

Mechanical and manufacturing engineering

Department of Mechanical and Manufacturing Engineering

The department was first established after the Second World War, although the course in mechanical engineering began in 1907 as a faculty stream. An industrial engineering degree was added in the late 1950s. In 1988 an extensive review of the curriculum led to the undergraduate courses being restructured into a new, single degree course in mechanical and manufacturing engineering with students having the option to choose between streams from their third year onwards. In 1994 an additional stream in environmental engineering was added. A 1995 review of the department by a team from the US and UK ranked its research and teaching at the highest international standards. In 1996, the five-year combined degree in mechatronics commenced. Mechanical and manufacturing engineering applies human and material resources to the design, construction, operation and maintenance of machines (supported increasingly by sophisticated computer technology) to move people, goods and materials; generate energy; produce goods and services; and control pollution and dispose of wastes. It interacts with all other branches of engineering.

First-year students acquire a flexible, broad scientific training in mathematics, computing and physics and an introduction to engineering.

Second-year students continue with mathematics and are introduced to engineering design plus basic mechanical engineering sciences (thermodynamics, fluid mechanics, mechanics of solids and machine dynamics), manufacturing science, materials, electro-mechanical systems modeling and computational methods.

Third- and fourth-year students continue engineering science, design and manufacturing studies, but increasingly choose to specialise in aspects of applied mechanics or manufacturing.

Fourth year includes a major research project and electives in engineering and management. Students planning to enter industry directly after graduating can choose how best to prepare for their careers, bearing in mind that many design and research engineers move into management.

In laboratory and research work students have access to specialised facilities for materials testing and robotics and a heavy engineering workshop for the manufacture of testing facilities.

Engineering design, which draws on the faculty's extensive computer facilities and computational mechanics, is now established as an area of study and research with computer science.

Graduate research programs are available in aspects of mechanical, mechatronics and manufacturing engineering. The department is internationally regarded in fluid mechanics, automotive engineering, solar energy, machine dynamics and mechanics of material removal.

Department of Mechanical and Manufacturing Engineering: undergraduate course structures

There are three streams to the course: mechanical, manufacturing and environmental engineering. In addition to meeting the faculty requirement of 400 points for the BE, students must pass specified core subjects and a prescribed number of electives. Prerequisites are designed to meet these requirements. The manufacturing and mechanical streams are common to the end of Semester 1, level three. The environmental stream has subjects in common with the mechanical stream, except for special design subjects at levels two and three and more electives (focused on environmental topics) at level four. In addition there are mechatronics design subjects taken only by those studying the BE(Mechatronics)/BCS.

Study abroad students may take units of most 12.5 point subjects as 6.25 point subjects.

Bachelor of Engineering (BE)

The recommended or standard course structures are listed below. When setting the timetable every effort will be made to avoid clashes between the times of classes associated with these sets of subjects. Students should be aware however, that if it proves to be impossible to achieve a timetable without clashes in these sets of subjects, the faculty reserves the right to modify course structures in order to eliminate the conflicts. Students will be advised during the enrolment period of the semester if the recommended courses need to be varied. Where the courses include elective subjects these should be chosen so that timetable clashes are avoided. In particular, students in combined degrees should plan their courses so that the subjects chosen in the other faculty do not clash with those recommended for the engineering component.

First year		Points
Semester 1		
433-151	Introduction to Programming (Advanced) (p.15)	12.5
	or	
433-171	Introduction to Programming (p.15)	12.5
436-102	Introduction to Design and Manufacture (p.7)	12.5
620-121	Mathematics A (Advanced) (p.4)	12.5
	or	
620-141	Mathematics A (p.5)	12.5
640-141	Physics A (p.2) ¹	12.5
Semester 2		
431-101	Fundamentals of Electrical Engineering (p.9)	12.5
436-101	Engineering Mechanics and Materials (p.7)	12.5
436-105	Engineering Communications (p.7)	12.5
620-123	Applied Mathematics (Advanced) (p.4)	12.5
	or	
620-143	Applied Mathematics (p.5)	12.5
	1. Or elective	
Second year		Points
Semester 1		
431-201	Engineering Analysis A (p.9)	12.5
436-202	Mechanics 1 (p.8)	12.5
436-203	Manufacturing Studies 1 (p.8)	12.5
436-220	Engineering Design and Materials 1 (p.8)	12.5
	or	
436-222	Design and Materials 1 - Environmental (p.9)	12.5
Semester 2		
431-202	Engineering Analysis B (p.9)	12.5
436-201	Thermofluids 1 (p.7)	12.5
436-204	Systems Modelling (p.8)	12.5
436-221	Engineering Design and Materials 2 (p.9)	12.5
	or	
436-223	Design and Materials 2 - Environmental (p.9)	12.5
Third year		Points
Semester 1		
436-351	Thermofluids 2 (p.10)	12.5
436-353	Mechanics 2 (p.10)	12.5
436-355	Design/Control 1 (p.11)	12.5
	or	
436-357	Design/Control 1 - Environmental (p.11)	12.5
436-363	Manufacturing Studies 2 (p.12)	12.5
Semester 2 (mechanical)		
436-352	Thermofluids 3 (p.10)	12.5
436-354	Mechanics 3 (p.10)	12.5
436-356	Design/Control 2 (p.11)	12.5
620-370	Statistics for Mechanical Engineers (p.13)	12.5
Semester 2 (manufacturing)		
436-361	Manufacturing Control and Systems (p.12)	12.5
436-364	Manufacturing Science 1 (p.13)	12.5
436-365	Operations Analysis (p.13)	12.5
620-370	Statistics for Mechanical Engineers (p.13)	12.5
Semester 2 (environmental)		
436-352	Thermofluids 3 (p.10)	12.5
436-354	Mechanics 3 (p.10)	12.5
436-358	Design/Control 2 - Environmental (p.11)	12.5
620-370	Statistics for Mechanical Engineers (p.13)	12.5
Fourth year (mechanical)		Points
Year long		
436-420	Engineering Design (p.15)	12.5
436-422	Research Project (p.16)	12.5
Semester 1		
436-431	Mechanics 4 (p.16)	12.5
436-432	Thermofluids 4 (p.16)	12.5
436-433	Mechanical Systems (p.16)	12.5
Semester 2		
Applied mechanics advanced options (choose between two and four)		
436-405	Advanced Control Systems (p.14)	6.25
436-406	Rotor Dynamics (p.14)	6.25
436-407	Advanced Fluid Mechanics (p.14)	6.25
436-408	Advanced Mechanics of Solids (p.14)	6.25
436-409	Power Generation Systems (p.14)	6.25

Fourth year (mechanical)

	Points
Electives (choose sufficient to make a total of 37.5 points for options and electives)	
325-209 Human Resource Management (<i>p.2</i>)	12.5
436-435 Bioengineering (<i>p.17</i>)	12.5
436-436 Robotics and Computational Mechanics (<i>p.17</i>)	12.5
436-437 Advanced Materials and Testing (<i>p.17</i>)	12.5
436-438 Advances In Industrial Automation (<i>p.17</i>)	12.5
436-467 Resources Applications & Environment (<i>p.18</i>)	12.5
436-469 Refrigeration, A/C & Alternative Fuels (<i>p.18</i>)	12.5

Fourth year (manufacturing)

	Points
Year long	
436-420 Engineering Design (<i>p.15</i>)	12.5
436-422 Research Project (<i>p.16</i>)	12.5

Semester 1

436-412 Manufacturing Science 2 (<i>p.14</i>)	12.5
436-414 Optimisation for Productive Systems (<i>p.15</i>)	12.5
436-415 Quality and Reliability (<i>p.15</i>)	12.5

Semester 2

436-413 Manufacturing Science 3 (<i>p.15</i>)	12.5
436-416 Manufacturing Systems (<i>p.15</i>)	12.5

Electives (choose one)

325-209 Human Resource Management (<i>p.2</i>)	12.5
436-435 Bioengineering (<i>p.17</i>)	12.5
436-436 Robotics and Computational Mechanics (<i>p.17</i>)	12.5
436-437 Advanced Materials and Testing (<i>p.17</i>)	12.5
436-438 Advances In Industrial Automation (<i>p.17</i>)	12.5
436-467 Resources Applications & Environment (<i>p.18</i>)	12.5
436-469 Refrigeration, A/C & Alternative Fuels (<i>p.18</i>)	12.5

Fourth year (environmental)

	Points
Semester 1	
436-431 Mechanics 4 (<i>p.16</i>)	12.5
436-432 Thermofluids 4 (<i>p.16</i>)	12.5
436-433 Mechanical Systems (<i>p.16</i>)	12.5

Environmental option (choose one)

421-629 Energy Efficiency Technology (<i>p.12</i>)	12.5
436-466 Renewable Energy (<i>p.18</i>)	12.5

Semester 2

436-423 Research and Design (<i>p.16</i>)	12.5
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Applied mechanics advanced options (choose two)

436-405 Advanced Control Systems (<i>p.14</i>)	6.25
436-406 Rotor Dynamics (<i>p.14</i>)	6.25
436-407 Advanced Fluid Mechanics (<i>p.14</i>)	6.25
436-408 Advanced Mechanics of Solids (<i>p.14</i>)	6.25
436-409 Power Generation Systems (<i>p.14</i>)	6.25

Environmental options (choose two)

421-629 Energy Efficiency Technology (<i>p.12</i>)	12.5
436-435 Bioengineering (<i>p.17</i>)	12.5
436-467 Resources Applications & Environment (<i>p.18</i>)	12.5
436-469 Refrigeration, A/C & Alternative Fuels (<i>p.18</i>)	12.5

Bachelor of Arts/Bachelor of Engineering (BA/BE)

The recommended or standard course structures are listed below. When setting the timetable every effort will be made to avoid clashes between the times of classes associated with these sets of subjects. Students should be aware however, that if it proves to be impossible to achieve a timetable without clashes in these sets of subjects, the faculty reserves the right to modify course structures in order to eliminate the conflicts. Students will be advised during the enrolment period of the semester if the recommended courses need to be varied. Where the courses include elective subjects these should be chosen so that timetable clashes are avoided. In particular, students in combined degrees should plan their courses so that the subjects chosen in the other faculty do not clash with those recommended for the engineering component.

First year

	Points
Semester 1	
436-105 Engineering Communications (<i>p.7</i>)	12.5
620-121 Mathematics A (Advanced) (<i>p.4</i>)	12.5
or	
620-141 Mathematics A (<i>p.5</i>)	12.5
Arts subjects as required	25

Semester 2

431-101 Fundamentals of Electrical Engineering (<i>p.9</i>)	12.5
436-101 Engineering Mechanics and Materials (<i>p.7</i>)	12.5
620-123 Applied Mathematics (Advanced) (<i>p.4</i>)	12.5

First year

	Points
or	
620-143 Applied Mathematics (<i>p.5</i>)	12.5
Arts subject as required	12.5

Second year

	Points
Semester 1	
436-202 Mechanics 1 (<i>p.8</i>)	12.5
436-203 Manufacturing Studies 1 (<i>p.8</i>)	12.5
436-220 Engineering Design and Materials 1 (<i>p.8</i>)	12.5
Arts subject as required	12.5
433-151 Introduction to Programming (Advanced) (<i>p.15</i>) ¹	12.5

or

433-171 Introduction to Programming (<i>p.15</i>)	12.5
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Semester 2

436-201 Thermofluids 1 (<i>p.7</i>)	12.5
436-221 Engineering Design and Materials 2 (<i>p.9</i>)	12.5
Arts subjects as required	25

1. Recommended enrichment material, approved subject to prior academic performance.

Third year

	Points
Semester 1	

431-201 Engineering Analysis A (<i>p.9</i>)	12.5
436-353 Mechanics 2 (<i>p.10</i>)	12.5
Arts subjects as required	25

Semester 2

431-202 Engineering Analysis B (<i>p.9</i>)	12.5
436-204 Systems Modelling (<i>p.8</i>)	12.5
620-370 Statistics for Mechanical Engineers (<i>p.13</i>)	12.5
Arts subject as required	12.5

Fourth year (mechanical)

	Points
Semester 1	

436-351 Thermofluids 2 (<i>p.10</i>)	12.5
436-355 Design/Control 1 (<i>p.11</i>)	12.5
Arts subjects as required	25
436-363 Manufacturing Studies 2 (<i>p.12</i>) ¹	12.5

Semester 2

436-352 Thermofluids 3 (<i>p.10</i>)	12.5
436-354 Mechanics 3 (<i>p.10</i>)	12.5
436-356 Design/Control 2 (<i>p.11</i>)	12.5
Arts subject as required	12.5

1. Recommended enrichment material, approved subject to prior academic performance.

Fourth year (manufacturing)

	Points
Semester 1	

436-355 Design/Control 1 (<i>p.11</i>)	12.5
436-363 Manufacturing Studies 2 (<i>p.12</i>)	12.5
Arts subjects as required	25
436-351 Thermofluids 2 (<i>p.10</i>) ¹	12.5

Semester 2

436-361 Manufacturing Control and Systems (<i>p.12</i>)	12.5
436-364 Manufacturing Science 1 (<i>p.13</i>)	12.5
436-365 Operations Analysis (<i>p.13</i>)	12.5
Arts subject as required	12.5

1. Recommended enrichment material, approved subject to prior academic performance.

Students entering the fifth year of this course are encouraged to see a departmental course advisor due to the transition from the 7.14 to 12.5 point system.

