Mechanical and Manufacturing Engineering

Course Outline
Semester 1 2018

MMAN4020

THESIS B

Contents

1. Staff contact details

All academic staff, together with some senior engineers from industry, act as supervisors to students undertaking BE thesis work. Support is also provided by the workshop and laboratory staff.

Contact details of the thesis course convenor

Mr. David Lyons CEng FRINA MIEAust GCULT
Office location: Ainsworth J17 208D
Tel: (02) 9385 6120
Email: david.lyons@unsw.edu.au (email is the best way to contact me)

It is recommended you email the course convenor to make a specific appointment if you need to discuss any important issues, particularly if you want to discuss extensions, supervisor issues, etc. Always consult the course Moodle first in case your questions have already been answered.

Contact details of the thesis administrator

Name: Mr Jonathan Pritchard
Office location: Ainsworth J17 Level 1, Student Services Office
Tel: (02) 9385 4154
Email: jonathan.pritchard@unsw.edu.au

Contact Jonathan directly, with copy to the course convenor, if you have issues relating to your enrolment, progress, or other administrative queries.

Please see the course Moodle.

2. Important links
- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

3. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course, and involves an unprescribed number of contact hours per week (h/w) with your supervisor. This varies on a case-by-case basis, as agreed with your supervisor.

The UNSW website states "The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week."

Thesis differs. Various factors, such as your own ability, your target grade, etc., will influence the time needed in your case.

This means that you should aim to spend not less than about 10 h/w on this course, including consultation with supervisor and workshop/laboratory staff and library/internet search. However, most students spend more time on their thesis work.

It is essential that you consult the Moodle site *throughout the semester* for the most up-to-date and detailed information relating to Thesis B. All announcements relating to Thesis B will be made via Moodle. Numerous announcements will be made, including in relation to:
- **Submissions: your Thesis Extended Abstract/Poster, your Thesis report submission via Moodle, changes to thesis report format or size etc.**
- **Your registration for the Thesis Conference. You must make your presentation and mark your peers' presentations on Moodle. Attendance at the Conference is compulsory. Attendance at the Conference is checked via Moodle and IP address/logon details.**
- **The end-of-semester Thesis Conference timetable.**

Contact hours

There are no set contact hours for thesis. You must make your own arrangements for consultations with your supervisor, lab and workshop times etc.

Summary and Aims of the course

BE Thesis is usually completed in two consecutive semesters during the last academic year. This is the only course where the students have complete freedom to work on his/her chosen thesis project from the initiation to the end – the project contains a large amount of original research and/or novel design work or analysis. It is not the responsibility of the supervisor to tell the student what to do, nor should it be assumed that the supervisor is an expert in all areas of engineering. They are there to offer guidance and advice, as are laboratory staff, workshop staff, and others in the school that may have expertise in the area of your project. The successful execution of the project is solely the responsibility of the student.

Thesis B is to be taken in the last semester required for the completion of all requirements for the award of the degree. This course—together with MMAN4010 Thesis A, which is to be taken in the previous semester—requires each student to demonstrate managerial, technical and professional skills in planning and executing an approved engineering project within a

stipulated time limit. Each student is guided by their supervisor, but successfully planning, executing and reporting on the project are the sole responsibility of each student.

Laboratory Staff

The laboratories are the responsibility of the staff-in-charge and you must operate within the accepted practices of the laboratory concerned. You should not expect laboratory staff to take responsibility for your thesis or carry out work for you. The laboratory staff are highly skilled and helpful; take full advantage of their experience.

If your project involves laboratory work, contact the officer-in-charge (OIC) of the laboratory in which you will be working as soon as possible to discuss your requirements. They will issue you with a Laboratory Access Approval (LAA) form which you must complete and return to the OIC.

Before you start work in a laboratory or undertake any activity which might be considered hazardous in any way, you must read and understand the practices and procedures described in the OHS section of the School's intranet:
https://eng-intranet.unsw.edu.au/mech-engineering/whs/SitePages/Home.aspx

Workshop

All student activities requiring manufacture in the Mechanical and Manufacturing Engineering (MME) workshop should be discussed with the workshop personnel at the inception of the work. The workshop personnel must have the opportunity to advise and influence the design to help minimise assembly, manufacture or functional problems.

The workshop is usually in very high demand. If you require the workshop to manufacture equipment essential to your thesis, then make sure that you discuss your requirements as early as possible with the Workshop/Laboratory Manager. You should provide engineering drawings which are first approved by the laboratory officer-in-charge. You should make every effort to minimise the Workshop load by modifying existing equipment rather than building from new, and by keeping your designs simple.

