M1 Report – Mechanical and Manufacturing Engineering

This document includes a response to the requested M1 reporting for five specialisations in Mechanical and Manufacturing Engineering. Integrated stream specifications for the following streams are included:

- BE (Hons) (Aerospace Engineering) – AEROAH3707
- BE (Hons) (Mechanical Engineering) – MECHAH3707
- BE (Hons) (Mechanical and Manufacturing Engineering) – MANFBH3707
- BE (Hons) (Mechatronic Engineering) – MTRNAH3707
- ME (Hons) (Mechanical Engineering) – MECHBS8621

Each specialisation (stream) will be addressed in its own section.

BE (Hons) (Aerospace) - AEROAH3707

Introduction

UNSW Bachelor of Engineering (Honours) (Aerospace Engineering) is a four-year, full-time degree delivered by the School of Mechanical and Manufacturing Engineering. The degree is AQF level 8 and provides graduates with *advanced knowledge and skills for professional or highly skilled work and/or further learning*.

Aims of the Stream

Aerospace Engineering at UNSW is an accredited entry-to-practice degree designed around the requirements of future aerospace engineers in Australia and abroad. Aerospace Engineers that graduate from UNSW can go on to work in design offices, on the manufacturing, testing and repair of aircraft, in regulatory and certification authorities, in defence organisations, in research, in software development companies and much more. UNSW graduates develop rewarding careers across a wide range of sectors, including:

- Commercial Aviation
- Aeronautics
- Transportation
- Space
- Defence
- Consulting
- Maritime Construction

The UNSW Mechanical and Manufacturing Engineering, which offers the stream, is Australia's largest Mechanical and Aerospace School and is rated the highest in Australia on the three major university ranking indices. The School has a breadth of research strengths and offers students a high degree of flexibility for elective and thesis specialisation.

Stream Plan

The stream plan for BE (Hons) Aerospace is shown. The plan is based on a default student progression, with commonly chosen electives. Course codes and names are shown in the tables, including a list of elective options. The UNSW trimester delivery offers students significant flexibility in the scheduling of many courses.

	Year 1			Summer	Year 2			Summer	Year 3			Summer	Year 4		
	Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3
	ENGG1000	MATH1231	ENGG1300		MMAN2700	MMAN2300	ENGG2500		AERO3410	DESN3000	ENGG1811		AERO4620	Elective	AERO4110
T1 Intake Normal Load	MATH1131	PHYS1121	MMAN1130		MATH2019	ENGG2400	DESN2000		AERO3630	AERO3110	Gen Ed		Elective	Elective	Elective
	Elective		ELEC1111		Gen Ed	MATH2089			AERO3660	MMAN3200			MMAN4010/ MMAN4951*	MMAN4020/ MMAN4952*	MMAN4953*

Core courses | General education | Thesis | Elective

Figure 1: BE (Hons) Aerospace basic course plan

Table 1: Core course codes for BE (Hons) Aerospace

DESN1000	Introduction to Engineering Design and Innovation
ELEC1111	Electrical and Telecommunications Engineering
PHYS1121	Physics 1A

MMAN1130	Design and Manufacturing
MATH1131	Mathematics 1A
MATH1231	Mathematics 1B
ENGG1300	Engineering Mechanics
ENGG1811	Computing for Engineers
DESN2000	Engineering Design and Professional Practice
MATH2019	Engineering Mathematics 2E
MATH2089	Numerical Methods and Statistics
ENGG2400	Mechanics of Solids 1
ENGG2500	Fluid Mechanics for Engineers
MMAN2300	Engineering Mechanics 2
MMAN2700	Thermodynamics
AERO3110	Aerospace Design
AERO3410	Aerospace Structures
AERO3630	Aerodynamics
AERO3660	Flight Performance and Propulsion
MMAN3000	Professional Engineering and Communication
MMAN3200	Linear Systems and Control
MMAN4010	Thesis A
MMAN4020	Thesis B
AERO4110	Aerospace Design Project
AERO4620	Dynamics of Aerospace Vehicles, Systems and Avionics

Table 2: Elective course options for BE (Hons) Aerospace
(* indicates course was used in curriculum mapping)

***AERO9500**	Space Systems Architectures and Orbits
***AERO9610**	The Space Segment
AERO9660	Advanced Aerospace Propulsion
ARTS2755	Development in Practice: Humanitarian Action
BABS1201	Molecules, Cells and Genes
BIOM1010	Engineering in Medicine and Biology
BIOS1301	Ecology, Sustainability and Environmental Science
CEIC1000	Sustainable Product Engineering and Design
CHEM1011	Chemistry A: Atoms, Molecules and Energy
CHEM1021	Chemistry B: Elements, Compounds and Life
CHEM1811	Engineering Chemistry 1A
CHEM1821	Engineering Chemistry 1B
COMP1521	Computer Systems Fundamentals
COMP1531	Software Engineering Fundamentals
COMP3141	Software System Design and Implementation
COMP3331	Computer Networks and Applications
CVEN1701	Environmental Principles and Systems
ELEC4633	Real-Time Engineering
ENGG1200	Undergraduate Special Projects
ENGG1400	Engineering Infrastructure Systems

ENGG2600	Engineering Vertically Integrated Project
ENGG3001	Fundamentals of Humanitarian Engineering
ENGG3060	Maker Games
ENGG3600	Engineering Vertically Integrated Project
ENGG4600	Engineering Vertically Integrated Project
GEOS1111	Fundamentals of Geology
GMAT1110	Surveying and Geospatial Engineering
MANF4100	Design and Analysis of Product-Process Systems
MANF4430	Reliability and Maintenance Engineering
MANF4611	Process Modelling and Simulation
MANF6860	Strategic Manufacturing Management
MANF9400	Industrial Management
MANF9420	Operations and Supply Chain Management in Engineering
MANF9472	Production Planning and Control
MATH1081	Discrete Mathematics
MATS1101	Engineering Materials and Chemistry
MECH4100	Mechanical Design 2
MECH4305	Fundamental and Advanced Vibration Analysis
MECH4320	Engineering Mechanics 3
***MECH4620**	Computational Fluid Dynamics
MECH4880	Refrigeration and Air Conditioning 1
MECH4900	Mechanics of Fracture and Fatigue
MECH9325	Fundamentals of Acoustics & Noise
***MECH9420**	Composite Materials and Mechanics
MECH9650	Introduction to Micro Electromechanical Systems
MECH9720	Solar Thermal Energy Design
MECH9761	Automobile Engine Technology
MINE1010	Mineral Resources Engineering
MMAN4200	Additive Manufacturing
MMAN4400	Engineering Management
***MMAN4410**	Finite Element Methods
PHYS1231	Higher Physics 1B
PSYC1001	Psychology 1A
PSYC1028	Psychology of Human Centred Design
SOLA1070	Sustainable Energy
SOLA5052	Biomass
SOLA5053	Wind Energy Converters
SOLA5056	Sustainable Energy for Developing Countries
SOLA5057	Energy Efficiency

Note: Many nuanced elective rules have been omitted for simplicity, but the selected plan is a valid a common choice of courses.

Stream Learning Outcomes

On successful completion of the AEROAH3707 program, graduates will be able to:

1. demonstrate proficiency of knowledge in the enabling sciences (mathematics, computer science and physics) that form the foundation of aerospace engineering.
2. demonstrate expertise and technical knowledge in underpinning aerospace engineering disciplines such as: mechanics, thermodynamics, fluid mechanics, mechanics of solids and structures and manufacturing.
3. understand the national and international regulatory environments under which aircraft and space systems operate and the role that aerospace engineers play in the continued safe operation of the aviation industry.
4. use appropriate analytical and computational tools, both general and specialised, to solve complex problems in aerospace engineering.
5. analyse and design integrated aerospace systems considering the fundamental facets of safe and controlled flight: aerospace structures, aerodynamics, flight dynamics and stability, propulsion, and avionics.
6. design and implement innovative engineering solutions to complex problems in aerospace engineering that consider technical, economic, social and environmental implications, based on rigorous analysis and application of critically evaluated current research.
7. demonstrate a high level of personal autonomy, perseverance, ethical conduct, and professional accountability when working as an individual and within diverse multi-cultural and multi-disciplinary team environments.
8. communicate professionally and effectively within and outside of aerospace engineering.

Learning Outcome Development

The Stream Learning Outcomes (SLOs) were drafted by the School Education Committee, specifically the Stream Coordinators for each of our accredited BE and ME streams. The drafts were developed considering: benchmarking conducted for the 2021 accreditation report; feedback from industry partners; and expectations of graduate outcomes aligned with EA Stage 1 competencies.

The draft SLOs were reviewed and aligned by the Deputy Head of School (Education) before being presented to the School Education Committee for endorsement. School Industry Advisory Network (IAN) consultation was sought in writing, with a follow-up workshop.

The SLOs align with the Engineers Australia expectations for a graduate engineer, but are articulated in an Aerospace Engineering context. Reference is made to both Aerospace specific knowledge and skills.

Curriculum Mapping

A curriculum map from CLOs to SLOs to EA Stage 1 Competencies was developed using the CMAP2 tool, described in the Faculty report. The specific mappings for BE (Hons) Aerospace are included here.

CO → SLO Mapping	Stream Learning Outcomes (SLOs)							
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8
DESN1000	9.2	9.2	8.5	8.3	8.5	11.0	28.1	17.1
ELEC1111	0.0	22.0	5.0	22.0	0.0	0.0	0.0	0.0
ENGG1300	14.2	76.5	0.0	1.9	0.0	0.0	0.0	7.5
ENGG1811	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
MATH1131	48.2	0.0	0.0	48.2	0.0	0.0	0.0	3.6
MATH1231	48.2	0.0	0.0	48.2	0.0	0.0	0.0	3.6
MMAN1130	0.0	29.4	18.8	4.4	0.0	8.1	6.2	33.1
PHYS1121	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0
DESN2000	0.0	0.0	20.0	15.0	0.0	18.0	27.0	20.0
ENGG2400	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGG2500	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
MATH2019	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0
MATH2089	21.2	0.0	0.0	72.6	0.0	0.0	0.0	0.0
MMAN2300	0.0	92.5	0.0	0.0	0.0	0.0	0.0	7.5
MMAN2700	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
AERO3110	0.0	11.9	26.1	6.5	31.5	11.9	0.0	11.9
AERO3410	0.0	0.0	8.3	30.6	30.6	30.6	0.0	0.0
AERO3630	0.0	25.0	0.0	33.3	33.3	0.0	0.0	8.3
AERO3660	0.0	7.1	0.0	92.9	0.0	0.0	0.0	0.0
MMAN3000	0.0	0.0	0.0	0.0	0.0	0.0	17.0	83.0
MMAN3200	41.7	0.0	0.0	41.7	16.7	0.0	0.0	0.0
AERO4110	0.0	0.0	20.0	6.7	6.7	6.7	30.0	30.0
AERO4620	0.0	0.0	26.0	13.0	61.0	0.0	0.0	0.0
MECH4620	0.0	25.0	0.0	25.0	25.0	0.0	0.0	25.0
MMAN4010	0.0	0.0	0.0	0.0	0.0	50.0	25.0	25.0
MMAN4020	0.0	0.0	0.0	0.0	0.0	50.0	25.0	25.0
MMAN4410	0.0	0.0	0.0	50.0	0.0	33.3	8.3	8.3
AERO9500	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
AERO9610	0.0	0.0	25.0	20.8	33.3	20.8	0.0	0.0
MECH9420	0.0	0.0	0.0	50.0	0.0	0.0	0.0	50.0