Fifth year (mechanical)

	Points
Semester 1	

436-431 Mechanics 4 (<i>p.16</i>)	12.5
436-432 Thermofluids 4 (<i>p.16</i>)	12.5
436-433 Mechanical Systems (<i>p.16</i>)	12.5
Arts subject as required	12.5

Semester 2

436-423 Research and Design (<i>p.16</i>)	12.5
Arts subjects as required	37.5

Fifth year (manufacturing)

	Points
Semester 1	

436-412 Manufacturing Science 2 (<i>p.14</i>)	12.5
436-414 Optimisation for Productive Systems (<i>p.15</i>)	12.5
436-415 Quality and Reliability (<i>p.15</i>)	12.5
Arts subject as required	12.5

Fifth year (manufacturing)	Points
Semester 2	
436-423 Research and Design (<i>p.16</i>)	12.5
Arts subjects as required	37.5
436-416 Manufacturing Systems (<i>p.15</i>) ¹	12.5

1. Recommended enrichment material, approved subject to prior academic performance

Bachelor of Engineering/Bachelor of Commerce (BE/BCom)

The recommended or standard course structures are listed below. When setting the timetable every effort will be made to avoid clashes between the times of classes associated with these sets of subjects. Students should be aware however, that if it proves to be impossible to achieve a timetable without clashes in these sets of subjects, the faculty reserves the right to modify course structures in order to eliminate the conflicts. Students will be advised during the enrolment period of the semester if the recommended courses need to be varied. Where the courses include elective subjects these should be chosen so that timetable clashes are avoided. In particular, students in combined degrees should plan their courses so that the subjects chosen in the other faculty do not clash with those recommended for the engineering component.

First year	Points
Semester 1	
316-102 Introductory Microeconomics (<i>p.1</i>)	12.5
436-101 Engineering Mechanics and Materials (<i>p.7</i>)	12.5
436-105 Engineering Communications (<i>p.7</i>)	12.5
620-121 Mathematics A (Advanced) (<i>p.4</i>)	12.5
or	
620-141 Mathematics A (<i>p.5</i>)	12.5
Semester 2	
316-101 Introductory Macroeconomics (<i>p.1</i>)	12.5
316-130 Quantitative Methods 1 (<i>p.1</i>)	12.5
431-101 Fundamentals of Electrical Engineering (<i>p.9</i>)	12.5
620-123 Applied Mathematics (Advanced) (<i>p.4</i>)	12.5
or	
620-143 Applied Mathematics (<i>p.5</i>)	12.5
Second year	Points
Semester 1	
316-205 Introductory Econometrics (<i>p.1</i>)	12.5
431-201 Engineering Analysis A (<i>p.9</i>)	12.5
436-220 Engineering Design and Materials 1 (<i>p.8</i>)	12.5
Commerce subject as required	12.5
433-151 Introduction to Programming (Advanced) (<i>p.15</i>) ¹	12.5
or	
433-171 Introduction to Programming (<i>p.15</i>)	12.5
Semester 2	
431-202 Engineering Analysis B (<i>p.9</i>)	12.5
436-221 Engineering Design and Materials 2 (<i>p.9</i>)	12.5
Commerce subjects as required	25

1. Recommended enrichment material, approved subject to prior academic performance.

Third year	Points
Semester 1	
325-201 Organisational Behaviour (<i>p.1</i>) ¹ or other commerce subject	12.5
436-202 Mechanics 1 (<i>p.8</i>)	12.5
436-362 Design/Processes (<i>p.12</i>)	12.5
Commerce subjects as required	12.5
Semester 2	
436-201 Thermofluids 1 (<i>p.7</i>)	12.5
436-204 Systems Modelling (<i>p.8</i>)	12.5
Commerce subjects as required	25

1. The Department of Mechanical and Manufacturing Engineering strongly recommends BE/BCom students take this subject as part of the BCom.

Fourth year	Points
Semester 1	
436-351 Thermofluids 2 (<i>p.10</i>)	12.5
436-353 Mechanics 2 (<i>p.10</i>)	12.5
436-359 Control/Forming (<i>p.12</i>)	12.5
Commerce subject as required	12.5
Semester 2 (Mechanical)	
436-352 Thermofluids 3 (<i>p.10</i>)	12.5
436-354 Mechanics 3 (<i>p.10</i>)	12.5

Fourth year	Points
436-356 Design/Control 2 (<i>p.11</i>)	12.5
Commerce subject as required	12.5
Semester 2 (manufacturing)	
436-361 Manufacturing Control and Systems (<i>p.12</i>)	12.5
436-364 Manufacturing Science 1 (<i>p.13</i>)	12.5
436-365 Operations Analysis (<i>p.13</i>)	12.5
Commerce subject as required	12.5

Students entering the fifth year of this course are encouraged to see a departmental course advisor due to transition from the 7.14 to 12.5 point system.

Fifth year (mechanical)	Points
Semester 1	
436-431 Mechanics 4 (<i>p.16</i>)	12.5
436-432 Thermofluids 4 (<i>p.16</i>)	12.5
436-433 Mechanical Systems (<i>p.16</i>)	12.5
Commerce subject as required	12.5
Semester 2	
436-423 Research and Design (<i>p.16</i>)	12.5
Applied mechanics advanced options (choose two)	
436-405 Advanced Control Systems (<i>p.14</i>)	6.25
436-406 Rotor Dynamics (<i>p.14</i>)	6.25
436-407 Advanced Fluid Mechanics (<i>p.14</i>)	6.25
436-408 Advanced Mechanics of Solids (<i>p.14</i>)	6.25
436-409 Power Generation Systems (<i>p.14</i>)	6.25
Commerce subjects as required	25
Fifth year (manufacturing)	Points
Semester 1	
436-412 Manufacturing Science 2 (<i>p.14</i>)	12.5
436-414 Optimisation for Productive Systems (<i>p.15</i>)	12.5
436-415 Quality and Reliability (<i>p.15</i>)	12.5
Commerce subject as required	12.5
Semester 2	
436-423 Research and Design (<i>p.16</i>)	12.5
Manufacturing option (choose one)	
436-413 Manufacturing Science 3 (<i>p.15</i>)	12.5
436-416 Manufacturing Systems (<i>p.15</i>)	12.5
Commerce subjects as required	25

Bachelor of Laws/Bachelor of Engineering (Mechanical) (LLB/BE)

The recommended or standard course structures are listed below. When setting the timetable every effort will be made to avoid clashes between the times of classes associated with these sets of subjects. Students should be aware however, that if it proves to be impossible to achieve a timetable without clashes in these sets of subjects, the faculty reserves the right to modify course structures in order to eliminate the conflicts. Students will be advised during the enrolment period of the semester if the recommended courses need to be varied. Where the courses include elective subjects these should be chosen so that timetable clashes are avoided. In particular, students in combined degrees should plan their courses so that the subjects chosen in the other faculty do not clash with those recommended for the engineering component.

First year	Points
Year long	
730-104 Torts and the Process Of Law (<i>p.1</i>)	25
Semester 1	
436-101 Engineering Mechanics and Materials (<i>p.7</i>)	12.5
620-121 Mathematics A (Advanced) (<i>p.4</i>)	12.5
or	
620-141 Mathematics A (<i>p.5</i>)	12.5
730-105 History and Philosophy of Law I (<i>p.1</i>)	12.5
Semester 2	
436-105 Engineering Communications (<i>p.7</i>)	12.5
620-123 Applied Mathematics (Advanced) (<i>p.4</i>)	12.5
or	
620-143 Applied Mathematics (<i>p.5</i>)	12.5
730-115 History and Philosophy of Law II (<i>p.1</i>)	12.5
Second year	Points
Year long	
730-260 Criminal Law and Procedure (<i>p.1</i>)	25
730-202 Contracts (<i>p.1</i>)	25
Semester 1	
436-202 Mechanics 1 (<i>p.8</i>)	12.5
436-203 Manufacturing Studies 1 (<i>p.8</i>)	12.5
433-151 Introduction to Programming (Advanced) (<i>p.15</i>) ¹	12.5

Second year	Points
or	
433-171 Introduction to Programming (p.15)	12.5
Semester 2	
431-101 Fundamentals of Electrical Engineering (p.9)	12.5
436-201 Thermofluids 1 (p.7)	12.5
1. Recommended enrichment material, approved subject to prior academic performance.	

Third year	Points
Year long	
730-301 Constitutional and Administrative Law (p.2)	25
Semester 1	
431-201 Engineering Analysis A (p.9)	12.5
436-220 Engineering Design and Materials 1 (p.8)	12.5
436-353 Mechanics 2 (p.10)	12.5
Semester 2	
431-202 Engineering Analysis B (p.9)	12.5
436-204 Systems Modelling (p.8)	12.5
436-221 Engineering Design and Materials 2 (p.9)	12.5

Fourth year (mechanical)	Points
Year long	
730-304 Property (p.2)	25
Semester 1	
436-351 Thermofluids 2 (p.10)	12.5
436-355 Design/Control 1 (p.11)	12.5
Law subject as required	12.5
436-363 Manufacturing Studies 2 (p.12) ¹	12.5
Semester 2	
436-354 Mechanics 3 (p.10)	12.5
620-370 Statistics for Mechanical Engineers (p.13)	12.5
Law subject as required	12.5
1. Recommended enrichment material, approved subject to prior academic performance.	

Fourth year (manufacturing)	Points
Year long	
730-304 Property (p.2)	25
Semester 1	
436-355 Design/Control 1 (p.11)	12.5
436-363 Manufacturing Studies 2 (p.12)	12.5
Law subject as required	12.5
436-351 Thermofluids 2 (p.10) ¹	12.5
Semester 2	
436-361 Manufacturing Control and Systems (p.12)	12.5
620-370 Statistics for Mechanical Engineers (p.13)	12.5
Law subject as required	12.5
1. Recommended enrichment material, approved subject to prior academic performance.	

Students entering the fifth year of this course are strongly advised to see a departmental course adviser due to the transition from the 7.14 to 12.5 point system.

Fifth year (mechanical)	Points
Semester 1	
436-431 Mechanics 4 (p.16)	12.5
730-462 Equity and Trusts (p.2)	12.5
Law subjects as required	25
436-363 Manufacturing Studies 2 (p.12) ¹	12.5
Semester 2	
436-352 Thermofluids 3 (p.10)	12.5
436-356 Design/Control 2 (p.11)	12.5
Law subjects as required	25
1. Recommended enrichment material, approved subject to prior academic performance.	

Fifth year (manufacturing)	Points
Semester 1	
436-415 Quality and Reliability (p.15)	12.5
730-462 Equity and Trusts (p.2)	12.5
Law subjects as required	25
436-351 Thermofluids 2 (p.10) ¹	12.5
Semester 2	
436-364 Manufacturing Science 1 (p.13)	12.5
436-365 Operations Analysis (p.13)	12.5
Law subjects as required	25

1. Recommended enrichment material, approved subject to prior academic performance.
Students entering the sixth year of this course are strongly advised to see a departmental course advisor due to the transition from the 7.14 to 12.5 point system.

Sixth year (mechanical)	Points
Semester 1	
436-432 Thermofluids 4 (p.16)	12.5
436-433 Mechanical Systems (p.16)	12.5
Law subjects as required	25
Semester 2	
436-423 Research and Design (p.16)	12.5
Law subjects as required	37.5
Sixth year (manufacturing)	Points
Semester 1	
436-412 Manufacturing Science 2 (p.14)	12.5
436-414 Optimisation for Productive Systems (p.15)	12.5
Law subjects as required	25
Semester 2	
436-423 Research and Design (p.16)	12.5
Law subjects as required	37.5
436-416 Manufacturing Systems (p.15) ¹	12.5

1. Recommended enrichment material, approved subject to prior academic performance.

Bachelor of Engineering/Bachelor of Science (BE/BSc)

The courses shown below are based on a structure being adopted by all faculties, in which most subjects carry 12.5 points. (A small number of subjects carry 6.25 or 25 points).

The mathematics, statistics and physics listed in the following structure will gain credit towards the BSc. Students wanting to pursue engineering mathematics will receive no such credit.

The recommended or standard course structures are listed below. When setting the timetable every effort will be made to avoid clashes between the times of classes associated with these sets of subjects. Students should be aware however, that if it proves to be impossible to achieve a timetable without clashes in these sets of subjects, the faculty reserves the right to modify course structures in order to eliminate the conflicts. Students will be advised during the enrolment period of the semester if the recommended courses need to be varied. Where the courses include elective subjects these should be chosen so that timetable clashes are avoided. In particular, students in combined degrees should plan their courses so that the subjects chosen in the other faculty do not clash with those recommended for the engineering component.

First year	Points
Semester 1	
433-151 Introduction to Programming (Advanced) (p.15)	12.5
or	
433-171 Introduction to Programming (p.15) ¹	12.5
436-101 Engineering Mechanics and Materials (p.7)	12.5
620-121 Mathematics A (Advanced) (p.4)	12.5
or	
620-141 Mathematics A (p.5)	12.5
Science subject as required	12.5
Semester 2	
431-101 Fundamentals of Electrical Engineering (p.9) ²	12.5
436-105 Engineering Communications (p.7)	12.5
620-122 Mathematics B (Advanced) (p.4)	12.5
or	
620-142 Mathematics B (p.5)	12.5
620-123 Applied Mathematics (Advanced) (p.4)	12.5
or	
620-143 Applied Mathematics (p.5)	12.5

1. Students planning to undertake computer science as the science major in the combined degree will be required to complete 433-172 Algorithmic Problem Solving or 433-152 Algorithmic Problem Solving (Advanced) for science points prior to commencing second-year computer science subjects.
2. 431-101 Fundamentals of Electrical Engineering may be substituted by 640-142 Physics B (provided 640-141 Physics A has been completed) followed by 640-251 Instrumentation for Scientists. Students intending to take the sequence 433-171 and 431-101 should seek course advice to ensure science points requirements are met.

