

# ELEC4952

Research Thesis B

Term 1, 2022



## Course Overview

### Staff Contact Details

#### Convenors

Name	Email	Availability	Location	Phone
Aron Michael	<a href="mailto:a.michael@unsw.edu.au">a.michael@unsw.edu.au</a>	Monday 4:00pm-4:30pm	G17, 316	(02)93855 663

### School Contact Information

**Consultations:** Lecturer consultation times will be advised during the first lecture. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. **ALL** email enquiries should be made from your student email address with **ELEC/TELExxxx** in the subject line; otherwise they will not be answered.

**Keeping Informed:** Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle <https://moodle.telt.unsw.edu.au/login/index.php>. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

### Student Support Enquiries

[For enrolment and progression enquiries please contact Student Services](#)

### Web

[Electrical Engineering Homepage](#)

[Engineering Student Support Services](#)

[Engineering Industrial Training](#)

[UNSW Study Abroad and Exchange](#) (for inbound students)

[UNSW Future Students](#)

## Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

## Email

[Engineering Student Support Services](#) – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

## Course Details

### Units of Credit 4

### Summary of the Course

#### Contact Hours

The Research Thesis consists of regular online meetings with the supervisor, typically about 30 minutes weekly. In addition, the Project usually involves experimental work and thus requires laboratory assistance from the supervisor and/or technical staff.

#### Context

This course is normally undertaken in the second term of the last year of the BE degree program. Its purpose is for students to undertake directed laboratory and research work on an approved topic under the guidance of an academic supervisor

### Course Aims

The thesis provides an opportunity for the student to bring together engineering principles learned over their previous years of study and apply these principles to innovatively solve problems such as the development of a specific design, process and/or the investigation of a hypothesis. Thesis projects must be complex, open-ended problems that allow room for student creativity, and the acquisition, analysis and interpretation of results. There must be multiple possible solutions or conclusions at the outset and sufficient complexity to require a degree of project planning from the student. The thesis requires the student to formulate problems in engineering terms, manage an engineering project and find solutions by applying engineering methods. Students also develop their ability to work in a research and development environment.

The course also provides a good introduction to work in industry and research and serves as an important indicator of how well students can utilize and integrate the knowledge and skills they have learnt throughout their program.

### Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Develop a design or a process or investigate a hypothesis following industry and professional engineering standards.	PE1.2, PE1.3, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE2.4, PE3.1, PE3.3, PE3.6
2. Critically reflect on a specialist body of knowledge related to their thesis topic.	PE1.3, PE1.4, PE1.6, PE3.1, PE3.2
3. Apply scientific and engineering methods to solve an engineering problem.	PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3, PE2.4, PE3.3, PE3.5, PE3.6

<b>Learning Outcome</b>	<b>EA Stage 1 Competencies</b>
4. Analyse data objectively using quantitative and mathematical methods.	PE1.2, PE1.3, PE2.1, PE2.2
5. Demonstrate oral and written communication in professional and lay domains.	PE3.1, PE3.2, PE3.3, PE3.4, PE3.5, PE3.6

## Teaching Strategies

The course is taught as an individual research project, to develop a level of research skills and autonomy.

### Delivery Mode

- Regular weekly online meetings between supervisor and student – to discuss and get advice on the Project work.
- Laboratory access throughout the semester – for students to carry out practical design and development work with some assistance from technical staff

### Learning in this course

The Research Thesis gives you the opportunity to take on a project on your own, to produce a self-contained and rounded piece of work and write it up for others to assess and use. While the project is yours alone, you will need to obtain advice, information and assistance from others, for example your supervisor, technical officers responsible for laboratories, or computing and workshop staff.

While a majority of the design and synthesis tasks will be carried out in the third term (Research Thesis C), it is important that you take full advantage of time in the second term to complete preliminary works, refine your solution, formulate detailed plan, and begin the design and synthesis tasks.

Regular online meetings with your supervisor are important not only because one of the assessments in this course is participation effort but also to check what you are doing is indeed what is required. If you want to contact your supervisor outside a regular online meeting time, leave a message arranging a time to meet. Pre-arranged consultations are often more effective, check contact details on the School website.

Having completed Research Thesis Part A, at this stage you should have preliminary idea what you are going to do, and what tasks have got to be performed on the way to achieving your goal. In this, Research Thesis part B, you will further develop the preliminary idea into a clear idea and refine the research tasks to set achievable milestones and solid plan towards accomplishing your objectives. Moreover, you will be expected to begin executing the main task of the project in this Research Thesis part B.

