance the functionalities of the online lab experiments. The growth of educational technology hardware and software resources for experimental purposes could potentially benefit learning and teaching. The School already has a dedicated Learning and Teaching Innovation Laboratory and the aim will be to continue supplying it with the latest technologies for experimentation.

7. Summary

Curriculum mapping of the TELEAH Telecommunications stream of the 3707 Bachelor of Engineering (Honours) program has been studied using the UNSW Engineering Faculty mapping tool CMAP. The stream design covers all the EA competencies with a split of 52% on PE1, 26% on PE2 and 22% on PE3. The stream is designed such that students develop in-depth technical competence in Telecommunications Engineering and all key elements of the total learning experience are covered in balanced proportion. Accordingly, it develops enabling skills and knowledge, in-depth technical competence, problem-solving design and project-based learning, personal and professional practices.

BE Quantum Engineering (ELECCH3707)

1. Introduction

This report is in response to Engineers Australia (EA) M1 requirements regarding the curriculum mapping of the ELECCH Quantum Engineering stream of the 3707 Bachelor of Engineering (Honours) program. Firstly, it presents the aims of this stream, its structure and uniqueness. The stream comprises a suite of courses, each plays a role in achieving the overall objectives and this is revealed through the mapping between the Course Learning Outcomes (CLOs) and the Stream Learning Outcomes (SLOs). These SLOs in turn are then mapped to EA Stage 1 Graduate Competencies which completes the CLO/SLO/EA competency chain and from which curriculum mapping from the course level to the EA competencies is obtained. Finally, the strengths and weaknesses of the stream are drawn from these mapping results and an action plan to strengthen the stream is presented.

2. Aims of the stream

The BE Quantum Engineering stream prepares students with advanced theoretical and technical knowledge, cognitive and communication skills in accordance with AQF level 8, for a broad and creative profession concerned with the design, development, planning and management of quantum systems and devices.

The progress of nanotechnology enables the fabrication of devices whose physical dimensions approach the atomic scale. The behaviour of physical systems at the atomic scale does not obey the familiar laws of classical physics. Atomic-size systems behave according to quantum mechanics, which allows them to exhibit rather spectacular properties and dynamics. Quantum engineering is concerned with the design and development of technologies that exploit the laws of quantum mechanics, unlocking novel functionalities and improved performance. This broad field draws skills from a diverse range of disciplines, including fundamental physics, electrical engineering, telecommunications and computer science.

A quantum engineer will apply their knowledge of quantum science and the principles of engineering design to the following fields: quantum electronic devices and computers; quantum sensors; quantum communications and quantum-safe cryptography; quantum control.

The stream design and delivery put emphasis on rigorous engineering analytical and practical skills, design and innovation, both within and external to the curriculum, to ensure that our graduates have the complete fundamental skillset required for a successful industry career, including at the cutting edge of R&D, innovation and technical leadership. Our innovative and unique final-year Design Proficiency course acts as a form of quality control on students' technical knowledge and skills.

The stream structure and recommended study plan is shown in Table 1. It comprises 27 core courses (7 Level 1, 6 Level 2, 7 Level 3, and 7 Level 4), 4 elective courses (1 Level 3 Breadth elective, and 3 Level 4 Practice electives), 2 General Education courses, and Industrial Training (60 days). Flexibility and choice are maintained throughout the entire structure by providing many elective courses.

Year	Term	Course	Course name
1	1	ELEC1111	Electrical Circuit Fundamentals
		MATH1131	Maths 1A (or MATH1141 Higher Maths 1A)
		DESN1000	Introduction to Engineering Design & Innovation
	2	COMP1511	Intro. to Programming (or COMP1911 Computing 1A)
		MATH1231	Maths 1B (or MATH1241 Higher Maths 1B)
		PHYS1131	Higher Physics 1A
	3	PHYS1231	Higher Physics 1B
		MATH2069	Maths 2A
2	1	ELEC2134	Circuits and Signals
		ELEC2141	Digital Circuit Design
		ELEC3115	Electromagnetic Engineering
	2	ELEC2133	Analogue Electronics
		MATH2099	Maths 2B
		DESN2000	Engineering Design and Professional Practice
	3	ELEC3104	Digital Signal Processing
		ELEC3705	Fundamentals of Quantum Engineering
		GENxxxx	General Education
3	1	ELEC3106	Electronics
		TELE9757	Quantum Communications
		GENxxxx	General Education
	2	PHYS3118	Quantum Physics of Solids and Devices
		ELEC3114	Control Systems
		ELEC3117	Electrical Engineering Design
	3	L3/L4 elective	choose from L3/L4 list or ELEC4635 Quantum Control
		L4 elective	choose from L4 elective list or cross-institutional study
4	1	ELEC4951	Thesis A
		ELEC4122	Strategic Leadership and Ethics
		L4 elective	choose from L3/L4 list or ELEC4603 Solid-State Electronics
	2	ELEC4952	Thesis B
		ELEC4605	Quantum Devices and Computers
		L4 elective	choose from L4 elective list or cross-institutional study
	3	ELEC4953	Thesis C
		ELEC4123	Electrical Design Proficiency

Table 1: ELECCH3707 Stream – Recommended Study Plan

3. Stream Learning Outcomes (SLOs)

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

1. Show proficiency of knowledge in the fundamental enabling sciences of quantum mechanics, mathematics, computer science and electromagnetics that underpins Quantum Engineering, and relate the physical laws of quantum mechanics to the fundamental principles of engineering.
2. Identify, select and proficiently apply specialist technical knowledge and mathematical and computational tools to analyse engineered quantum and electrical systems and networks.
3. Critically evaluate quantum and electrical devices and systems to solve complex open-ended problems and recognize their relevance to the future development of the discipline.
4. Demonstrate a broad understanding of design and operation principles for engineered quantum systems and networks, and articulate future directions for the development of enhanced quantum devices and their application to problems of practical relevance in the fields of computing, communications, and sensing.
5. Design, assemble and utilize classical electrical engineering devices, for example electronic and microwave devices and computational tools, needed to interface with and operate quantum systems.

6. Lead and manage quantum engineering projects, individually or as part of an interdisciplinary team, in a systematic and professional manner.
7. Synthesize engineering practices with norms and regulations of relevance to the safe and ethical application of engineered quantum systems.
8. Demonstrate proficiency in the effective communication of systematic engineering synthesis, design processes, critical evaluation, and implications of results to all audiences, in particular as they apply to quantum engineered systems.

4. Development of SLOs

The SLOs were developed through rigorous internal consultations (School and Engineering Faculty). In the first stage at the school level, working groups were formed with members of academic teaching staff from various disciplinary areas to formulate the SLOs. The SLOs were reviewed by the School Academic Executive Committee. External consultations were then sought from the School Industry Advisory Board for their advice and feedback, particularly the expectation of industry with regards to graduate capabilities. The Faculty of Engineering Academic Programs Committee reviewed and approved the SLOs before the final approval by the Faculty Board. The developed SLOs were shared and discussed with all teaching staff in the school through a School Board meeting.

5. Curriculum Mapping

At the course level, the course coordinators develop their course outlines (COs) to articulate the course's context and relevance within the program. Each CO includes details about the course learning outcomes (CLOs) which lists the knowledge, attitudes, skills, and practices that students are expected to acquire and demonstrate after completing that course. Each CO also specifies the various assessments (exam, quiz, lab work, assignment, etc) to validate attainment of the CLOs. UNSW Assessment Policy prescribes that each course can have up to four main assessment components of varying weightings and each component may comprise several sub-components. The assessment weightings and the mapping of the assessments to the CLOs are developed by the course coordinators and provided in the COs for precision and transparency in the course design and assessment. A web-based platform (ACOA) developed by UNSW Engineering Faculty is used for constructing the COs so that CLOs, assessments, and other key course information can be easily found, and in a consistent format across all courses.

The cognitive scales for each CLO in a course are calculated by aggregating the weighted assessment contributions, using a curriculum mapping tool (CMAP) developed by UNSW Engineering Faculty. An example is shown in Table 2 for the ELEC1111 course which has 4 assessment components and 7 CLOs. CLO1 is the most important learning outcome in this course and its cognitive scale indicates the assessments correctly put emphasis on attainment of this CLO.

The mapping of the CLOs to the 12 different Assessment types are shown in Table 3. All the core courses together with a representative range of elective courses are shown in the table.

At the stream level, the course coordinators provide the mapping of the CLOs to the SLOs for their courses. The mapping results are shown in Table 4.

The SLOs in turn are mapped to the 16 EA Stage 1 Competencies. This mapping was done by expert working groups in the school with review and final endorsement from the Academic Executive Committee. The SLO/EA mapping is shown in Table 5.

As the stream specifies a quota of electives to be taken, the more popular electives (large enrolment) are included in the mapping to complete the CLO/SLO/EA Competency chain and the overall curriculum mapping results are shown in Table 6.

The final cognitive scale (last row in Table 6) reveals the percentage coverage of the stream for each of the 16 EA Competencies. Table 7 aggregates these and shows the percentage coverage of the stream for each of the 3 competency categories: 53% on Knowledge and skill base (PE1), 19% on Engineering application ability (PE2), and 28% on Professional and personal attributes (PE3).

Core | Learning Outcomes | Assessment | AS→CLO Mapping | CLO→SLO Mapping

AS → CLO Mapping	Learning Outcomes (CLO)						
Assessments (AS)	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
As1 Midterm Exam (20%)	✓	✓	✓	-	-	✓	-
As2 Weekly Online Quizzes (15%)	✓	✓	✓	✓	-	✓	-
As3 Final Exam (45%)	✓	✓	✓	✓	-	✓	-
As4 Laboratory Assessment and Exam (20%)	✓	-	-	✓	✓	-	✓
Cognitive Scale	22.0	17.0	17.0	17.0	5.0	17.0	5.0

Table 2: Mapping from Assessments to CLOs for ELEC1111 course

ELECCH Quantum Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → AT Mapping — Assessment Types (AT)

Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut	
COMP1511	26	-	54	13	-	-	-	-	-	-	7	-	L1 core courses
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-	
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-	
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-	
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-	
PHYS1131	-	-	50	20	30	-	-	-	-	-	-	-	
PHYS1231	-	-	50	20	30	-	-	-	-	-	-	-	
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-	L2 core courses
ELEC2133	15	-	85	-	-	-	-	-	-	-	-	-	
ELEC2134	-	-	80	20	-	-	-	-	-	-	-	-	
ELEC2141	25	-	55	20	-	-	-	-	-	-	-	-	
MATH2069	-	-	60	-	-	-	-	-	-	-	40	-	
MATH2099	-	-	60	-	18	-	-	-	-	-	23	-	
ELEC3104	-	-	50	-	-	-	-	-	30	-	20	-	L3 core courses
ELEC3106	10	-	60	15	-	-	-	-	-	-	15	-	
ELEC3114	-	-	70	20	-	-	-	-	-	-	10	-	
ELEC3115	15	-	55	15	-	-	-	-	-	-	15	-	
ELEC3117	-	-	30	5	-	-	-	25	-	40	-	-	
ELEC3705	25	-	75	-	-	-	-	-	-	-	-	-	
PHYS3118	-	-	60	20	20	-	-	-	-	-	-	-	
ELEC4122	30	-	32	-	-	-	-	14	-	-	24	-	L4 core courses
ELEC4123	-	-	-	46	10	-	-	-	-	15	29	-	
ELEC4605	25	-	75	-	-	-	-	-	-	-	-	-	
ELEC4951	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4952	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4953	-	-	-	-	-	-	-	-	100	-	-	-	
TELE9757	-	-	60	-	-	-	-	-	20	-	20	-	
ENGG2600	-	-	-	-	25	-	-	15	60	-	-	-	L3 Breadth Electives
COMP3211	-	-	40	-	40	-	-	-	-	-	20	-	
ELEC3145	-	-	60	25	-	-	-	-	-	-	15	-	
ENGG3001	-	20	-	-	10	-	-	20	-	50	-	-	
MATH3411	-	-	60	-	-	-	-	-	-	-	40	-	
TELE3113	-	-	60	20	-	-	-	-	-	-	20	-	
ELEC4445	-	10	40	-	-	-	-	-	-	25	25	-	L4 Practice Electives
ELEC4601	10	-	60	30	-	-	-	-	-	-	-	-	
ELEC4602	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4603	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4621	-	-	50	30	-	-	-	-	-	-	20	-	
ELEC4622	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4631	-	-	76	12	-	-	-	-	-	-	12	-	
ELEC4632	-	-	60	20	-	-	-	-	-	-	20	-	
PHTN4661	-	-	75	-	-	-	-	-	-	25	-	-	
TELE4642	-	-	70	30	-	-	-	-	-	-	-	-	
TELE4651	-	-	50	40	-	-	-	-	-	10	-	-	