Second year	Points
Semester 1	
436-203 Manufacturing Studies 1 (p.8)	12.5
436-220 Engineering Design and Materials 1 (p.8)	12.5

Second year	Points	Fifth year (mechanical)	Points
620-231 Vector Analysis (p.7)	12.5	436-406 Rotor Dynamics (p.14)	6.25
Science subject as required	12.5	436-407 Advanced Fluid Mechanics (p.14)	6.25
Semester 2		436-408 Advanced Mechanics of Solids (p.14)	6.25
436-221 Engineering Design and Materials 2 (p.9)	12.5	436-409 Power Generation Systems (p.14)	6.25
620-232 Mathematical Methods (p.7)	12.5	Science subjects as required	25
620-160 Experimental Design & Data Analysis (p.6)	12.5	Fifth year (manufacturing)	Points
Science subject as required	12.5	Year long	
Third year	Points	436-420 Engineering Design (p.15)	12.5
Semester 1		436-422 Research Project (p.16)	12.5
436-202 Mechanics 1 (p.8)	12.5	Semester 1	
436-363 Manufacturing Studies 2 (p.12)	12.5	436-412 Manufacturing Science 2 (p.14)	12.5
620-331 Applied Partial Differential Equations (p.10)	12.5	436-414 Optimisation for Productive Systems (p.15)	12.5
Science subject as required	12.5	436-415 Quality and Reliability (p.15)	12.5
Semester 2		Semester 2	
436-201 Thermofluids 1 (p.7)	12.5	Manufacturing option (choose one)	
436-204 Systems Modelling (p.8)	12.5	436-413 Manufacturing Science 3 (p.15)	12.5
Science subjects as required	25	436-416 Manufacturing Systems (p.15)	12.5
Fourth year (2003 only)	Points	Science subjects as required	25
Semester 1		Fifth year (environmental)	Points
436-351 Thermofluids 2 (p.10)	12.5	Semester 1	
436-353 Mechanics 2 (p.10)	12.5	436-431 Mechanics 4 (p.16)	12.5
436-363 Manufacturing Studies 2 (p.12)	12.5	436-432 Thermofluids 4 (p.16)	12.5
Science subject/s as required	12.5	436-433 Mechanical Systems (p.16)	12.5
Semester 2		Environmental option (choose one)	
Mechanical and environmental streams		421-629 Energy Efficiency Technology (p.12)	12.5
436-352 Thermofluids 3 (p.10)	12.5	436-466 Renewable Energy (p.18)	12.5
436-354 Mechanics 3 (p.10)	12.5	Semester 2	
436-356 Design/Control 2 (p.11)	12.5	436-423 Research and Design (p.16)	12.5
or		Environmental option (choose one)	
436-358 Design/Control 2 - Environmental (p.11)	12.5	421-629 Energy Efficiency Technology (p.12)	12.5
Science subject/s as required	12.5	436-435 Bioengineering (p.17)	12.5
Manufacturing stream		436-467 Resources Applications & Environment (p.18)	12.5
436-361 Manufacturing Control and Systems (p.12)	12.5	436-469 Refrigeration, A/C & Alternative Fuels (p.18)	12.5
436-364 Manufacturing Science 1 (p.13)	12.5	Science subjects as required	25
436-365 Operations Analysis (p.13)	12.5		
Science subject/s as required	12.5	Bachelor of Engineering (Mechatronics)/Bachelor of Computer Science (BE/BCS)	
Students entering the fifth year of this course are encouraged to see a departmental course advisor due to transition from the 7.14 to 12.5 point system.		The recommended or standard course structures are listed below. When setting the timetable every effort will be made to avoid clashes between the times of classes associated with these sets of subjects. Students should be aware however, that if it proves to be impossible to achieve a timetable without clashes in these sets of subjects, the faculty reserves the right to modify course structures in order to eliminate the conflicts. Students will be advised during the enrolment period of the semester if the recommended courses need to be varied. Where the courses include elective subjects these should be chosen so that timetable clashes are avoided. In particular, students in combined degrees should plan their courses so that the subjects chosen in the other faculty do not clash with those recommended for the engineering component.	
Fourth year (for students who took 436-201 Thermofluids 1 in place of 436-204 Systems Modelling in 2001)	Points	First year	Points
Semester 1		Semester 1	
436-351 Thermofluids 2 (p.10)	12.5	431-102 Digital Systems 1: Fundamentals (p.9)	12.5
436-353 Mechanics 2 (p.10)	12.5	433-151 Introduction to Programming (Advanced) (p.15)	12.5
436-355 Design/Control 1 (p.11)	12.5	or	
or		433-171 Introduction to Programming (p.15)	12.5
436-357 Design/Control 1 - Environmental (p.11)	12.5	436-105 Engineering Communications (p.7)	12.5
Science subject as required	12.5	620-121 Mathematics A (Advanced) (p.4)	12.5
Semester 2		or	
Mechanical and environmental streams		620-141 Mathematics A (p.5)	12.5
436-352 Thermofluids 3 (p.10)	12.5	Semester 2	
436-354 Mechanics 3 (p.10)	12.5	431-103 Electrical Circuits (p.9)	12.5
436-356 Design/Control 2 (p.11)	12.5	433-152 Algorithmic Problem Solving (Advanced) (p.15)	12.5
or		or	
436-358 Design/Control 2 - Environmental (p.11)	12.5	433-172 Algorithmic Problem Solving (p.15)	12.5
Science subject/s as required	12.5	436-101 Engineering Mechanics and Materials (p.7)	12.5
Manufacturing stream		620-123 Applied Mathematics (Advanced) (p.4)	12.5
436-361 Manufacturing Control and Systems (p.12)	12.5	or	
436-364 Manufacturing Science 1 (p.13)	12.5	620-143 Applied Mathematics (p.5)	12.5
436-365 Operations Analysis (p.13)	12.5	640-142 Physics B (p.3) ¹	12.5
Science subject/s as required	12.5		
Fifth year (mechanical)	Points	1. Recommended enrichment material, approved subject to prior academic performance.	
Year long		Second year	Points
436-420 Engineering Design (p.15)	12.5	Semester 1	
436-422 Research Project (p.16)	12.5	431-201 Engineering Analysis A (p.9)	12.5
Semester 1			
436-431 Mechanics 4 (p.16)	12.5		
436-432 Thermofluids 4 (p.16)	12.5		
436-433 Mechanical Systems (p.16)	12.5		
Semester 2			
Applied mechanics advanced options (choose two)			
436-405 Advanced Control Systems (p.14)	6.25		

Second year

431-204	Digital Systems 2: System Design (p.9)	Points	12.5
436-202	Mechanics 1 (p.8)		12.5
436-280	Mechatronics Design and Laboratory 1 (p.9)		12.5
Semester 2			
431-202	Engineering Analysis B (p.9)		12.5
431-221	Fundamentals of Signals and Systems (p.10)		12.5
436-201	Thermofluids 1 (p.7)		12.5
436-281	Mechatronics Design and Laboratory 2 (p.9)		12.5

Third year (2003 only)

Semester 1			
431-210	Circuit Analysis (p.10)	Points	12.5
433-253	Algorithms and Data Structures (p.16)		12.5
436-353	Mechanics 2 (p.10)		12.5
436-370	Mechatronics Design and Laboratory 3 (p.13)		12.5
Semester 2			
431-222	Electronic Devices and Circuits (p.10)		12.5
433-254	Software Design (p.16)		12.5
436-354	Mechanics 3 (p.10)		12.5
436-371	Mechatronics Design and Laboratory 4 (p.13)		12.5

Fourth year

Semester 1			
433-332	Operating Systems (p.17)	Points	12.5
433-341	Software Engineering Process & Practice (p.17)		12.5
436-203	Manufacturing Studies 1 (p.8)		12.5
436-351	Thermofluids 2 (p.10)		12.5
Semester 2			
433-255	Logic and Computation (p.16)		12.5
433-353	Networks and Communications (p.18)		12.5
	Computer science 300-level elective		12.5
620-370	Statistics for Mechanical Engineers (p.13)		12.5
436-352	Thermofluids 3 (p.10) ¹		12.5

1. Recommended enrichment material, approved subject to prior academic performance.

Fifth year

Year long			
436-450	Mechatronics Design and Laboratory 5 (p.17)	Points	12.5
436-452	Mechatronics Project (p.18)		12.5
Semester 1			
436-433	Mechanical Systems (p.16)		12.5
	Electives		25
Semester 2			
	Electives		37.5

Note: Electives taken in fifth year over Semesters 1 and 2 must include two further BCS electives and 37.5 points (plus optional applied mechanics advanced options) from the elective subjects listed below. At least one management subject, as well as 436-431 or both 436-352 and 436-432 must be included.

Management electives (choose at least one):

325-201	Organisational Behaviour (p.1)	Points	12.5
325-203	Operations Management (p.1)		12.5
325-209	Human Resource Management (p.2)		12.5
325-211	Principles of Marketing (p.2)		12.5
325-302	Strategic Marketing (p.4)		12.5
325-308	Industrial Relations (p.4)		12.5
436-365	Operations Analysis (p.13)		12.5

Engineering electives (must include 436-431 or both 436-352 and 436-432)

431-326	Electronic System Design (p.11)	Points	12.5
431-328	Digital Systems 3: Circuits and Systems (p.11)		12.5
431-469	Multimedia Signal Processing (p.14)		12.5
433-480	Computer Vision and Image Processing (p.21)		12.5
433-681	Autonomous Robots - for subject details, please contact the Department of Computer Science and Software Engineering		12.5
436-352	Thermofluids 3 (p.10)		12.5
436-363	Manufacturing Studies 2 (p.12)		12.5
436-364	Manufacturing Science 1 (p.13)		12.5
436-365	Operations Analysis (p.13)		12.5
436-405	Advanced Control Systems (p.14)		6.25
436-431	Mechanics 4 (p.16)		12.5
436-432	Thermofluids 4 (p.16)		12.5
436-434	Mechatronic Systems and Data Fusion (p.16)		12.5
436-436	Robotics and Computational Mechanics (p.17)		12.5
436-438	Advances In Industrial Automation (p.17)		12.5

Fifth year

Applied mechanics advanced options (enrichment material)¹		Points	
436-406	Rotor Dynamics (p.14)		6.25
436-407	Advanced Fluid Mechanics (p.14)		6.25
436-408	Advanced Mechanics of Solids (p.14)		6.25
436-409	Power Generation Systems (p.14)		6.25

1. Recommended enrichment material, approved subject to prior academic performance.

Subject descriptions

145-126 Effective Communication for Engineering

See full subject details on page 1.

316-101 Introductory Macroeconomics

See full subject details on page 1.

316-102 Introductory Microeconomics

See full subject details on page 1.

316-130 Quantitative Methods 1

See full subject details on page 1.

316-205 Introductory Econometrics

See full subject details on page 1.

325-201 Organisational Behaviour

See full subject details on page 1.

325-203 Operations Management

See full subject details on page 1.

325-209 Human Resource Management

See full subject details on page 2.

325-211 Principles of Marketing

See full subject details on page 2.

325-302 Strategic Marketing

See full subject details on page 4.

325-304 Organisational Analysis

See full subject details on page 4.

325-308 Industrial Relations

See full subject details on page 4.

421-629 Energy Efficiency Technology

See full subject details on page 12.

431-101 Fundamentals of Electrical Engineering

See full subject details on page 9.

431-102 Digital Systems 1: Fundamentals

See full subject details on page 9.

431-103 Electrical Circuits

See full subject details on page 9.

431-201 Engineering Analysis A

See full subject details on page 9.

431-202 Engineering Analysis B

See full subject details on page 9.

431-210 Circuit Analysis

See full subject details on page 10.

431-469 Multimedia Signal Processing

See full subject details on page 14.

433-171 Introduction to Programming

See full subject details on page 15.

433-252 Software Engineering Principles & Tools

See full subject details on page 15.

433-253 Algorithms and Data Structures

See full subject details on page 16.

433-254 Software Design

See full subject details on page 16.

433-255 Logic and Computation

See full subject details on page 16.

433-303 Artificial Intelligence

See full subject details on page 16.

433-313 Computer Design

See full subject details on page 16.

433-332 Operating Systems

See full subject details on page 17.

433-340 Software Engineering Project

See full subject details on page 17.

433-341 Software Engineering Process & Practice

See full subject details on page 17.

433-343 Professional Issues in Computing

See full subject details on page 17.

433-351 Database Systems

See full subject details on page 18.

433-353 Networks and Communications

See full subject details on page 18.

433-361 Programming Language Implementation

See full subject details on page 18.

433-380 Graphics and Computation

See full subject details on page 18.

436-101 Engineering Mechanics and Materials**Credit points:** 12.5 **HECS-band:** 2**Coordinator:** Assoc Prof J Williams**Contact:** Thirty-six hours of lectures, 12 hours of tutorials (*Semester 1, repeat 2, Summer*).**Description:** Unit 1, Mechanics: On completion of this unit students should be able to calculate forces and moments in mechanisms and structures under load, determine torque and power transmission capacities of drive trains, solve problems in hydrostatics, calculate vibration responses of simple structures and use relevant computer packages.

Topics include application of vector algebra to engineering systems, forces, moments, couples and resultants; equilibrium of forces in two and three dimensions; properties of sections, theorem of Pappus; analysis of machine components; friction, wedges, screws, journal and thrust bearings, power transmission systems; elementary mechanics of continua; and dynamics of simple structural systems, introduction to computational mechanics.

Unit 2, Materials: On completion of this unit students should have a basic familiarity with properties and behaviour of materials and most common polymeric materials, preparation for appreciating the interrelationship between the structure, processing and properties of materials and of factors in selection of appropriate materials for specific applications.

Topics include mechanical properties; yield and ultimate strength, elastic modulus, hardness, nominal (engineering) stress and strain, true stress and strain, ductility, plastic flow, atomic structure and bonding; crystallographic notation, Miller indices; and fast fracture, fracture mechanics, toughness, oxidation and corrosion, introduction to structure, properties and processing of polymers.

Assessment: One examination not exceeding three hours, assignments and reports not exceeding 20 pages or equivalent and participation in seminars. Students will be notified of the weighting of assessment components at the beginning of semester.**436-102 Introduction to Design and Manufacture****Credit points:** 12.5**HECS-band:** 2**Coordinator:** Prof H Watson**Contact:** Eighteen hours of lectures, 22 hours of tutorials and 8 hours of laboratory experiments (*Semester 1*).**Description:** On completion, students should have developed effective study skills and communication techniques; and had practice at writing technical reports, conducting literature surveys and performing laboratory experiments. Through simulation and laboratory testing, students should comprehend the concepts involved in simultaneous engineering and have developed basic skills in designing, manufacturing and testing.