Once the research tasks are refined, careful and detailed planning is an important task in this course. The time duration of each task should be carefully checked to ensure if it is realistic and, in particular, allows sufficient time for tasks that are critical for the success of the project. For example, ordering components or equipment construction by the workshop, access to state-of-the art research facilities may have particularly time implications you need to be well aware of. There may be significant lead time with component delivery. Workshop time is always limited and long delays are frequently experienced and therefore it is important to get drawings to the workshop as soon as possible. Access to research

facility often requires laboratory inductions and extensive training. Discuss these issues with your supervisor to draw up realistic and time efficient plan.

## **Additional Course Information**

### **Credits**

This is a 4 UOC, level 4 course. The expected workload is 10 hours per week throughout the 10-week term. It is important to note that the weighting applied to the course is equivalent to a 1.2 UOC from the available overall 12 UOC for Thesis.

### **Relationship to Other Courses**

This is an undergraduate core course for students following a BE or BE ME in Electrical or Telecommunications or Quantum program in the EE&T School and other combined degree programs. This course constitutes the second part (Research Thesis B) of the three-part project work (Research Thesis A, B and C). It involves completing preliminary work, producing initial results from the execution of the main task, acquiring high level of skills in using software and hardware (tools or equipment) relevant to the project, and revising research plan in the context of preliminary work. This prepares the student for the detailed project work that will be undertaken in Research Thesis C in the following subsequent term.

### **Pre-requisites and Assumed knowledge**

The pre-requisite for this course is ELEC4951.

### **Following Courses**

The course can be a pre-requisite or a co-requisite for ELEC4953. When it is a pre-requisite, ELEC4953 must be taken in the immediately following term. When it is also a co-requisite, ELEC4953 will be taken in the same term.

## Assessment

Assessment is based on evaluating the student's work through the progress report (50%) and participation effort (50%). The assessments will be carried out by the **thesis supervisor only**.

It is intended that Research Thesis B covers: (i) completing preliminary work that was started in Research Thesis A to acquire and demonstrate the required skills for carrying out the project; (ii) detailed and revised planning; (iii) refining solution (methodology) and; (iv) initial work into executing the main task. To measure these achievements through the progress report, the marking breakdowns are: (i) 60% for completing preliminary work, refining solution (methodology) and producing initial results from project execution; (ii) 15% for detailed and revised project planning; (iii) 15% for reflection on progress including the research tasks and experience in Research Thesis A; (iv) 10% on the presentation.

It is most important to note that Research Thesis B is not just about completing preliminary work but also producing initial results from the execution of the main task. Students must demonstrate real progress in the project with tangible project deliverables. It is also expected that students have already undertaken and completed the literature review in Research Thesis A, and the literature review should not be the focus of Research Thesis B.

## Policy for lateness

The penalty is detailed below:

- For Project progress report – 5 marks off the *Project* for every day late. Penalty applies until the marks for the *course* decrease to 50, and further lateness does not result in failure of the *course*, but might be a failure of the Project (weekends count as days). Any Project report not turned in within 6 weeks after the deadline will be finalised at zero (0) marks.
- For participation effort – 1 mark off the participation mark for every day late submission of three-page weekly update report.

In all cases, applications for late submission can be applied for BEFORE the due date. This is at the discretion of the thesis coordinator but should only be granted in exceptional circumstances. As per normal, students can also apply through myUNSW for special consideration.

## Relationship of Assessment Methods to Learning Outcomes

Assessment	Learning outcomes				
	1	2	3	4	5
Written report	P	P	P	P	P
Participation effort	P		P	P	P

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Progress report	50%	28/03/2022 12:00 PM	1, 2, 3, 4, 5
2. Participation	50%	21/04/2022 12:00 PM	1, 2, 3, 4, 5

## **Assessment 1: Progress report**

**Assessment length:** 7-10 pages

**Due date:** 28/03/2022 12:00 PM

The progress report is to be submitted by 12 pm, Thursday week 5 of the term. For those doing B&C together, the progress report must be submitted by 12 pm, Thursday week 3 of the term. This is done by uploading the report via Moodle as a pdf formatted file. The progress report must be individually written even for cases where a group of students work on the same topic. If your supervisor or assessor specifically requests a printed copy of your report, please make one and hand it to them directly (but you still also need to upload your report).