Safety Training

A full list of safety training requirements for BE Thesis students is available on the School's intranet. Safety in any project is paramount and it is mandatory to complete risk paperwork for all activities. Always discuss with your supervisor what your plans are and what risk assessments will be required

Student learning outcomes

This course is designed to address the below learning outcomes and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

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.	PE2.1, PE2.2, PE2.3, PE2.4
2.	Critically reflect on a specialist body of knowledge related to their thesis topic.	PE1.3
3.	Apply scientific and engineering methods to solve an engineering problem.	PE2.1
4.	Analyse data objectively using quantitative and mathematical methods.	PE1.2, PE2.1, P2.2
5.	Demonstrate oral and written communication in professional and lay domains.	PE3.2

4. Teaching strategies

There is no formal teaching, but the students learn from both internal and external sources. The supervisor, other academics and laboratory/workshop staff are the internal sources, whereas the Library, internet and industry mentors are the external sources.

5. Course schedule

There are no set lectures for this course, but a number of workshops may be provided to assist students to complete their thesis to a high standard. The date and time of the workshops will be announced on Moodle and by email. All workshops will be recorded and made available to students on Moodle. Monitor Moodle on a regular basis for critical announcements that may affect your grade.

6. Assessment
The Thesis B grade will be made up from:

Thesis extended abstract/poster	5%
Thesis Conference	10%
Thesis Report	85%

For calculation of Honours, Thesis A is worth 25% and Thesis B is worth 75% of the total 12 unit course credit.

It is your responsibility to keep your project details (supervision, title, working abstract) up to date in the "your project details" section of Moodle.

Thesis extended abstract/poster

PLEASE NOTE: This is a student-peer assessment task; supervisors are not required to take any action.

There are three tasks involved:
1. Mark the examples set for you, so that your overall marking accuracy can be calibrated. This works in your favour too! More accurate markers mean more marks for you, if your work is good.
2. Upload a "poster" to Moodle in whatever form you like. This could be a few PowerPoint slides, a plain document, a YouTube video …etc. Be imaginative. You need to describe to your fellow students what your thesis is, what you have found, what you still need to do, and it should take the viewer three minutes or less to get all this info.
3. Mark all of the submissions that are allocated to you. It is critical that your marking is fair, accurate, and provides feedback to the author. After all, both of you are getting marked when you mark a submission.

Your Submission Deadline for Extended Abstract/Poster via Moodle: Wednesday 28 March (Week 5) at 5pm.

Peer Assessment Deadline via Moodle (for you to complete marking submissions assigned to you): Friday 13 April (Week 6) at 5pm.

Marking Criteria
Aspect 1 Logical Structure (20%)

Mark	Explanation
0 – 9	Difficult to understand the flow of information.
10 – 20	Layout is logical and it is easy to navigate through the content.

Aspect 2 Use of suitable fonts, illustrations, images, videos, etc. (20%)

Mark	Explanation
0 – 9	Images are of poor quality, poorly captioned, don't explain the thesis well.
10 – 20	Visual aids in the poster are high impact and greatly aid in assisting understanding of the material being presented.

Aspect 3 Use of Grammar, spelling and language (10%)

Mark	Explanation
0 – 4	Some typos, some English incorrect, communication of ideas is hindered by language or grammar.
5 – 10	Correct grammar, tense and language are used to communicate effectively.

Aspect 4 Effective Communication of research (30%)

Mark	Explanation
0 – 9	The work doesn't appear to be carefully completed, not much seems to have been done
10 – 19	The motivation for the project is not clear, results are thin or poorly explained, further research ideas not evidenced
20 – 30	Research objectives motivations, outcomes and forecasts are clear to the reader/viewer and are presented at a level expected of a completing Honours student.

Aspect 5 Length (10%)

Mark	Explanation
0 – 4	Reading/viewing this poster takes more than 3 minutes (+/- a small margin)
5 – 10	The poster can be read or viewed, at a normal pace, in three minutes (+/- margin) without difficulty.

Aspect 6 Overall Effectiveness of the Submission (10%)

Mark	Explanation
0 – 4	Doesn't grab or keep your attention, you wouldn't recommend others view the submission.
5 – 10	You want to tell your friends to look at it, you wish yours was this good!

Thesis Report Submission

Electronic copies (no hardcopy!) due Monday 28 May (Week 13) at 5pm.