Part 1 introduces the science and art of the design and manufacture of high performance vehicles, such as racing cars. Hands-on experience will include component or systems analysis, material selection, manufacture and testing of engines, transmissions and vehicles. Part 2 topics include materials processing, as applied to manufacture; hands-on materials processing of metals, glass polymers and composites; production management, quality control and manufacturing processes (including computer controlled machine tools and robots), design for manufacture, value analysis, forecasting, stock control and work measurement; and computer-integrated management information systems. Part 3 topics include lasers as applied to a range of scientific and industrial design and testing processes; applications to the measurement of displacement, vibration and flow; and applications in material removal and other industrial processes.

Assessment: Assignments and reports not exceeding 10 pages or equivalent, oral presentation and one examination not exceeding three hours. Students will be notified of the weighting of assessment components at the beginning of semester.**436-105 Engineering Communications****Credit points:** 12.5**HECS-band:** 2**Coordinator:** Dr.Akbar Afaghi**Contact:** Seventeen hours of lectures, seven hours of tutorials, 14 hours of project work and 10 hours practice classes (*Semester 1, repeat 2*).**Description:** Students successfully completing this unit should have the ability to construct 2-D geometric models of 3-D objects and phenomena, communicate their descriptions in standard drafting format and read and understand drawings prepared in accordance with Australian Standards. They should be proficient in visualising 3-D objects and phenomena; in applying analytical and computer techniques in geometrical modelling; in graphic communication; have developed effective study skills and learning practices; and have had practice at oral and written communication of technical material.

Topics covered include projection systems, 3-D geometry principal and auxiliary views; sketching, computational geometry and computer graphics; and written technical communication and oral presentation.

Assessment: Assignments and reports not exceeding 20 pages or equivalent, an oral presentation and one examination not exceeding three hours. Students will be notified of the weighting of assessment components at the beginning of semester.**436-201 Thermofluids 1****Credit points:** 12.5**HECS-band:** 2**Coordinator:** Assoc Prof.M Chong**Prerequisites:** Students will be expected to be familiar with material covered in 100-level Mathematics**Contact:** Thirty-four hours of lectures and 14 hours of tutorials and laboratory (*Semester 2*).**Description:** Unit 1, Fluid mechanics: Students should develop a fundamental understanding of basic principles of fluid statics and dynamics, gain experience in practical methodologies applied to the solution of engineering flow problems, have an ability to perform force and stability analysis in fluid statics; analyse control volumes analysis for continuity, energy and momentum balances; perform dimensional analysis; and understand fluid resistance, drag and lift.

Topics include fluid statics, static forces on submerged structures, stability of floating bodies; fluid dynamics; streamlines; pathlines and streaklines; conservation of mass, momentum and energy; Euler's equation and Bernoulli's equation; control volume analysis; dimensional analysis; incompressible flow in pipes and ducts; boundary layers; flow around immersed bodies; and drag and lift.

Unit 2, Thermodynamics: Students should develop an understanding of laws of thermodynamics and thermodynamic property relationships; apply these principles to engineering systems; non-flow and steady flow processes; understand second law limitations; formulate equations for process performance and cycle efficiency; and carry out combustion analysis.

Topics include heat and work, ideal non-flow and flow processes; laws of thermodynamics; Carnot's principle; Clausius inequality; direct and reversed heat engines; thermal efficiencies; properties of pure substances; change of phase; representation of properties; steam and air tables; and vapour equation of state, ideal gases.

Assessment: One examination not exceeding three hours, tutorial tests, assignments and laboratory reports not exceeding 20 pages. Students will be notified of the weighting of assessment components at the beginning of semester.

436-202 Mechanics 1

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.J.Krodkiewski

Prerequisites: Students will be expected to be familiar with material covered in 436-101 Engineering Mechanics and Materials and 100-level mathematics

Contact: Thirty-six hours of lectures and 12 hours of tutorial and laboratory work (*Semester 1*).

Description: Unit 1, Mechanics of Materials: On completion of this unit, students should be able to understand elastic and inelastic behaviour; and determine stresses and deformations in common structural elements.

Topics covered include two-dimensional stress and strain analysis; principal values; Mohr's circle; failure criteria; basic properties of beams, symmetric bending; flexure by McAulay's method, superposition, indeterminacy; and short and long columns, inelastic behaviour.

Unit 2, Dynamics of Machines: On completion of this unit students should understand how to perform kinematic and dynamic analysis of planar mechanisms using analytical, numerical and/or graphical methods and be proficient at identifying, modelling and analysing vibrating single-degree-of-freedom systems.

Topics covered include structural analysis and synthesis; mobility, velocity and acceleration diagrams; analytical kinematics of planar mechanisms; forces in machine members; dynamic reactions in joints; dynamics of mechanism input links, equation of motion, balancing; equations of motion of undamped, damped, free and forced vibration, kinematic and dynamic excitation; natural frequency, critical speed, resonance, transfer functions; application of integral transforms; and applications in machine design.

Assessment: Laboratory and tutorial work assignments not exceeding 20 pages or equivalent; one examination not exceeding three hours. Students will be notified of the weighting of assessment components at the beginning of semester.

436-203 Manufacturing Studies 1

Credit points: 12.5

HECS-band: 2

Coordinator: Dr A Smith

Prerequisites: Students will be expected to be familiar with material covered in 436-105 Engineering Communications, 436-101 Engineering Mechanics and Materials.

Contact: Thirty-four hours of lectures and 14 hours of laboratory/practice classes (*Semester 1*).

Description: Unit 1, Introduction to Manufacturing Processes: Upon completion, students should understand the basic principles, objectives and performance characteristics of some major methods of shaping components; understand the variables affecting the performance of the various processes and the process capabilities as a basis for simultaneous engineering and a more advanced study of manufacturing processes.

Topics covered include principles, performance characteristics and process selection of manufacturing processes; and casting, moulding and other forming, bulk deformation processes, material removal, finishing and fabrication.

Unit 2, Engineering Economics: Upon completion, students should understand how engineers contribute to business (including costing and financial management), have acquired knowledge for measuring economic performance of people, be aware of competitive methods, be able to assess equipment purchase proposals, cost a design and comprehend the principal ingredients required to manufacture and manage efficiently.

Topics covered include supply and demand, theory of the firm, methods of competing and increasing gross margin, break-even calculations, sources of income, capital and operating expenditure; preparation of budgets and performance measurements, profit and loss, balance sheet, funds movement and cash budget; organisation charts and corporate structure; operation of service departments, decision making and personal communications; and costing of designs and services, criteria for equipment purchase and management information systems.

Assessment: Two examinations not exceeding two hours each; tutorial problem sheets and laboratory reports of up to 50 pages. Students will be notified of the weighting of assessment components at the beginning of semester.

436-204 Systems Modelling

Note: This subject requires code to be written in a version of C programming language and the use of Matlab. Students may avail themselves of a pre-semester week of language tuition.

Credit points: 12.5

HECS-band: 2

Coordinator: Dr. A.Ooi

Prerequisites: Students will be expected to have a working knowledge of the material covered in 100-level mathematics, 433-171 Introduction to Programming (or equivalent), 431-101 Electrical Engineering 1, 436-202 Mechanics 1 and 431-201 Engineering Analysis A (prior to 2001, 421-204 Engineering Analysis A) or equivalent.

Contact: Thirty-two hours of lectures and 16 hours of tutorials, assignments and laboratory work (*Semester 2*).

Description: Unit 1, Computational Mechanics: Upon completion students should be able to formulate algorithms into working computer programs in C language in order to solve engineering problems, and be aware of numerical errors inherent in many computational schemes.

Topics covered include fundamentals of numerical modelling; approximation and errors; roots of equations; numerical solution of linear algebraic equations; curve fitting and splines; interpolation and extrapolation; numerical differentiation and integration; pre- and post-computational analysis; and graphical representation of results.

Unit 2, Electro-mechanical Machine Behaviour: Upon completion students should be familiar with the concepts and terminology of electrical power engineering; be able to describe the construction of common electrical and mechanical power sources; understand the operating characteristics of common electrical and mechanical devices used for motive power; be able to construct time and frequency, domain models of simple electrical, mechanical, pneumatic and hydraulic engineering components and systems; and be able to compute time and frequency-domain responses of linear dynamical systems.

Topics covered include DC and AC power supplies and distribution systems; inverters, transformers and rectifiers; principles and operation of single and multi-phase AC machines, induction motors, and DC machines; solid-state control of machines, principles and operation of electro-hydraulic and electro-pneumatic servo valves and actuators, system modelling; and unified approach to modelling electrical, mechanical and thermal systems, block diagrams, transfer function and state-space representations, computation of transient, steady-state time responses, harmonic frequency responses and use of Matlab for system response calculations.

Assessment: Two examinations not exceeding two hours each; tutorial tests and assignments not exceeding 50 pages or equivalent. Students will be notified of the weighting of assessment components at the beginning of semester.

436-220 Engineering Design and Materials 1

Credit points: 12.5

HECS-band: 2

Coordinator: Dr C Burvill

Prerequisites: Students will be expected to be familiar with material covered in 436-101 Engineering Mechanics and Materials, 100-level mathematics and 436-105 Engineering Communications.

Contact: Twenty-four hours of lectures and 24 hours of tutorials, guided design exercises and laboratory work (*Semester 1*).

Description: Unit 1, Engineering Design: Upon completion, students should have gained practice in the skill of designing simple engineering components for structural integrity and be confident with practical work formulated in a graded progression from well delineated problems to dealing with complex and/or vaguely defined design tasks.

Topics covered include failure modes for engineering systems, failure predictors for engineering components under multi-axial stress conditions; rational assessment of safety factors and maximum credible accident; integrity of structures and machines, design against failure; modelling of complex load-bearing systems in terms of simple engineering components; design of elements of structures and machines from first principles; design to resist fatigue, axial tension and compression, combined torsion, bending and internal pressure (only common metallic materials are considered); design of bolted and welded joints; and approaches to uncertainty in design problems.

Unit 2, Engineering Materials: Upon completion, students should have further developed their understanding of the behaviour of materials, aided by laboratory exercises based on topics covered in 436-101 Engineering Mechanics and Materials.

Topics covered include dislocations and their relevance to plastic flow; particulate and fibre-reinforced composite materials; recovery, recrystallisation and grain growth in metals; creep; static and dynamic fatigue; and friction and wear.

Assessment: Assignments and laboratory and technical reports not exceeding 50 pages or equivalent; participation in oral presentations and seminars, two examinations not exceeding two hours each. Completion and submission of satisfactory laboratory reports and assignments is a prerequisite for admis-

sion to the written examination. Students will be notified of the weighting of assessment components at the beginning of semester.

436-221 Engineering Design and Materials 2

Credit points: 12.5

HECS-band: 2

Coordinator: Dr C Burvill

Prerequisites: Students will be expected to be familiar with material covered in 436-101 Engineering Mechanics and Materials, 100-level mathematics and 436-105 Engineering Communications.

Contact: Twenty-four hours of lectures and 24 hours of tutorials, guided design exercises and laboratory work (*Semester 2*).

Description: Unit 1, Engineering Design: Upon completion, students should comprehend fundamental concepts of engineering design through various stages of the design process; problem formulation and structuring, ideation, decision making and communication; have developed an awareness of the integrative nature of engineering design through the experience of balancing a range of factors; and have observed the close interrelation between the properties of engineering materials and the design process.

Topics covered include general approach to design problems; invention, analysis, decision making; goal, objectives, criteria and constraints; strategies for synthesis and decision making; technical, ergonomic and economic factors; appraisal of benefit and cost; fault and failure analysis; probability, uncertainty, and assessment of risk; and interfacing geometric and mathematical models, sensitivity analyses, combinatorial search.

Unit 2, Engineering Materials: Upon completion, students should be able to appreciate the interrelationship between the structure, processing and properties of metals and of key factors in the selection of appropriate materials for specific applications.

Topics covered include Gibbs Phase Rule; development of microstructure, and its influence on properties; the iron carbon system; isothermal and constant-cooling transformation diagrams; heat treatments, including precipitation hardening; and light alloys;

Assessment: Practical work, projects and reports not exceeding 40 pages; two examinations not exceeding two hours each. Completion and submission of satisfactory laboratory reports and assignments is a prerequisite for admission to the written examination. Students will be notified of the weighting of assessment components at the beginning of semester.

436-222 Design and Materials 1 - Environmental

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.C.Burvill

Prerequisites: Students should be familiar with material covered in 436-101 Engineering Mechanics and Materials, 436-105 Engineering Communications and 100-level mathematics.

Contact: Twenty-four hours of lectures and 24 hours of tutorials, guided design exercises and laboratory work (*Semester 1*).

Description: Unit 1, Engineering Design: Students should gain skill in designing simple engineering components for the structural integrity of environmental systems, be confident with practical work formulated in a graded progression from well-delineated problems to dealing with complex and/or vaguely defined design tasks in environmental areas.

Topics include failure modes for engineering systems, failure predictors for engineering components under multi-axial stress conditions; rational assessment of safety factors and maximum credible accident; integrity of structures and machines, design against failure; modelling of complex load-bearing systems in terms of simple engineering components; design of elements of structures and machines from first principles; design to resist fatigue, axial tension and compression, combined torsion and bending and internal pressure (only common metallic materials are considered); design of bolted and welded joints; and approaches to uncertainty in design problems, particularly those related to the environment.

Unit 2, Engineering Materials: Students should develop further understanding of materials, aided by laboratory exercises based on topics covered in 436-101 Engineering Mechanics and Materials.

Topics covered include dislocations and their relevance to plastic flow; particulate and fibre-reinforced composite materials; recovery, recrystallisation and grain growth in metals; creep; static and dynamic fatigue; and friction and wear.

Assessment: Assignments, laboratory and technical reports not exceeding 50 pages or equivalent; participation in oral presentations and seminars; two examinations not exceeding two hours each. Completion and submission of satisfactory laboratory reports and assignments is a prerequisite for admission to the written examination. Students will be notified of the weighting of assessment components at the beginning of semester.