Table 3: Mapping from CLOs to Assessment Types

ELECCH Quantum Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → SLO Mapping — Stream Learning Outcomes (SLOs)

Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8	
COMP1511	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	
DESN1000	0.0	18.3	8.3	0.0	0.0	56.3	0.0	17.1	
ELEC1111	83.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
MATH1131	64.4	23.9	0.0	0.0	0.0	0.0	0.0	11.7	L1 core courses
MATH1231	64.4	23.9	0.0	0.0	0.0	0.0	0.0	11.7	
PHYS1131	48.3	48.3	0.0	0.0	0.0	0.0	0.0	3.3	
PHYS1231	48.1	48.1	0.0	0.0	0.0	0.0	0.0	3.7	
DESN2000	0.0	28.0	0.0	0.0	15.0	27.0	0.0	30.0	
ELEC2133	0.0	69.7	15.2	0.0	15.2	0.0	0.0	0.0	
ELEC2134	25.0	33.3	0.0	0.0	33.3	0.0	0.0	8.3	L2 core courses
ELEC2141	31.2	31.2	12.5	0.0	12.5	0.0	0.0	12.5	
MATH2069	77.1	22.9	0.0	0.0	0.0	0.0	0.0	0.0	
MATH2099	71.8	28.3	0.0	0.0	0.0	0.0	0.0	0.0	
ELEC3104	0.0	66.7	0.0	0.0	0.0	0.0	0.0	33.3	
ELEC3106	0.0	0.0	0.0	0.0	57.5	0.0	0.0	30.5	
ELEC3114	34.2	44.0	2.2	7.6	9.8	2.2	0.0	0.0	
ELEC3115	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	L3 core courses
ELEC3117	0.0	14.5	23.2	0.0	23.2	0.0	0.0	39.2	
ELEC3705	23.1	13.1	36.4	27.5	0.0	0.0	0.0	0.0	
PHYS3118	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	
ELEC4122	0.0	0.0	0.0	0.0	0.0	40.0	60.0	0.0	
ELEC4123	15.0	15.0	15.0	15.0	15.0	8.3	8.3	8.3	
ELEC4605	26.2	20.7	20.7	11.1	4.2	7.5	0.0	9.6	
ELEC4951	6.7	18.0	24.7	14.7	4.0	14.7	10.7	6.7	L4 core courses
ELEC4952	6.7	18.0	24.7	14.7	4.0	14.7	10.7	6.7	
ELEC4953	6.7	18.0	24.7	14.7	4.0	14.7	10.7	6.7	
TELE9757	47.5	25.7	2.7	12.2	0.0	2.7	0.0	2.7	
ENGG2600	4.3	0.0	0.0	12.9	0.0	12.3	0.0	70.5	
COMP3211	0.0	31.7	31.7	0.0	6.7	30.0	0.0	0.0	
ELEC3145	0.0	50.0	0.0	0.0	0.0	0.0	0.0	50.0	L3 Breadth Electives
ENGG3001	0.0	0.0	0.0	0.0	0.0	0.0	90.0	10.0	
MATH3411	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	
TELE3113	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	
ELEC4445	0.0	0.0	0.0	0.0	0.0	21.5	12.8	65.7	
ELEC4601	0.0	33.3	33.3	0.0	33.3	0.0	0.0	0.0	
ELEC4602	0.0	0.0	42.0	0.0	47.0	0.0	0.0	10.9	
ELEC4603	43.6	43.6	0.0	0.0	0.0	0.0	0.0	12.8	
ELEC4621	0.0	70.8	8.3	0.0	0.0	0.0	0.0	20.8	L4 Practice Electives
ELEC4622	0.0	87.1	12.9	0.0	0.0	0.0	0.0	0.0	
ELEC4631	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	
ELEC4632	8.4	54.7	7.0	12.0	7.0	8.4	1.2	1.2	
PHTN4661	10.5	16.7	16.7	16.7	8.7	5.4	8.7	16.7	
TELE4642	68.8	18.8	0.0	0.0	0.0	6.2	0.0	6.2	
TELE4651	5.0	0.0	0.0	27.5	0.0	0.0	0.0	0.0	

Table 4: Mapping from CLOs to SLOs

Stream Learning Outcomes (SLOs)	Engineers Australia Stage 1 Competencies															
	1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
	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
1	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	✓	✓	-	-	-	✓	✓	-	-	-	-	-	✓	-	-
3	-	-	✓	✓	-	-	-	-	-	-	-	-	✓	-	-	-
4	-	-	✓	✓	-	-	-	-	✓	-	-	-	✓	-	-	-
5	-	-	-	-	✓	-	-	✓	✓	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓	✓	✓
7	-	-	-	-	-	✓	-	-	-	-	✓	-	-	-	-	-
8	-	-	-	-	✓	-	-	-	✓	-	-	✓	-	✓	-	-

Table 5: Mapping of SLOs to EA Stage 1 Competencies

ELECCH Quantum Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

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
COMP1511	25.0	35.0	10.0	-	-	-	10.0	10.0	-	-	-	-	-	10.0	-	-
DESN1000	-	3.7	6.4	2.8	4.3	-	3.7	3.7	4.3	14.1	-	4.3	2.8	22.0	14.1	14.1
ELEC1111	41.5	41.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MATH1131	32.2	37.0	4.8	-	2.9	-	4.8	4.8	2.9	-	-	2.9	-	7.7	-	-
MATH1231	32.2	37.0	4.8	-	2.9	-	4.8	4.8	2.9	-	-	2.9	-	7.7	-	-
PHYS1131	24.2	33.8	9.7	-	0.8	-	9.7	9.7	0.8	-	-	0.8	-	10.5	-	-
PHYS1231	24.1	33.7	9.6	-	0.9	-	9.6	9.6	0.9	-	-	0.9	-	10.6	-	-
DESN2000	-	5.6	5.6	-	12.5	-	5.6	10.6	12.5	6.8	-	7.5	-	19.9	6.8	6.8
ELEC2133	-	13.9	19.0	5.1	5.1	-	13.9	19.0	5.1	-	-	-	5.1	13.9	-	-
ELEC2134	12.5	19.2	6.7	-	13.2	-	6.7	17.8	13.2	-	-	2.1	-	8.7	-	-
ELEC2141	15.6	21.9	10.4	4.2	7.3	-	6.2	10.4	7.3	-	-	3.1	4.2	9.4	-	-
MATH2069	38.5	43.1	4.6	-	-	-	4.6	4.6	-	-	-	-	-	4.6	-	-
MATH2099	35.9	41.5	5.7	-	-	-	5.7	5.7	-	-	-	-	-	5.7	-	-
ELEC3104	-	13.3	13.3	-	8.3	-	13.3	13.3	8.3	-	-	8.3	-	21.7	-	-
ELEC3106	-	-	-	-	26.8	-	-	19.2	26.8	-	-	7.6	-	7.6	-	-
ELEC3114	17.1	25.9	11.4	2.6	3.3	-	8.8	12.1	5.2	0.5	-	-	2.6	9.3	0.5	0.5
ELEC3115	25.0	35.0	10.0	-	-	-	10.0	10.0	-	-	-	-	-	10.0	-	-
ELEC3117	-	2.9	10.6	7.7	17.5	-	2.9	10.6	17.5	-	-	9.8	7.7	12.7	-	-
ELEC3705	11.5	14.1	21.6	19.0	-	-	2.6	2.6	6.9	-	-	-	19.0	2.6	-	-
PHYS3118	25.0	35.0	10.0	-	-	-	10.0	10.0	-	-	-	-	-	10.0	-	-
ELEC4122	-	-	-	-	-	30.0	-	-	-	10.0	30.0	-	-	10.0	10.0	10.0
ELEC4123	7.5	10.5	11.8	8.8	7.1	4.2	3.0	8.0	10.8	2.1	4.2	2.1	8.8	7.2	2.1	2.1
ELEC4602	-	-	14.0	14.0	18.4	-	-	15.7	18.4	-	-	2.7	14.0	2.7	-	-
ELEC4603	21.8	30.5	8.7	-	3.2	-	8.7	8.7	3.2	-	-	3.2	-	11.9	-	-
ELEC4605	13.1	17.3	13.8	9.7	3.8	-	4.1	5.5	6.6	1.9	-	2.4	9.7	8.4	1.9	1.9
ELEC4621	-	14.2	16.9	2.8	5.2	-	14.2	14.2	5.2	-	-	5.2	2.8	19.4	-	-
ELEC4631	25.0	35.0	10.0	-	-	-	10.0	10.0	-	-	-	-	-	10.0	-	-
ELEC4951	3.3	6.9	15.5	11.9	3.0	5.3	3.6	4.9	6.7	3.7	5.3	1.7	11.9	8.9	3.7	3.7
ELEC4952	3.3	6.9	15.5	11.9	3.0	5.3	3.6	4.9	6.7	3.7	5.3	1.7	11.9	8.9	3.7	3.7
ELEC4953	3.3	6.9	15.5	11.9	3.0	5.3	3.6	4.9	6.7	3.7	5.3	1.7	11.9	8.9	3.7	3.7
TELE9757	23.8	28.9	9.1	3.9	0.7	-	5.1	5.1	3.7	0.7	-	0.7	3.9	6.5	0.7	0.7
Cognitive Scale	13.9	15.4	7.2	5.5	4.6	6.6	4.6	6.2	5.2	3.1	6.6	2.4	5.5	6.8	3.1	3.1

Table 6: Mapping of ELECCH3707 courses to EA Competencies

Engineers Australia Stage 1 Competencies																
1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
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
13.9	15.4	7.2	5.5	4.6	6.6	4.6	6.2	5.2	3.1	6.6	2.4	5.5	6.8	3.1	3.1
53						19				28					

Table 7: Overall mapping of ELECCH3707 stream to EA Competencies

6. Reflection and Future Action

The SLOs were developed specifically for this stream but aimed to address the overarching EA Stage 1 Competencies (Table 5). The first 4 SLOs are more about acquiring the particular knowledge and skill base which align with the EA PE1 Competencies. Engineering applications (EA PE2) are mostly covered by SLOs 2 and 5, while professional and personal attributes (PE3) are mainly covered by SLOs 6 and 8.

Overall, as a stream, all the EA competencies are covered, with a greater emphasis on the Knowledge and Skill Base PE1 competencies, particularly PE1.1 and PE1.2. This is expected given that ELECCH3707 is a fundamental, undergraduate program. The Academic Executive Committee felt that a split of roughly 50% (PE1), 25% (PE2) and 25% (PE3) is a fair reflection of the objectives of the undergraduate program.