Figure 2: BE (Hons) Aerospace - CLO to SLO Mapping

CO → AT Mapping	Assessment Types (AT)											
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-
ENGG1300	15	-	75	-	10	-	-	-	-	-	-	-
ENGG1811	20	-	70	10	-	-	-	-	-	-	-	-
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-
MMAN1130	-	-	-	20	-	-	-	-	-	25	55	-
PHYS1121	-	-	50	20	30	-	-	-	-	-	-	-
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-
ENGG2400	15	-	50	-	15	-	-	-	-	-	20	-
ENGG2500	20	-	80	-	-	-	-	-	-	-	-	-
MATH2019	-	-	60	-	10	-	-	-	-	-	30	-
MATH2089	-	-	60	-	20	-	-	-	-	-	20	-
MMAN2300	-	-	45	-	5	-	-	-	-	30	20	-
MMAN2700	15	-	40	20	-	-	-	-	-	-	25	-
AERO3110	45	-	-	-	-	-	-	-	35	-	20	-
AERO3410	-	-	40	20	-	-	-	-	20	-	20	-
AERO3630	30	-	40	20	-	-	-	-	10	-	-	-
AERO3660	40	-	50	10	-	-	-	-	-	-	-	-
MMAN3000	-	-	-	-	100	-	-	-	-	-	-	-
MMAN3200	-	-	45	20	-	-	-	-	-	-	35	-
AERO4110	-	-	-	-	-	-	-	20	50	30	-	-
AERO4620	-	-	48	12	-	-	-	-	-	-	40	-
MECH4620	-	-	50	-	-	-	-	-	-	40	10	-
MMAN4010	-	-	-	-	-	-	-	25	-	75	-	-
MMAN4020	-	-	-	-	-	-	-	20	-	80	-	-
MMAN4410	15	-	20	-	-	-	-	-	50	-	15	-
AERO9500	30	-	40	-	-	-	-	-	-	-	30	-
AERO9610	10	-	-	-	-	-	-	-	70	20	-	-
MECH9420	-	-	45	-	-	-	-	-	-	55	-	-

Figure 3: BE (Hons) Aerospace – Course Assessment Map

SLO → GC Mapping	Engineers Australia Stage 1 Competencies															
Learning Outcomes (LO)	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
SLO1 demonstrate proficienc...	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SLO2 demonstrate expertise ...	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
SLO3 understand the nationa...	-	-	-	-	✓	✓	-	-	-	-	✓	-	-	-	-	-
SLO4 use appropriate analyt...	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-	-	-
SLO5 analyse and design int...	-	-	-	-	✓	-	-	-	✓	-	-	-	✓	-	-	-
SLO6 design and implement i...	-	-	-	✓	✓	✓	-	-	✓	✓	-	-	✓	✓	-	-
SLO7 demonstrate a high lev...	-	-	-	-	-	✓	-	-	-	✓	✓	-	-	✓	✓	✓
SLO8 communicate profession...	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	✓	✓

Figure 4: BE (Hons) Aerospace - SLO to EA Competency Mapping

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
DESN1000	4.6	7.6	3.1	4.6	7.3	9.1	4.2	4.2	4.4	6.3	7.5	5.7	4.4	6.3	10.4	10.4
ELEC1111	-	7.3	7.3	7.3	1.7	1.7	11.0	11.0	-	-	1.7	-	-	-	-	-
ENGG1300	7.1	32.6	25.5	25.5	-	-	0.9	0.9	-	-	-	2.5	-	-	2.5	2.5
ENGG1811	-	-	-	-	-	-	50.0	50.0	-	-	-	-	-	-	-	-
MATH1131	24.1	24.1	-	-	-	-	24.1	24.1	-	-	-	1.2	-	-	1.2	1.2
MATH1231	24.1	24.1	-	-	-	-	24.1	24.1	-	-	-	1.2	-	-	1.2	1.2
MMAN1130	7.1	11.9	4.8	4.8	4.8	4.8	-	-	-	-	4.8	-	-	-	-	-
PHYS1121	25.0	25.0	-	-	-	-	25.0	25.0	-	-	-	-	-	-	-	-
DESN2000	-	-	-	2.6	9.2	13.7	7.5	7.5	2.6	7.1	11.2	6.7	2.6	7.1	11.2	11.2
ENGG2400	-	33.3	33.3	33.3	-	-	-	-	-	-	-	-	-	-	-	-
ENGG2500	-	33.3	33.3	33.3	-	-	-	-	-	-	-	-	-	-	-	-
MATH2019	25.0	25.0	-	-	-	-	25.0	25.0	-	-	-	-	-	-	-	-
MATH2089	10.6	10.6	-	-	-	-	36.3	36.3	-	-	-	-	-	-	-	-
MMAN2300	-	30.8	30.8	30.8	-	-	-	-	-	-	-	2.5	-	-	2.5	2.5
MMAN2700	-	33.3	33.3	33.3	-	-	-	-	-	-	-	-	-	-	-	-
AERO3110	-	4.0	4.0	5.7	20.9	10.4	3.3	3.3	12.2	1.7	8.7	4.0	12.2	1.7	4.0	4.0
AERO3410	-	-	-	4.4	17.3	7.1	15.3	15.3	14.6	4.4	2.8	-	14.6	4.4	-	-
AERO3630	-	8.3	8.3	8.3	11.1	-	16.7	16.7	11.1	-	-	2.8	11.1	-	2.8	2.8
AERO3660	-	2.4	2.4	2.4	-	-	46.4	46.4	-	-	-	-	-	-	-	-
MMAN3000	-	-	-	-	-	2.8	-	-	-	2.8	2.8	27.7	-	2.8	30.5	30.5
MMAN3200	20.8	20.8	-	-	5.6	-	20.8	20.8	5.6	-	-	-	5.6	-	-	-
AERO4110	-	-	-	1.0	9.8	12.6	3.3	3.3	3.2	6.0	11.7	10.0	3.2	6.0	15.0	15.0
AERO4620	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MECH4620	-	8.3	8.3	8.3	8.3	-	12.5	12.5	8.3	-	-	8.3	8.3	-	8.3	8.3
MMAN4010	-	-	-	7.1	7.1	11.3	-	-	7.1	11.3	4.2	8.3	7.1	11.3	12.5	12.5
MMAN4020	-	-	-	7.1	7.1	11.3	-	-	7.1	11.3	4.2	8.3	7.1	11.3	12.5	12.5
MMAN4410	-	-	-	4.8	4.8	6.2	25.0	25.0	4.8	6.2	1.4	2.8	4.8	6.2	4.2	4.2
AERO9500	-	-	-	-	33.3	-	-	-	33.3	-	-	-	33.3	-	-	-
AERO9610	-	-	-	3.0	22.4	11.3	10.4	10.4	14.1	3.0	8.3	-	14.1	3.0	-	-
MECH9420	-	-	-	-	-	-	25.0	25.0	-	-	-	16.7	-	-	16.7	16.7
Cognitive Scale	8.9	10.3	8.8	6.5	6.2	4.6	10.4	10.4	5.3	3.2	3.1	3.9	5.3	3.2	4.9	4.9

Figure 5: BE (Hons) Aerospace - CLO to EA Competency Curriculum Map

Reflection

Curriculum Map

Course learning outcomes in the Aerospace Engineering stream (AEROAH) map well to EA Stage 1 Competencies, through the developed SLOs.

There is evidently more weight applied to the first order knowledge and application competencies (1.1, 1.2, 2.1, 2.2). The curriculum map indicates that much of this enhanced weighting comes from our foundational science/computing courses in the first two years of the degree.

Although the weighting of category 3 competencies is relatively lower than some other categories, they are disproportionately developed in year 3 and 4 of the plan, most strongly by thesis and design courses. There is a reasonable argument that these capstone experiences have a greater influence on the graduate engineer than foundational studies, so

there is perhaps a need to include a weighting factor for coursework based on the year-level of study.

Assessment Map

A review of assessment distribution indicates that the stream has an overreliance on examination and quizzes, particularly in technical engineering science subjects. The remainder of the assessment is usually in the form of assignments/reports, most commonly associated with lab work or extended analysis calculations. For design courses, thesis and other professional engineering courses, there is a far greater spread of other assessment types, including major works and portfolios.

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

- All exam papers are reviewed by another academic, along with worked solutions.
- Online exams use as much randomisation as practically possible for the question type (question banks, numerical input randomisation and in some cases multiple parallel versions of questions with slightly different solution paths)
- Students must upload working along with numerical answers. This is for marking purposes, but also can be a deterrent to some forms of contract cheating.
- Academics are encouraged to include open-ended elements in all their examination questions, with students answering short essay-style questions. This enables the marker to check the alignment between simple answers and comprehension.
- Reports are submitted using TurnItIn, which ensures that students are not plagiarising or colluding, but does not deter some forms of contract cheating.
- Model report/assignment rubrics have been provided to staff rewarding open-ended and creative solutions by students to discourage collusion and contract cheating. These have shown some initial promise, but there is a lot more evaluation and testing required.
- Important works, such as thesis, have two (or three) markers to ensure consistency.
- Some courses have taken on viva-style assessments for all students, but these have proved challenging at scale without centralised support for scheduling. The quality of vivas is also a concern, as most engineering academics have limited experience with this form of assessment.

Summary of Future Actions

- Curriculum Revision
  - The Aerospace curriculum is well situated. No immediate need for revisions.
- Assessment
  - Assessment structures need review and refinement to improve integrity in a post-COVID environment.
  - The School is piloting models which allow for more individualised (non-exam) assessment, including open-ended projects, portfolios and vivas.
- Continuous Improvement

- Both the School Education Committee and the Industry Advisory Network will review the curriculum mapping findings.
- Annual revisions to curriculum content, SLOs and mapping will be conducted by these committees.

BE(Mechanical) - MECHAH3707

Introduction

UNSW Bachelor of Engineering (Honours) (Mechanical Engineering) is a four-year, full-time degree delivered by the School of Mechanical and Manufacturing Engineering. The degree is AQF level 8 and provides graduates with *advanced knowledge and skills for professional or highly skilled work and/or further learning*.

Stream Objectives

BE (Hons) Mechanical is an accredited entry-to-practice degree which prepares students for the stunning breadth of career options available to Mechanical Engineers; systematically applying mathematics and the physical sciences to the design, analysis, manufacture and maintenance of mechanical systems. Almost every product or service in everyday life is influenced in by a mechanical engineer, so our graduates are prepared to apply their knowledge to solve contemporary and unfamiliar problems. They create future solutions in health care, energy, transportation, world hunger, space exploration, climate change, and more.

Mechanical Engineering continues to evolve as technology improves and the design and construction of machines is optimised or revolutionised. UNSW Mechanical Engineers are prepared with skills that can be used in power generation, transport, composite structures, building services, infrastructure, medical devices and more.

The UNSW Mechanical and Manufacturing Engineering, which offers the stream, is Australia's largest Mechanical and Aerospace School and is rated the highest in Australia on the three major university ranking indices. The School has a breadth of research strengths and offers students a high degree of flexibility for elective and thesis specialisation.

Stream Plan

	Year 1			Summer	Year 2			Summer	Year 3			Summer	Year 4		
	Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3
	ENGG1000	MATH1231	ENGG1300		MMAN2700	MMAN2300	ENGG2500		MMAN3400	MECH3610	Elective		Elective	MECH4100	Elective
T1 Intake Normal Load	MATH1131	PHYS1121	ENGG1811		MATH2019	ENGG2400	DESN2000		MECH3110	DESN3000	Gen Ed		Elective	Elective	Elective
	Elective	MMAN1130			Gen Ed		ELEC1111		MATH2089	MMAN3200			MMAN4010/ MMAN4951*	MMAN4020/ MMAN4952*	MMAN4953*

Core courses | General education | Thesis | Elective

Figure 6: BE (Hons) Mechanical basic course plan

Table 3: Core course codes for BE (Hons) Mechanical

DESN1000	Introduction to Engineering Design and Innovation
ELEC1111	Electrical and Telecommunications Engineering
ENGG1300	Engineering Mechanics
ENGG1811	Computing for Engineers
MATH1131	Mathematics 1A
MATH1231	Mathematics 1B
MMAN1130	Design and Manufacturing
PHYS1121	Physics 1A

DESN2000	Engineering Design and Professional Practice
ENGG2400	Mechanics of Solids 1
ENGG2500	Fluid Mechanics for Engineers
MATH2019	Engineering Mathematics 2E
MATH2089	Numerical Methods and Statistics
MMAN2300	Engineering Mechanics 2
MMAN2700	Thermodynamics
MECH3110	Mechanical Design 1
MECH3610	Advanced Thermofluids
MMAN3000	Professional Engineering and Communication
MMAN3200	Linear Systems and Control
MMAN3400	Mechanics of Solids 2
MECH4100	Mechanical Design 2
MMAN4010	Thesis A
MMAN4020	Thesis B

Table 4: Elective course options for BE (Hons) Mechanical
(* indicates course was used in curriculum mapping)