436-223 Design and Materials 2 - Environmental

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.C.Burvill

Prerequisites: Students will be expected to be familiar with material covered in 436-101 Engineering Mechanics and Materials, 436-105 Engineering Communications and 100-level mathematics.

Contact: Twenty-four hours of lectures and 24 hours of tutorials, guided design exercises and laboratory work (*Semester 2*).

Description: Unit 1, Engineering Design: Upon completion, students should comprehend fundamental concepts of engineering design through various stages of the design process: problem formulation and structuring, ideation, decision making and communication (with special emphasis on those related to environmental engineering); develop an awareness of the integrative nature of engineering design through the experience of balancing a range of factors including uncertainties related to the environment; and have observed the close interrelation between the properties and performance of engineering materials and the design process.

Topics covered include general approach to engineering design problems; invention, analysis, decision making; goal, objectives, criteria and constraints; strategies for synthesis and decision making; technical, ergonomic and economic factors; appraisal of benefit and cost; fault and failure analysis; probability, uncertainty and assessment of risk; and interfacing geometric and mathematical models, sensitivity analyses, combinatorial search.

Unit 2, Engineering Materials: Upon completion, students should be able to appreciate the interrelationships between the structure, processing and properties of metals, and of key factors in the selection of appropriate materials for specific applications.

Topics covered include Gibbs Phase Rule; development of microstructure, and its influence on properties; the iron carbon system; isothermal and constant-cooling transformation diagrams; heat treatments, including precipitation hardening; and light alloys;

Assessment: Practical work, projects and reports not exceeding 40 pages; two examinations not exceeding two hours each. Completion and submission of satisfactory laboratory reports and assignments is a prerequisite for admission to the written examination. Students will be notified of the weighting of assessment components at the beginning of semester.

436-280 Mechatronics Design and Laboratory 1

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.C.Burvill

Prerequisites: Students will be expected to be familiar with material covered in 436-101 Engineering Mechanics and Materials, 436-105 Engineering Communications and 100-level mathematics.

Contact: 24 hours of lectures and 24 hours of tutorials, guided design exercises and laboratory work (*Semester 1*).

Description: Unit 1, Engineering Design: Students should gain skill in designing simple engineering components and systems for structural and functional integrity; and be confident with practical work formulated in a graded progression from well-delineated problems to dealing with complex and/or vaguely defined design tasks.

Topics include elements of mechatronic design, examples of mechatronic systems; failure modes for engineering systems, failure predictors for engineering components under multi-axial stress conditions; rational assessment of safety factors and maximum credible accident; integrity of structures and machines, design against failure; modelling of complex load-bearing systems in terms of simple engineering components; design of elements of structures and machines from first principles; design to resist fatigue, axial tension and compression, combined torsion and bending and internal pressure (only common metallic materials are considered); design of bolted and welded joints; and approaches to uncertainty in design problems, particularly those related to mechatronic applications.

Unit 2, Engineering Materials: Students should develop further understanding of materials behaviour, aided by laboratory exercises based on topics covered in 436-101 Engineering Mechanics and Materials.

Topics include dislocations and their relevance to plastic flow; particulate and fibre-reinforced composite materials; recovery, recrystallisation and grain growth in metals; creep; static and dynamic fatigue; and friction and wear.

Assessment: Assignments, laboratory and technical reports not exceeding 50 pages or equivalent; participation in oral presentations and seminars; two examinations not exceeding two hours each. Completion and submission of satisfactory laboratory reports and assignments is a prerequisite for admission to the written examination. Students will be notified of the weighting of assessment components at the beginning of semester.

436-281 Mechatronics Design and Laboratory 2

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.C.Burvill

Prerequisites: Students will be expected to be familiar with material covered in 436-101 Engineering Mechanics and Materials, 436-105 Engineering Communications and 100-level mathematics.

Contact: Twenty-four hours of lectures and 24 hours of tutorials, guided design exercises and laboratory work (*Semester 2*).

Description: Unit 1, Mechatronics Design: Upon completion, students should comprehend fundamental concepts of mechatronics design through various stages of the design process: problem formulation and structuring, ideation, decision making and communication; have developed an awareness of the integrative nature of mechatronics design through the experience of balancing a range of factors; and have observed the close interrelation between the properties and performance of engineering materials and the design process.

Topics covered include general approach to mechatronics design problems; invention, analysis, decision making; goal, objectives, criteria and constraints; strategies for synthesis and decision making; technical, ergonomic and economic factors; appraisal of benefit and cost; fault and failure analysis; and probability, uncertainty and assessment of risk; interfacing geometric and mathematical models, sensitivity analyses, combinatorial search.

Unit 2, Materials: Upon completion, students should be able to appreciate the interrelationships between the structure, processing and properties of metals, and of key factors in the selection of appropriate materials for specific applications.

Topics covered include Gibbs Phase Rule; development of microstructure and its influence on properties; the iron carbon system; isothermal and constant-cooling transformation diagrams; heat treatments, including precipitation hardening; and light alloys;

Assessment: Practical work, projects and reports not exceeding 40 pages; two examinations not exceeding two hours each. Completion and submission of satisfactory laboratory reports and assignments is a prerequisite for admission to the written examination. Students will be notified of the weighting of assessment components at the beginning of semester.

436-351 Thermofluids 2

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.A.Ooi

Prerequisites: Students will be expected to be familiar with the material of 436-201 Thermofluids 1 and 200-level mathematics

Contact: Unit 1: 20 hours of lectures, four hours of tutorials and laboratory work Unit 2: 16 hours of lectures, eight hours of tutorials and laboratory work (*Semester 1*).

Description: Unit 1, Fluid Dynamics: On completion of this unit students should be able to analyse inviscid flow of an incompressible fluid for simple boundary conditions and know where the concepts are applicable in practice; appreciate the application of Laplace's equation to a number of phenomena including fluid flow; be able to use complex velocity potential analysis to solve a variety of inviscid flow problems including incompressible flow past airfoils; and know the basic characteristics of pumps and fans and their classification and how to match these with operating systems.

Topics covered include basic introduction to inviscid flow with and without vorticity; concepts and analysis using stream function and velocity potential. Incompressible viscous flow past bodies with vortex shedding; and basic equations of pumps and fans and their classification and characteristics.

Unit 2, Thermodynamics: On completion of this unit students should have an understanding of the fundamentals of heat transfer under steady and unsteady conditions; appreciate the application of Laplace's equation to heat conduction; understand the principles of thermodynamic plant design including heat and mass transfer; and have a working knowledge of heat exchangers and regenerators.

Topics covered include thermal conduction in steady and unsteady conditions; convection, Reynolds analogy and dimensional analysis; free and forced convection; radiation heat transfer; heat and mass transfer, boiling and condensation; and heat exchangers and regenerators, heat exchanger applications.

Assessment: One examination not exceeding three hours. Tutorial tests, assignments and laboratory reports not exceeding 30 pages. Students will be notified of the weighting of assessment components at the beginning of semester.

436-352 Thermofluids 3

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.A.Ooi

Prerequisites: Students will be expected to be familiar with the material of 436-351 Thermofluids 2 and 200-level mathematics.

Contact: Unit 1: 20 hours of lectures, four hours of tutorials and laboratory work Unit 2: 16 hours of lectures, eight hours of tutorials and laboratory work (*Semester 2*).

Description: Unit 1, Aerodynamics: Upon completion, students should be familiar with further theory of airfoils and gas dynamics in subsonic and supersonic flow; be able to apply shock expansion theory to the solution of flow in a variety of situations including prediction of lift and drag of two-dimensional bodies in supersonic flow; be able to apply Ackeret or linear the-

ory to thin airfoils; and be aware of viscous effects, boundary layer and shock wave interactions.

Topics covered include theories of thin airfoils; gas dynamics in subsonic and supersonic flow; shock expansion theory; and boundary layer and shock wave interactions.

Unit 2, Thermodynamics: Upon completion, students should understand the principles of combustion in single and two phase fluids; comprehend the benefits and costs (including some environmental and management implications) of refinements in plant design and/or working fluid; and appreciate the complexity of real plant performance evaluation.

Topics covered include cycles of simple and compound compressors; gas turbines, influence of reheat, intercooling and design parameters; refrigeration, vapour compression and absorption cycles and gas liquefaction; steam plant, with superheating, regeneration and feed water heating; and spark ignition and diesel engines and their fuels.

Assessment: One examination not exceeding three hours, tutorial tests, assignments and laboratory reports not exceeding 30 pages. Students will be notified of the weighting of assessment components at the beginning of semester.

436-353 Mechanics 2

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc Prof J Williams

Prerequisites: Students will be expected to be familiar with the material of 436-202 Mechanics 1 and 200-level mathematics.

Contact: Unit 1: 18 hours of lectures, six hours of tutorial and laboratory work. Unit 2: 17 hours of lectures, seven hours of tutorial and laboratory work (*Semester 1*).

Description: Unit 1, Stress Analysis: Upon completion of this unit, students should understand the principles of energy methods as applied to solving a variety of problems in elasticity, including statically indeterminate ones; comprehend the nature of inelastic deformation and its basic governing laws together with their application to simple manufacturing processes; and understand the techniques of experimental stress analysis.

Topics covered include energy methods in stress analysis, stationary potential and complementary energy theorems, virtual work, Castigliano's first and second theorems, method of Rayleigh-Ritz, statically indeterminate systems, suddenly applied loads, impact stresses, inelastic behaviour, yield criteria, constitutive relations, work hardening, basic problems in inelastic deformation, thermal stresses and experimental stress analysis.

Unit 2, Mechanics of Rigid Bodies: Upon completion of this unit students should be able to understand the principles of three-dimensional mechanics of rigid body and carry out kinematic analysis of mechanical systems.

Topics covered include motion of particles in terms of inertial frames, motion of particles in terms of translating and rotating frames, matrix of directional cosines, Euler's angles, angular velocity and angular acceleration, Coriolis statement, motion of a rigid body, kinetics of a system of particles, linear and angular momentum, inertia constants, parallel axes theorem, principal axes, Euler equations, and modified Euler equations.

Assessment: Laboratory/tutorial work, assignments and tests up to 30 pages or equivalent. One examination not exceeding three hours. Students will be notified of the weighting of assessment components at the beginning of semester.

436-354 Mechanics 3

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc.Prof.J.Williams

Prerequisites: Students will be expected to be familiar with the material of 436-353 Mechanics 2 and 200-level mathematics.

Contact: Unit 1: 18 hours of lectures and six hours of tutorials and laboratory Unit 2: 13 hours of lectures and 11 hours of tutorials and laboratory (*Semester 2*).

Description: Unit 1, Stress Analysis: Upon completion of this unit, students should be able to model a variety of mechanical engineering structures as a number of elementary components and stress analyse each component to determine failure loads and deflections of the complete structure.

Topics covered include engineering plasticity, design of pressure vessels and pipes, thick-walled cylinders, shrink fitting, duplex pressure vessels, inelastic deformation, residual stresses, membrane theory of shells of revolution, yielding, rotating shells, local bending stresses, stress analysis of rotating discs with and without holes, shrink fitting, initial and ultimate yielding; fracture mechanics and fatigue; and introduction to the finite element method.

Unit 2, Dynamics of Mechanical Systems: Upon completion, students should be able to formulate physical and mathematical models for three-dimensional dynamic analysis of mechanical systems, solve the mathematical models by means of analytical and numerical methods and assess stability of their solutions.

Topics covered include constraints, mobility, generalised coordinates, number of degrees of freedom, driving forces, virtual displacement, generalised force, impressed forces and constraint forces, principle of virtual work, Lagrange equations of motion, kinetic energy function, potential energy function, collisions of unconstrained and constrained bodies, and analysis of mathematical models.

Assessment: One examination not exceeding three hours; tutorials, tests, assignments and laboratory reports not exceeding 30 pages. Students will be notified of the weighting of assessment components at the beginning of semester.

436-355 Design/Control 1

Credit points: 12.5

HECS-band: 2

Coordinator: Mr.J.Weir

Prerequisites: Students will be expected to be familiar with material covered in 436-105 Engineering Communications, 436-203 Manufacturing Studies 1 and 436-204 Systems Modelling, 436-221 Engineering Design and Materials 2 or 436-223 Design and Materials 2 - Environmental.

Contact: Twenty-eight hours of lectures and case studies, 12 hours of practical work in engineering design and eight hours of tutorials and laboratory work (*Semester 1*).

Description: Unit 1, Engineering Design: Upon completion of this unit, students should be skilled in synthesising solutions to open-ended design problems at an intermediate level of complexity in mechanical engineering, skilled in the management of design projects requiring the solution of such problems; have gained an appreciation of computer-based methods in concurrent design; and have gained a deep understanding of the concepts and methods of designing for quality, of managing variability and of integrating design with downstream manufacturing operations.

Topics include concurrent design of systems and products; computer-based techniques for geometric modelling, materials selection, service simulations and representation of manufacturing knowledge; management of variability in product geometry and performance; tolerance technology in 1-D, 2-D and 3-D applications, techniques for robust design; quality assurance in engineering design; and life cycle design, quality function deployment, causal networks and failure modes and effects analyses, ISO 9001 and traceability of critical decisions.

Unit 2, Control: Upon completion of this unit, students should be able to design simple control systems to start-up, shut-down and regulate the motion of a range of mechanical, electrical and hydraulic engineering systems commonly found in engineering practice, and to make effective use of computational aids for the design of these control systems.

Topics covered include sequence controllers, ladder diagrams, and PLCs; a review of mathematical representations of linear continuous dynamical systems, and of the relationships between model properties and system response characteristics; design specifications and strategies for linear control systems; classical compensator design using root locus and frequency response techniques; lag, lead, lag-lead, PID, cascade and feedback compensation; and application of Matlab or similar software as a systems design tool.

Assessment: Two examination papers not exceeding two hours each; tests, continuous assessment of projects, assignments and laboratory reports not exceeding 40 pages. All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of assessment components at the beginning of semester.

436-356 Design/Control 2

Credit points: 12.5

HECS-band: 2

Coordinator: Mr.J.Weir

Prerequisites: Students will be expected to be familiar with the material of 431-101 Fundamentals of Electrical Engineering, 436-101 Engineering Mechanics and Materials, 436-220/222 Engineering Design and Materials 1/1E and 436-355/357 Design/Control 1/1E.