Table 7 shows PE2 is slightly under weighted. This perhaps reflects the fact that Quantum Engineering is an emerging innovative engineering field, and this stream is newly introduced. Table 7 (PE3.2) also reveals the stream appears to have less focus in the area of oral/written communication skills. This is a point for future action as the quantum courses are developed further.

Early in the program, many core courses are very much focused on the Knowledge and Skill Base (PE1) but compensated by the Design courses (DESN1000, DESN2000) which put emphasis on Engineering Applications (PE2) and Professional/Personal Attributes (PE3). This is further consolidated by more advanced Design courses (ELEC3117, ELEC4123) later in the program. Final-year electives and thesis tend to develop much a broader mix of competencies, as would be expected.

From Table 3, assessments for most courses rely heavily on exams (mid-term and final). The other forms of assessments include take-home assignments, lab skills assessments and lab reports. Enquiry-based learning courses include thesis work and design proficiency that have various assessments like seminar presentations, design concept mapping, reports, poster presentation and design showcase.

To ensure academic integrity, all final exam papers are reviewed by another academic with relevant technical knowledge and then a final review of the papers is done by the Director of Academic Studies. Thesis reports are submitted using TurnItIn for checking against plagiarism, and they are blind marked by two academics to ensure consistency. A third assessor is utilised if there is a discrepancy of larger than ten marks. For online written exams, various approaches have been adopted such as personalised exam papers or having a number of different versions. Some courses include an oral assessment as a compulsory component to pass the course. The markers are trained to identify plagiarism in the exams / reports and if anything identified, these are referred to the School Student Integrity Advisor, who meets with students before finalising

an outcome. Plagiarism cases found are recorded in the university Plagiarism Register or Misconduct Register, the latter for serious cases.

The curriculum mapping did not take into account the Industrial Training component. The 60-day Industrial Training amounts to 480 hours in total as compared to the standard study load of 150 hours for a course. Thus, it is equivalent to 3 courses targeting mainly on PE2 and PE3 competencies, resulting in a more balanced overall curriculum alignment. The heatmaps (Tables 4 and 6) provide a high-level, strategic view of the stream that will inform all future course and stream revisions.

Among the strengths of the stream is practical learning experience. As noted in the Self-Study report, the laboratory component (every week in every technical course) accounts for 30% of in-class contact hours. The post-pandemic era presents a new education landscape, particularly the shift to online education delivery. To this end, the School has already taken initiatives to migrate laboratory facilities towards network-connected remote-control equipment that has easy-to-use interfaces. Web-enabled laboratory equipment is a crucial aspect of the School's remote laboratory course offerings. The School will continue to expand/enhance the functionalities of the online lab experiments. The growth of educational technology hardware and software resources for experimental purposes could potentially benefit learning and teaching. The School already has a dedicated Learning and Teaching Innovation Laboratory and the aim will be to continue supplying it with the latest technologies for experimentation.

7. Summary

Curriculum mapping of the ELECCH Quantum Engineering stream of the 3707 Bachelor of Engineering (Honours) program has been studied using the UNSW Engineering Faculty mapping tool CMAP. The stream design covers all the EA competencies with a split of 53% on PE1, 19% on PE2 and 28% on PE3. The stream is designed such that students develop in-depth technical competence in Quantum Engineering and all key elements of the total learning experience are covered in balanced proportion. Accordingly, it develops enabling skills and knowledge, in-depth technical competence, problem solving design and project-based learning, personal and professional practices.

BE ME (Electrical Engineering) (ELECBH3736)

1. Introduction

This report is in response to Engineers Australia (EA) M1 requirements regarding the curriculum mapping of the Bachelor of Engineering (Honours) and Master of Engineering (BE ME) in Electrical Engineering program. Firstly, it presents the aims of this stream, its structure and uniqueness. The stream comprises a suite of courses, each plays a role in achieving the overall objectives and this is revealed through the mapping between the Course Learning Outcomes (CLOs) and the Stream Learning Outcomes (SLOs). These SLOs in turn are then mapped to the EA Stage 1 Graduate Competencies which completes the CLO/SLO/EA competency chain and from which curriculum mapping from the course level to the EA competencies is obtained. Finally, the strengths and weaknesses of the stream are drawn from these mapping results and an action plan to strengthen the stream is presented.

2. Aims of the stream

The Electrical Engineering stream prepares students for a broad and creative profession concerned with the design, development, planning and management of systems and devices which underpin modern economics and contribute to the quality of life.

An Electrical Engineer may be responsible for the research, design, development, manufacturing and management of complex hardware and software systems and reliable, cost-effective electrical/electronic devices, many involving the use of new information and computer-intensive technologies. These include computer systems; data telecommunication networks including the internet; mobile communications and wireless networks; integrated electronic systems; control systems, advanced robotics and intelligent machines; video and image processing systems; generation, transmission, distribution and utilisation of electrical power; renewable energy systems and solar energy conversion; biomedical equipment and devices, such as medical imaging scanners, pacemaker implants and hearing aids.

This five-year program is unique as it caters for elite students aiming for an integrated Bachelor Honours degree (AQF level 8 criteria) and Master degree (AQF level 9 criteria) in Electrical Engineering. Students benefit from receiving both an undergraduate and a postgraduate qualification in Electrical Engineering, while also studying a broader discipline through choosing a Minor from a large range of other engineering or non-engineering areas, e.g., Computing, Internet of Things, Management, Finance, Business Economics, etc.

The stream structure and recommended study plan is shown in Table 1. Students must complete 27 Electrical Engineering core courses, 9 Discipline elective courses and 6 Broadening Discipline Electives (at least 4 Minor electives; and up to 2 Free electives). Students are also required to complete 60 days of Industrial Training. Flexibility and choice are maintained throughout the entire structure by providing many elective courses. The structure is designed such that at graduation, students would be expected to have desired skills competency, such as creative problem solving, innovative design, capacity for analytical and critical thinking, independent in reflective learning, in-depth discipline specific knowledge, good communication skills, professional attitude and ethical practice, and teamwork.

Year	Term	Course	Course name
1	1	ELEC1111	Electrical Circuit Fundamentals
		MATH1131	Maths 1A (or MATH1141 Higher Maths 1A)
		ELEC2141	Digital Circuit Design
	2	COMP1511	Intro. to Programming (or COMP1911 Computing 1A)
		MATH1231	Maths 1B (or MATH1241 Higher Maths 1B)
		PHYS1131	Higher Physics 1A
	3	PHYS1231	Higher Physics 1B
		MATH2069	Maths 2A
		DESN1000	Introduction to Engineering Design & Innovation
2	1	ELEC2134	Circuits and Signals
		ELEC3115	Electromagnetic Engineering
		Minor elective	Broadening Discipline Elective
	2	ELEC2133	Analogue Electronics
		MATH2099	Maths 2B
		DESN2000	Engineering Design and Professional Practice
	3	ELEC3104	Digital Signal Processing
		ELEC2117	Electrical System Design
		Minor elective	Broadening Discipline Elective
3	1	L3 elective	Level 3 Discipline Elective
		ETM elective	Engineering Technical Management Elective
		Minor elective	Broadening Discipline Elective
	2	ELEC3105	Electrical Energy
		ELEC3114	Control Systems
		ELEC3117	Electrical Engineering Design
	3	Industrial Training or International Exchange	
4	1	ELEC4951	Thesis A
		ELEC4122	Strategic Leadership and Ethics
		L4 elective	Level 4 Discipline Elective
	2	ELEC4952	Thesis B
		L4 elective	Level 4 Discipline Elective
		L4 elective	Level 4 Discipline Elective
	3	ELEC4953	Thesis C
		ELEC4123	Electrical Design Proficiency
		L5 elective	Level 5 Discipline Elective
5	1	ELEC9451	Masters Project A
		L5 elective	Level 5 Discipline Elective
		Minor elective	Broadening Discipline Elective
	2	ELEC9452	Masters Project B
		L5 elective	Level 5 Discipline Elective
		Minor elective	Broadening Discipline Elective
	3	ELEC9453	Masters Project C
		L5 elective	Level 5 Discipline Elective
		Minor elective	Broadening Discipline Elective

Table 1: ELECBH3736 Stream – Recommended Study Plan

3. Stream Learning Outcomes (SLOs)

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

1. Demonstrate a rigorous understanding of the fundamental principles embodied in Electrical Engineering.
2. Identify, select, and apply specialist in-depth, advanced technical knowledge in electrical energy systems, electronics, control systems, signal processing, and communications technology and knowledge from a broadening complementary discipline.
3. Think independently, critically, logically and apply analytical procedures and tools to develop complex hardware and software electrical systems.
4. Precisely articulate research problems based on appreciation and critical analysis of the electrical engineering literature and apply research and experimental skills to investigate the problems and make novel contributions.

5. Proficiently utilise advanced and creative problem-solving and design skills in demanding, unfamiliar and open-ended electrical design challenges and the creation of products.
6. Demonstrate a professional aptitude concerning the role of engineers in society and a well-developed, respectful, responsible ethic including safety, privacy, security, environmental concerns, and human rights.
7. Communicate technical and non-technical concepts fluently and effectively with all stakeholders in document and verbal form, whether as part of a project team or in a leadership context.
8. Confidently employ technical and entrepreneurial management skills in engineering projects.

4. Development of SLOs

The SLOs were developed through rigorous internal consultations (School and Engineering Faculty). In the first stage at the school level, working groups were formed with members of academic teaching staff from various disciplinary areas to formulate the SLOs. The SLOs were reviewed by the School Academic Executive Committee. External consultations were then sought from the School Industry Advisory Board for their advice and feedback, particularly the expectation of industry with regards to graduate capabilities. The Faculty of Engineering Academic Programs Committee reviewed and approved the SLOs before the final approval by the Faculty Board. The developed SLOs were shared and discussed with all teaching staff in the school through a School Board meeting.

5. Curriculum Mapping

At the course level, the course coordinators develop their course outlines (COs) to articulate the course's context and relevance within the program. Each CO includes details about the course learning outcomes (CLOs) which lists the knowledge, attitudes, skills, and practices that students are expected to acquire and demonstrate after completing that course. Each CO also specifies the various assessments (exam, quiz, lab work, assignment, etc) to validate attainment of the CLOs. UNSW Assessment Policy prescribes that each course can have up to four main assessment components of varying weightings and each component may comprise several sub-components. The assessment weightings and the mapping of the assessments to the CLOs are developed by the course coordinators and provided in the COs for precision and transparency in the course design and assessment. A web-based platform (ACOA) developed by UNSW Engineering Faculty is used for constructing the COs so that CLOs, assessments, and other key course information can be easily found, and in a consistent format across all courses.

The cognitive scales for each CLO in a course are calculated by aggregating the weighted assessment contributions, using a curriculum mapping tool (CMAP) developed by UNSW Engineering Faculty. An example is shown in Table 2 for the ELEC1111 course which has 4 assessment components and 7 CLOs. CLO1 is the most important learning outcome in this course and its cognitive scale indicates the assessments correctly put emphasis on attainment of this CLO.

The mapping of the CLOs to the 12 different Assessment types are shown in Table 3. All the core courses together with a representative range of elective courses are shown in the table.

At the stream level, the course coordinators provide the mapping of the CLOs to the SLOs for their courses. The mapping results are shown in Table 4.

The SLOs in turn are mapped to the 16 EA Stage 1 Competencies. This mapping was done by expert working groups in the school with review and final endorsement from the Academic Executive Committee. The SLO/EA mapping is shown in Table 5.

As the stream specifies a quota of electives to be taken, the more popular electives (large enrolment) are included in the mapping to complete the CLO/SLO/EA Competency chain and the overall curriculum mapping results are shown in Table 6. In this example, the Broadening Discipline Minor chosen is Computing.