AERO9500	Space Systems Architectures and Orbits
AERO9610	The Space Segment
AERO9660	Advanced Aerospace Propulsion
ARTS2755	Development in Practice: Humanitarian Action
BABS1201	Molecules, Cells and Genes
BIOM1010	Engineering in Medicine and Biology
BIOS1301	Ecology, Sustainability and Environmental Science
CEIC1000	Sustainable Product Engineering and Design
CHEM1011	Chemistry A: Atoms, Molecules and Energy
CHEM1021	Chemistry B: Elements, Compounds and Life
CHEM1811	Engineering Chemistry 1A
CHEM1821	Engineering Chemistry 1B
COMP1521	Computer Systems Fundamentals
COMP1531	Software Engineering Fundamentals
COMP3141	Software System Design and Implementation
COMP3331	Computer Networks and Applications
CVEN1701	Environmental Principles and Systems
ELEC4633	Real-Time Engineering
ENGG1200	Undergraduate Special Projects
ENGG1400	Engineering Infrastructure Systems
ENGG2600	Engineering Vertically Integrated Project
ENGG3001	Fundamentals of Humanitarian Engineering
ENGG3060	Maker Games
ENGG3600	Engineering Vertically Integrated Project
ENGG4600	Engineering Vertically Integrated Project
GEOS1111	Fundamentals of Geology
GMAT1110	Surveying and Geospatial Engineering
MANF4100	Design and Analysis of Product-Process Systems

MANF4430	Reliability and Maintenance Engineering
MANF4611	Process Modelling and Simulation
MANF6860	Strategic Manufacturing Management
MANF9400	Industrial Management
MANF9420	Operations and Supply Chain Management in Engineering
MANF9472	Production Planning and Control
MATH1081	Discrete Mathematics
***MATS1101**	Engineering Materials and Chemistry
MECH4305	Fundamental and Advanced Vibration Analysis
MECH4320	Engineering Mechanics 3
***MECH4620**	Computational Fluid Dynamics
MECH4880	Refrigeration and Air Conditioning 1
***MECH4900**	Mechanics of Fracture and Fatigue
MECH9325	Fundamentals of Acoustics & Noise
***MECH9420**	Composite Materials and Mechanics
MECH9650	Introduction to Micro Electromechanical Systems
***MECH9720**	Solar Thermal Energy Design
***MECH9761**	Automobile Engine Technology
MINE1010	Mineral Resources Engineering
MMAN4200	Additive Manufacturing
MMAN4400	Engineering Management
***MMAN4410**	Finite Element Methods
PHYS1231	Higher Physics 1B
PSYC1001	Psychology 1A
PSYC1028	Psychology of Human Centred Design
SOLA1070	Sustainable Energy
SOLA5052	Biomass
SOLA5053	Wind Energy Converters
SOLA5056	Sustainable Energy for Developing Countries
SOLA5057	Energy Efficiency

Note: Many nuanced elective rules have been omitted for simplicity, but the selected plan is a valid a common choice of courses.

Stream Learning Outcomes

On successful completion of the MECHAH3707 program, graduates will be able to:

1. demonstrate proficiency of knowledge in the enabling sciences (mathematics, computer science and physics) that form the foundation of mechanical engineering.
2. demonstrate expertise and technical knowledge in mechanical engineering disciplines such as: mechanics of both fluids and solids, materials, thermodynamics, design and manufacturing.
3. understand the national and international standards and regulatory environment which practising Mechanical Engineers operate within.
4. use appropriate analytical and computational tools, both general and specialised, to solve complex problems in mechanical engineering.

5. design and implement innovative engineering solutions to complex problems in mechanical engineering based on rigorous analysis and application of critically evaluated current research.
6. lead and manage mechanical engineering projects, individually or as part of a team, in a systematic and professional manner.
7. apply distinct professional judgement that contributes to the ethical and sustainable practice of mechanical engineering.
8. communicate professionally and effectively within and outside of mechanical engineering.

Learning Outcome Development

The Stream Learning Outcomes (SLOs) were drafted by the School Education Committee, specifically the Stream Coordinators for each of our accredited BE and ME streams. The drafts were developed considering: benchmarking conducted for the 2021 accreditation report; feedback from industry partners; and expectations of graduate outcomes aligned with EA Stage 1 competencies.

The draft SLOs were reviewed and aligned by the Deputy Head of School (Education) before being presented to the School Education Committee for endorsement. School Industry Advisory Network (IAN) consultation was sought in writing, with a follow-up workshop.

The SLOs align with the Engineers Australia expectations for a graduate engineer but are articulated in a Mechanical Engineering context. Reference is made to both Mechanical specific knowledge and skills.

Curriculum Mapping

A curriculum map from CLOs to SLOs to EA Stage 1 Competencies was developed using the CMAP2 tool, described in the Faculty report. The specific mappings for BE (Hons) Mechanical are included here.

CO → SLO Mapping	Stream Learning Outcomes (SLOs)							
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8
DESN1000	0.0	6.1	8.5	10.3	18.8	39.2	0.0	17.1
ELEC1111	0.0	22.0	5.0	22.0	0.0	0.0	0.0	0.0
ENGG1300	14.2	78.3	0.0	0.0	0.0	0.0	0.0	7.5
ENGG1811	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
MATH1131	48.2	0.0	0.0	48.2	0.0	0.0	0.0	3.6
MATH1231	48.2	0.0	0.0	48.2	0.0	0.0	0.0	3.6
MATS1101	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
MMAN1130	0.0	23.8	45.0	6.2	0.0	0.0	0.0	25.0
PHYS1121	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0
DESN2000	0.0	0.0	0.0	27.5	7.5	28.5	8.5	28.0
ENGG2400	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGG2500	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
MATH2019	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0
MATH2089	0.0	21.2	0.0	72.6	0.0	0.0	0.0	0.0
MMAN2300	0.0	92.5	0.0	0.0	0.0	0.0	0.0	7.5
MMAN2700	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
MECH3110	0.0	0.0	0.0	0.0	34.2	24.2	24.2	17.5
MECH3610	0.0	50.0	0.0	50.0	0.0	0.0	0.0	0.0
MMAN3000	0.0	0.0	0.0	0.0	0.0	8.5	8.5	83.0
MMAN3200	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
MMAN3400	0.0	0.0	0.0	87.5	12.5	0.0	0.0	0.0
MECH4100	0.0	0.0	0.0	0.0	25.0	25.0	25.0	25.0
MECH4620	0.0	25.0	0.0	25.0	37.5	0.0	0.0	12.5
MECH4900	0.0	12.9	0.0	74.2	0.0	0.0	0.0	12.9
MMAN4010	0.0	0.0	0.0	0.0	50.0	25.0	0.0	25.0
MMAN4020	0.0	0.0	0.0	0.0	50.0	25.0	0.0	25.0
MMAN4410	0.0	0.0	0.0	50.0	33.3	0.0	8.3	8.3
MECH9420	0.0	0.0	0.0	50.0	50.0	0.0	0.0	0.0
MECH9720	0.0	0.0	0.0	0.0	50.0	12.5	12.5	25.0
MECH9761	0.0	43.8	0.0	14.6	0.0	0.0	28.8	12.9

Figure 7: BE (Hons) Mechanical - CLO to SLO Mapping

CO → AT Mapping					Assessment Types (AT)							
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-
ENGG1300	15	-	75	-	10	-	-	-	-	-	-	-
ENGG1811	20	-	70	10	-	-	-	-	-	-	-	-
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-
MATS1101	-	-	70	30	-	-	-	-	-	-	-	-
MMAN1130	-	-	-	20	-	-	-	-	-	25	55	-
PHYS1121	-	-	50	20	30	-	-	-	-	-	-	-
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-
ENGG2400	15	-	50	-	15	-	-	-	-	-	20	-
ENGG2500	20	-	80	-	-	-	-	-	-	-	-	-
MATH2019	-	-	60	-	10	-	-	-	-	-	30	-
MATH2089	-	-	60	-	20	-	-	-	-	-	20	-
MMAN2300	-	-	45	-	5	-	-	-	-	30	20	-
MMAN2700	15	-	40	20	-	-	-	-	-	-	25	-
MECH3110	10	-	-	-	30	-	-	20	-	40	-	-
MECH3610	15	-	40	15	-	-	-	-	-	-	30	-
MMAN3000	-	-	-	-	100	-	-	-	-	-	-	-
MMAN3200	-	-	45	20	-	-	-	-	-	-	35	-
MMAN3400	-	-	40	14	-	-	-	-	-	-	46	-
MECH4100	-	-	-	-	-	30	-	20	-	50	-	-
MECH4620	-	-	50	-	-	-	-	-	-	40	10	-
MECH4900	25	-	45	-	-	-	-	-	-	-	30	-
MMAN4010	-	-	-	-	-	-	-	25	-	75	-	-
MMAN4020	-	-	-	-	-	-	-	20	-	80	-	-
MMAN4410	15	-	20	-	-	-	-	-	50	-	15	-
MECH9420	-	-	45	-	-	-	-	-	-	55	-	-
MECH9720	-	-	40	-	-	-	-	-	-	50	10	-
MECH9761	10	-	70	-	-	-	-	-	-	20	-	-

Figure 8: BE (Hons) Mechanical – Course Assessment Map

SLO → GC Mapping							Engineers Australia Stage 1 Competencies									
Learning Outcomes (LO)	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
SLO1 demonstrate proficienc...	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SLO2 demonstrate expertise ...	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
SLO3 understand the nationa...	-	-	-	-	✓	✓	-	-	-	-	✓	-	-	-	-	-
SLO4 use appropriate analyt...	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-	-
SLO5 design and implement i...	-	-	-	✓	-	-	-	-	✓	✓	-	-	✓	-	-	-
SLO6 lead and manage mechan...	-	-	-	-	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
SLO7 apply distinct profess...	-	-	-	-	✓	✓	-	-	-	-	✓	-	-	✓	✓	-
SLO8 communicate profession...	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓

Figure 9: BE (Hons) Mechanical - SLO to EA Competency Mapping

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
DESN1000	-	2.0	2.0	6.7	2.8	10.7	3.4	3.4	8.1	4.7	10.7	8.5	4.7	7.8	7.8	16.4
ELEC1111	-	7.3	7.3	7.3	1.7	1.7	7.3	7.3	7.3	-	1.7	-	-	-	-	-
ENGG1300	7.1	33.2	26.1	26.1	-	-	-	-	-	-	-	3.8	-	-	-	3.8
ENGG1811	-	-	-	-	-	-	33.3	33.3	33.3	-	-	-	-	-	-	-
MATH1131	24.1	24.1	-	-	-	-	16.1	16.1	16.1	-	-	1.8	-	-	-	1.8
MATH1231	24.1	24.1	-	-	-	-	16.1	16.1	16.1	-	-	1.8	-	-	-	1.8
MATS1101	25.0	41.7	16.7	16.7	-	-	-	-	-	-	-	-	-	-	-	-
MMAN1130	-	4.8	4.8	8.3	7.6	10.5	4.8	4.8	8.3	3.6	10.5	7.1	3.6	5.7	5.7	10.0
PHYS1121	25.0	25.0	-	-	-	-	16.7	16.7	16.7	-	-	-	-	-	-	-
DESN2000	-	-	-	1.9	1.7	7.4	9.2	9.2	11.0	1.9	7.4	14.0	1.9	7.4	7.4	19.7
ENGG2400	-	33.3	33.3	33.3	-	-	-	-	-	-	-	-	-	-	-	-
ENGG2500	-	33.3	33.3	33.3	-	-	-	-	-	-	-	-	-	-	-	-
MATH2019	25.0	25.0	-	-	-	-	16.7	16.7	16.7	-	-	-	-	-	-	-
MATH2089	-	7.1	7.1	7.1	-	-	24.2	24.2	24.2	-	-	-	-	-	-	-
MMAN2300	-	30.8	30.8	30.8	-	-	-	-	-	-	-	3.8	-	-	-	3.8
MMAN2700	-	33.3	33.3	33.3	-	-	-	-	-	-	-	-	-	-	-	-
MECH3110	-	-	-	8.5	4.8	9.7	-	-	8.5	8.5	9.7	8.8	8.5	9.7	9.7	13.6
MECH3610	-	16.7	16.7	16.7	-	-	16.7	16.7	16.7	-	-	-	-	-	-	-
MMAN3000	-	-	-	-	1.7	3.4	-	-	-	-	3.4	41.5	-	3.4	3.4	43.2
MMAN3200	-	-	-	-	-	-	33.3	33.3	33.3	-	-	-	-	-	-	-
MMAN3400	-	-	-	3.1	-	-	29.2	29.2	32.3	3.1	-	-	3.1	-	-	-
MECH4100	-	-	-	6.2	5.0	10.0	-	-	6.2	6.2	10.0	12.5	6.2	10.0	10.0	17.5
MECH4620	-	8.3	8.3	17.7	-	-	8.3	8.3	17.7	9.4	-	6.2	9.4	-	-	6.2
MECH4900	-	4.3	4.3	4.3	-	-	24.7	24.7	24.7	-	-	6.5	-	-	-	6.5
MMAN4010	-	-	-	12.5	-	5.0	-	-	12.5	12.5	5.0	12.5	12.5	5.0	5.0	17.5
MMAN4020	-	-	-	12.5	-	5.0	-	-	12.5	12.5	5.0	12.5	12.5	5.0	5.0	17.5
MMAN4410	-	-	-	8.3	1.7	1.7	16.7	16.7	25.0	8.3	1.7	4.2	8.3	1.7	1.7	4.2
MECH9420	-	-	-	12.5	-	-	16.7	16.7	29.2	12.5	-	-	12.5	-	-	-
MECH9720	-	-	-	12.5	2.5	5.0	-	-	12.5	12.5	5.0	12.5	12.5	5.0	5.0	15.0
MECH9761	-	14.6	14.6	14.6	5.8	5.8	4.9	4.9	4.9	-	5.8	6.5	-	5.8	5.8	6.5
Cognitive Scale	11.4	10.8	8.9	7.6	1.8	3.3	8.7	8.7	9.0	4.2	3.3	5.1	4.2	3.2	3.2	6.3

Figure 10: BE (Hons) Mechanical - CLO to EA Competency Curriculum Map

Reflection

Curriculum Map

Course learning outcomes in the Mechanical Engineering stream (MECHAH) map well to EA Stage 1 Competencies, through the newly created SLO map.