### **Assessment criteria**

The progress report assessment criteria are: (i) report on progress; (ii) reflection; (iii) revised project planning; (iv) document presentation

#### **Report on Progress:**

Achievement with respect of plan; Discussion on completed work; Understanding of meaning and implication of findings

#### **Marking guide:**

0-49: Achievement is not satisfactory with respect to the plan. Little work has been done to address any complexities or challenges encountered. Little or no discussion of the work completed. It is unclear that the student understands what their results mean.

50-64: Marginal achievement compared to the plan. If complexities have been encountered a plan for equivalent work has been developed but with little progress. Only superficial discussions of the work completed. The student will probably be able to demonstrate some understanding of the meaning of their results.

65-74: Mostly satisfactory achievement against the plan. If complexities have been encountered a plan for equivalent work has been developed and a good start has been made. Some discussion of the work completed. The student looks to be developing a reasonable understanding of the meaning of their research findings.

75-84: Highly satisfactory achievement against the plan. If complexities or challenges have been encountered, a plan for equivalent work has been developed with satisfactory progress made. Detailed discussions on the work completed. The student clearly on their way to demonstrating a good understanding of the meaning and implications of their research findings.

85-100: Achievement is beyond expectations with respect to plan. If any complexities or challenges have been encountered, a plan for equivalent work has been developed with significant progress made. Highly detailed discussions on work completed. The student is clearly on track to demonstrate a sophisticated understanding of the meaning and implications of their research findings.

#### **Reflection on Progress:**



Compares and contrasts the thesis with industrial and other academic experience; Understanding of their field(s) of study and broadening perspective through the research experience. Evaluates changes in learning through the thesis; Recognizing complex contextual factors (e.g. works with ambiguity and risk, deals with frustration), demonstrating self-awareness, and envisions a future self or develops plans that build on the research experience.

### **Marking guide:**

0-49: Identifies superficial connections between the thesis, and industrial or other academic experiences. Describes own performances during the thesis with general descriptors of success and failure at a superficial level.

50-64: Compares and contrasts the thesis, with industrial or other academic experiences, inferring differences and similarities between them. Articulates strengths and challenges during the thesis, with contexts.

65-74: Compares and contrasts the thesis, with industrial and/or other academic experiences, illuminating the differences and similarities between them. Evaluates changes in learning through the thesis, recognizing complex contextual factors (e.g. works with ambiguity and risk, deals with frustration).

75-84: Compares and contrasts the thesis, with industrial and other academic experiences, illuminating the differences and similarities between them. The student also demonstrates a growing understanding of their field(s) of study and developing perspective through the research experience. Evaluates changes in learning through the thesis, through either recognizing complex contextual factors (e.g. works with ambiguity and risk, deals with frustration), demonstrating self-awareness, and/or envisioning a future self / developing plans that build on the research experience.

85-100: Compares and contrasts the thesis, with industrial and other academic experiences, illuminating the differences and similarities between them. The student also demonstrates deep understanding of their field(s) of study and broadening perspective through the research experience. Evaluates changes in learning through the thesis, recognizing complex contextual factors (e.g. works with ambiguity and risk, deals with frustration), demonstrating self-awareness, and envisions a future self or develops plans that build on the research experience.

### **Revised Project Plan:**

Discussion on future plan and expected results

### **Marking guide:**

0-49: Little or no discussion of future project plan or outcomes. No reasonable strategy to ensure progress is stated.

50-64: Superficial discussion of future project plan &/or outcomes. A reasonable strategy to ensure progress is stated.

65-74: Some discussions of future project plan and outcomes. A reasonable strategy to ensure progress is stated and briefly explained.

75-84: Quality discussion of the future project plan and expected results. A reasonable strategy to ensure progress is stated and explained in detail.

85-100: Highly thoughtful and incisive discussions on future project plan and expected results. A reasonable strategy to ensure progress is stated, explained in detail and innovative.

### **Document presentation:**

Physical presentation (report structure, legibility, layout); quality of writing (grammar, spelling, wording, style, clarity, adequately proofread); referencing (fully documented reference list, using correct citation conventions); report self-contained, (provide all information needed).