The final cognitive scale (last row in Table 6) reveals the percentage coverage of the stream for each of the 16 EA Competencies. Table 7 aggregates these and shows the percentage coverage of the stream for each of the 3 competency categories: 52% on Knowledge and skill base (PE1), 26% on Engineering application ability (PE2), and 22% on Professional and personal attributes (PE3).

Core | Learning Outcomes | Assessment | AS→CLO Mapping | CLO→SLO Mapping

AS → CLO Mapping	Learning Outcomes (CLO)						
Assessments (AS)	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
As1 Midterm Exam (20%)	✓	✓	✓	-	-	✓	-
As2 Weekly Online Quizzes (15%)	✓	✓	✓	✓	-	✓	-
As3 Final Exam (45%)	✓	✓	✓	✓	-	✓	-
As4 Laboratory Assessment and Exam (20%)	✓	-	-	✓	✓	-	✓
Cognitive Scale	22.0	17.0	17.0	17.0	5.0	17.0	5.0

Table 2: Mapping from Assessments to CLOs for ELEC1111 course

ELECBH Electrical Engineering, BE(Hons) + ME

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → AT Mapping — Assessment Types (AT)

Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut	
COMP1511	26	-	54	13	-	-	-	-	-	-	7	-	L1 core courses
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-	
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-	
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-	
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-	
PHYS1131	-	-	50	20	30	-	-	-	-	-	-	-	
PHYS1231	-	-	50	20	30	-	-	-	-	-	-	-	
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-	L2 core courses
ELEC2117	-	-	60	-	-	-	-	-	40	-	-	-	
ELEC2133	15	-	85	-	-	-	-	-	-	-	-	-	
ELEC2134	-	-	80	20	-	-	-	-	-	-	-	-	
ELEC2141	25	-	55	20	-	-	-	-	-	-	-	-	
MATH2069	-	-	60	-	-	-	-	-	-	-	40	-	
MATH2099	-	-	60	-	18	-	-	-	-	-	23	-	
ELEC3104	-	-	50	-	-	-	-	-	30	-	20	-	L3 core courses
ELEC3105	10	-	65	20	-	-	-	-	-	-	5	-	
ELEC3114	-	-	70	20	-	-	-	-	-	-	10	-	
ELEC3115	15	-	55	15	-	-	-	-	-	-	15	-	
ELEC3117	-	-	30	5	-	-	-	25	-	40	-	-	
ELEC4122	30	-	32	-	-	-	-	14	-	-	24	-	L4 core courses
ELEC4123	-	-	-	46	10	-	-	-	-	15	29	-	
ELEC4951	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4952	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4953	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC9451	-	-	-	-	-	-	-	-	100	-	-	-	L5 core courses
ELEC9452	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC9453	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC3106	10	-	60	15	-	-	-	-	-	-	15	-	Discipline Electives
ELEC4602	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4614	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4632	-	-	60	20	-	-	-	-	-	-	20	-	
ELEC9703	25	-	75	-	-	-	-	-	-	-	-	-	
ELEC9711	40	-	60	-	-	-	-	-	-	-	-	-	
ELEC9713	20	-	60	-	-	-	-	-	-	-	20	-	
ELEC9731	50	-	50	-	-	-	-	-	-	-	-	-	
GSOE9445	-	10	40	-	-	-	-	-	-	25	25	-	
COMP1521	20	-	60	10	-	-	-	-	-	-	10	-	Broadening Discipline Electives
COMP2521	30	-	40	18	-	-	-	-	-	-	12	-	
COMP3211	-	-	40	-	40	-	-	-	-	-	20	-	
COMP3231	40	-	60	-	-	-	-	-	-	-	-	-	
MATH3411	-	-	60	-	-	-	-	-	-	-	40	-	
COMP6441	-	30	70	-	-	-	-	-	-	-	-	-	

Table 3: Mapping from CLOs to Assessment Types

ELECBH Electrical Engineering, BE(Hons) + ME

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → SLO Mapping — Stream Learning Outcomes (SLOs)

Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8	
COMP1511	50.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	
DESN1000	9.2	0.0	11.5	0.0	30.4	0.0	41.5	7.4	
ELEC1111	80.5	11.0	8.5	0.0	0.0	0.0	0.0	0.0	
MATH1131	64.4	23.9	0.0	0.0	0.0	0.0	11.7	0.0	L1 core courses
MATH1231	64.4	0.0	23.9	0.0	0.0	0.0	11.7	0.0	
PHYS1131	48.3	0.0	48.3	0.0	0.0	0.0	3.3	0.0	
PHYS1231	48.1	0.0	48.1	0.0	0.0	0.0	3.7	0.0	
DESN2000	5.0	28.0	5.0	0.0	13.5	10.0	10.0	28.5	
ELEC2117	6.6	13.1	21.1	14.5	7.9	14.5	21.1	1.3	
ELEC2133	38.6	38.6	11.4	0.0	11.4	0.0	0.0	0.0	
ELEC2134	25.0	33.3	33.3	0.0	0.0	0.0	8.3	0.0	L2 core courses
ELEC2141	31.2	31.2	12.5	0.0	12.5	0.0	12.5	0.0	
MATH2069	77.1	0.0	22.9	0.0	0.0	0.0	0.0	0.0	
MATH2099	71.8	0.0	28.3	0.0	0.0	0.0	0.0	0.0	
ELEC3104	44.4	8.3	19.4	0.0	8.3	0.0	19.4	0.0	
ELEC3105	22.9	16.7	22.9	4.2	22.9	0.0	10.4	0.0	
ELEC3114	22.8	30.3	30.3	7.4	7.4	1.7	0.0	0.0	L3 core courses
ELEC3115	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0	
ELEC3117	10.2	23.2	14.2	27.2	10.2	7.0	4.0	4.0	
ELEC4122	0.0	0.0	0.0	0.0	0.0	70.0	20.0	10.0	
ELEC4123	15.0	15.0	15.0	15.0	15.0	8.3	8.3	8.3	
ELEC4951	6.7	19.0	25.7	15.7	5.0	10.7	10.7	6.7	L4 core courses
ELEC4952	6.7	19.0	25.7	15.7	5.0	10.7	10.7	6.7	
ELEC4953	6.7	19.0	25.7	15.7	5.0	10.7	10.7	6.7	
ELEC9451	0.0	23.3	23.3	6.7	0.0	17.8	17.8	11.1	
ELEC9452	0.0	23.3	23.3	6.7	0.0	17.8	17.8	11.1	L5 core courses
ELEC9453	0.0	23.3	23.3	6.7	0.0	17.8	17.8	11.1	
ELEC3106	63.2	0.0	12.2	0.0	12.2	0.0	12.2	0.0	
ELEC4602	29.6	50.9	7.5	0.0	3.1	0.0	8.8	0.0	
ELEC4614	25.0	25.0	25.0	0.0	25.0	0.0	0.0	0.0	
ELEC4632	7.2	32.9	6.2	32.9	6.2	1.2	7.2	6.2	
ELEC9703	21.9	29.0	10.0	14.8	24.3	0.0	0.0	0.0	Discipline Electives
ELEC9711	59.2	17.5	14.2	0.0	9.2	0.0	0.0	0.0	
ELEC9713	16.7	16.7	16.7	16.7	16.7	0.0	16.7	0.0	
ELEC9731	22.0	23.4	6.4	23.4	7.8	1.4	7.8	7.8	
GSOE9445	0.0	0.0	4.8	0.0	13.4	24.0	28.9	28.9	
COMP1521	63.6	0.0	25.6	0.0	10.8	0.0	0.0	0.0	
COMP2521	0.0	48.6	48.6	0.0	0.0	0.0	2.9	0.0	
COMP3211	0.0	31.7	31.7	0.0	6.7	0.0	30.0	0.0	Broadening Discipline Electives
COMP3231	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	
MATH3411	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	
COMP6441	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	

Table 4: Mapping from CLOs to SLOs

Stream Learning Outcomes (SLOs)	Engineers Australia Stage 1 Competencies															
	1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
	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
1	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-	-
4	-	-	-	✓	-	-	-	-	-	-	-	-	✓	✓	-	-
5	-	-	-	-	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓
6	-	-	-	-	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
7	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓
8	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-

Table 5: Mapping of SLOs to EA Stage 1 Competencies

Electrical Engineering, BE(Hons) + ME

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

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
COMP1511	25.0	25.0	-	-	-	-	16.7	16.7	16.7	-	-	-	-	-	-	-
COMP1521	31.8	31.8	-	-	1.2	-	9.7	9.7	9.7	1.2	-	1.2	1.2	1.2	-	1.2
DESN1000	4.6	4.6	-	-	3.4	-	7.2	7.2	7.2	10.7	-	13.8	3.4	13.8	10.4	13.8
ELEC1111	40.2	40.2	3.7	3.7	3.7	-	2.8	2.8	2.8	-	-	-	-	-	-	-
MATH1131	32.2	32.2	8.0	8.0	8.0	-	-	-	-	-	-	2.9	-	2.9	2.9	2.9
MATH1231	32.2	32.2	-	-	-	-	8.0	8.0	8.0	-	-	2.9	-	2.9	2.9	2.9
PHYS1131	24.2	24.2	-	-	-	-	16.1	16.1	16.1	-	-	0.8	-	0.8	0.8	0.8
PHYS1231	24.1	24.1	-	-	-	-	16.0	16.0	16.0	-	-	0.9	-	0.9	0.9	0.9
COMP2521	-	-	16.2	16.2	16.2	-	16.2	16.2	16.2	-	-	0.7	-	0.7	0.7	0.7
DESN2000	2.5	2.5	9.3	9.3	10.8	2.0	3.2	3.2	3.2	30.0	2.0	4.0	1.5	6.0	4.5	6.0
ELEC2117	3.3	3.3	4.4	9.2	5.3	2.9	7.9	7.9	7.9	2.2	2.9	6.1	5.7	13.9	8.2	9.0
ELEC2133	19.3	19.3	12.9	12.9	14.1	-	5.1	5.1	5.1	1.3	-	1.3	1.3	1.3	-	1.3
ELEC2134	12.5	12.5	11.1	11.1	11.1	-	11.1	11.1	11.1	-	-	2.1	-	2.1	2.1	2.1
ELEC2141	15.6	15.6	10.4	10.4	11.8	-	5.6	5.6	5.6	1.4	-	4.5	1.4	4.5	3.1	4.5
MATH2069	38.5	38.5	-	-	-	-	7.6	7.6	7.6	-	-	-	-	-	-	-
MATH2099	35.9	35.9	-	-	-	-	9.4	9.4	9.4	-	-	-	-	-	-	-
COMP3211	-	-	10.6	10.6	11.3	-	11.3	11.3	11.3	0.7	-	8.2	0.7	8.2	7.5	8.2
COMP3231	-	-	16.7	16.7	16.7	-	16.7	16.7	16.7	-	-	-	-	-	-	-
ELEC3104	22.2	22.2	2.8	2.8	3.7	-	7.4	7.4	7.4	0.9	-	5.8	0.9	5.8	4.9	5.8
ELEC3105	11.5	11.5	5.6	6.9	8.1	-	10.2	10.2	10.2	2.5	-	5.2	3.9	6.5	2.6	5.2
ELEC3106	31.6	31.6	-	-	1.4	-	5.4	5.4	5.4	1.4	-	4.4	1.4	4.4	3.1	4.4
ELEC3114	11.4	11.4	10.1	12.6	10.9	0.3	10.9	10.9	10.9	0.8	0.3	0.8	3.3	3.7	0.3	1.2
ELEC3115	16.7	16.7	11.1	11.1	11.1	-	11.1	11.1	11.1	-	-	-	-	-	-	-
ELEC3117	5.1	5.1	7.7	16.8	8.9	1.4	5.9	5.9	5.9	5.1	1.4	2.1	10.2	12.6	2.4	3.5
MATH3411	-	-	16.7	16.7	16.7	-	16.7	16.7	16.7	-	-	-	-	-	-	-
ELEC4122	-	-	-	-	-	14.0	-	-	-	10.0	14.0	5.0	-	19.0	19.0	19.0
ELEC4123	7.5	7.5	5.0	10.0	6.7	1.7	6.7	6.7	6.7	10.0	1.7	3.7	6.7	10.4	3.7	5.4
ELEC4602	14.8	14.8	17.0	17.0	17.3	-	2.9	2.9	2.9	0.3	-	2.6	0.3	2.6	2.2	2.6
ELEC4614	12.5	12.5	8.3	8.3	11.1	-	11.1	11.1	11.1	2.8	-	2.8	2.8	2.8	-	2.8
ELEC4632	3.6	3.6	11.0	21.9	11.6	0.2	2.8	2.8	2.8	6.9	0.2	2.5	11.6	13.7	2.1	2.7
ELEC4951	3.3	3.3	6.3	11.6	6.9	2.1	9.1	9.1	9.1	7.2	2.1	3.2	5.8	10.6	4.8	5.4
ELEC4952	3.3	3.3	6.3	11.6	6.9	2.1	9.1	9.1	9.1	7.2	2.1	3.2	5.8	10.6	4.8	5.4
ELEC4953	3.3	3.3	6.3	11.6	6.9	2.1	9.1	9.1	9.1	7.2	2.1	3.2	5.8	10.6	4.8	5.4
COMP6441	-	-	16.7	16.7	16.7	-	16.7	16.7	16.7	-	-	-	-	-	-	-
ELEC9451	-	-	7.8	10.0	7.8	3.6	7.8	7.8	7.8	11.1	3.6	4.4	2.2	10.2	8.0	8.0
ELEC9452	-	-	7.8	10.0	7.8	3.6	7.8	7.8	7.8	11.1	3.6	4.4	2.2	10.2	8.0	8.0
ELEC9453	-	-	7.8	10.0	7.8	3.6	7.8	7.8	7.8	11.1	3.6	4.4	2.2	10.2	8.0	8.0
ELEC9703	11.0	11.0	9.7	14.6	12.4	-	6.0	6.0	6.0	2.7	-	2.7	7.6	7.6	-	2.7
ELEC9711	29.6	29.6	5.8	5.8	6.9	-	5.7	5.7	5.7	1.0	-	1.0	1.0	1.0	-	1.0
ELEC9713	8.3	8.3	5.6	11.1	7.4	-	7.4	7.4	7.4	1.9	-	6.0	7.4	11.6	4.2	6.0
ELEC9731	11.0	11.0	7.8	15.6	8.7	0.3	3.0	3.0	3.0	8.7	0.3	2.8	8.7	10.9	2.2	3.1
GSOE9445	-	-	-	-	1.5	4.8	3.1	3.1	3.1	30.3	4.8	8.7	1.5	13.5	12.0	13.5
Cognitive Scale	13.3	13.3	7.2	9.0	7.1	2.3	6.9	6.9	6.9	5.2	2.3	3.0	3.0	5.7	3.8	4.0