There is evidently more weight applied to the first order knowledge and application competencies (1.1, 1.2, 2.1, 2.2, 2.3). The curriculum map indicates that much of this enhanced weighting comes from our foundational science/computing courses in the first two years of the degree and technical courses in later years.

Although the weighting of category 3 competencies is relatively lower than some other categories, they are disproportionately developed in year 3 and 4 of the plan, most strongly by thesis and design courses. There is a reasonable argument that these capstone experiences have a greater influence on the graduate engineer than foundational studies, so

there is perhaps a need to include a weighting factor for coursework based on the year-level of study.

One poorly mapped competency was 1.5. There is scope to enhance the development of this competency through the spine of design courses running through the degree (DESN1000, DESN2000, MMAN3000, MECH4100), which will be investigated with the School Education Committee. The knowledge associated with this competency is already in the curriculum, but needs to be more explicitly addressed through assessment and course learning outcomes.

Assessment Map

A review of assessment distribution indicates that the stream has an overreliance on examination and quizzes, particularly in technical engineering science subjects. The remainder of the assessment is usually in the form of assignments/reports, most commonly associated with lab work or extended analysis calculations. For design courses, thesis and other professional engineering courses, there is a far greater spread of other assessment types, including major works and portfolios.

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

- All exam papers are reviewed by another academic, along with worked solutions.
- Online exams use as much randomisation as practically possible for the question type (question banks, numerical input randomisation and in some cases multiple parallel versions of questions with slightly different solution paths)
- Students must upload working along with numerical answers. This is for marking purposes, but also can be a deterrent to some forms of contract cheating.
- Academics are encouraged to include open-ended elements in all their examination questions, with students answering short essay-style questions. This enables the marker to check the alignment between simple answers and comprehension.
- Reports are submitted using TurnItIn, which ensures that students are not plagiarising or colluding, but does not deter some forms of contract cheating.
- Model report/assignment rubrics have been provided to staff rewarding open-ended and creative solutions by students to discourage collusion and contract cheating. These have shown some initial promise, but there is a lot more evaluation and testing required.
- Important works, such as thesis, have two (or three) markers to ensure consistency.
- Some courses have taken on viva-style assessments for all students, but these have proved challenging at scale without centralised support for scheduling. The quality of vivas is also a concern, as most engineering academics have limited experience with this form of assessment.

Summary of Future Actions

- Curriculum Revision
  - Review the development of EA Stage 1 Competency 1.5 - Knowledge of engineering design practice and contextual factors impacting the engineering discipline.
- Assessment
  - Assessment structures need review and refinement to improve integrity in a post-COVID environment.
  - The School is piloting models which allow for more individualised (non-exam) assessment, including open-ended projects, portfolios and vivas.
- Continuous Improvement
  - Both the School Education Committee and the Industry Advisory Network will review the curriculum mapping findings.
  - Annual revisions to curriculum content, SLOs and mapping will be conducted by these committees.

BE(Mechanical and Manufacturing) - MANFBH3707

Introduction

UNSW Bachelor of Engineering (Honours) (Mechanical and Manufacturing Engineering) is a four-year, full-time degree delivered by the School of Mechanical and Manufacturing Engineering. The degree is AQF level 8 and provides graduates with *advanced knowledge and skills for professional or highly skilled work and/or further learning*.

Stream Objectives

Mechanical and Manufacturing Engineering at UNSW is an accredited entry-to-practice degree in which students learn how to transform a design from a conceptual stage into a prototype and finally into a commercially viable product. They integrate the knowledge gained from this degree into a framework and process that allows them to implement designs, solutions and ideas in a commercial environment. The final year courses are based on global industry best practice in manufacturing and industrial engineering.

Mechanical and Manufacturing Engineering at UNSW create diverse graduates that design smart mechanical systems and develop products, as well as the machines that create them. UNSW Mechanical and Manufacturing engineers apply scientific and engineering knowledge to the development, manufacture, and distribution of all types of products. Graduates are prepared for a wide variety of career paths and professional opportunities in manufacturing industries, such as Automotive, Defence, Aerospace or any industry that turns a raw material into a product for commercial or consumer use.

The UNSW Mechanical and Manufacturing Engineering, which offers the stream, is Australia's largest Mechanical and Aerospace School and is rated the highest in Australia on the three major university ranking indices. The School has a breadth of research strengths and offers students a high degree of flexibility for elective and thesis specialisation.

Stream Plan

	Year 1			Summer	Year 2			Summer	Year 3			Summer	Year 4		
	Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3
T1 Intake Normal Load	ENGG1000	MATH1231	ENGG1300		MMAN2700	MMAN2300	ENGG2500		MANF4100	DESN3000	ENGG1811		MANF4430	MANF4611	MMAN4400
	MATH1131	PHYS1121	Gen Ed		MATH2019	ENGG2400	DESN2000		MECH3110	MMAN3200	Elective		MANF4150	Elective	Elective
	Elective	MMAN1130			Gen Ed		ELEC1111		MATH2089	MANF3510			MMAN4010/ MMAN4951*	MMAN4020/ MMAN4952*	MMAN4953*

Core courses | General education | Thesis | Elective

Figure 11: BE (Hons) Mechanical and Manufacturing basic course plan

Table 5: Core course codes for BE (Hons) Mechanical and Manufacturing

DESN1000	Introduction to Engineering Design and Innovation
ELEC1111	Electrical and Telecommunications Engineering
ENGG1300	Engineering Mechanics
ENGG1811	Computing for Engineers
MATH1131	Mathematics 1A
MATH1231	Mathematics 1B
MMAN1130	Design and Manufacturing
PHYS1121	Physics 1A

DESN2000	Engineering Design and Professional Practice
ENGG2400	Mechanics of Solids 1
ENGG2500	Fluid Mechanics for Engineers
MATH2019	Engineering Mathematics 2E
MATH2089	Numerical Methods and Statistics
MMAN2300	Engineering Mechanics 2
MMAN2700	Thermodynamics
MANF3510	Process Technology and Automation
MECH3110	Mechanical Design 1
MMAN3000	Professional Engineering and Communication
MMAN3200	Linear Systems and Control
MANF4100	Design and Analysis of Product-Process Systems
MANF4150	Design of Intelligent Manufacturing Systems
MANF4430	Reliability and Maintenance Engineering
MANF4611	Process Modelling and Simulation
MMAN4010	Thesis A
MMAN4020	Thesis B
MMAN4400	Engineering Management

Table 6: Elective course options for BE (Hons) Mechanical and Manufacturing
(* indicates course was used in curriculum mapping)

AERO9500	Space Systems Architectures and Orbits
AERO9610	The Space Segment
AERO9660	Advanced Aerospace Propulsion
ARTS2755	Development in Practice: Humanitarian Action
BABS1201	Molecules, Cells and Genes
BIOM1010	Engineering in Medicine and Biology
BIOS1301	Ecology, Sustainability and Environmental Science
CEIC1000	Sustainable Product Engineering and Design
CHEM1011	Chemistry A: Atoms, Molecules and Energy
CHEM1021	Chemistry B: Elements, Compounds and Life
CHEM1811	Engineering Chemistry 1A
CHEM1821	Engineering Chemistry 1B
COMP1521	Computer Systems Fundamentals
COMP1531	Software Engineering Fundamentals
COMP3141	Software System Design and Implementation
COMP3331	Computer Networks and Applications
CVEN1701	Environmental Principles and Systems
ELEC4633	Real-Time Engineering
ENGG1200	Undergraduate Special Projects
ENGG1400	Engineering Infrastructure Systems
ENGG2600	Engineering Vertically Integrated Project
ENGG3001	Fundamentals of Humanitarian Engineering
ENGG3060	Maker Games
ENGG3600	Engineering Vertically Integrated Project

ENGG4600	Engineering Vertically Integrated Project
GEOS1111	Fundamentals of Geology
GMAT1110	Surveying and Geospatial Engineering
***MANF6860**	Strategic Manufacturing Management
***MANF9400**	Industrial Management
***MANF9420**	Operations and Supply Chain Management in Engineering
***MANF9472**	Production Planning and Control
MATH1081	Discrete Mathematics
MATS1101	Engineering Materials and Chemistry
MECH4100	Mechanical Design 2
MECH4305	Fundamental and Advanced Vibration Analysis
MECH4320	Engineering Mechanics 3
MECH4620	Computational Fluid Dynamics
MECH4880	Refrigeration and Air Conditioning 1
MECH4900	Mechanics of Fracture and Fatigue
MECH9325	Fundamentals of Acoustics & Noise
***MECH9420**	Composite Materials and Mechanics
MECH9650	Introduction to Micro Electromechanical Systems
MECH9720	Solar Thermal Energy Design
MECH9761	Automobile Engine Technology
MINE1010	Mineral Resources Engineering
***MMAN4200**	Additive Manufacturing
MMAN4410	Finite Element Methods
PHYS1231	Higher Physics 1B
PSYC1001	Psychology 1A
PSYC1028	Psychology of Human Centred Design
SOLA1070	Sustainable Energy
SOLA5052	Biomass
SOLA5053	Wind Energy Converters
SOLA5056	Sustainable Energy for Developing Countries
SOLA5057	Energy Efficiency

Note: Many nuanced elective rules have been omitted for simplicity, but the selected plan is a valid a common choice of courses.

Stream Learning Outcomes

On successful completion of the MANFBH3707 program, graduates will be able to:

1. demonstrate proficiency of knowledge in the enabling sciences (mathematics, computer science and physics) that form the foundation of mechanical and manufacturing engineering.
2. demonstrate expertise and technical knowledge in mechanical and manufacturing engineering disciplines such as: mechanics, thermodynamics, fluid mechanics, mechanics of solids, advanced materials, product design, management, process technology and automation.
3. understand the national and international standards and regulatory environment which practising Mechanical and Manufacturing Engineers operate within.

4. use critical thinking, best practice analytical techniques and detailed data to make engineering and financial management decisions, supported by detailed data and analysis.
5. apply product-system development and decision-making methods for product lifecycle management.
6. specify, design, integrate and improve systems for manufacturing and process automation (including measurement and feedback control), incorporating advanced digital, AI and IOT technologies.
7. lead and manage mechanical and manufacturing engineering projects, individually or as part of a team, in a systematic and professional manner.
8. link the impact of design, plan, and control decisions in different disciplines and apply distinct professional judgement that contributes to the ethical and sustainable practice of mechanical and manufacturing engineering.
9. communicate professionally and effectively within and outside of mechanical and manufacturing engineering.

Learning Outcome Development

The Stream Learning Outcomes (SLOs) were drafted by the School Education Committee, specifically the Stream Coordinators for each of our accredited BE and ME streams. The drafts were developed considering: benchmarking conducted for the 2021 accreditation report; feedback from industry partners; and expectations of graduate outcomes aligned with EA Stage 1 competencies.