The quality of the presented work is very important and great care must be taken with the typing and presentation of graphs and diagrams; drawings should be to standard engineering practice. Drawings submitted to the Workshop must be approved by the Officer-in-Charge of the relevant laboratory. The English should be clear and grammatically correct with a high standard of spelling and punctuation.

There is no strict minimum length for a thesis. Your thesis report shall comprise a maximum of 50 pages. Appendices must be brief and should contain only material which is indispensable but at the same time cannot be included in the text.

Confidential Theses

If your thesis contains confidential information: in order to restrict it from viewing for two years, you must complete a Confidentiality Form—available from the School's BE Thesis Moodle Site—and submit this statement with your thesis. Confidential theses should not be uploaded to the database but should be submitted in all other required formats. Discuss submission with the Thesis coordinator.

Production and Submission Specifications

All BE thesis students are required to submit copies of their thesis in the formats shown below. Students who do not submit as required will be denied graduation until the requirements have been met.

Your submission on Moodle indicates that the thesis is entirely your own original work, which is a binding statement.

One PDF copy through Moodle

You MUST submit a PDF copy through the Thesis B Moodle page. Name this file 'z1234567_Thesis', with '1234567' being your student ID number.

The submitted file should be less than 20MB – if you feel that your work would benefit from a larger, higher-res version, please submit this directly to your supervisor. The electronic

version must have the copyright declaration included in it, as a scanned version of the signed original, though by your submission you will also agree that the work is all your own.

Data

Your thesis mark will not be released until you have organised to pass on your thesis data to your supervisor. This can be Dropbox, USB stick, hard drive, etc. – discuss with your supervisor. However, it is now a legal requirement of research conducted at UNSW that the original data be archived, and so you must collate all the work that went into your thesis (drawings, excel files, CAD files, CFD/FEA result files, etc. – everything that went into creating your thesis, but not early work or dead-ends that were unused).

Specifications for Thesis

Paper must be ISO size A4 (width 210 x height 297mm). All text should be size 11 or 12 font Times New Roman or similar font, apart from titles and figures. Margins must be not less than 20 mm all around.

The thesis must include a title sheet using the template provided on Moodle. Do not include any UNSW logo or crest.

You are free to choose your report writing software, either Word or LaTeX document preparation system. Necessary expertise in either system is your responsibility.

See Moodle for further tips and helpful files.

BACK UP YOUR WORK. Failure to do so and any lost files will not be considered as a mitigating circumstance.

All sheets must be numbered. The main body of the thesis must be numbered consecutively from beginning to end in Arabic (1, 2, 3, 3, …) numerals. The preliminary pages (Abstract, List of Contents, List of Figures, List of Symbols) should be numbered using lower-case Roman numerals (i, ii, iii, iv …), commencing with the title page (but not shown on the title page). Pages in appendices may be numbered consecutively as part of the main text or may have their own numbering system.

Graphs, diagrams and photographs should be inserted as close as possible to their first reference in the text. Graphs and tables which are printed in landscape format should be readable from the right-hand side.

Supplementary data (e.g. CFD animations) can also be uploaded within the size limit and can be referenced within the text. These are considered as extra material. The thesis must stand alone without them.

All quoted sources must be clearly referenced at the end of the thesis using a single referencing system (e.g. https://student.unsw.edu.au/apa).

Please submit your PDF copy through the Moodle Thesis B submission portal.

Thesis B report marking rubrics:
Criteria 1: Lit review/background and putting the results in context (20%)

Grade	Mark	Brief description	Explanation/Examples
Fail	0 – 9	Aims not clear	The student hasn't done a good job explaining the research aims to the reader - I'm not really sure what this is about.
Pass	10 – 12	Reason for research not clear	I understand the project aims but the student has not made it clear to the reader how it is connected to the background - why is this aim being pursued? What is the hypothesis being tested? What is the broader significance?
Credit	13 – 15	Background clear - results not contextualised	The student makes the project background clear to the reader, and the significance of the research aim within a broader context. The student has not been able to take a step back and make an assessment of the significance of their results.
Distinction	16 – 18	Background and aims are clear, context is incomplete	The student makes the project background clear to the reader, and the significance of the research aim within a broader context. The literature review is comprehensive but may be lacking depth of insight. The student has made a reasonable attempt to assess the significance of their results but it is either not realistic, or does not follow logically from the arguments presented.
High Distinction	19 – 20	Background to research and significance of conclusions reached are clear	The student makes the project background clear to the reader, and the significance of the research aim within a broader context. The student also makes a realistic assessment of the significance of their results in this context. The literature review is comprehensive and insightful.