Table 6: Mapping of ELECBH3736 courses to EA Competencies

Engineers Australia Stage 1 Competencies																
1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
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
13.3	13.3	7.2	9.0	7.1	2.3	6.9	6.9	6.9	5.2	2.3	3.0	3.0	5.7	3.8	4.0
52						26				22					

Table 7: Overall mapping of ELECBH3736 stream to EA Competencies

6. Reflection and Future Action

The SLOs were developed specifically for this stream but aimed to address the overarching EA Stage 1 Competencies (Table 5). The first 2 SLOs are more about acquiring the particular knowledge and skill base which align with the EA PE1 Competencies. Engineering applications (EA PE2) are mostly covered by SLOs 3, 5 and 8, while professional and personal attributes (PE3) are mainly covered by SLOs 5, 6 and 7.

Overall, as a stream, all the EA competencies are covered, with a greater emphasis on the Knowledge and Skill Base PE1 competencies, particularly PE1.1 and PE1.2. Relative to the BE (Elec) stream, the BE ME shows more strength in engineering technical management (PE2.4) and creativity (PE3.3), which reflects the inclusion of management electives in the final year and design courses in every year of the program. Note that there are 2 design core courses in the second year.

Table 7 also reveals the stream appears to have relatively less focus on sustainable engineering practice (PE1.6) and ethical conduct (PE3.1). As can be seen from the Table 6 heatmap, the core course ELEC4122 is very much focused on these two competencies, the reduction in the overall cognitive scale is due to other courses in the stream.

From Table 3, assessments for most courses rely heavily on exams (mid-term and final). The other forms of assessments include take-home assignments, lab skills assessments and lab reports. Enquiry-based learning courses include thesis work and design proficiency that have various assessments like seminar presentations, design concept mapping, reports, poster presentation and design showcase.

To ensure academic integrity, all final exam papers are reviewed by another academic with relevant technical knowledge and then a final review of the papers is done by the Director of Academic Studies. Thesis reports are submitted using TurnItIn for checking against plagiarism, and they are blind marked by two academics to ensure consistency. A third assessor is utilised if there is a discrepancy of larger than ten marks. For online written exams, various approaches have been adopted such as personalised exam papers or having a number of different versions. Some courses include an oral assessment as a compulsory component to pass the course. The markers are trained to identify plagiarism in the exams / reports and if anything identified, these are referred to the School Student Integrity Advisor, who meets with students before finalising an outcome. Plagiarism cases found are recorded in the university Plagiarism Register or Misconduct Register, the latter for serious cases.

The curriculum mapping did not take into account the Industrial Training component. The 60-day Industrial Training amounts to 480 hours in total as compared to the standard study load of 150 hours for a course. Thus, it is equivalent to 3 courses targeting mainly on PE2 and PE3 competencies, resulting in a more balanced overall curriculum alignment. The heatmaps (Tables 4 and 6) provide a high-level, strategic view of the stream that will inform all future course and stream revisions.

Among the strengths of the stream is practical learning experience. As noted in the Self-Study report, the laboratory component (every week in every technical course) accounts for 30% of in-class contact hours. The post-pandemic era presents a new education landscape, particularly the shift to online education delivery. To this end, the School has already taken initiatives to migrate laboratory facilities toward network-connected remote-control equipment that has easy-to-use interfaces. Web-enabled laboratory equipment is a crucial aspect of the School's remote laboratory course offerings. The School will continue to expand/enhance the functionalities of the online lab experiments. The growth of educational technology hardware and software resources for experimental purposes could potentially benefit learning and teaching. The School already has a dedicated Learning and Teaching Innovation Laboratory and the aim will be to continue supplying it with the latest technologies for experimentation.

7. Summary

Curriculum mapping of the Bachelor of Engineering (Honours) and Master of Engineering in Electrical Engineering ELECBH3736 program has been studied using the UNSW Engineering Faculty mapping tool CMAP. The stream design covers all the EA competencies with a split of 52% on PE1, 26% on PE2 and 22% on PE3. The stream is designed to equip students with creative problem solving, innovative design, capacity for analytical and critical thinking, independence in reflective learning, in-depth discipline specific knowledge, advanced technical confidence, advanced engineering management and communication skills, professional attitude and ethical practice, teamwork, broadened knowledge base via the minor.

ME (Electrical Engineering) (ELECAS8621)

1. Introduction

This report is in response to Engineers Australia (EA) M1 requirements regarding the curriculum mapping of the ELECAS Electrical Engineering stream of the 8621 Master of Engineering program. Firstly, it presents the aims of this stream, its structure and uniqueness. The stream comprises a suite of courses, each plays a role in achieving the overall objectives and this is revealed through the mapping between the Course Learning Outcomes (CLOs) and the Stream Learning Outcomes (SLOs). These SLOs in turn are then mapped to EA Stage 1 Graduate Competencies which completes the CLO/SLO/EA competency chain and from which curriculum mapping from the course level to the EA competencies is obtained. Finally, the strengths and weaknesses of the stream are drawn from these mapping results and an action plan to strengthen the stream is presented.

2. Aims of the stream

The Electrical Engineering stream prepares students for a broad and creative profession concerned with the design, development, planning and management of systems and devices which underpin modern economics and contribute to the quality of life.

An Electrical Engineer may be responsible for the research, design, development, manufacturing and management of complex hardware and software systems and reliable, cost-effective electrical/electronic devices, many involving the use of new information and computer-intensive technologies. These include computer systems; data telecommunication networks including the internet; mobile communications and wireless networks; integrated electronic systems; control systems, advanced robotics and intelligent machines; video and image processing systems; generation, transmission, distribution and utilisation of electrical power; renewable energy systems and solar energy conversion; biomedical equipment and devices, such as medical imaging scanners, pacemaker implants and hearing aids.

This stream is open to students who already have an undergraduate degree in Electrical Engineering or a related cognate area but non-accredited under the Washington Accord. The stream is designed to enable students to fulfil a number of needs including updating qualifications and knowledge to meet/maintain professional accreditation standards and Australian engineering practice, acquiring advanced in-depth discipline knowledge, research skills, deeper project experience, increased technical confidence to analyse critically and synthesise complex concepts, developing and expanding engineering management skills and transmitting knowledge to specialist and non-specialist audiences, in accordance with AQF level 9.

The stream structure and recommended study plan is shown in Table 1. Students must complete a total of 17 courses comprising 4 core courses, 6 Disciplinary Knowledge (Level 4) elective courses, 5 Advanced Disciplinary Knowledge (Level 5) elective courses, and 2 Engineering and Technical Management elective courses). Students are also required to complete 60 days of Industrial Training. Flexibility and choice are maintained throughout the entire structure by providing many elective courses.

Year	Term	Course	Course name
1	1	L4 elective	Disciplinary Knowledge Elective
		L4 elective	Disciplinary Knowledge Elective
		ETM elective	Engineering Technical Management Elective
	2	L4 elective	Disciplinary Knowledge Elective
		L4 elective	Disciplinary Knowledge Elective
		ETM elective	Engineering Technical Management Elective
	3	L4 elective	Disciplinary Knowledge Elective
		L4 elective	Disciplinary Knowledge Elective
		L5 elective	Advanced Disciplinary Knowledge Elective
2	1	ELEC9451	Masters Project A
		L5 elective	Advanced Disciplinary Knowledge Elective
		L5 elective	Advanced Disciplinary Knowledge Elective
	2	ELEC9452	Masters Project B
		ELEC9123	Design Proficency
		L5 elective	Advanced Disciplinary Knowledge Elective
	3	ELEC9453	Masters Project C
		L5 elective	Advanced Disciplinary Knowledge Elective

Table 1: ELECAS8621 Stream – Recommended Study Plan

3. Stream Learning Outcomes (SLOs)

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

1. Demonstrate a deeper understanding of advanced theory embodied in Electrical Engineering.
2. Apply specialist in-depth technical knowledge in electrical energy systems, electronics, control systems, and/or signal processing.
3. Identify, critically evaluate, and use current research to the solution of complex problems in Electrical Engineering.
4. Think independently, critically, logically and apply analytical procedures and tools to develop complex hardware and software electrical systems.
5. Proficiently apply self-directed learning, innovative problem-solving and design skills to open-ended electrical and interdisciplinary design challenges and the creation of products.
6. Demonstrate a professional aptitude concerning the role of engineers in society and a well-developed, respectful, responsible ethic including safety, privacy, security, environmental concerns, and human rights.
7. Communicate technical and non-technical concepts fluently and effectively with all stakeholders in document and verbal form, whether as part of a project team or in a leadership context.