The draft SLOs were reviewed and aligned by the Deputy Head of School (Education) before being presented to the School Education Committee for endorsement. School Industry Advisory Network (IAN) consultation was sought in writing, with a follow-up workshop.

The SLOs align with the Engineers Australia expectations for a graduate engineer but are articulated in a Manufacturing Engineering context. Reference is made to both Manufacturing specific knowledge and skills.

Curriculum Mapping

A curriculum map from CLOs to SLOs to EA Stage 1 Competencies was developed using the CMAP2 tool, described in the Faculty report. The specific mappings for BE (Hons) Mechanical and Manufacturing are included here.

CO → SLO Mapping				Stream Learning Outcomes (SLOs)					
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8	SLO9
DESN1000	0.0	9.2	17.1	8.3	0.0	9.2	39.2	0.0	17.1
ELEC1111	0.0	22.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0
ENGG1300	0.0	92.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5
ENGG1811	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
MATH1131	48.2	0.0	0.0	48.2	0.0	0.0	0.0	0.0	3.6
MATH1231	48.2	0.0	0.0	48.2	0.0	0.0	0.0	3.6	0.0
MMAN1130	0.0	56.2	18.8	0.0	0.0	12.5	0.0	0.0	12.5
PHYS1121	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0
DESN2000	0.0	0.0	0.0	21.5	17.5	0.0	8.5	28.5	24.0
ENGG2400	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGG2500	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MATH2019	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0
MATH2089	0.0	21.2	0.0	72.6	0.0	0.0	0.0	0.0	0.0
MMAN2300	0.0	92.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5
MMAN2700	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANF3510	0.0	0.0	0.0	78.9	5.6	15.6	0.0	0.0	0.0
MECH3110	0.0	0.0	0.0	0.0	0.0	34.2	24.2	24.2	17.5
MMAN3000	0.0	0.0	0.0	0.0	0.0	0.0	8.5	8.5	83.0
MMAN3200	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
MANF4100	0.0	0.0	0.0	20.0	40.0	35.0	5.0	0.0	0.0
MANF4150	0.0	0.0	0.0	0.0	0.0	90.0	0.0	10.0	0.0
MANF4430	28.3	0.0	0.0	0.0	0.0	56.7	0.0	7.5	7.5
MANF4611	0.0	0.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0
MMAN4010	0.0	0.0	0.0	0.0	0.0	25.0	25.0	25.0	25.0
MMAN4020	0.0	0.0	0.0	0.0	0.0	25.0	25.0	25.0	25.0
MMAN4200	0.0	25.0	0.0	25.0	25.0	0.0	0.0	25.0	0.0
MMAN4400	0.0	0.0	0.0	33.3	0.0	0.0	33.3	33.3	0.0
MANF6860	0.0	0.0	25.0	8.3	33.3	0.0	8.3	25.0	0.0
MANF9400	0.0	0.0	0.0	0.0	0.0	0.0	50.0	25.0	0.0
MANF9420	0.0	0.0	0.0	54.2	8.3	0.0	8.3	16.7	12.5
MANF9472	0.0	0.0	0.0	0.0	0.0	0.0	50.0	50.0	0.0
MECH9420	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0	0.0

Figure 12: BE (Hons) Mechanical and Manufacturing - CLO to SLO Mapping

CO → AT Mapping	Assessment Types (AT)											
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-
ENGG1300	15	-	75	-	10	-	-	-	-	-	-	-
ENGG1811	20	-	70	10	-	-	-	-	-	-	-	-
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-
MMAN1130	-	-	-	20	-	-	-	-	-	25	55	-
PHYS1121	-	-	50	20	30	-	-	-	-	-	-	-
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-
ENGG2400	15	-	50	-	15	-	-	-	-	-	20	-
ENGG2500	20	-	80	-	-	-	-	-	-	-	-	-
MATH2019	-	-	60	-	10	-	-	-	-	-	30	-
MATH2089	-	-	60	-	20	-	-	-	-	-	20	-
MMAN2300	-	-	45	-	5	-	-	-	-	30	20	-
MMAN2700	15	-	40	20	-	-	-	-	-	-	25	-
MANF3510	-	-	40	-	-	-	-	-	-	40	20	-
MECH3110	10	-	-	-	30	-	-	20	-	40	-	-
MMAN3000	-	-	-	-	100	-	-	-	-	-	-	-
MMAN3200	-	-	45	20	-	-	-	-	-	-	35	-
MANF4100	-	-	30	-	10	-	-	-	30	-	30	-
MANF4150	80	-	20	-	-	-	-	-	-	-	-	-
MANF4430	-	-	40	-	-	-	-	-	60	-	-	-
MANF4611	80	-	20	-	-	-	-	-	-	-	-	-
MMAN4010	-	-	-	-	-	-	-	25	-	75	-	-
MMAN4020	-	-	-	-	-	-	-	20	-	80	-	-
MMAN4200	-	25	40	-	-	-	-	-	25	-	10	-
MMAN4400	20	-	-	-	35	-	-	-	-	-	45	-
MANF6860	90	-	-	-	-	-	-	10	-	-	-	-
MANF9400	30	-	70	-	-	-	-	-	-	-	-	-
MANF9420	-	-	60	-	15	-	-	-	25	-	-	-
MANF9472	35	-	35	-	-	-	-	-	-	30	-	-
MECH9420	-	-	45	-	-	-	-	-	-	55	-	-

Figure 13: BE (Hons) Mechanical and Manufacturing – Course Assessment Map

SLO → GC Mapping	Engineers Australia Stage 1 Competencies															
Learning Outcomes (LO)	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
SLO1 demonstrate proficienc...	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SLO2 demonstrate expertise ...	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
SLO3 understand the nationa...	-	-	-	-	✓	✓	-	-	-	-	✓	-	-	-	-	-
SLO4 use critical thinking,...	-	-	-	✓	-	-	✓	✓	-	-	-	-	-	✓	-	-
SLO5 apply product-system d...	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
SLO6 specify, design, integ...	-	-	-	✓	✓	-	✓	✓	✓	-	-	-	-	-	-	-
SLO7 lead and manage mechan...	-	-	-	-	-	-	-	-	-	✓	-	-	✓	-	-	✓
SLO8 link the impact of des...	-	-	-	-	-	✓	-	-	-	-	✓	-	✓	✓	✓	-
SLO9 communicate profession...	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓

Figure 14: BE (Hons) Mechanical and Manufacturing - SLO to EA Stage 1 Competency Mapping

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
DESN1000	-	4.6	4.6	3.9	7.5	5.7	3.9	3.9	1.8	13.1	5.7	8.5	13.1	2.1	-	21.6
ELEC1111	-	11.0	11.0	1.2	1.7	1.7	1.2	1.2	-	-	1.7	-	-	1.2	-	-
ENGG1300	-	46.2	46.2	-	-	-	-	-	-	-	-	3.8	-	-	-	3.8
ENGG1811	-	-	-	25.0	-	-	25.0	25.0	-	-	-	-	-	25.0	-	-
MATH1131	24.1	24.1	-	12.0	-	-	12.0	12.0	-	-	-	1.8	-	12.0	-	1.8
MATH1231	24.1	24.1	-	12.0	-	0.7	12.0	12.0	-	-	0.7	-	0.7	12.8	0.7	-
MMAN1130	7.1	14.3	7.1	3.6	4.8	4.8	3.6	3.6	7.1	7.1	4.8	-	-	3.6	-	-
PHYS1121	25.0	25.0	-	12.5	-	-	12.5	12.5	-	-	-	-	-	12.5	-	-
DESN2000	-	-	-	5.4	-	5.7	5.4	5.4	8.8	11.6	5.7	12.0	8.5	11.1	5.7	14.8
ENGG2400	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
ENGG2500	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
MATH2019	25.0	25.0	-	12.5	-	-	12.5	12.5	-	-	-	-	-	12.5	-	-
MATH2089	-	10.6	10.6	18.2	-	-	18.2	18.2	-	-	-	-	-	18.2	-	-
MMAN2300	-	46.2	46.2	-	-	-	-	-	-	-	-	3.8	-	-	-	3.8
MMAN2700	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
MANF3510	-	-	-	22.8	3.1	-	22.8	22.8	5.9	2.8	-	-	-	19.7	-	-
MECH3110	-	-	-	6.8	6.8	4.8	6.8	6.8	6.8	8.1	4.8	8.8	12.9	4.8	4.8	16.8
MMAN3000	-	-	-	-	-	1.7	-	-	-	2.8	1.7	41.5	4.5	1.7	1.7	44.3
MMAN3200	-	-	-	25.0	-	-	25.0	25.0	-	-	-	-	-	25.0	-	-
MANF4100	-	-	-	12.0	7.0	-	12.0	12.0	27.0	21.7	-	-	1.7	5.0	-	1.7
MANF4150	-	-	-	18.0	18.0	2.0	18.0	18.0	18.0	-	2.0	-	2.0	2.0	2.0	-
MANF4430	14.2	14.2	-	11.3	11.3	1.5	11.3	11.3	11.3	-	1.5	3.8	1.5	1.5	1.5	3.8
MANF4611	-	-	-	12.5	-	10.0	12.5	12.5	-	-	10.0	-	10.0	22.5	10.0	-
MMAN4010	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	8.3	5.0	12.5	13.3	5.0	5.0	20.8
MMAN4020	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	8.3	5.0	12.5	13.3	5.0	5.0	20.8
MMAN4200	-	12.5	12.5	6.2	-	5.0	6.2	6.2	12.5	12.5	5.0	-	5.0	11.2	5.0	-
MMAN4400	-	-	-	8.3	-	6.7	8.3	8.3	-	11.1	6.7	-	17.8	15.0	6.7	11.1
MANF6860	-	-	-	2.1	8.3	13.3	2.1	2.1	16.7	19.4	13.3	-	7.8	7.1	5.0	2.8
MANF9400	-	-	-	-	-	5.0	-	-	-	16.7	5.0	-	21.7	5.0	5.0	16.7
MANF9420	-	-	-	13.5	-	3.3	13.5	13.5	4.2	6.9	3.3	6.2	6.1	16.9	3.3	9.0
MANF9472	-	-	-	-	-	10.0	-	-	-	16.7	10.0	-	26.7	10.0	10.0	16.7
MECH9420	-	-	-	22.5	10.0	-	22.5	22.5	10.0	-	-	-	-	12.5	-	-
Cognitive Scale	10.1	13.7	14.5	5.9	3.7	2.6	5.9	5.9	5.1	5.6	2.6	5.3	5.0	5.3	2.4	6.6

Figure 15: BE (Hons) Mechanical and Manufacturing - CLO to EA Competency Curriculum Map

Reflection

Curriculum Map

Course learning outcomes in the Mechanical and Manufacturing Engineering stream (MANFBH) map well to EA Stage 1 Competencies, through the newly created SLO map.

There is evidently weight applied to the first order knowledge and application competencies (1.1, 1.2, 1.3, 2.1, 2.2, 2.3). The curriculum map indicates that much of this enhanced weighting comes from our foundational science/computing courses in the first two years of the degree and technical courses in later years.

Although the weighting of category 3 competencies is relatively lower than some other categories, they are disproportionately developed in year 3 and 4 of the plan, most strongly by thesis and design courses. There is a reasonable argument that these capstone experiences have a greater influence on the graduate engineer than foundational studies, so

there is perhaps a need to include a weighting factor for coursework based on the year-level of study.

There are a cluster of (relatively) poorly developed competencies our professionalism, ethics and norms (1.6, 3.1, 3.5). A review of the mapping matrix identifies that these topics are addressed by many courses (>15) but with low weightings in each course. This dispersed approach to professional knowledge and skills has been actively pursued by the MANFBH stream coordinator, but there is perhaps a problem with how assessment and course learning outcomes are reflecting the value of these topics and skillsets. This will be reviewed.

Assessment Map

A review of assessment distribution indicates that the stream has an overreliance on examination and quizzes, particularly in technical engineering science subjects. The remainder of the assessment is usually in the form of assignments/reports, most commonly associated with lab work or extended analysis calculations. For design courses, thesis and other professional engineering courses, there is a far greater spread of other assessment types, including major works and portfolios.