Contact: Unit 1: 12 hours of lectures and case studies and 12 hours of practical work in engineering design. Unit 2: 18 hours of lectures and six hours of tutorials and laboratory work (*Semester 2*).

Description: Unit 1, Engineering Design: Upon completion of this unit, students should have gained an appreciation of methods for synthesising solutions to open-ended design problems at an intermediate level of complexity in mechanical and manufacturing engineering, a deep understanding of the concepts and methods of designing for system and component integrity under conditions of fatigue and wear; and a deep understanding of information-based techniques for the management of engineering design.

Topics covered include general concepts of function, integrity, value, quality, efficient use of resources in the synthesis of solutions to design problems; design for fatigue: characteristics of fatigue fracture, 2-D and 3-D stress conditions, cumulative damage hypothesis, Weibull distribution; design for wear: surface phenomena and tribology in design, application to bearings and seals; and management of the design process: initial appreciation, information flows

and networks, characteristics of manufacturing processes affecting product design.

Unit 2, Control: On completion of this unit students should be able to apply a systems approach to the design and specification of data acquisition and control systems; have an appreciation of the characteristics of a range of sensors and actuators; and have gained experience in system identification and control.

Topics covered include structure of computer-controlled systems; characteristics of some common analog and digital sensors and actuators; signal conditioning, amplification and filtering; analog-to-digital conversion, sample rates and aliasing; signal processing, digital filtering, implementation of simple control algorithms; programming for real-time operations, interrupts; and cases studies in system identification and control, including the effects of common nonlinearities.

Assessment: Two examination papers not exceeding two hours each; tests, continuous assessment of projects, assignments and laboratory reports not exceeding 40 pages. All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of assessment components at the beginning of semester.

436-357 Design/Control 1 - Environmental

Credit points: 12.5

HECS-band: 2

Coordinator: Mr.J.Weir

Prerequisites: Students will be expected to be familiar with material covered in 436-105 Engineering Communications, 436-203 Manufacturing Studies 1, 436-204 Systems Modelling and 436-221/ 436-223 Engineering Design and Materials 2/2E or equivalent.

Contact: Twenty-eight hours of lectures and case studies, 12 hours of practical work in engineering design and eight hours of tutorials and laboratory work (*Semester 1*).

Description: Unit 1, Engineering Design: Upon completion of this unit, students will have an opportunity to undertake project work with a specifically environmental focus. This will enable students to gain a deep understanding of concepts and methods employed in assessing and moderating environmental impacts in the context of the wider design process. Students will be skilled in synthesising solutions to open-ended design problems at an intermediate level of complexity in mechanical engineering, and skilled in the management of design projects requiring the solution of such problems; have gained an appreciation of computer-based methods in concurrent design; have gained a deep understanding of the concepts and methods of designing for quality, of managing variability and of integrating design with downstream manufacturing operations.

Topics include concurrent design of systems and products: computer-based techniques for geometric modelling, materials selection, service simulations and representation of manufacturing knowledge; management of variability in product geometry and performance: tolerance technology in 1-D, 2-D and 3-D applications, techniques for robust design; and quality assurance in engineering design: life cycle design, quality function deployment, causal networks and failure modes and effects analyses, ISO 9001 and traceability of critical decisions.

Unit 2, Control: On completion of this unit students should be able to design simple control systems to start-up, shut-down and regulate the motion of a range of mechanical, electrical and hydraulic engineering systems commonly found in engineering practice, and to make effective use of computational aids for the design of these control systems.

Topics covered include sequence controllers, ladder diagrams, and PLCs; a review of mathematical representations of linear continuous dynamical systems, and of the relationships between model properties and system response characteristics; design specifications and strategies for linear control systems; and classical compensator design using root locus and frequency response techniques: lag, lead, lag-lead, PID, cascade and feedback compensation. Application of Matlab or similar software as a systems design tool.

Assessment: Two examination papers not exceeding two hours each, tests, continuous assessment of projects, assignments and laboratory reports not exceeding 40 pages. All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of assessment components at the beginning of semester.

436-358 Design/Control 2 - Environmental

Credit points: 12.5

HECS-band: 2

Coordinator: Mr J Weir

Prerequisites: Students will be expected to be familiar with the material of 431-101 Fundamentals of Electrical Engineering, 436-101 Engineering Mechanics and Materials, 436-220/222 Engineering Design and Materials 1/1E and 436-355/357 Design/Control 1/1E.

Contact: Unit 1: 12 hours of lectures and case studies and 12 hours of practical work in engineering design. Unit 2: 18 hours of lectures and six hours of tutorials and laboratory work (*Semester 2*).

Description: Unit 1, Engineering Design: On completion of the unit, students will have an opportunity to undertake project work with a specifically environmental focus, at an intermediate level of complexity. This will enable students to gain an appreciation of methods for synthesising solutions to open-ended design problems relating to environmental matters. Students will also develop a deep understanding of the concepts and methods of designing for system and component integrity under conditions of fatigue and wear. Students should develop a deep understanding of information-based techniques for the management of engineering design.

Topics covered include general concepts of function, integrity, value, quality, efficient use of resources in the synthesis of solutions to design problems; design for fatigue: characteristics of fatigue fracture, 2-D and 3-D stress conditions, cumulative damage hypothesis, Weibull distribution; design for wear: surface phenomena and tribology in design, application to bearings and seals; and management of the design process: initial appreciation, information flows and networks, characteristics of manufacturing processes affecting product design.

Unit 2, Control: Upon completion of this unit, students should be able to apply a systems approach to the design and specification of data acquisition and control systems; have an appreciation of the characteristics of a range of sensors and actuators; and have gained experience in system identification and control.

Topics covered include structure of computer-controlled systems; characteristics of some common analog and digital sensors and actuators; signal conditioning, amplification and filtering; analog-to-digital conversion, sample rates and aliasing; signal processing, digital filtering, implementation of simple control algorithms; programming for real-time operations, interrupts; and cases studies in system identification and control, including the effects of common nonlinearities.

Assessment: Two examination papers not exceeding two hours each; tests, continuous assessment of projects, assignments and laboratory reports not exceeding 40 pages. All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of assessment components at the beginning of semester.

436-359 Control/Forming

Availability: This subject is intended to be taken by students enrolled in BE/BCom within the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc.Prof.K.Xia

Prerequisites: 436-203 Manufacturing Studies, 436-204 Systems Modelling or equivalents, 436-220/1 Engineering Design and Materials 1/1E and 436-222/3 Engineering Design and Materials 2/2E.

Contact: Thirty-eight hours of lectures and case studies and 10 hours of tutorials and laboratory work (*Semester 1*).

Description: Unit 1, Control: Upon completion of this unit, students should be able to design simple control systems to start-up, shut-down and regulate the motion of a range of mechanical, electrical and hydraulic engineering systems commonly found in engineering practice, and to make effective use of computational aids for the design of these control systems.

Topics covered include sequence controllers, ladder diagrams, and PLCs; a review of mathematical representations of linear continuous dynamical systems and of the relationships between model properties and system response characteristics; design specifications and strategies for linear control systems; classical compensator design using root locus and frequency response techniques: lag, lead, lag-lead, PID, cascade and feedback compensation; and application of Matlab or similar software as a systems design tool.

Unit 2, Forming Processes: Drawing on the second-year introduction, students completing this course should be able to predict main forming parameters, such as loads, pressures and work of deformation and have the ability to design tooling for selected metal forming processes.

Topics covered include metals: metal forming as a system, metal forming processes including sheet metal forming, drawing forging, net shape manufacturing; process modelling; tools and material used in forming processes; ceramics and powder metallurgy: types of technical ceramics, applications, pressing, plastic forming, injection moulding and casting; drying and firing; powder metallurgy processes, metal-matrix composites.

Assessment: Two 2-hour examinations (60%), group and individual assignments, laboratory and tutorial work not exceeding 20 pages including computations, diagrams, tables and computer output (40%). All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-361 Manufacturing Control and Systems

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.M.Brear

Prerequisites: Students will be expected to be familiar with the material of 431-101 Fundamentals of Electrical Engineering and 436-355 Design/Control 1.

Contact: Unit 1: 12 hours of lectures, 12 hours of tutorials and practical work. Unit 2: 24 hours of lectures and demonstrations (*Semester 2*).

Description: Unit 1, Control: Upon completion of this unit, students should be able to apply a systems approach to the design and specification of data acquisition and control systems; have an appreciation of the characteristics of a range of sensors and actuators; and have gained experience in system identification and control.

Topics covered include structure of computer-controlled systems; characteristics of some common analog and digital sensors and actuators; signal conditioning, amplification and filtering; analog-to-digital conversion, sample rates and aliasing; signal processing, digital filtering, implementation of simple control algorithms; programming for real-time operations, interrupts; and cases studies in system identification and control, including the effects of common nonlinearities.

Unit 2, Work Organisation and Design: Upon completion of this unit, students should understand the theoretical basis of predetermined motion time systems and have learned how to apply several of these systems in estimating time for industrial tasks. Students should understand some of the problems associated with people working in industry, including those of heavy work, inspection processes and shift work.

Topics covered include predetermined motion time systems; workplace design: anthropometry, effects of noise in the work environment, temperature/humidity, lighting; industrial assembly; problems of shift work; manual handling; and task and job analysis and design.

Assessment: Two examinations not exceeding two hours each, reports on practical work and assignments to a total of no more than 50 pages. All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of assessment components at the beginning of semester.

436-362 Design/Processes

Note: This subject is intended to be taken by students enrolled in BE/BCom within the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5

HECS-band: 2

Coordinator: Mr J Weir

Prerequisites: Students will be expected to be familiar with material covered in 436-101 Engineering Mechanics and Materials, 436-105 Engineering Communications, 436-221/223 Engineering Design and Materials 2/2E.

Contact: Twenty-two hours of lectures and two hours of laboratory work (*Semester 1*).

Description: Unit 1, Engineering Design: Upon completion of this unit, students should be skilled in synthesising solutions to open-ended design problems at an intermediate level of complexity in mechanical engineering; skilled in the management of design projects requiring the solution of such problems; have gained an appreciation of computer-based methods in concurrent design; and have gained a deep understanding of the concepts and methods of designing for quality, of managing variability and of integrating design with downstream manufacturing operations.

Topics include concurrent design of systems and products; computer-based techniques for geometric modelling, materials selection, service simulations and representation of manufacturing knowledge; management of variability in product geometry and performance; tolerance technology in 1-D, 2-D and 3-D applications, techniques for robust design; quality assurance in engineering design; and life cycle design, quality function deployment, causal networks and failure modes and effects analyses, ISO 9001 and traceability of critical decisions.

Unit 2, Introduction to Manufacturing Processes: Upon completion, students should understand the basic principles, objectives and performance characteristics of some major methods of shaping components; and understand the variables affecting the performance of the various processes and the process capabilities as a basis for simultaneous engineering and a more advanced study of manufacturing processes.

Topics covered include principles, performance characteristics and process selection of manufacturing processes; and casting, moulding and other forming and bulk deformation processes; and material removal, finishing and fabrication.

Assessment: Two examination papers not exceeding two hours each; tests, continuous assessment of projects, assignments and laboratory reports not exceeding 40 pages. Students will be notified of the weighting of assessment components at the beginning of semester.

436-363 Manufacturing Studies 2

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc.Prof.K.Xia

Prerequisites: Students will be expected to be familiar with the material of 436-203 Manufacturing Studies 1 and 436-220/1 Engineering Design and Materials 1 and 436-222/3 Engineering Design and Materials 2.

Contact: Unit 1: 12 hours of lectures, 12 hours of tutorial/practice classes
Unit 2: 22 hours of lectures/tutorials, two hours of laboratory (*Semester 1*).

Description: Unit 1, Industrial Psychology: Upon completion of this unit, students should have gained knowledge of human behaviour in work organisations; be able to identify relationships among organisational variables including formal structure, interpersonal relations, groups, managers and motivation theory; and be able to transfer their knowledge and skills to the behavioural problems of the future employers.

Topics covered include individual and group behaviour in organisations, particularly in small organisations; motivation, leadership and morale; organisational culture, group dynamics, conflict and its resolution; power, politics and ethics; and organisational change.

Unit 2, Forming Processes: Drawing on the second-year introduction, students completing this course should be able to predict main forming parameters, such as loads, pressures and work of deformation and have the ability to design tooling for selected metal forming processes.

Topics covered include metals: metal forming as a system; metal forming processes including sheet metal forming, drawing forging, net shape manufacturing; process modelling; tools and material used in forming processes; and ceramics and powder metallurgy: types of technical ceramics, applications, pressing, plastic forming, injection moulding and casting; drying and firing; and powder metallurgy processes, metal-matrix composites.

Assessment: Two examinations not exceeding two hours each at the end of semester, group and individual assignments, laboratory and tutorial work to a maximum of 10 000 words or equivalent. Students will be notified of the weighting of assessment components at the beginning of semester.

Prescribed texts: G Moorhead and Griffin, *Organisational Behaviour*, 3rd edn, Houghton and Mifflin, 1992.

436-364 Manufacturing Science 1

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.A.Smith

Prerequisites: Students will be expected to be familiar with the material of 620-370 Statistics for Mechanical Engineers and 436-203 Manufacturing Studies 1.

Contact: Unit 1: 18 hours of lectures and six hours of tutorials and laboratory
Unit 2: 12 hours of lectures and 12 hours of tutorials and laboratory (*Semester 2*).

Description: Unit 1, Material Removal: Upon completion, students should have a basic understanding of the generation process, cutting action and engineering science phenomena involved in conventional material removal processes; and be able to develop cutting analyses for 'classical' and practical turning operations for tool design and performance prediction purposes.

Topics covered include machining as a means of shaping components, chip formation and mechanics of cutting; turning operations, single point lathe tools, prediction of force, torque power, chip flow and surface finish, computerised predictive models for machining processes; and cutting fluid action and application.