4. Development of SLOs

The SLOs were developed through rigorous internal consultations (School and Engineering Faculty). In the first stage at the school level, working groups were formed with members of academic teaching staff from various disciplinary areas to formulate the SLOs. The SLOs were reviewed by the School Academic Executive Committee. External consultations were then sought from the School Industry Advisory Board for their advice and feedback, particularly the expectation of industry with regards to graduate capabilities. The Faculty of Engineering Academic Programs Committee reviewed and approved the SLOs before the final approval by

the Faculty Board. The developed SLOs were shared and discussed with all teaching staff in the school through a School Board meeting.

5. Curriculum Mapping

At the course level, the course coordinators develop their course outlines (COs) to articulate the course's context and relevance within the program. Each CO includes details about the course learning outcomes (CLOs) which lists the knowledge, attitudes, skills, and practices that students are expected to acquire and demonstrate after completing that course. Each CO also specifies the various assessments (exam, quiz, lab work, assignment, etc) to validate attainment of the CLOs. UNSW Assessment Policy prescribes that each course can have up to four main assessment components of varying weightings and each component may comprise several sub-components. The assessment weightings and the mapping of the assessments to the CLOs are developed by the course coordinators and provided in the COs for precision and transparency in the course design and assessment. A web-based platform (ACOA) developed by UNSW Engineering Faculty is used for constructing the COs so that CLOs, assessments, and other key course information can be easily found, and in a consistent format across all courses.

The cognitive scales for each CLO in a course are calculated by aggregating the weighted assessment contributions, using a curriculum mapping tool (CMAP) developed by UNSW Engineering Faculty. An example is shown in Table 2 for the ELEC9123 course which has 4 assessment components and 4 CLOs.

The mapping of the CLOs to the 12 different Assessment types are shown in Table 3. All the core courses together with a representative range of elective courses are shown in the table.

At the stream level, the course coordinators provide the mapping of the CLOs to the SLOs for their courses. The mapping results are shown in Table 4.

The SLOs in turn are mapped to the 16 EA Stage 1 Competencies. This mapping was done by expert working groups in the school with review and final endorsement from the Academic Executive Committee. The SLO/EA mapping is shown in Table 5.

As the stream specifies a quota of electives to be taken, the more popular electives (large enrolment) are included in the mapping to complete the CLO/SLO/EA Competency chain and the overall curriculum mapping results are shown in Table 6.

The final cognitive scale (last row in Table 6) reveals the percentage coverage of the stream for each of the 16 EA Competencies. Table 7 aggregates these and shows the percentage coverage of the stream for each of the 3 competency categories: 45% on Knowledge and skill base (PE1), 27% on Engineering application ability (PE2), and 28% on Professional and personal attributes (PE3).

Core | Learning Outcomes | Assessment | AS→CLO Mapping | CLO→SLO Mapping

AS → CLO Mapping	Learning Outcomes (CLO)			
Assessments (AS)	CLO1	CLO2	CLO3	CLO4
As1 Online Engagement/Participation Activ... (10%)	-	✓	✓	-
As2 Design Task 3 (30%)	✓	✓	✓	✓
As3 Design Task 1 (30%)	✓	✓	✓	✓
As4 Design Task 2 (30%)	✓	✓	✓	✓
Cognitive Scale	22.5	27.5	27.5	22.5

Table 2: Mapping from Assessments to CLOs for ELEC9123 course

ELECAS Electrical Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → AT Mapping — Assessment Types (AT)

Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut	
ELEC9123	-	-	-	90	10	-	-	-	-	-	-	-	Core courses
ELEC9451	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC9452	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC9453	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4601	10	-	60	30	-	-	-	-	-	-	-	-	L4 Electives
ELEC4602	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4603	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4604	-	-	60	-	-	-	-	-	-	20	20	-	
ELEC4611	-	-	85	10	-	-	-	-	-	5	-	-	
ELEC4612	-	-	50	20	30	-	-	-	-	-	-	-	
ELEC4613	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4614	-	-	70	20	-	-	-	-	-	10	-	-	
ELEC4617	-	-	60	20	-	-	-	-	-	-	20	-	
ELEC4621	-	-	50	30	-	-	-	-	-	-	20	-	
ELEC4622	-	-	60	30	-	-	-	-	-	-	10	-	
ELEC4623	-	-	50	20	20	-	-	-	10	-	-	-	
ELEC4631	-	-	76	12	-	-	-	-	-	-	12	-	
ELEC4632	-	-	60	20	-	-	-	-	-	-	20	-	
ELEC9701	-	-	65	-	25	-	-	-	-	-	10	-	L5 Electives
ELEC9702	26	-	75	-	-	-	-	-	-	-	-	-	
ELEC9703	25	-	75	-	-	-	-	-	-	-	-	-	
ELEC9704	25	-	75	-	-	-	-	-	-	-	-	-	
ELEC9711	40	-	60	-	-	-	-	-	-	-	-	-	
ELEC9712	15	-	85	-	-	-	-	-	-	-	-	-	
ELEC9713	20	-	60	-	-	-	-	-	-	-	20	-	
ELEC9714	15	-	50	-	-	-	-	10	20	-	5	-	
ELEC9715	-	-	50	-	15	-	-	-	25	-	10	-	
ELEC9716	20	-	35	25	-	-	-	-	-	-	20	-	
ELEC9719	10	-	-	20	-	-	-	-	-	70	-	-	
ELEC9721	-	-	60	25	-	-	-	-	-	-	15	-	
ELEC9731	50	-	50	-	-	-	-	-	-	-	-	-	
ELEC9732	-	-	40	-	30	-	-	-	30	-	-	-	
ELEC9741	15	-	70	-	-	-	-	-	15	-	-	-	
GSOE9210	-	-	60	-	40	-	-	-	-	-	-	-	ETM Electives
GSOE9445	-	10	40	-	-	-	-	-	-	25	25	-	
GSOE9510	-	-	50	-	50	-	-	-	-	-	-	-	
GSOE9820	50	-	40	-	-	-	-	-	-	-	10	-	
GSOE9830	-	-	100	-	-	-	-	-	-	-	-	-	

Table 3: Mapping from CLOs to Assessment Types

ELECAS Electrical Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → SLO Mapping — Stream Learning Outcomes (SLOs)

Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	
ELEC9123	38.8	11.2	9.2	9.2	31.7	0.0	0.0	
ELEC9451	0.0	23.3	23.3	6.7	0.0	23.3	23.3	Core courses
ELEC9452	0.0	23.3	23.3	6.7	0.0	23.3	23.3	
ELEC9453	0.0	23.3	23.3	6.7	0.0	23.3	23.3	
ELEC4601	12.5	37.5	0.0	25.0	25.0	0.0	0.0	
ELEC4602	0.0	0.0	0.0	14.0	5.2	0.0	22.2	
ELEC4603	37.6	37.6	0.0	15.1	0.0	0.0	9.6	
ELEC4604	10.6	26.4	0.0	36.9	15.6	0.0	10.6	
ELEC4611	12.1	31.6	0.0	19.5	19.5	5.2	12.1	
ELEC4612	16.3	16.3	9.2	16.3	9.2	16.3	16.3	L4 Electives
ELEC4613	29.2	29.2	0.0	29.2	12.5	0.0	0.0	
ELEC4614	25.0	25.0	25.0	25.0	0.0	0.0	0.0	
ELEC4617	19.6	19.6	19.6	19.6	19.6	0.0	1.9	
ELEC4621	38.3	38.3	0.0	5.0	5.0	0.0	13.3	
ELEC4622	25.8	37.9	12.1	12.1	12.1	0.0	0.0	
ELEC4623	11.7	21.7	0.0	41.7	5.0	20.0	0.0	
ELEC4631	24.2	24.2	24.2	27.2	0.0	0.0	0.0	
ELEC4632	8.2	33.9	33.9	7.2	7.2	1.4	8.2	
ELEC9701	37.7	37.7	11.0	4.5	4.5	0.0	4.5	
ELEC9702	32.3	19.8	0.0	32.3	15.6	0.0	0.0	
ELEC9703	21.9	29.0	10.0	14.8	24.3	0.0	0.0	
ELEC9704	34.6	34.6	9.6	13.3	8.0	0.0	0.0	
ELEC9711	57.5	17.5	5.0	12.5	7.5	0.0	0.0	
ELEC9712	26.5	26.5	18.2	3.6	3.6	9.8	11.9	
ELEC9713	16.7	16.7	16.7	16.7	16.7	0.0	16.7	L5 Electives
ELEC9714	33.3	33.3	0.0	0.0	0.0	16.7	16.7	
ELEC9715	31.7	31.7	0.0	0.0	0.0	18.3	18.3	
ELEC9716	21.8	21.8	6.9	6.9	6.9	21.8	14.0	
ELEC9719	31.7	31.7	31.7	5.0	0.0	0.0	0.0	
ELEC9721	24.3	24.3	2.7	24.3	2.7	0.0	21.7	
ELEC9731	23.1	24.7	24.7	7.5	9.2	1.7	9.2	
ELEC9732	25.0	25.0	0.0	25.0	25.0	0.0	0.0	
ELEC9741	43.3	12.5	10.1	12.5	10.8	0.0	10.8	
GSOE9210	0.0	0.0	0.0	50.0	0.0	50.0	0.0	
GSOE9445	0.0	0.0	0.0	6.1	17.5	38.2	38.2	ETM Electives
GSOE9510	0.0	0.0	0.0	0.0	0.0	50.0	50.0	
GSOE9820	0.0	0.0	0.0	0.0	50.0	0.0	50.0	
GSOE9830	0.0	0.0	0.0	0.0	50.0	0.0	50.0	

Table 4: Mapping from CLOs to SLOs

Stream Learning Outcomes (SLOs)	Engineers Australia Stage 1 Competencies															
	1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
	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
1	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-
3	-	-	-	✓	-	-	-	-	✓	-	-	-	-	-	-	-
4	-	-	-	-	-	-	✓	✓	✓	✓	-	-	-	-	-	-
5	-	-	-	-	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓
6	-	-	-	-	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
7	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓

Table 5: Mapping of SLOs to EA Stage 1 Competencies

ELECAS Electrical Engineering

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

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
ELEC4602	-	-	-	-	0.6	-	4.1	4.1	4.1	4.1	-	6.1	0.6	6.1	5.6	6.1
ELEC4603	12.5	12.5	12.5	7.5	7.5	7.5	11.3	11.3	3.8	3.8	-	2.4	-	2.4	2.4	2.4
ELEC4614	8.3	8.3	8.3	17.5	5.0	5.0	11.2	11.2	18.7	6.2	-	-	-	-	-	-
ELEC4617	6.5	6.5	6.5	13.7	6.1	3.9	11.0	11.0	16.9	7.1	-	2.6	2.2	2.6	0.5	2.6
ELEC4622	8.6	8.6	8.6	13.6	8.9	7.6	11.9	11.9	10.4	4.4	-	1.3	1.3	1.3	-	1.3
ELEC4632	2.7	2.7	2.7	23.7	7.6	7.1	9.4	9.4	19.5	2.6	0.3	2.9	0.8	3.1	2.3	3.1
ELEC9123	12.9	12.9	12.9	6.8	5.8	2.2	8.1	8.1	10.4	5.8	-	3.5	3.5	3.5	-	3.5
ELEC9451	-	-	-	16.3	4.7	9.3	6.3	6.3	13.3	1.7	4.7	5.8	-	10.5	10.5	10.5
ELEC9452	-	-	-	16.3	4.7	9.3	6.3	6.3	13.3	1.7	4.7	5.8	-	10.5	10.5	10.5
ELEC9453	-	-	-	16.3	4.7	9.3	6.3	6.3	13.3	1.7	4.7	5.8	-	10.5	10.5	10.5
ELEC9703	7.3	7.3	7.3	10.8	8.5	5.8	12.2	12.2	11.4	6.4	-	2.7	2.7	2.7	-	2.7
ELEC9711	19.2	19.2	19.2	6.0	4.3	3.5	7.5	7.5	6.5	4.0	-	0.8	0.8	0.8	-	0.8
ELEC9713	5.6	5.6	5.6	11.7	5.2	3.3	9.4	9.4	14.4	6.0	-	6.0	1.9	6.0	4.2	6.0
ELEC9716	7.3	7.3	7.3	7.8	5.1	8.7	6.8	6.8	5.9	2.5	4.4	4.3	0.8	8.6	7.9	8.6
ELEC9731	7.7	7.7	7.7	17.3	6.0	5.3	7.8	7.8	15.3	2.9	0.3	3.3	1.0	3.6	2.6	3.6
GSOE9445	-	-	-	-	1.9	7.6	3.5	3.5	3.5	3.5	7.6	11.5	1.9	19.1	17.2	19.1
GSOE9510	-	-	-	-	-	10.0	-	-	-	-	10.0	12.5	-	22.5	22.5	22.5
Cognitive Scale	7.7	7.7	7.7	11.3	4.6	5.6	7.1	7.1	9.6	3.4	3.9	4.1	1.4	6.0	6.9	6.0