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

- All exam papers are reviewed by another academic, along with worked solutions.
- Online exams use as much randomisation as practically possible for the question type (question banks, numerical input randomisation and in some cases multiple parallel versions of questions with slightly different solution paths)
- Students must upload working along with numerical answers. This is for marking purposes, but also can be a deterrent to some forms of contract cheating.
- Academics are encouraged to include open-ended elements in all their examination questions, with students answering short essay-style questions. This enables the marker to check the alignment between simple answers and comprehension.
- Reports are submitted using TurnItIn, which ensures that students are not plagiarising or colluding, but does not deter some forms of contract cheating.
- Model report/assignment rubrics have been provided to staff rewarding open-ended and creative solutions by students to discourage collusion and contract cheating. These have shown some initial promise, but there is a lot more evaluation and testing required.
- Important works, such as thesis, have two (or three) markers to ensure consistency.
- Many courses in the MANFBH stream have embraced viva-style assessments for all students. The smaller scale of these classes allows them to be a testbed and share their experiences with the rest of the School.

Summary of Future Actions

- Curriculum Revision
    - Review the development of EA competencies 1.6, 3.1, 3.5. The breadth of subjects mapping to these capabilities is high, but the weighting is low.

- Assessment
    - Assessment structures need review and refinement to improve integrity in a post-COVID environment.
    - Manufacturing Engineering is a pilot space for viva-style and highly individualised assessments and will investigate deploying them at scale.
- Continuous Improvement
    - Both the School Education Committee and the Industry Advisory Network will review the curriculum mapping findings.
    - Annual revisions to curriculum content, SLOs and mapping will be conducted by these committees.

BE(Mechatronic) - MTRNAH3707

Introduction

UNSW Bachelor of Engineering (Honours) (Mechatronic Engineering) is a four-year, full-time degree delivered by the School of Mechanical and Manufacturing Engineering. The degree is AQF level 8 and provides graduates with *advanced knowledge and skills for professional or highly skilled work and/or further learning*.

Stream Objectives

BE (Hons) Mechatronic is an accredited entry-to-practice degree which intertwines mechanical engineering, control engineering and software development, especially for controlling sophisticated smart machines. Mechatronic engineers work across all aspects of smart machines – from design and testing through to manufacture in industries such as robotics, medical and assistive technology, human-machine interaction, manufacturing, unmanned aerial and ground vehicles and education. Graduates understand the conception, design, construction, maintenance, integration and repair of smart machines. These machines range from humble consumer goods to integrated robotic production systems at factory scale.

This degree builds knowledge and skills in areas including building services, computer-controlled plant, manufacturing, robotics and autonomous vehicles. It emphasises the application of engineering science, development and management in these fields. UNSW Mechatronic engineers work in many industries where automation is in demand, such as manufacturing, automotive, mining, cargo handling and agriculture. Our graduates also have the expertise to contribute to the design and manufacture of consumer devices such as mobile phones, specialised industrial equipment, video game consoles and biomedical devices. Graduates can pursue careers in the following industries and sectors:

- Automation
- Robotics
- Computer simulations and modelling
- Gaming
- Engineering design
- Propulsion systems
- Control systems

The UNSW Mechanical and Manufacturing Engineering, which offers the stream, is Australia's largest Mechanical and Aerospace School and is rated the highest in Australia on the three major university ranking indices. The School has a breadth of research strengths and offers students a high degree of flexibility for elective and thesis specialisation.

Stream Plan

	Year 1			Summer	Year 2			Summer	Year 3			Summer	Year 4		
	Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3		Term 1	Term 2	Term 3
T1 Intake Normal Load	ENGG1000	MATH1231	ENGG1300		MATH2019	MMAN2300	MTRN2500		MATH2089	DESN3000	Elective		MTRN4010	MTRN4110	Elective
	PHYS1121	COMP1511	MMAN1130		COMP1531	ENGG2400	DESN2000		MMAN3200^{x}	MTRN3020	Gen Ed		Elective	MTRN4230	Elective
	MATH1131		Elective		Gen Ed		ELEC1111		ELEC2141	MTRN3500			MMAN4010/ MMAN4951*	MMAN4020/ MMAN4952*	MMAN4953*

Core courses | General education | Thesis | Elective

Figure 16: BE (Hons) Mechatronic basic course plan

Table 7: Core course codes for BE (Hons) Mechatronic

COMP1511	Programming Fundamentals
COMP1531	Software Engineering Fundamentals
DESN1000	Introduction to Engineering Design and Innovation
ELEC1111	Electrical and Telecommunications Engineering
ENGG1300	Engineering Mechanics
MATH1131	Mathematics 1A
MATH1231	Mathematics 1B
MMAN1130	Design and Manufacturing
PHYS1121	Physics 1A
DESN2000	Engineering Design and Professional Practice
ELEC2141	Digital Circuit Design
ENGG2400	Mechanics of Solids 1
MATH2019	Engineering Mathematics 2E
MATH2089	Numerical Methods and Statistics
MMAN2300	Engineering Mechanics 2
MTRN2500	Computing for Mechatronic Engineers
MMAN3000	Professional Engineering and Communication
MMAN3200	Linear Systems and Control
MTRN3020	Modelling and Control of Mechatronic Systems
MTRN3500	Computing Applications in Mechatronics Systems
MMAN4010	Thesis A
MMAN4020	Thesis B
MTRN4010	Advanced Autonomous Systems
MTRN4110	Robot Design
MTRN4230	Robotics

Table 8: Elective course options for BE (Hons) Mechatronic
(* indicates course was used in curriculum mapping)

AERO9500	Space Systems Architectures and Orbits
AERO9610	The Space Segment
AERO9660	Advanced Aerospace Propulsion
ARTS2755	Development in Practice: Humanitarian Action
BABS1201	Molecules, Cells and Genes

BIOM1010	Engineering in Medicine and Biology
BIOS1301	Ecology, Sustainability and Environmental Science
CEIC1000	Sustainable Product Engineering and Design
CHEM1011	Chemistry A: Atoms, Molecules and Energy
CHEM1021	Chemistry B: Elements, Compounds and Life
CHEM1811	Engineering Chemistry 1A
CHEM1821	Engineering Chemistry 1B
COMP1521	Computer Systems Fundamentals
***COMP3141**	Software System Design and Implementation
COMP3331	Computer Networks and Applications
COMP3431	Robotic Software Architecture
COMP9417	Machine Learning and Data Mining
COMP9444	Neural Networks and Deep Learning
COMP9517	Computer Vision
CVEN1701	Environmental Principles and Systems
ELEC4633	Real-Time Engineering
ENGG1200	Undergraduate Special Projects
ENGG1400	Engineering Infrastructure Systems
ENGG2600	Engineering Vertically Integrated Project
ENGG3001	Fundamentals of Humanitarian Engineering
ENGG3060	Maker Games
ENGG3600	Engineering Vertically Integrated Project
ENGG4600	Engineering Vertically Integrated Project
GEOS1111	Fundamentals of Geology
GMAT1110	Surveying and Geospatial Engineering
MANF4100	Design and Analysis of Product-Process Systems
MANF4430	Reliability and Maintenance Engineering
***MANF4611**	Process Modelling and Simulation
MANF6860	Strategic Manufacturing Management
MANF9400	Industrial Management
MANF9420	Operations and Supply Chain Management in Engineering
MANF9472	Production Planning and Control
MATH1081	Discrete Mathematics
MATS1101	Engineering Materials and Chemistry
MECH4100	Mechanical Design 2
MECH4305	Fundamental and Advanced Vibration Analysis
MECH4320	Engineering Mechanics 3
MECH4620	Computational Fluid Dynamics
MECH4880	Refrigeration and Air Conditioning 1
MECH4900	Mechanics of Fracture and Fatigue
MECH9325	Fundamentals of Acoustics & Noise
MECH9420	Composite Materials and Mechanics
MECH9650	Introduction to Micro Electromechanical Systems
MECH9720	Solar Thermal Energy Design
MECH9761	Automobile Engine Technology

MINE1010	Mineral Resources Engineering
***MMAN4200**	Additive Manufacturing
MMAN4400	Engineering Management
PHYS1231	Higher Physics 1B
PSYC1001	Psychology 1A
PSYC1028	Psychology of Human Centred Design
SOLA1070	Sustainable Energy
SOLA5052	Biomass
SOLA5053	Wind Energy Converters
SOLA5056	Sustainable Energy for Developing Countries
SOLA5057	Energy Efficiency

Note: Many nuanced elective rules have been omitted for simplicity, but the selected plan is a valid a common choice of courses.

Stream Learning Outcomes

On successful completion of the MTRNAH3707 program, graduates will be able to:

1. demonstrate proficiency of knowledge in the enabling sciences (mathematics, computer science and physics) that form the foundation of mechatronic engineering.
2. demonstrate expertise and technical knowledge in mechatronic engineering disciplines such as: mechanics, design, electronics, modelling, control, robotics, autonomous and AI systems.
3. identify all components of an electrical, mechanical or software system and the national and international standards that apply.
4. design and implement hardware (sensors, data acquisition and PLC) and software interfaces and document them professionally.
5. model combinations of common mechanical, electrical and/or software components and design and implement control systems for these mechatronic systems.
6. design and implement innovative engineering solutions to complex problems in mechatronic engineering based on rigorous analysis and application of critically evaluated current research.
7. design, build and operate mechatronic systems and devise and implement experiments to evaluate their performance.
8. communicate professionally and effectively within and outside of mechatronic engineering.
9. demonstrate a high level of personal autonomy, perseverance, ethical conduct and professional accountability when working as an individual and within diverse multi-cultural and multi-disciplinary team environments.

Learning Outcome Development

The Stream Learning Outcomes (SLOs) were drafted by the School Education Committee, specifically the Stream Coordinators for each of our accredited BE and ME streams. The drafts were developed considering: benchmarking conducted for the 2021 accreditation report; feedback from industry partners; and expectations of graduate outcomes aligned with EA Stage 1 competencies.

The draft SLOs were reviewed and aligned by the Deputy Head of School (Education) before being presented to the School Education Committee for endorsement. School Industry Advisory Network (IAN) consultation was sought in writing, with a follow-up workshop.

The SLOs align with the Engineers Australia expectations for a graduate engineer but are articulated in a Mechatronic Engineering context. Reference is made to both Mechatronic specific knowledge and skills.

Curriculum Mapping

A curriculum map from CLOs to SLOs to EA Stage 1 Competencies was developed using the CMAP2 tool, described in the Faculty report. The specific mappings for BE (Hons) Mechatronic are included here.

CO → SLO Mapping	Stream Learning Outcomes (SLOs)								
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8	SLO9
COMP1511	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMP1531	0.0	0.0	0.0	69.7	0.0	0.0	11.9	6.4	11.9
DESN1000	0.0	6.1	17.1	8.2	8.2	2.1	2.1	28.1	28.1
ELEC1111	0.0	0.0	50.0	8.5	41.5	0.0	0.0	0.0	0.0
ENGG1300	0.0	92.5	0.0	0.0	0.0	0.0	0.0	7.5	0.0
MATH1131	94.6	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0
MATH1231	94.6	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0
MMAN1130	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PHYS1121	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DESN2000	0.0	3.8	0.0	13.8	13.8	3.8	4.0	28.5	32.5
ELEC2141	0.0	25.0	25.0	25.0	25.0	0.0	0.0	0.0	0.0
ENGG2400	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MATH2019	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MATH2089	0.0	21.2	0.0	0.0	48.1	0.0	0.0	0.0	0.0
MMAN2300	0.0	92.5	0.0	0.0	0.0	0.0	0.0	7.5	0.0
MTRN2500	0.0	0.0	0.0	83.8	16.2	0.0	0.0	0.0	0.0
COMP3141	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
MMAN3000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.0	17.0
MMAN3200	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
MTRN3020	0.0	0.0	30.0	20.0	50.0	0.0	0.0	0.0	0.0
MTRN3500	0.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0	0.0
MANF4611	0.0	0.0	0.0	0.0	16.7	66.7	0.0	0.0	16.7
MMAN4010	0.0	0.0	0.0	0.0	0.0	25.0	12.5	25.0	37.5
MMAN4020	0.0	0.0	0.0	0.0	0.0	37.5	12.5	25.0	25.0
MMAN4200	0.0	25.0	0.0	25.0	0.0	25.0	0.0	25.0	0.0
MTRN4010	0.0	0.0	0.0	0.0	0.0	66.7	33.3	0.0	0.0
MTRN4110	0.0	0.0	0.0	0.0	38.3	38.3	18.3	2.5	2.5
MTRN4230	0.0	0.0	10.5	0.0	26.5	21.0	42.0	0.0	0.0