Criteria 2: Execution of the research project, quality of analysis, discussion of results (50%)

Grade	Mark	Brief description	Explanation/Examples
Fail	0 – 24	Clearly deficient	Work at this level is clearly deficient - in not addressing the stated project aims or in containing major problems that the student should reasonably have been aware of but did not address in the thesis.
Pass	25 – 30	"Thin" results, lacking intellectual engagement	The student has completed a body of work and presented some results but not succeeded in interpreting meaning from them (=intellectual input is largely absent from the discussion, which is essentially equivalent to observation of the results). Performance at this level may also indicate a lack of engagement with the project, sometimes evidenced as a "thin" or "one-dimensional" investigation characterised by attempted padding.
Credit	31 – 37	Several components to the research work, not coherently linked.	The student probably has a number of components to their research, such as literature, experiments, designs, simulations etc. They have interpreted meaning from the results but have overall not succeeded in linking the components of their research together as a coherent scientific story. There's no clear "big picture".

Grade	Mark	Brief description	Explanation/Examples
Distinction	38 – 44	Solid, coherent work, linking all the research components together into a consistent story.	At this level the student has assembled the pieces of their research project (which could include literature, different sets of experiments or measurements, simulations or analyses) into a coherent scientific story. Overall, you are left with a clear and convincing picture of what the research question was and what the answer is (along with its caveats). A student is generally not going to be able to achieve this if there are conceptual or methodological problems with their work, or if their review of literature is inadequate.
High Distinction	45 – 50	Solid, coherent and consistent story PLUS something unexpected.	Student would have to have achieved as at the previous level but additionally has achieved something unexpected, thoughtful and original, such as a novel perspective or theory. This requires deep thinking of the student.

Criteria 3: Conclusion, and value added (20%)

Grade	Mark	Brief description	Explanation/Examples
Fail	0 – 9	No value	There are obvious and substantial problems with what was presented – the work as it stands has no value because it doesn't "hold water".
Pass	10 – 12	No interesting results	The presented work is not at all challenging and yields entirely expected results – the student does not appear to appreciate this. The work doesn't really add any significant value.
Credit	13 – 15	Minimal value	The presented work adds some value in some way – improvement of "local knowledge" such as techniques, additional data points in a larger design or hypothesis etc. The student worked well but did not push themselves harder to make any real new discoveries or interpretations, therefore the conclusions are limited and discussions of future work are predictable extensions of the work completed.
Distinction	16 – 18	Will have wider impact when further work is done.	You are fairly sure that the results and discussion can eventually form the core of a research publication or change in industry practice (it may have already been included in a conference publication during the course of the thesis). However, further work will first be required – such as repeated experiments – before the work is truly sufficient. The student has included good, thoughtful discussion of limitations and provided insight into future work on this project or new avenues of research which could be followed.
High Distinction	19 – 20	Will have wider impact now.	This is valuable work. This work can easily form the basis of a peer-reviewed journal publication, or other form of professional dissemination/presentation appropriate to the field (i.e. patent application, best practice document at a company, trade publication, workshop, etc.).

Criteria 4: Document presentation (10%)

Grade	Mark	Brief description	Explanation/Examples
Fail	0 – 4	Impedes document reading	Presentation is poor to the extent that it impedes reading of the document. Examples include multiple inconsistent citation styles or incomplete citations, unintelligible grammar, figures or tables not labelled or badly inconsistent document formatting.

Pass	5	Poor formatting / document structure	Document is not at a professional level. Although figures and diagrams are labelled and references in text match reference list (and vice versa), formatting is unclear and inconsistent to the extent that the reader can lose track of the context when reading. The structure of the document is poor or illogical, with little discernible flow.
Credit	6 – 7	Poor judgement with respect to layout, possible padding	Document is not at a professional level. Figures and diagrams are labelled, formatting is consistent, references in text match reference list (and vice versa), pictures are clear and attributed, sections clearly labelled. Poor judgement has been exercised in placing data, tables or figures in the body of the work, and/or excessive figures/tables – some of which would have been better placed in an appendix or discarded. An attempt might have been made to "pad" the work or increase the page count using unnecessary, repetitive, or large figures, unnecessarily lengthy text, wide margins, etc. The language is not sophisticated or sufficient for describing the technical aspects clearly and rigorously, and there are disjointed aspects to the structure.
Distinction	8 – 9	Professional, may have issues with data presentation	Document is at a professional level. Figures and diagrams are correctly and clearly labelled, text spacing aids readability, consistent formatting, references in text match reference list (and vice versa), pictures are clear and attributed, sections clearly labelled, and good use made of appendices. Some of the graphical presentation of data is inappropriate - poor choice of axes, overcrowding, poor use of chart space etc. Padding is not a feature of work at this level. The structure is well thought out and logical, and there is a good command of descriptive and technical language – descriptions and explanations have depth but clarity, and are concisely worded.
High Distinction	10	Professional, concise and readable	Document is at a professional level. Figures and diagrams are correctly and clearly labelled, text spacing aids readability, consistent formatting, references in text match reference list (and vice versa), pictures are clear and attributed, sections clearly