Table 6: Mapping of ELECAS8621 courses to EA Competencies

Engineers Australia Stage 1 Competencies																
1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes						
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	
7.7	7.7	7.7	11.3	4.6	5.6	7.1	7.1	9.6	3.4	3.9	4.1	1.4	6.0	6.9	6.0	
45						27				28						

Table 7: Overall mapping of ELECAS8621 stream to EA Competencies

6. Reflection and Future Action

The SLOs were developed specifically for this stream but aimed to address the overarching EA Stage 1 Competencies (Table 5). The first 2 SLOs are mostly about acquiring the particular knowledge and skill base which align with the EA PE1 Competencies. Engineering applications (EA PE2) are mostly covered by SLOs 2, 4 and 5, while professional and personal attributes (PE3) are mainly covered by SLOs 5, 6 and 7.

Overall, as a stream, all the EA competencies are covered, with a greater emphasis on the Knowledge and Skill Base PE1 competencies. In particular, it shows a significantly larger emphasis on research (PE1.4) which is to be expected from the higher level of the Disciplinary Knowledge and Advanced Disciplinary Knowledge courses (many of which touch on research directions) and the higher level of the ME Project, which is an individual research project. There is also a greater emphasis on systematic engineering synthesis and design (PE2.3) given that the program includes a dedicated design course.

From Table 3, assessments for most courses rely heavily on exams (mid-term and final). The other forms of assessments include take-home assignments, lab skills assessments and lab reports. Enquiry-based learning courses include thesis work and design proficiency that have various assessments like seminar presentations, design concept mapping, reports, poster presentation and design showcase.

To ensure academic integrity, all final exam papers are reviewed by another academic with relevant technical knowledge and then a final review of the papers is done by the Director of Academic Studies. Thesis reports are submitted using TurnItIn for checking against plagiarism, and they are blind marked by two academics to ensure consistency. A third assessor is utilised if there is a discrepancy of larger than ten marks. For online written exams, various approaches have been adopted such as personalised exam papers or having a number of different versions. Some courses include an oral assessment as a compulsory component to pass the course. The markers are trained to identify plagiarism in the exams / reports and if anything identified, these are referred to the School Student Integrity Advisor, who meets with students before finalising an outcome. Plagiarism cases found are recorded in the university Plagiarism Register or Misconduct Register, the latter for serious cases.

The curriculum mapping did not take into account the Industrial Training component. The 60-day Industrial Training amounts to 480 hours in total as compared to the standard study load of 150 hours for a course. Thus, it is equivalent to 3 courses targeting mainly on PE2 and PE3 competencies, resulting in a more balanced overall curriculum alignment. The heatmaps (Tables 4 and 6) provide a high-level, strategic view of the stream that will inform all future course and stream revisions.

7. Summary

Curriculum mapping of the ELECAS Electrical Engineering stream of the Master of Engineering 8621 program has been studied using the UNSW Engineering Faculty mapping tool CMAP. The stream design covers all the EA competencies with a split of 45% on PE1, 27% on PE2 and 28% on PE3. The stream is designed to equip students with in-depth and advanced knowledge and research in Electrical Engineering, independent and reflective learning, creative problem solving, design skills, deeper project experience, increased technical confidence, and increased management skills.

ME (Telecommunications) (TELEAS8621)

1. Introduction

This report is in response to Engineers Australia (EA) M1 requirements regarding the curriculum mapping of the TELEAS Telecommunications stream of the 8621 Master of Engineering program. Firstly, it presents the aims of this stream, its structure and uniqueness. The stream comprises a suite of courses, each plays a role in achieving the overall objectives and this is revealed through the mapping between the Course Learning Outcomes (CLOs) and the Stream Learning Outcomes (SLOs). These SLOs in turn are then mapped to EA Stage 1 Graduate Competencies which completes the CLO/SLO/EA competency chain and from which curriculum mapping from the course level to the EA competencies is obtained. Finally, the strengths and weaknesses of the stream are drawn from these mapping results and an action plan to strengthen the stream is presented.

2. Aims of the stream

The Telecommunications stream prepares students for a broad and creative profession concerned with the design, development, planning and management of systems and devices which underpin modern economics and contribute to the quality of life.

Telecommunications engineering is concerned with communicating information at a distance. It is strongly associated with data communications, largely because of the need to encode, compress and encrypt all information, and because of the growing importance of digital and wireless (e.g., mobile telephony) networks. It is designed to equip students who are interested in the following fields: satellite communications; signal and image processing; optical fibres and photonics; optical and microwave communications; mobile satellite communications; data networks; software systems including e-commerce; microelectronic devices and systems; data coding, compression, encryption and transmission; real-time embedded systems; quantum telecommunications.

This stream is open to students who already have an undergraduate degree in Telecommunications engineering or a related cognate area but non-accredited under the Washington Accord. The stream is designed to enable students to fulfil a number of needs including updating qualifications and knowledge to meet/maintain professional accreditation standards and Australian engineering practice, acquiring advanced in-depth discipline knowledge, research skills, deeper project experience, increased technical confidence to analyse critically and synthesise complex concepts, developing and expanding engineering management skills and transmitting knowledge to specialist and non-specialist audiences, in accordance with AQF level 9.

The stream structure and recommended study plan is shown in Table 1. Students must complete a total of 17 courses comprising 4 core courses, 6 Disciplinary Knowledge (Level 4) elective courses, 5 Advanced Disciplinary Knowledge (Level 5) elective courses, and 2 Engineering and Technical Management elective courses). Students are also required to complete 60 days of Industrial Training. Flexibility and choice are maintained throughout the entire structure by providing many elective courses.

Year	Term	Course	Course name
1	1	L4 elective	Disciplinary Knowledge Elective
		L4 elective	Disciplinary Knowledge Elective
		ETM elective	Engineering Technical Management Elective
	2	L4 elective	Disciplinary Knowledge Elective
		L4 elective	Disciplinary Knowledge Elective
		ETM elective	Engineering Technical Management Elective
	3	L4 elective	Disciplinary Knowledge Elective
		L4 elective	Disciplinary Knowledge Elective
		L5 elective	Advanced Disciplinary Knowledge Elective
2	1	ELEC9451	Masters Project A
		L5 elective	Advanced Disciplinary Knowledge Elective
		L5 elective	Advanced Disciplinary Knowledge Elective
	2	ELEC9452	Masters Project B
		ELEC9123	Design Proficency
		L5 elective	Advanced Disciplinary Knowledge Elective
	3	ELEC9453	Masters Project C
		L5 elective	Advanced Disciplinary Knowledge Elective

Table 1: TELEAS8621 Stream – Recommended Study Plan

3. Stream Learning Outcomes (SLOs)

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

1. Demonstrate a deeper understanding of advanced theory embodied in Telecommunications Engineering.
2. Apply specialist in-depth technical knowledge in telecommunications and networking protocols.
3. Identify, critically evaluate, and use current research to the solution of complex problems in Telecommunications Engineering.
4. Think independently, critically, logically and apply analytical procedures and tools to develop complex hardware and software telecommunications and networking systems.
5. Proficiently apply self-directed learning, innovative problem-solving and design skills to open-ended telecommunications and interdisciplinary design challenges and the creation of products.
6. Demonstrate a professional aptitude concerning the role of engineers in society and a well-developed, respectful, responsible ethic including safety, privacy, security, environmental concerns, and human rights.
7. Communicate technical and non-technical concepts fluently and effectively with all stakeholders in document and verbal form, whether as part of a project team or in a leadership context.

4. Development of SLOs

The SLOs were developed through rigorous internal consultations (School and Engineering Faculty). In the first stage at the school level, working groups were formed with members of academic teaching staff from various disciplinary areas to formulate the SLOs. The SLOs were reviewed by the School Academic Executive Committee. External consultations were then sought from the School Industry Advisory Board for their advice and feedback, particularly the expectation of industry with regards to graduate capabilities. The Faculty of Engineering Academic Programs Committee reviewed and approved the SLOs before the final approval by

the Faculty Board. The developed SLOs were shared and discussed with all teaching staff in the school through a School Board meeting.

5. Curriculum Mapping

At the course level, the course coordinators develop their course outlines (COs) to articulate the course's context and relevance within the program. Each CO includes details about the course learning outcomes (CLOs) which lists the knowledge, attitudes, skills, and practices that students are expected to acquire and demonstrate after completing that course. Each CO also specifies the various assessments (exam, quiz, lab work, assignment, etc) to validate attainment of the CLOs. UNSW Assessment Policy prescribes that each course can have up to four main assessment components of varying weightings and each component may comprise several sub-components. The assessment weightings and the mapping of the assessments to the CLOs are developed by the course coordinators and provided in the COs for precision and transparency in the course design and assessment. A web-based platform (ACOA) developed by UNSW Engineering Faculty is used for constructing the COs so that CLOs, assessments, and other key course information can be easily found, and in a consistent format across all courses.

The cognitive scales for each CLO in a course are calculated by aggregating the weighted assessment contributions, using a curriculum mapping tool (CMAP) developed by UNSW Engineering Faculty. An example is shown in Table 2 for the ELEC9123 course which has 4 assessment components and 4 CLOs.

The mapping of the CLOs to the 12 different Assessment types are shown in Table 3. All the core courses together with a representative range of elective courses are shown in the table.

At the stream level, the course coordinators provide the mapping of the CLOs to the SLOs for their courses. The mapping results are shown in Table 4.

The SLOs in turn are mapped to the 16 EA Stage 1 Competencies. This mapping was done by expert working groups in the school with review and final endorsement from the Academic Executive Committee. The SLO/EA mapping is shown in Table 5.

As the stream specifies a quota of electives to be taken, the more popular electives (large enrolment) are included in the mapping to complete the CLO/SLO/EA Competency chain and the overall curriculum mapping results are shown in Table 6.

The final cognitive scale (last row in Table 6) reveals the percentage coverage of the stream for each of the 16 EA Competencies. Table 7 aggregates these and shows the percentage coverage of the stream for each of the 3 competency categories: 44% on Knowledge and skill base (PE1), 30% on Engineering application ability (PE2), and 26% on Professional and personal attributes (PE3).