Figure 17: BE (Hons) Mechatronic - CLO to SLO Mapping

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	-
COMP1531	-	-	50	14	-	-	-	-	36	-	-	-
DESN1000	-	5	-	-	20	-	15	15	-	45	-	-
ELEC1111	-	-	65	20	-	-	-	-	-	-	15	-
ENGG1300	15	-	75	-	10	-	-	-	-	-	-	-
MATH1131	10	-	50	-	40	-	-	-	-	-	-	-
MATH1231	10	-	50	-	40	-	-	-	-	-	-	-
MMAN1130	-	-	-	20	-	-	-	-	-	25	55	-
PHYS1121	-	-	50	20	30	-	-	-	-	-	-	-
DESN2000	25	-	-	-	60	-	-	15	-	-	-	-
ELEC2141	25	-	55	20	-	-	-	-	-	-	-	-
ENGG2400	15	-	50	-	15	-	-	-	-	-	20	-
MATH2019	-	-	60	-	10	-	-	-	-	-	30	-
MATH2089	-	-	60	-	20	-	-	-	-	-	20	-
MMAN2300	-	-	45	-	5	-	-	-	-	30	20	-
MTRN2500	-	-	35	-	-	-	-	-	50	-	15	-
COMP3141	20	-	50	-	-	-	-	-	20	-	10	-
MMAN3000	-	-	-	-	100	-	-	-	-	-	-	-
MMAN3200	-	-	45	20	-	-	-	-	-	-	35	-
MTRN3020	-	-	50	50	-	-	-	-	-	-	-	-
MTRN3500	-	-	60	40	-	-	-	-	-	-	-	-
MANF4611	80	-	20	-	-	-	-	-	-	-	-	-
MMAN4010	-	-	-	-	-	-	-	25	-	75	-	-
MMAN4020	-	-	-	-	-	-	-	20	-	80	-	-
MMAN4200	-	25	40	-	-	-	-	-	25	-	10	-
MTRN4010	50	-	50	-	-	-	-	-	-	-	-	-
MTRN4110	60	-	40	-	-	-	-	-	-	-	-	-
MTRN4230	10	-	-	15	-	-	-	-	75	-	-	-

Figure 18: BE (Hons) Mechatronic -Course Assessment Map

SLO → GC Mapping							Engineers Australia Stage 1 Competencies									
Learning Outcomes (LO)	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
SLO1 demonstrate proficienc...	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SLO2 demonstrate expertise ...	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
SLO3 identify all component...	-	-	-	-	✓	✓	-	-	-	-	✓	-	-	-	-	-
SLO4 design and implement h...	-	-	-	-	✓	-	-	-	✓	-	-	-	-	✓	-	-
SLO5 model combinations of ...	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-	-	-
SLO6 design and implement i...	-	-	-	✓	✓	✓	-	-	✓	✓	-	-	✓	-	-	-
SLO7 design, build and oper...	-	-	-	-	✓	-	✓	✓	✓	-	-	-	✓	-	-	-
SLO8 communicate profession...	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓
SLO9 demonstrate a high lev...	-	-	-	-	-	✓	-	-	-	-	✓	-	-	✓	✓	-

Figure 19: BE (Hons) Mechatronic - SLO to EA Competency Mapping

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
COMP1511	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
COMP1531	-	-	-	-	25.6	3.0	2.4	2.4	25.6	-	3.0	3.2	2.4	26.2	3.0	3.2
DESN1000	-	3.1	3.1	0.3	9.2	13.1	4.5	4.5	3.5	0.3	12.7	14.1	0.8	9.8	7.0	14.1
ELEC1111	-	-	-	-	19.5	16.7	20.8	20.8	2.8	-	16.7	-	-	2.8	-	-
ENGG1300	-	46.2	46.2	-	-	-	-	-	-	-	-	3.8	-	-	-	3.8
MATH1131	47.3	47.3	-	-	-	-	-	-	-	-	-	2.7	-	-	-	2.7
MATH1231	47.3	47.3	-	-	-	-	-	-	-	-	-	2.7	-	-	-	2.7
MMAN1130	7.1	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHYS1121	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DESN2000	-	1.9	1.9	0.6	6.0	8.8	7.7	7.7	6.0	0.6	8.1	14.2	1.4	12.7	8.1	14.2
ELEC2141	-	12.5	12.5	-	16.7	8.3	12.5	12.5	8.3	-	8.3	-	-	8.3	-	-
ENGG2400	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
MATH2019	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MATH2089	-	10.6	10.6	-	-	-	24.0	24.0	-	-	-	-	-	-	-	-
MMAN2300	-	46.2	46.2	-	-	-	-	-	-	-	-	3.8	-	-	-	3.8
MTRN2500	-	-	-	-	27.9	-	8.1	8.1	27.9	-	-	-	-	27.9	-	-
COMP3141	-	-	-	-	-	-	50.0	50.0	-	-	-	-	-	-	-	-
MMAN3000	-	-	-	-	-	4.2	-	-	-	-	4.2	41.5	-	4.2	4.2	41.5
MMAN3200	-	-	-	-	-	-	50.0	50.0	-	-	-	-	-	-	-	-
MTRN3020	-	-	-	-	16.7	10.0	25.0	25.0	6.7	-	10.0	-	-	6.7	-	-
MTRN3500	-	-	-	-	26.7	16.7	10.0	10.0	10.0	-	16.7	-	10.0	-	-	-
MANF4611	-	-	-	11.1	11.1	15.3	8.3	8.3	11.1	11.1	4.2	-	11.1	4.2	4.2	-
MMAN4010	-	-	-	4.2	6.7	13.5	2.5	2.5	6.7	4.2	9.4	12.5	6.7	9.4	9.4	12.5
MMAN4020	-	-	-	6.2	8.8	12.5	2.5	2.5	8.8	6.2	6.2	12.5	8.8	6.2	6.2	12.5
MMAN4200	-	12.5	12.5	4.2	12.5	4.2	-	-	12.5	4.2	-	12.5	4.2	8.3	-	12.5
MTRN4010	-	-	-	11.1	17.8	11.1	6.7	6.7	17.8	11.1	-	-	17.8	-	-	-
MTRN4110	-	-	-	6.4	10.1	7.0	22.8	22.8	10.1	6.4	0.6	1.2	10.1	0.6	0.6	1.2
MTRN4230	-	-	-	3.5	15.4	7.0	21.6	21.6	11.9	3.5	3.5	-	11.9	-	-	-
Cognitive Scale	17.6	13.6	11.3	2.3	6.7	4.4	7.2	7.2	4.9	2.3	3.5	4.5	3.4	4.3	2.4	4.5

Figure 20: BE (Hons) Mechatronic - CLO to EA Competency Curriculum Map

Reflection

Curriculum Map

Course learning outcomes in the Mechatronic Engineering stream (MTRNAH) map well to EA Stage 1 Competencies, through the newly created SLO map.

There is evidently weight applied to the first order knowledge competencies (1.1, 1.2, 1.3). The curriculum map indicates that much of this enhanced weighting comes from our foundational science/computing courses in the first two years of the degree and technical courses in later years.

Although the weighting of category 3 competencies is relatively lower than some other categories, they are disproportionately developed in year 3 and 4 of the plan, most strongly by thesis and design courses. There is a reasonable argument that these capstone experiences have a greater influence on the graduate engineer than foundational studies, so there is perhaps a need to include a weighting factor for coursework based on the year-level of study.

There are no low outlier competencies in the Mechatronics stream, although a few categories are slightly below expectation (1.4, 2.4, 3.4).

Assessment Map

A review of assessment distribution indicates that the stream has an overreliance on examination and quizzes, particularly in technical engineering science subjects. The remainder of the assessment is usually in the form of assignments/reports, most commonly lab work or extended analysis. Design courses, thesis and other professional engineering courses use a far greater spread of other assessment types, including major works and portfolios.

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

- All exam papers are reviewed by another academic, along with worked solutions.
- Online exams use as much randomisation as practically possible for the question type (question banks, numerical input randomisation and in some cases multiple parallel versions of questions with slightly different solution paths)
- Students must upload working along with numerical answers. This is for marking purposes, but also can be a deterrent to some forms of contract cheating.
- Academics are encouraged to include open-ended elements in all their examination questions, with students answering short essay-style questions. This enables the marker to check the alignment between simple answers and comprehension.
- Reports are submitted using TurnItIn, which ensures that students are not plagiarising or colluding, but does not deter some forms of contract cheating.
- Model report/assignment rubrics have been provided to staff rewarding open-ended and creative solutions by students to discourage collusion and contract cheating. These have shown some initial promise, but there is a lot more evaluation and testing required.
- Important works, such as thesis, have two (or three) markers to ensure consistency.
- Some courses have taken on viva-style assessments for all students, but these have proved challenging at scale without centralised support for scheduling.

Summary of Future Actions

- Curriculum Revision
  - Review the development of EA competencies 1.4, 2.4 and 3.4. These capabilities are addressed within the program, but need to be explicitly linked to assessment and learning outcomes.
- Assessment
  - Assessment structures need review and refinement to improve integrity in a post-COVID environment.
  - The School is piloting models which allow for more individualised (non-exam) assessment, including open-ended projects, portfolios and vivas.
- Continuous Improvement
  - Both the School Education Committee and the Industry Advisory Network will review the curriculum mapping findings.
  - Annual revisions to curriculum content, SLOs and mapping will be conducted by these committees.

ME(Mechanical) – MECHBS8621

Introduction

UNSW Master of Engineering (Mechanical Engineering) is a two-year (full-time equivalent) flexible degree delivered by the School of Mechanical and Manufacturing Engineering. The degree is AQF level 9 and provides graduates with *specialised knowledge and skills for research, and/or professional practice and/or further learning.*

Stream Objectives

ME Mechanical is a flexible postgraduate degree lets graduates specialise in many aspects of mechanical engineering through diverse elective choices. The degree is an accredited entry-to-practice under the Washington accord. Graduates gain in-depth knowledge and technical ability built around a core of design and research skills. A key differentiator of the ME program is a greater focus on management and leadership skills. Graduates gain the theory, tools and strategies to design engineering systems and manage a product's full life-cycle. An integrated research project enables students to gain valuable skills in critical analysis, interpretation and communication of results.

Mechanical Engineering continues to evolve as technology improves and the design and construction of machines is optimised or revolutionised. Masters level Mechanical Engineers at UNSW are prepared with skills to manage and lead projects in power generation, transport, lightweight structures, building services, infrastructure, medical devices and more.

The UNSW Mechanical and Manufacturing Engineering, which offers the stream, is Australia's largest Mechanical and Aerospace School and is rated the highest in Australia on the three major university ranking indices. The School has a breadth of research strengths and offers students a high degree of flexibility for elective and thesis specialisation.

Stream Plan

	Year 1			Summer	Year 2		
	Term 1	Term 2	Term 3		Term 1	Term 2	Term 3
T1 Intake Normal Load	Elective	MECH4100	Elective		Elective	Elective	Elective
	Elective	Elective	Elective		Elective	Elective	Elective
	Elective	Elective			MMAN9451	MMAN9452	MMAN9453

Core Course	Disciplinary Elective	Advanced Disciplinary Elective	ETM Elective	Thesis

Figure 21: ME Mechanical basic course plan

Table 9: Core course codes for ME Mechanical

MECH4100	Mechanical Design 2
MMAN9451	Masters Project A
MMAN9452	Masters Project B
MMAN9453	Masters Project C

Table 10: Disciplinary Elective course options for ME Mechanical
(* indicates course was used in curriculum mapping)

***MANF4430**	Reliability and Maintenance Engineering
***MECH4305**	Fundamental and Advanced Vibration Analysis
MECH4320	Engineering Mechanics 3
***MECH4620**	Computational Fluid Dynamics
MECH4880	Refrigeration and Air Conditioning 1
***MECH4900**	Mechanics of Fracture and Fatigue
***MMAN4400**	Engineering Management
***MMAN4410**	Finite Element Methods

Table 11: Advanced Disciplinary Elective course options for ME Mechanical
(* indicates course was used in curriculum mapping)

AERO9500	Space Systems Architectures and Orbits
AERO9610	The Space Segment
AERO9660	Advanced Aerospace Propulsion
ENGG9741	Introduction to Nuclear Engineering
MANF9543	Computer Aided Design / Computer Aided Manufacture
MECH9223	Machine Condition Monitoring
***MECH9325**	Fundamentals of Acoustics & Noise
***MECH9420**	Composite Materials and Mechanics
MECH9650	Introduction to Micro Electromechanical Systems
***MECH9720**	Solar Thermal Energy Design
***MECH9761**	Automobile Engine Technology

Table 12: Engineering and Technical Management course options for ME Mechanical
(* indicates course was used in curriculum mapping)

***GSOE9810**	Process and Product Quality in Engineering
***GSOE9820**	Engineering Project Management
GSOE9830	Economic Decision Analysis in Engineering
GSOE9340	Life Cycle Engineering
MANF6860	Strategic Manufacturing Management
MANF9400	Industrial Management
***MANF9472**	Production Planning and Control

Stream Learning Outcomes

On successful completion of the MECHBS8621 program, graduates will be able to:

1. demonstrate mastery of advanced technical knowledge in mechanical engineering disciplines such as thermodynamics, mechanics of both solids and fluids, design, manufacturing and advanced materials.
2. understand the national and international standards and regulatory environment which practicing Mechanical Engineers operate within.