### **Marking guide:**

0-49: Impedes document reading

50-64: Poor formatting/document structure

65-74: Poor judgment with respect to layout, possible padding

75-84: Professional, may have some issues with data presentation

85-100: Professional, concise and readable

## **Assessment 2: Participation**

**Due date:** 21/04/2022 12:00 PM

The participation effort is based on: (i) student's attendance at lab and meetings throughout the term, levels of intellectual contribution (e.g. did the student come up with ideas), examination of relevant documentation (project diary, student's lab book detailing experiment activities or measurement records), etc; (ii) submission of a three-page executive summary and meeting log sheet in week 10.

The three-page executive summary and meeting log sheet are to be submitted by Thursday 12pm in week 10. This is done by uploading the report and log sheet via Moodle as a pdf formatted file. The executive summary must be individually written even for cases where a group of students work on the same topic. If your supervisor or assessor specifically requests a printed copy of your report, please make one and hand it to them directly (but you still also need to upload your report)

### **Assessment criteria**

The assessment criteria are: (i) Initiative and engagement ; (ii) sustained activity; (ii) Diligence and competence in performing the task. They are equally weighted.

### **Additional details**

#### **Initiative and engagement**

Did the student actively engage in the thesis work, take ownership of the task with enthusiasm, initiate own ideas to overcome various roadblocks along the journey?

### **Marking guide:**

0-49: Deficient – none or minimal effort across all areas, need a lot of pushing from supervisor to make things happen

50-64: Satisfactory – some evidence of student driving the project; student put in some effort but considerable need for improvement

65-74: Good – above satisfactory effort, clear evidence of student driving the project

75-84: Very good – student showed genuine interest and enthusiasm in the work, initiated many own ideas during the process

85-100: Excellent – superior evidence of effort; student intellectually and practically led the project all the way, went beyond what was expected of a student

#### **Sustained activity:**

for example, based on student's attendance in lab, regular meetings/contacts with supervisor throughout the semester, etc.

#### **Marking guide:**

0-49: Deficient – irregular, sporadic engagement in the project

50-64: Satisfactory – regular engagement but only just adequate

65-74: Good – regular engagement; project progressing smoothly as planned

75-84: Very good – high level of sustained effort throughout the whole project

85-100: Excellent – superior evidence of effort, student attended all meetings or had regular weekly contact with the supervisor

#### **Diligence and competence in performing the task:**

for example, based on examination of relevant documentation (project diary, student's lab book detailing experiment activities or measurement records). Did the student put in serious effort? Was it meticulous, professional?

#### **Marking guide:**

0-49: Deficient – careless or technically incompetent in doing the work

50-64: Satisfactory – you are fairly sure results from project are useable and trustworthy

65-74: Good – you closely monitored the work and are confident with student's results

75-84: Very good – work is professionally, meticulously performed and recorded

85-100: Excellent – very persistent and unrelenting in performing the task, demonstrate superior level of knowledge and applied thinking to solving an engineering problem.

## Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

## Course Schedule

Period	Activity
	<ul style="list-style-type: none"> <li>▪ Student will continue working on the same Project topic as in Project A with the same supervisor</li> <li>▪ Weekly online meetings during the term with supervisor for technical guidance on Project work</li> <li>▪ Laboratory work during the term subject to arrangement with technical staff</li> </ul>
Week 1	<ul style="list-style-type: none"> <li>▪ Online meeting with supervisor to discuss plan and update progress</li> </ul>
Week 1-4 (Week 1-2)*	<ul style="list-style-type: none"> <li>▪ Provide Project details for each assessment via Moodle course page 'ELEC4952/9452 Research Thesis B/Masters Project B 2022 T1' <ul style="list-style-type: none"> <li>◦ For start, provide general Project topic, your name and supervisor's name. Project topic has already been finalised in Project A.</li> <li>◦ The details should be provided for each assessment. In this course, the assessments are PART B REPORT ASSESSMENT and PART B PARTICIPATION EFFORT</li> <li>◦ To provide the details for PART B REPORT ASSESSMENT, follow the steps below <ul style="list-style-type: none"> <li>▪ Go to Project B REPORT (click to expand the section)</li> <li>▪ Click on PART B REPORT ASSESSMENT</li> </ul> </li> <li>◦ To provide the details for PART B PARTICIPATION EFFORT, follow the steps below <ul style="list-style-type: none"> <li>▪ Go to Project B Report (click to expand the section)</li> <li>▪ Click on PART B PARTICIPATION EFFORT</li> </ul> </li> </ul> </li> </ul>
Week 5 (Week 3) *	<ul style="list-style-type: none"> <li>▪ Submit progress report by week 5, Thursday 12pm (week 3, Thursday 12pm) *</li> </ul>
Week 6	Flexible week
Week 7-10	<ul style="list-style-type: none"> <li>▪ Meet with supervisor and keep attendance log sheet</li> </ul>
Week 10	<ul style="list-style-type: none"> <li>▪ Submit a 3-page executive summary and attendance log sheet by week 10 Thursday 12pm. <b>The executive summary is a condensation of the whole thesis to date (part A and B).</b> To submit, follow the steps below <ul style="list-style-type: none"> <li>▪ Go to Project B Report (click to expand the section)</li> <li>▪ Click on PART B PARTICIPATION EFFORT and follow the prompt</li> </ul> </li> </ul>