Unit 2, Dimensional Metrology: Upon completion of this subject, students should be able to identify and appreciate the importance of standards; relate geometric tolerances to dimensional errors; perform and interpret error analyses; understand the components and requirements of measurement systems; and possess knowledge of the sources of measurement errors and how their influence may be reduced.

Topics covered may include length, angle and form tolerances; standards; statistical estimation of measurement error; gauging and measurement systems design; lasers, interferometry and collimation; metrology of specific features and classes of engineering components; computer controlled coordinate measuring machines; estimation of conformance to form and dimensional tolerances; and large scale engineering metrology.

Assessment: One examination not exceeding three hours at the end of semester, tutorial problem sheets, and laboratory reports of up to 15 pages each. Students will be notified of the weighting of assessment components at the beginning of semester.

436-365 Operations Analysis

Credit points: 12.5

HECS-band: 2

Coordinator: Dr A Smith

Prerequisites: Students will be expected to be familiar with the material of 200-level mathematics, 436-203 Manufacturing Studies 1.

Contact: Thirty-two hours of lectures and 16 hours of tutorial/practice classes (*Semester 2*).

Description: Upon completion, students should understand the functional units in manufacturing firms, the design and characteristics of productive sys-

tems and the product life cycle, economic analysis of production and modern manufacturing strategies; be able to analyse and design production and assembly flow lines for discrete part manufacture; be able to solve production mix problems; and be able to apply network analysis to project management.

Topics covered include functional units of manufacturing firms, classification and characteristics of productive systems, product life cycle; economic analysis of production; heuristic and optimal analyses for automated flow lines, assembly line balancing and their design; linear programming applied to production problems, integer programming models; integer programming models for assembly line balancing and scheduling; and network analysis for project management.

Assessment: One examination not exceeding three hours at the end of semester, a tutorial problem sheet, assignments of up to 15 pages each. Students will be notified of the weighting of assessment components at the beginning of semester.

436-370 Mechatronics Design and Laboratory 3

Credit points: 12.5

HECS-band: 2

Coordinator: Mr.J.Weir

Prerequisites: Students will be expected to be familiar with material covered in 431-103 Electrical Circuits, 431-201 Engineering Analysis A (or equivalent), 431-204 Digital Systems 2: System Design, 436-105 Engineering Communications, 436-202 Mechanics 1 and 436-281 Mechatronics Design and Laboratory 2.

Corequisites: 431-210 Circuit Analysis

Contact: Twenty-eight hours of lectures and case studies, 12 hours of practical work in engineering design and eight hours of tutorials and laboratory work (*Semester 1*).

Description: Unit 1, Engineering Design: Upon completion of this unit, students should be skilled in synthesising solutions to open-ended design problems at an intermediate level of complexity in mechatronics, skilled in the management of design projects requiring the solution of such problems; have gained an appreciation of computer-based methods in concurrent design; and have gained a deep understanding of the concepts and methods of designing for quality and of managing variability and of integrating design with downstream manufacturing operations.

Topics include concurrent design of systems and products; computer-based techniques for geometric modelling, materials selection, service simulations and representation of manufacturing knowledge; management of variability in product geometry and performance; tolerance technology in 1-D, 2-D and 3-D applications, techniques for robust design; quality assurance in engineering design: life cycle design, quality function deployment, causal networks and failure modes and effects analyses, ISO 9001 and traceability of critical decisions.

Unit 2, Control: Upon completion of this unit, students should be able to design simple control systems to start-up, shut-down and regulate the motion of a range of mechanical, electrical and hydraulic engineering systems commonly found in engineering practice, and to make effective use of computational aids for the design of these control systems.

Topics covered include sequence controllers, ladder diagrams, and PLCs; a review of mathematical representations of linear continuous dynamical systems and the relationships between model properties and system response characteristics; design specifications and strategies for linear control systems; and classical compensator design using root locus and frequency response techniques: lag, lead, lag-lead, PID, cascade and feedback compensation. Application of Matlab or similar software as a systems design tool.

Assessment: Two examination papers not exceeding two hours each; tests, continuous assessment of projects, assignments and laboratory reports not exceeding 40 pages. All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of assessment components at the beginning of semester.

436-371 Mechatronics Design and Laboratory 4

Credit points: 12.5

HECS-band: 2

Coordinator: Mr.J.Weir

Prerequisites: Students will be expected to be familiar with material covered in 431-204 Digital Systems 2: System Design, 431-210 Circuit Analysis, 436-353 Mechanics 2, and 436-381 Mechatronics Design and Laboratory 3.

Contact: Twenty-eight hours of lectures and case studies, 12 hours of practical work in engineering design and eight hours of tutorials and laboratory work (*Semester 2*).

Description: Unit 1, Engineering Design: Upon completion of this unit, students should have gained an appreciation for synthesising solutions to open-ended design problems at an intermediate level of complexity in mechanical and manufacturing engineering; a deep understanding of the concepts and methods of designing for system and component integrity under conditions of fatigue and wear; and a deep understanding of information-based techniques for the management of engineering design.

Topics covered include general concepts of function, integrity, value, quality, efficient use of resources in the synthesis of solutions to design problems; design for fatigue: characteristics of fatigue fracture, 2-D and 3-D stress conditions, cumulative damage hypothesis, Weibull distribution; design for wear: surface phenomena and tribology in design, application to bearings and seals; and management of the design process: initial appreciation, information flows and networks, characteristics of manufacturing processes affecting product design.

Unit 2, Control: Upon completion of this subject, students should be able to apply a systems approach to the design and specification of data acquisition and control systems; have an appreciation of the characteristics of a range of sensors and actuators; and have gained experience in system identification and control.

Topics covered include structure of computer-controlled systems; characteristics of some common analog and digital sensors and actuators; signal conditioning, amplification and filtering; analog-to-digital conversion, sample rates and aliasing; signal processing, digital filtering, implementation of simple control algorithms; programming for real-time operations, interrupts; and cases studies in system identification and control, including the effects of common nonlinearities.

Assessment: Two examination papers not exceeding two hours each; tests, continuous assessment of projects, assignments and laboratory reports not exceeding 40 pages. All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of assessment components at the beginning of semester.

436-405 Advanced Control Systems

Credit points: 6.25

HECS-band: 2

Coordinator: Prof.M.Good

Prerequisites: 436-433 Mechanical Systems or equivalent

Contact: Eighteen hours of lectures and six hours of tutorial and laboratory work (*Semester 2*).

Description: Upon completion of this subject, students should be able to design analog and digital controllers for advanced mechanical engineering systems modelled by linear multi-variable systems; and demonstrate a knowledge and understanding of several advanced control system topics.

Topics covered include linear multivariable control systems: LQR steady-state optimal control, optimal estimation, multivariable control system design; and nonlinear control system analysis and design, adaptive control systems, fuzzy control systems.

Assessment: A 2-hour examination (50%); tests, assignments and laboratory reports not exceeding 15 pages including computations, diagrams, tables and computer output (50%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-406 Rotor Dynamics

Credit points: 6.25

HECS-band: 2

Coordinator: Dr J Krodkiwski

Prerequisites: 436-354 Mechanics 3 and 436-431 Mechanics 4 or equivalents.

Contact: Twenty-four hours of lectures (*Semester 2*).

Description: Upon completion students should be able to formulate mathematical models of machine sub-systems (shafts, bearings, rigid and elastic elements, foundations); be able to create a mathematical model of a complex rotor-bearing foundation system including the dynamic properties of its sub-systems, unbalanced forces, environmental excitation and accuracy of manufacturing; and be able to carry out analysis of the formulated mathematical models to assess equilibrium positions, critical speeds and stability of motion of the rotor system.

Topics covered include modelling of shafts, rigid and elastic elements, oil bearing and foundations; composition of mathematical model of rotor systems; condensation techniques; analysis: equilibrium position, response to the external excitation, free vibration, stability of equilibrium position; influence of internal and external damping; influence of the gyroscopic effect; and rotors with non-circular cross-sections.

Assessment: One 2-hour examination (75%), assignments (15%) and reports (10%) not exceeding 15 pages including computations, diagrams, tables and computer output.

436-407 Advanced Fluid Mechanics

Credit points: 6.25

HECS-band: 2

Coordinator: Assoc.Prof.M.Chong

Prerequisites: 436-432 Thermofluids 4 or equivalent

Contact: Twenty hours of lectures and four hours of practice classes (*Semester 2*).

Description: Upon completion, students should be able to understand and apply theories and techniques which are at the forefront of fluid mechanics research.

Topics include theories of turbulence, flow pattern topology; critical point theory; and vortex dynamics.

Assessment: One examination not exceeding three hours (100%).

436-408 Advanced Mechanics of Solids

Credit points: 6.25

HECS-band: 2

Coordinator: Dr.A.Afaghi

Prerequisites: 436-431 Mechanics 4 or equivalent

Contact: Twenty-four hours of lectures (*Semester 2*).

Description: Students completing this subject should have a deeper understanding of the finite element method and develop advanced analysis skills in the other topics selected.

The content of the subject will comprise a selection from the finite element method and its application to practical problems in stress analysis; bending and buckling of plates and shells, anisotropic elasticity and its application to composite materials; viscoelasticity; and engineering plasticity.

Assessment: A 2-hour examination (80%) and assignments not exceeding 10 pages including computations, diagrams, tables and computer output (20%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-409 Power Generation Systems

Credit points: 6.25

HECS-band: 2

Coordinator: Prof H Watson

Prerequisites: 436-403 Thermofluids or equivalent

Contact: Twenty hours of lectures and four hours of practice classes (*Semester 2*).

Description: Upon completion, students should be able to analyse and design a range of energy processes or utilisation equipment and to appreciate the directions in which the technology will evolve for improved performance and/or operating economics.

The contents of this course will comprise selections from steam turbines, boiler design and control characteristics; cycle optimisation; economics of plant operation; gas turbines; cycle performance; stationary and aircraft gas turbines; working fluids in open and closed cycles; component matching and off-design operation; engines; ideal air and fuel-air cycles; effect of fuel composition, dissociation and heat transfer on efficiency; characteristics of spark ignition and diesel engines; advanced engine simulation; abnormal combustion; solar energy; absorptivity and transmissivity, selective surfaces and surface treatment; thermal performance of collectors; cost analyses; unsteady gas dynamics; isentropic and non-isentropic wave propagation; one-dimensional unsteady compressible flow; pressure exchangers and exhaust systems; generalised thermodynamic property relations; Maxwell's equations, Gibbs free energy and fugacity; estimation of plant performance using rare working fluids; turbocharging; compressor and turbine characteristics; turbine performance; and turbo-charger/engine matching.

Assessment: One 2-hour examination (65%), assignments and laboratory reports not exceeding 15 pages including computations, diagrams, tables and computer output (35%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-412 Manufacturing Science 2

Credit points: 12.5

HECS-band: 2

Coordinator: Dr. A.Smith

Prerequisites: Students are expected to be familiar with the material of 436-363 Manufacturing Studies 2 and 436-364 Manufacturing Science 1.

Contact: Thirty lectures and 18 hours of tutorial and laboratory classes (*Semester 1*).

Description: Unit 1, Metal Forming: Upon completion, students should be prepared for a career in the manufacturing industry, with an in-depth knowledge of methods used in the theory of plasticity and lubrication. There will be an assignment in designing a manufacturing process for a typical net-shape forming operation. It is expected that students will understand the principles of designing tools for metal forming.

Topics covered include a selection from principles and applications of plasticity theory; analysis of metal forming processes such as heading, extrusion and forging; friction in metal forming; lubrication; non-traditional methods of metal forming; high energy rate and high velocity forming; applications of CAD/CAM; and experimental verification of forming parameters.

Unit 2, Material Removal: Upon completion, students should understand: the basic cutting action, performance, capabilities and latest development in abrasive processes; the development and computerisation of fundamental mechanics of cutting models for the major machining operations such as milling for tool design and performance prediction.

Topics covered include a selection from abrasive processes: grinding, honing, lapping and super finishing; bulk material removal processes: mechanics of cutting; analyses of single point and multi-point tool processes; machining with form tools, turning, drilling, milling and rotary tool operations.

Assessment: Two 2-hour examinations (50%), assignments, tutorial problem sheets and laboratory reports not exceeding 15 pages including computations, diagrams, tables and computer output (50%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-413 Manufacturing Science 3

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.A.Smith

Prerequisites: 436-363 Manufacturing Studies 2 and 436-412 Manufacturing Science 2, or equivalents

Contact: Thirty-two lectures, six tutorials and 10 hours of laboratory (*Semester 2*).

Description: Unit 1, Casting Processes: Upon completion, students should understand the processes of moulding, casting and powder metallurgy as practised by industry and be able to identify and use methods for detecting defects and improving process performance.

Topics covered include sand casting, investment casting, permanent mould casting, pressure die casting, semi-solid casting and continuous casting; design factors: feeding, running and gating, solidification, solidification contraction and porosity; geometric factors; simulation software; and powder metallurgy processing.

Unit 2, Material Removal: Upon completion, students should understand the fundamentals of tool wear, tool-life and computer-based optimisation of single and multi-pass machining operations for use in process planning.

Topics covered include wear theories and tool-life; machinability of materials; computer-aided prediction of machining performance; economics of material removal processes: objective functions and constrained optimisation of process variables for single and multi-pass machining operations such as turning, drilling and milling; and computer-aided optimisation for off-line process planning and canned cycles for CNC machine tool controllers.

Assessment: Laboratory, tutorial work and assignments not exceeding 20 pages including computations, diagrams, tables and computer output (67%), and tests (33%). Students will be notified of the weighting of the non-test assessment components at the beginning of semester.

436-414 Optimisation for Productive Systems

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc.Prof.A.Wirth

Prerequisites: 200-level Mathematics and 620-370 Statistics for Mechanical Engineers or equivalent

Contact: Twenty-four lectures and 24 hours of tutorial/practice classes (*Semester 1*).