Thesis Conference

Your thesis will also be assessed by a presentation that you will give during the School Thesis Conference. This will be held (subject to confirmation) between Monday to Wednesday in Week 14. See Moodle for announcements.

Thesis presentation marking rubrics:
Aspect 1: Presentation skills (25%)

Criteria	Grade
Did the presenter speak with clarity (volume, speed, enunciation)?	/5
Did the presenter speak in an engaging way (tone, passion)?	/5
Did the presenter engage the audience (eye contact, body language)?	/5
Did the presenter deliver in a relaxed, confident manner?	/5
Did the speaker make good use of well-designed visual aids?	/5

Aspect 2: Knowledge base (25%)

Criteria	Grade
Was proper background information on the topic given?	/5
Was the material selected for presentation appropriate to the topic?	/5
Was enough essential information given to allow the audience to effectively evaluate the work done in context?	/5
Was the talk free of irrelevant or filler information?	/5
Did the presenter demonstrate a clear understanding of the material presented?	/5

Aspect 3: Critical thinking & planning (30%)

Criteria	Grade
Did the approach to the work demonstrate thought and planning?	/5
Were the strengths and weaknesses of the work, and the methods used to gather evidence/data, clearly explained?	/5
Did the presenter demonstrate they had completed progress on their topic?	/15
Did answers to questions show an understanding of the project and background?	/5

Aspect 4: Overall impression (20%)

Criteria	Grade
Overall impression of the presentation	/20

Thesis Extended Abstract/Poster

As part of the Conference, you may be required to submit an e-poster on your thesis. More details will be provided via Moodle.

Consequences if you fail in Thesis A and B

If you Fail in Thesis B, you have two options:
- re-enrol for Thesis A & B again with a new project and supervisor.
- re-enrol for Thesis B again with the same project (needs consent of an appropriate supervisor & student).

Late Procedure

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

- For all other components beside thesis report – zero (0) mark is awarded
- For thesis document – 5 marks off the thesis 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 thesis (weekends count as days).
- Any thesis not turned in within 6 weeks after the deadline will be assigned zero (0) marks.

Discrepancy amongst thesis marks

Thesis marks will be provided by the two assessors independently, without collusion or knowledge of the other mark.

- For any mark difference less than or equal to 10 marks, the unweighted average.
- For any mark difference of 11-15 marks, the thesis course convenor discusses the marking rationale with the two markers and assists the two markers to come to an agreement on a final mark.
- For any mark difference greater than 15 marks, a third assessor must be found. An unweighted average of the three marks will be used.
- If the situation arises that one mark is invalid, the thesis course convenor has the discretion to eliminate that mark and average the other two (if they fail within the 10 mark difference). This includes theses involving 3 markers.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see the School intranet, and the information on UNSW's Special Consideration page.

7. Expected resources for students

Of course, there is no prescribed textbook.

The School maintains a database of past theses, accessible via the School intranet.

Content on the Moodle page will be updated often with tips, discussions and resources, so you are strongly advised to make sure you are able to receive updates.

Students may find other resources on their particular project at the UNSW library: https://www.library.unsw.edu.au/

8. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include revised marking schemes, faculty-wide marking guidelines and faculty templates.

9. Academic honesty and plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism: student.unsw.edu.au/plagiarism The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:
www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

10.   Administrative matters and links

All students are expected to read and be familiar with School guidelines and polices, available on the intranet. In particular, students should be familiar with the following:

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities

- [Assessment Matters](#) (including guidelines for assignments, exams and special consideration)
- [Academic Honesty and Plagiarism](#)
- [Student Equity and Disabilities Unit](#)
- [Health and Safety](#)
- [Student Support Services](#)

David Lyons
Thesis course convenor
2 Feb 2018

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex 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
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (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