\*for those doing B and C together

## Resources

### Prescribed Resources

#### Recommended texts(s)

Reading materials are specified by the supervisor (related to particular Project topic).

#### On-line Resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate materials, host forums: <https://moodle.telt.unsw.edu.au/login/index.php>. All information about this course is available from this link which is regularly updated.

Mailing list

Announcements concerning course information will be given on Moodle and/or via email (which will be sent to your student email address).

## ADDITIONAL INFORMATION ABOUT THE PROJECT

### Progress report

A written progress report is to be submitted in **week 5 (Thursday 12pm)**, by uploading the report as one single pdf formatted file. **For those who are doing Research Thesis B and C together, the due date for submitting the report will be in week 3 (Thursday 12pm)**. The report will have three key aspects: (i) 5-6 pages of progress – progress made on the project since Thesis A; (ii) 1-2 pages of reflection; (iii) 1-2 pages of updated planning.

The progress report must be individually written even for cases where a group of students work on the same topic. Submission is via Moodle.

### Three-page executive summary

A three-page executive summary should be submitted on Thursday 12pm in **week 10** by uploading a pdf formatted file. The file should also include a meeting log sheet as an additional attachment. This applies to those who are doing Research Thesis B and C together.

There are no any particular formats for the three-page executive summary and meeting log sheet. The report should be able to summarize the progress that has been made since the beginning of the term. The executive summary must be submitted individually even for a group project. Submission is via Moodle.

### If Things Go Wrong

If you start having serious problems, don't ignore them or stop working; the problems won't go away. Talk over your worries with your supervisor to see what you can do to get going again. If you are still not able to resolve the problems, then see the Thesis Coordinator, the Director of Academic Studies in

EE&T or the Student Counselling and Careers Unit. The Learning Centre also offers advice and support on these matters. Often some advice or perhaps reducing the scope of the project can get you working effectively for the rest of the year

## **Academic Honesty and Plagiarism**

### **Academic Honesty and Plagiarism**

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see <https://student.unsw.edu.au/plagiarism>. To find out if you understand plagiarism correctly, try this short quiz: <https://student.unsw.edu.au/plagiarism-quiz>.

### **General Conduct and Behaviour**

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

## Academic Information

### COVID19 - Important Health Related Notice

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by [NSW health](#) or government authorities. Current alerts and a list of hotspots can be found [here](#). **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the [Nucleus: Student Hub](#). If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for [special consideration](#) through the [Special Consideration portal](#). To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this [form](#).

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the [Safe Return to Campus](#) guide for students for more information on safe practices.

### Dates to note

Important Dates available at: <https://student.unsw.edu.au/dates>

## Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see <https://student.unsw.edu.au/policy>), and particular attention is drawn to the following:

### Workload

It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both formal classes and *independent, self-directed study*. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

### Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

### Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.



## Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the “fit to sit/submit” rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see <https://student.unsw.edu.au/special-consideration>.

## Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:

<https://student.unsw.edu.au/guide>

<https://www.engineering.unsw.edu.au/electrical-engineering/resources>

## Image Credit

Synergies in Sound 2016

## CRICOS

CRICOS Provider Code: 00098G

## Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

## Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	✓
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	✓
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	✓
PE3.2 Effective oral and written communication in professional and lay domains	✓
PE3.3 Creative, innovative and pro-active demeanour	✓
PE3.4 Professional use and management of information	✓
PE3.5 Orderly management of self, and professional conduct	✓
PE3.6 Effective team membership and team leadership	✓