3. evaluate and create analytical and computational tools, both general and specialised, to solve advanced problems in mechanical engineering.
4. create innovative engineering solutions to complex problems in mechanical engineering based on rigorous analysis and synthesis of current research.
5. develop and implement management strategies for multidisciplinary engineering projects.
6. lead mechanical engineering projects, individually or as part of a team, in a systematic and professional manner.
7. advance the ethical and sustainable practice of mechanical engineering.
8. communicate professionally and effectively across multi-disciplinary engineering teams.

Learning Outcome Development

The Stream Learning Outcomes (SLOs) were drafted by the School Education Committee, specifically the Stream Coordinators for each of our accredited BE and ME streams. The drafts were developed considering: benchmarking conducted for the 2021 accreditation report; feedback from industry partners; and expectations of graduate outcomes aligned with EA Stage 1 competencies.

The draft SLOs were reviewed and aligned by the Deputy Head of School (Education) before being presented to the School Education Committee for endorsement. School Industry Advisory Network (IAN) consultation was sought in writing, with a follow-up workshop.

The ME(Mechanical) and BE(Mechanical) share a common core of knowledge but aim to different levels of mastery and achievement. The similarities and differences in the graduate outcomes are reflected in the respective SLOs. In many cases, the topics are similar, yet the level is reflected through more advanced verbs to describe a greater mastery of the topic and/or professional skill.

Curriculum Mapping

A curriculum map from CLOs to SLOs to EA Stage 1 Competencies was developed using the CMAP2 tool, described in the Faculty report. The specific mappings for ME Mechanical are included here.

CO → SLO Mapping	Stream Learning Outcomes (SLOs)							
Courses (CO)	SLO1	SLO2	SLO3	SLO4	SLO5	SLO6	SLO7	SLO8
MANF4430	14.2	14.2	14.2	14.2	7.5	7.5	0.0	0.0
MECH4100	12.5	12.5	0.0	12.5	0.0	25.0	12.5	25.0
MECH4305	26.0	0.0	42.0	16.0	0.0	0.0	0.0	16.0
MECH4620	25.0	0.0	25.0	25.0	0.0	0.0	0.0	25.0
MECH4900	51.7	0.0	48.3	0.0	0.0	0.0	0.0	0.0
MMAN4400	25.0	0.0	37.5	0.0	25.0	12.5	0.0	0.0
MMAN4410	37.5	0.0	45.8	8.3	0.0	0.0	0.0	8.3
GSOE9810	25.0	8.3	0.0	8.3	20.8	12.5	25.0	0.0
GSOE9820	0.0	0.0	12.1	6.5	33.6	33.6	8.6	5.6
MANF9472	0.0	22.1	0.0	0.0	77.9	0.0	0.0	0.0
MECH9325	12.5	12.5	75.0	0.0	0.0	0.0	0.0	0.0
MECH9420	39.6	0.0	39.6	0.0	0.0	0.0	0.0	20.8
MECH9720	37.5	0.0	12.5	25.0	0.0	0.0	0.0	25.0
MECH9761	48.3	0.0	43.8	0.0	0.0	0.0	0.0	7.9
MMAN9451	10.0	10.0	20.0	50.0	0.0	0.0	0.0	10.0
MMAN9452	10.0	10.0	20.0	50.0	0.0	0.0	0.0	10.0
MMAN9453	17.0	17.0	8.5	25.5	0.0	0.0	0.0	32.0

Figure 22: ME Mechanical - CLO to SLO Mapping

CO → AT Mapping	Assessment Types (AT)										
Courses (CO)	Assi	Essa	Exam	Lab	Othe	Perf	Port	Pres	Proj	Repo	Test	Tut
MANF4430	-	-	40	-	-	-	-	-	60	-	-	-
MECH4100	-	-	-	-	-	30	-	20	-	50	-	-
MECH4305	60	-	40	-	-	-	-	-	-	-	-	-
MECH4620	-	-	50	-	-	-	-	-	-	40	10	-
MECH4900	25	-	45	-	-	-	-	-	-	-	30	-
MMAN4400	20	-	-	-	35	-	-	-	-	-	45	-
MMAN4410	15	-	20	-	-	-	-	-	50	-	15	-
GSOE9810	45	-	50	-	-	-	-	-	-	-	5	-
GSOE9820	50	-	40	-	-	-	-	-	-	-	10	-
MANF9472	35	-	35	-	-	-	-	-	-	30	-	-
MECH9325	20	-	60	-	20	-	-	-	-	-	-	-
MECH9420	-	-	45	-	-	-	-	-	-	55	-	-
MECH9720	-	-	40	-	-	-	-	-	-	50	10	-
MECH9761	10	-	70	-	-	-	-	-	-	20	-	-
MMAN9451	-	-	-	-	-	-	-	-	-	100	-	-
MMAN9452	-	-	-	-	-	-	-	-	-	100	-	-
MMAN9453	-	-	-	-	5	-	-	15	-	80	-	-

Figure 23: ME Mechanical – Course Assessment Map

SLO → GC Mapping	Engineers Australia Stage 1 Competencies															
Learning Outcomes (LO)	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
SLO1 demonstrate mastery of...	✓	✓	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-
SLO2 understand the nationa...	-	-	-	-	✓	✓	-	-	-	-	✓	-	-	-	-	-
SLO3 evaluate and create an...	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-	-
SLO4 create innovative engi...	-	-	✓	✓	-	-	-	-	✓	-	-	-	✓	-	-	-
SLO5 develop and implement ...	-	-	-	-	-	-	-	-	✓	✓	-	-	-	✓	✓	-
SLO6 lead mechanical engine...	-	-	-	-	-	✓	-	-	-	✓	-	-	-	✓	✓	✓
SLO7 advance the ethical an...	-	-	-	-	✓	✓	-	-	-	-	✓	-	-	-	✓	-
SLO8 communicate profession...	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-

Figure 24: ME Mechanical - SLO to EA Competency Mapping

Curriculum Mapping	Engineers Australia Stage 1 Competencies															
Courses (CO)	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6
MANF4430	3.5	3.5	7.1	3.5	4.7	6.2	8.3	4.7	10.1	3.4	4.7	-	3.5	3.4	3.4	1.5
MECH4100	3.1	3.1	6.2	3.1	7.3	12.3	3.1	-	3.1	5.0	7.3	12.5	3.1	17.5	8.1	5.0
MECH4305	6.5	6.5	10.5	4.0	-	-	20.5	14.0	18.0	-	-	8.0	4.0	8.0	-	-
MECH4620	6.2	6.2	12.5	6.2	-	-	14.6	8.3	14.6	-	-	12.5	6.2	12.5	-	-
MECH4900	12.9	12.9	12.9	-	-	-	29.0	16.1	16.1	-	-	-	-	-	-	-
MMAN4400	6.2	6.2	6.2	-	-	2.5	18.8	12.5	18.8	8.8	-	-	-	8.8	8.8	2.5
MMAN4410	9.4	9.4	11.5	2.1	-	-	24.7	15.3	17.4	-	-	4.2	2.1	4.2	-	-
GSOE9810	6.2	6.2	8.3	2.1	9.0	11.5	6.2	-	7.3	7.7	9.0	-	2.1	7.7	14.0	2.5
GSOE9820	-	-	1.6	1.6	2.2	8.9	4.0	4.0	14.0	15.1	2.2	2.8	1.6	17.9	17.3	6.7
MANF9472	-	-	-	-	7.4	7.4	-	-	19.5	19.5	7.4	-	-	19.5	19.5	-
MECH9325	3.1	3.1	3.1	-	4.2	4.2	28.1	25.0	25.0	-	4.2	-	-	-	-	-
MECH9420	9.9	9.9	9.9	-	-	-	23.1	13.2	13.2	-	-	10.4	-	10.4	-	-
MECH9720	9.4	9.4	15.6	6.2	-	-	13.5	4.2	10.4	-	-	12.5	6.2	12.5	-	-
MECH9761	12.1	12.1	12.1	-	-	-	26.7	14.6	14.6	-	-	4.0	-	4.0	-	-
MMAN9451	2.5	2.5	15.0	12.5	3.3	3.3	9.2	6.7	19.2	-	3.3	5.0	12.5	5.0	-	-
MMAN9452	2.5	2.5	15.0	12.5	3.3	3.3	9.2	6.7	19.2	-	3.3	5.0	12.5	5.0	-	-
MMAN9453	4.2	4.2	10.6	6.4	5.7	5.7	7.1	2.8	9.2	-	5.7	16.0	6.4	16.0	-	-
Cognitive Scale	4.8	4.8	7.3	4.1	3.8	4.8	11.4	7.8	10.8	7.3	3.8	6.2	4.1	7.5	8.7	2.7

Figure 25: ME Mechanical - CLO to EA Competency Curriculum Map

Reflection

Curriculum Map

The course learning outcomes in the Masters of Mechanical Engineering (MECHBS) are somewhat uniformly developed across the different EA Stage 1 Competencies. More so than the undergraduate streams, there is substantial weight allocated to application focussed capabilities (Cat 2), with less emphasis on knowledge development (Cat 1).

There is a weakness in the development of teamwork skills (Competency 3.6) relative to the other competencies. This graduate capability has generally not been a strong focus of Masters coursework, with more emphasis on management and leadership. The School is addressing this issue through the development of strong cornerstone coursework in the first year of the program. We have well-developed plans to deliver a cornerstone design experience (analogous to the DESN1000 course for UG students) with an emphasis on teamwork and cohort building.

Assessment Map

A review of assessment distribution indicates that the stream has a very strong reliance on three modes of assessment (examination, assignments and reports). This may have a tendency to skew student learning and make contract cheating more appealing. A greater breadth of assessment types should be deployed to our postgraduate elective courses. This will have a combined benefit to ensure that all dimensions of student learning are assessed and academic misconduct will be harder to disguise.

With the current assessment paradigm, the School has implemented many processes to ensure that academic integrity is maintained:

- All exam papers are reviewed by another academic, along with worked solutions.
- Online exams use as much randomisation as practically possible for the question type (question banks, numerical input randomisation and in some cases multiple parallel versions of questions with slightly different solution paths)
- Students must upload working along with numerical answers. This is for marking purposes, but also can be a deterrent to some forms of contract cheating.
- Academics are encouraged to include open-ended elements in all their examination questions, with students answering short essay-style questions. This enables the marker to check the alignment between simple answers and comprehension.
- Reports are submitted using TurnItIn, which ensures that students are not plagiarising or colluding, but does not deter some forms of contract cheating.
- Model report/assignment rubrics have been provided to staff rewarding open-ended and creative solutions by students to discourage collusion and contract cheating. These have shown some initial promise, but there is a lot more evaluation and testing required.
- Important works, such as thesis, have two (or three) markers to ensure consistency.
- Some courses have taken on viva-style assessments for all students, but these have proved challenging at scale without centralised support for scheduling. The quality of vivas is also a concern, as most engineering academics have limited experience with this form of assessment.

Summary of Future Actions

- Curriculum Revision
    - Review the development of EA competency 3.6 related to Teamwork.
    - Course under development already which will focus on team-based design.
- Assessment

  - The breadth of assessment types in MECHBS needs to be expanded.
  - The School is piloting models which allow for more individualised (non-exam) assessment, including open-ended projects, portfolios and vivas.
- Continuous Improvement
  - Both the School Education Committee and the Industry Advisory Network will review the curriculum mapping findings.
  - Annual revisions to curriculum content, SLOs and mapping will be conducted by these committees.