Core | Learning Outcomes | Assessment | AS→CLO Mapping | CLO→SLO Mapping

AS → CLO Mapping	Learning Outcomes (CLO)			
Assessments (AS)	CLO1	CLO2	CLO3	CLO4
As1 Online Engagement/Participation Activ... (10%)	-	✓	✓	-
As2 Design Task 3 (30%)	✓	✓	✓	✓
As3 Design Task 1 (30%)	✓	✓	✓	✓
As4 Design Task 2 (30%)	✓	✓	✓	✓
Cognitive Scale	22.5	27.5	27.5	22.5

Table 2: Mapping from Assessments to CLOs for ELEC9123 course

TELEAS Telecommunications

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → AT Mapping — Assessment Types (AT)

Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut	
ELEC9123	-	-	-	90	10	-	-	-	-	-	-	-	Core courses
ELEC9451	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC9452	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC9453	-	-	-	-	-	-	-	-	100	-	-	-	
ELEC4621	-	-	50	30	-	-	-	-	-	-	20	-	L4 Electives
PHTN4661	-	-	75	-	-	-	-	-	-	25	-	-	
PHTN4662	-	-	70	20	-	-	-	-	-	10	-	-	
TELE4642	-	-	70	30	-	-	-	-	-	-	-	-	
TELE4651	-	-	50	40	-	-	-	-	-	10	-	-	
TELE4652	-	-	55	20	-	-	-	-	-	20	5	-	
TELE4653	-	-	-	-	100	-	-	-	-	-	-	-	
ELEC9725	60	-	30	-	-	-	-	-	-	-	10	-	L5 Electives
ELEC9741	15	-	70	-	-	-	-	-	15	-	-	-	
ELEC9762	50	-	50	-	-	-	-	-	-	-	-	-	
ELEC9764	30	-	60	-	-	-	-	-	-	-	10	-	
GMAT9200	40	-	35	-	-	-	-	-	-	-	25	-	
GSOE9758	-	-	30	-	10	-	-	-	50	-	10	-	
TELE9752	-	-	60	-	40	-	-	-	-	-	-	-	
TELE9753	-	-	85	-	15	-	-	-	-	-	-	-	
TELE9754	-	-	60	-	-	-	-	10	20	10	-	-	
TELE9755	20	-	60	-	-	-	-	-	-	-	20	-	
TELE9756	20	-	60	-	-	-	-	-	-	-	20	-	
TELE9757	-	-	60	-	-	-	-	-	20	-	20	-	
GSOE9210	-	-	60	-	40	-	-	-	-	-	-	-	ETM Electives
GSOE9445	-	10	40	-	-	-	-	-	-	25	25	-	
GSOE9510	-	-	50	-	50	-	-	-	-	-	-	-	
GSOE9820	50	-	40	-	-	-	-	-	-	-	10	-	
GSOE9830	-	-	100	-	-	-	-	-	-	-	-	-	

Table 3: Mapping from CLOs to Assessment Types

TELEAS Telecommunications

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

CO → SLO Mapping — Stream Learning Outcomes (SLOs)

Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	
ELEC9123	38.8	11.2	9.2	9.2	31.7	0.0	0.0	
ELEC9451	0.0	23.3	23.3	6.7	0.0	23.3	23.3	Core courses
ELEC9452	0.0	23.3	23.3	6.7	0.0	23.3	23.3	
ELEC9453	0.0	23.3	23.3	6.7	0.0	23.3	23.3	
ELEC4621	38.3	38.3	0.0	5.0	5.0	0.0	13.3	
PHTN4661	16.9	16.9	16.9	9.5	16.9	6.2	16.9	
PHTN4662	18.3	18.3	18.3	11.4	18.3	7.5	7.9	
TELE4642	26.5	26.5	9.8	18.2	11.9	3.6	3.6	L4 Electives
TELE4651	21.2	26.9	8.1	15.6	13.1	7.5	7.5	
TELE4652	23.7	14.4	14.4	14.4	14.4	9.3	9.3	
TELE4653	11.1	16.7	16.7	16.7	16.7	11.1	11.1	
ELEC9725	23.0	23.0	12.3	7.3	7.3	4.0	23.0	
ELEC9741	9.1	0.0	12.8	15.8	13.2	0.0	13.2	
ELEC9762	32.4	32.4	0.0	32.4	1.3	0.0	1.3	
ELEC9764	17.4	17.4	17.4	0.0	38.3	0.0	9.6	
GMAT9200	36.2	27.7	0.0	36.2	0.0	0.0	0.0	
GSOE9758	16.7	13.3	11.7	11.7	5.0	10.0	11.7	
TELE9752	15.0	20.8	6.7	14.2	14.2	14.2	15.0	L5 Electives
TELE9753	14.9	14.9	14.9	5.6	20.3	14.7	14.7	
TELE9754	30.0	21.7	19.4	7.8	7.8	3.3	10.0	
TELE9755	22.9	8.3	14.6	31.2	8.3	0.0	14.6	
TELE9756	35.0	37.5	2.5	10.0	0.0	12.5	2.5	
TELE9757	38.0	25.7	0.0	3.6	3.6	0.0	3.6	
GSOE9210	0.0	0.0	0.0	50.0	0.0	50.0	0.0	
GSOE9445	0.0	0.0	0.0	6.1	17.5	38.2	38.2	
GSOE9510	0.0	0.0	0.0	0.0	0.0	50.0	50.0	ETM Electives
GSOE9820	0.0	0.0	0.0	0.0	50.0	0.0	50.0	
GSOE9830	0.0	0.0	0.0	0.0	50.0	0.0	50.0	

Table 4: Mapping from CLOs to SLOs

Stream Learning Outcomes (SLOs)	Engineers Australia Stage 1 Competencies															
	1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
	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
1	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-
3	-	-	-	✓	-	-	-	-	✓	-	-	-	-	-	-	-
4	-	-	-	-	-	-	✓	✓	✓	✓	-	-	-	-	-	-
5	-	-	-	-	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓
6	-	-	-	-	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
7	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓

Table 5: Mapping of SLOs to EA Stage 1 Competencies

TELEAS Telecommunications

Core | Learning Outcomes | Courses | CO → SLO | SLO → GC | Assessment Map | Curriculum Map

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
PHTN4661	5.6	5.6	5.6	11.8	5.2	4.6	7.6	7.6	12.7	4.3	1.2	6.1	1.9	7.3	5.5	7.3
PHTN4662	6.1	6.1	6.1	12.8	5.7	5.2	8.5	8.5	14.0	4.9	1.5	4.0	2.0	5.5	3.5	5.5
TELE4642	8.8	8.8	8.8	10.2	6.6	6.0	11.2	11.2	10.8	5.9	0.7	2.2	1.3	2.9	1.6	2.9
TELE4651	7.1	7.1	7.1	9.4	6.8	6.9	10.7	10.7	9.4	5.4	1.5	3.3	1.5	4.8	3.4	4.8
TELE4652	7.9	7.9	7.9	10.1	4.5	4.7	8.1	8.1	12.4	5.2	1.9	3.9	1.6	5.8	4.2	5.8
TELE4653	3.7	3.7	3.7	11.7	5.2	5.6	9.4	9.4	14.4	6.0	2.2	4.6	1.9	6.9	5.0	6.9
ELEC9123	12.9	12.9	12.9	6.8	5.8	2.2	8.1	8.1	10.4	5.8	-	3.5	3.5	3.5	-	3.5
ELEC9451	-	-	-	16.3	4.7	9.3	6.3	6.3	13.3	1.7	4.7	5.8	-	10.5	10.5	10.5
ELEC9452	-	-	-	16.3	4.7	9.3	6.3	6.3	13.3	1.7	4.7	5.8	-	10.5	10.5	10.5
ELEC9453	-	-	-	16.3	4.7	9.3	6.3	6.3	13.3	1.7	4.7	5.8	-	10.5	10.5	10.5
GSOE9758	5.6	5.6	5.6	8.5	3.2	4.7	6.1	6.1	9.3	3.5	2.0	3.5	0.6	5.5	4.9	5.5
TELE9752	5.0	5.0	5.0	7.5	5.7	7.0	9.3	9.3	8.4	5.1	2.8	5.3	1.6	8.2	6.6	8.2
TELE9753	5.0	5.0	5.0	10.4	5.2	5.9	6.6	6.6	11.1	3.7	2.9	5.9	2.3	8.9	6.6	8.9
TELE9754	10.0	10.0	10.0	14.1	5.2	5.0	7.1	7.1	12.5	2.8	0.7	3.4	0.9	4.0	3.2	4.0
TELE9756	11.7	11.7	11.7	8.8	7.5	10.0	10.0	10.0	3.8	2.5	2.5	0.6	-	3.1	3.1	3.1
Cognitive Scale	7.1	7.1	7.1	10.9	5.2	6.1	7.8	7.8	10.9	3.8	2.3	4.1	1.6	6.2	5.4	6.2

Table 6: Mapping of TELEAS8621 courses to EA Competencies

Engineers Australia Stage 1 Competencies															
1. Knowledge and skill base						2. Engineering application ability				3. Professional and personal attributes					
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
7.1	7.1	7.1	10.9	5.2	6.1	7.8	7.8	10.9	3.8	2.3	4.1	1.6	6.2	5.4	6.2
44						30				26					

Table 7: Overall mapping of TELEAS8621 stream to EA Competencies

6. Reflection and Future Action

The SLOs were developed specifically for this stream but aimed to address the overarching EA Stage 1 Competencies (Table 5). The first 2 SLOs are mostly about acquiring the particular knowledge and skill base which align with the EA PE1 Competencies. Engineering applications (EA PE2) are mostly covered by SLOs 2, 4 and 5, while professional and personal attributes (PE3) are mainly covered by SLOs 5, 6 and 7.

Overall, as a stream, all the EA competencies are covered, with a greater emphasis on the Knowledge and Skill Base PE1 competencies. In particular, it shows a significantly larger emphasis on research (PE1.4) which is to be expected from the higher level of the L4 Disciplinary Knowledge and L5 Advanced Disciplinary Knowledge courses, many of which touch on research directions, and the higher level of the ME Project, which is an individual research project. There is also a greater emphasis on systematic engineering synthesis and design (PE2.3) given that the program includes a dedicated graduate level design proficiency course. Many L4/L5 courses also touch on design processes.

From Table 3, assessments for most courses rely heavily on exams (mid-term and final). The other forms of assessments include take-home assignments, lab skills assessments and lab reports. Enquiry-based learning courses include thesis work and design proficiency that have

various assessments like seminar presentations, design concept mapping, reports, poster presentation and design showcase.

To ensure academic integrity, all final exam papers are reviewed by another academic with relevant technical knowledge and then a final review of the papers is done by the Director of Academic Studies. Thesis reports are submitted using TurnItIn for checking against plagiarism, and they are blind marked by two academics to ensure consistency. A third assessor is utilised if there is a discrepancy of larger than ten marks. For online written exams, various approaches have been adopted such as personalised exam papers or having a number of different versions. Some courses include an oral assessment as a compulsory component to pass the course. The markers are trained to identify plagiarism in the exams / reports and if anything identified, these are referred to the School Student Integrity Advisor, who meets with students before finalising an outcome. Plagiarism cases found are recorded in the university Plagiarism Register or Misconduct Register, the latter for serious cases.

The curriculum mapping did not take into account the Industrial Training component. The 60-day Industrial Training amounts to 480 hours in total as compared to the standard study load of 150 hours for a course. Thus, it is equivalent to 3 courses targeting mainly on PE2 and PE3 competencies, resulting in a more balanced overall curriculum alignment. The heatmaps (Tables 4 and 6) provide a high-level, strategic view of the stream that will inform all future course and stream revisions.

7. Summary

Curriculum mapping of the TELEAS Telecommunications stream of the Master of Engineering 8621 program has been studied using the UNSW Engineering Faculty mapping tool CMAP. The stream design covers all the EA competencies with a split of 44% on PE1, 30% on PE2 and 26% on PE3. The stream is designed to equip students with in-depth and advanced knowledge and research in Telecommunications Engineering, independent and reflective learning, creative problem solving, design skills, deeper project experience, increased technical confidence, and increased management skills.