Description: Upon completion, students should be able to model and solve a wide range of decision-making problems for productive systems such as facility location and layout, transportation and storage and retrieval, service facility configuration, inventory reorder points, lot-sizing, equipment replacement and production planning by applying the techniques of mathematical programming, network analysis and heuristic problem solving, using a range of optimisation software tools.

Topics covered include networks, goal programming and facility location, facility layouts using quadratic programming, heuristic solutions to machine sequencing and storage and retrieval problems, decision theory and production planning under risk, queuing models for service facilities, simulation of productive systems, inventory management, equipment replacement and Markov processes.

Assessment: One 3-hour examination (70%), assignments not exceeding 15 pages including computations, diagrams, tables and computer output (30%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-415 Quality and Reliability

Credit points: 12.5

HECS-band: 2

Coordinator: Dr A Smith

Prerequisites: 620-370 Statistics for Mechanical Engineers or 620-001 Statistics for Engineers (1995-1998), or equivalent

Contact: Thirty-four lectures and 14 hours of tutorial/practice class work (*Semester 1*).

Description: Upon completion of this subject, students should be able to understand what constitutes a quality system (both generally and with respect to international standards); develop strategies for implementing a quality system and its components; identify quality costs and use them for the economic analysis of quality projects; understand and quantify the relationships

between process capability and tolerances; design a 'single' attribute or variables sampling scheme to meet stated requirements, analyse and assess all common types of sampling schemes; design, analyse and interpret 'Shewhart-type' process control charts and CUSUMS for process control; develop a working knowledge of modern approaches to the management of reliability and maintenance, including the vital role of the quality of design; and develop the ability to undertake various analyses associated with reliability, preventative maintenance, and the selection of alternative plant and maintenance strategies.

Topics covered include total quality management, productivity and cost relationships; quality systems and their components, including international standards; interaction between quality and design functions; alternate systems approaches, including leading international concepts; quality control: the control function in quality; theory of sampling; the operating characteristic curve; the use of statistical distributions; sampling scheme design and analysis; quality improvement: process variability - measures and interaction with design; process capability and improvement studies; control charting; state of statistical stability; computerisation of process monitoring; cumulative sum techniques for quality studies; experimental design for quality improvement; reliability: failure determination and measures; failure frequency distributions; maintenance: probabilistic methods in design, analysis for optimal maintenance organisation; and design and organisation for humans to improve availability.

Assessment: One 3-hour examination (70%), assignments and reports not exceeding 40 pages including appendices, computations, diagrams, tables and computer output (30%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-416 Manufacturing Systems

Credit points: 12.5

HECS-band: 2

Coordinator: Prof.M.Good

Prerequisites: 436-361 Manufacturing Control and System, or equivalent

Contact: Thirty hours of lectures and 18 hours of tutorials/practice classes (*Semester 2*).

Description: Upon completion of this subject, students should comprehend the application of computers in manufacturing systems, have knowledge of alternative software procedures, understand the value of integrated manufacturing systems, identify systems and their interactions through knowledge of the concepts, and have gained experience in applying control concepts through case studies. Students should also be able to understand the structure and characteristics of computer numerical control systems and their servo drives; relate machine tool contouring errors to servo drive characteristics; and plan for and write simple part programs using standard NC code.

Topics covered include machine tool drives and their control; design considerations, performance criteria, feedback compensation, mathematical modelling, computer control; manufacturing systems: flexible manufacturing, computer integrated manufacturing, hierarchical control, interfaces with CAD systems; structure of NC and CNC motion control systems for manufacturing; and numerical control: requirements for NC programming; NC codes according to international standards; NC programming.

Assessment: One 3-hour examination (50%); assignments and class presentations not exceeding the equivalent of 40 pages including computations, diagrams, tables and computer output (50%). Students will be notified of the weighting of assessment components at the beginning of semester.

436-420 Engineering Design

Credit points: 12.5

HECS-band: 2

Coordinator: Dr.C.Burvill

Prerequisites: 436-356 Design/Control 2 or 436-358 Design/Control - Environmental and 436-363 Manufacturing Studies 2, or equivalents

Contact: Eight hours of lectures and 40 hours of practical project engineering (*Year long*).

Description: Upon completion, students should have learned to liaise with industrial clients, and to identify and define complex engineering problems with a special focus on engineering design in mechanical and manufacturing engineering. In the course of this work students will be guided in the synthesis of solutions to these problems while learning to adopt a professional approach to engineering problem solving through writing, proposals, making bids, setting, targets and schedules for meeting these targets, managing projects in accordance with agreed schedules, and reporting on the results achieved; gained an appreciation of the application of theoretical and practical knowledge to a wide range of design problems in mechanical and manufacturing engineering. The total work content in the engineering project represents approximately 100 person hours of effort per student.

Topics covered include the design process; invention and innovation, conceptual design; design strategies; topological and mathematical models; reliability, probabilistic methods in design; integration of design and manufacturing; quality and fitness for purpose; design project management, and concurrent engineering.

Assessment: A professional engineering project report of no more than 8000 words with no more than 40 pages of supporting material in the way of appendices, diagrams, tables, computations and computer output (80%). One lecture assignment not exceeding 400 words (10%). One professional presentation of the work completed in the engineering project (10%).

436-422 Research Project

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc. Prof.J.Williams

Contact: Forty-eight hours (*Year long*).

Description: Upon completion, students should have the ability to apply the knowledge gained in other subjects to a real engineering investigative problem; and have gained experience in working collaboratively, collating background data beyond the scope of coursework, making engineering decisions, and reporting the results of their investigations.

The course involves undertaking a major project requiring an independent investigation and the preparation of a report on an approved advanced topic in engineering.

Assessment: Work during the project (40%); oral presentations (15%) and a written engineering report of no more than 8000 words with no more than 40 pages of supporting material in the way of appendices, diagrams, tables, computations and computer output (45%).

436-423 Research and Design

Credit points: 12.5

HECS-band: 2

Coordinator: Prof.H.Watson

Prerequisites: 436-356 or 436-358 Design/Control 2 and 436-363 Manufacturing Studies, or equivalents.

Contact: Forty-eight hours of directed research and project engineering (*Semester 1, repeat 2*).

Description: Upon completion students should have learned to liaise with industrial clients, be able to identify and define complex engineering problems; developed the ability to apply the knowledge gained in other subjects to a real engineering investigative problem; and gained experience in working collaboratively, collating background data beyond the scope of coursework, making engineering decisions, and reporting the results of their investigations.

The course involves undertaking a major project requiring an independent investigation with both research and design components and the preparation of a report on an approved advanced topic in engineering. The total work content in the engineering project represents approximately 120 person-hours of effort per student.

Assessment: A professional engineering project of no more than 8000 words with no more than 40 pages of supporting material in the way of appendices, diagrams, tables, computations and computer output (85%). One professional presentation of the work completed in the engineering project (15%).

436-431 Mechanics 4

Credit points: 12.5

HECS-band: 2

Coordinator: Dr K Brown

Prerequisites: 436-354 Mechanics 3 or equivalent

Contact: Forty lectures and eight hours of tutorials and laboratory work (*Semester 1*).

Description: Unit 1, Mechanics of Solids: Upon completion, students should be able to formulate physical and mathematical models of mechanical systems for stress analysis, obtain solutions using analytical and/or numerical methods and have an increased understanding of the stress analysis of complex structures.

Topics covered include mathematical theory of elasticity in three dimensions; reduction to two dimensions; plane stress and plane strain; Airy's stress function and its application to practical problems; finite difference and finite element methods; and torsion.

Unit 2, Dynamics: Upon completion, students should be able to formulate physical and mathematical models of mechanical systems for vibration analysis, obtain solutions using analytical and/or numerical methods and have an increased understanding of vibration analysis of complex structures.

Topics include vibration of discrete and continuous systems; modal analysis; vibration isolation; torsional and bending vibrations; vibration absorbers; and system identification.

Assessment: Two 1.5-hour examinations (80%) and laboratory reports not exceeding 20 pages including computations, diagrams, tables and computer output (20%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-432 Thermofluids 4

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc.Prof.M.Chong

Prerequisites: 436-352 Thermofluids 3 or equivalent

Contact: Thirty-six hours of lectures and 12 hours of laboratory classes (*Semester 1*).

Description: Upon completion, students should have gained the ability to analyse and design a wide range of fluid mechanical devices and comprehend several fundamental engineering problems through analysing and studying boundary layers and turbulence; and understand the principles of operation and optimisation of combustion and air conditioning equipment for improved performance, including the quality of the air environment or workplace.

Topics covered include wing theory: Prandtl lifting line; three-dimensional effects; aircraft performance; propellers, jets and fans and pumps; waves, ship resistance; model testing; wave resistance, ocean waves; boundary layers: Navier-Stokes equations; Prandtl's assumptions; Laminar solutions; Von Karman's momentum integral equation; transition; turbulence; turbulent boundary layers; turbulent flow in pipes and ducts; mass transfer, air conditioning and refrigeration; applications to heating, cooling, humidification and dehumidification; combustion; equilibrium and rate controlled reactions; ignition, stability and flammability limits; detonation, premixed and diffusion flames; radiation in combustion; and pollution control.

Assessment: Two 1.5-hour examinations (75%); assignments and laboratory reports not exceeding 20 pages including computations, diagrams, tables and computer output (25%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-433 Mechanical Systems

Credit points: 12.5

HECS-band: 2

Coordinator: Prof M Good

Prerequisites: 436-356/358 Design/Control 2/2E or equivalent

Contact: Thirty-six lectures and 12 hours of tutorial and laboratory work (*Semester 1*).

Description: Unit 1, Control Systems: Upon completion of this unit, students should be able to understand the concepts of state space control and estimation; obtain state-space realisations of systems in several canonical forms and assess their stability, controllability and observability; design a state feedback control law and a state estimator to achieve desired closed-loop response characteristics; design simple digital controllers for single-input single-output systems using classical and state-space methods; and demonstrate familiarity with the structure, components and programming of practical controllers, and the effects of sampling rate and amplitude quantisation.

Topics covered include state-space design; analysis: representation, transformations, canonical forms; solution of state-space equations; stability, controllability, observability; design: pole-placement design of controllers and state estimators; comparison with classical control design; digital control theory: sampling theory, z-transforms, time- and z-domain analysis; bilinear transformation and frequency domain design; root locus design in z-plane; PID control; pole placement design using state-space and polynomial methods; control technology; digital control system hardware and real-time software development, implementing control loops with PCs and PLCs; and case studies: detailed examination of digital control issues for a representative mechanical engineering system, such as a fuel injection controller.

Unit 2, Professional Practice: Upon completion of this unit, students should have developed an appreciation of the role of technology in society, the responsibilities of engineers with respect to their fellow workers, society and the environment.

Topics covered include science and technology; historical, sociological and environmental factors in invention and innovation; technology forecasting; patenting; the engineering profession and professional ethics; statutory requirements and legal responsibilities; and new technology and the environment, workforce and human relations.

Assessment: One 3-hour examination (50%); tests, assignments and laboratory reports, not exceeding 40 pages including computations, diagrams, tables and computer output (50%). All components of assessment must be satisfactorily completed to pass the subject. Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-434 Mechatronic Systems and Data Fusion

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc.Prof.S.Halgamuge

Prerequisites: This is an advanced final-year elective. Familiarity with the content of prescribed subjects in the first four years of the mechatronics or manufacturing course will be assumed.

Contact: Twenty-four hours of lectures and 24 hours of seminars (*Semester 2*).

Description: Upon completion, students should have gained an overview of systems engineering concepts and their relevance to mechatronics, and their application in intelligent machines and manufacturing systems. Students

should also have gained an overview of basic concepts of data mining and data fusion in their relevance to mechatronic systems.

Topics covered include general systems concepts, overview of mechatronic system design methods, system architectures; concurrent engineering; hardware-software co-design, embedded systems; mechatronic system modelling techniques, systems engineering approaches in computer-integrated manufacturing and flexible manufacturing systems; concepts of data fusion and data mining with particular emphasis to robotics and automotive applications; integration in micro-electromechanical systems; introduction to nano-technology; and case studies.

Assessment: One 3-hour examination (70%); assignments and seminar presentations not exceeding the equivalent of 20 pages including computations, diagrams, tables and computer output (30%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-435 Bioengineering

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering

Credit points: 12.5 **HECS-band:** 2

Coordinator: Assoc.Prof.S.Halgamuge

Contact: Twenty-four hours of lectures and 24 hours of tutorials and project work (*Semester 2*).

Description: Unit 1: Bioengineering: Students should gain an understanding of the structure and function of the skeletal, muscular and sensory systems of the human body, insofar as they respond to the forces of impact, vibration and acceleration, biomechanical analysis of the human body, elementary design procedures for sound isolation and protection and some aspects of design for radiation hazards.

Topics covered will comprise a selection from structure and function of the body; effects of force and vibration on the human body; hearing and the auditory environment; vision and illumination; structural and functional biomechanics; and effects and control of ionising radiation.

Unit 2: Bioinformatics: Upon completion students should gain a basic understanding of the hierarchical organisation and information encoding of biological sequence data, use of interdisciplinary technological and computational methods to analyse DNA and protein data of different organisms, and the impact of such developments on the engineering and pharmaceutical industries.

Topics covered will include a selection from biological sequence data modelling; DNA and protein data analysis; motif detection, extraction and interpretation; computational and functional aspects of 3-dimensional protein structures; micro-array technology and clustering; and bio-inspired computing and engineering.

Assessment: Unit 1: One 1.5-hour test at the end of semester (100%). Unit 2: One 1.5-hour test at the end of semester (70%) and marked project work (30%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-436 Robotics and Computational Mechanics

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Assoc.Prof.M.Chong

Prerequisites: 431-202 Engineering Analysis B (prior to 2001, 421-205 Engineering Analysis B), 431226 Engineering Analysis B(old) or equivalent

Contact: Thirty-six hours of lectures and 12 hours of practice classes (*Semester 2*).

Description: Unit 1, Robotics: Upon completion, students should understand the classification and function of the spectrum of robots; have skill in devising methods for enhancing the performance of several robot types; and appreciate the bases of the long-term development of robots in industry.

Topics covered include a selection from overview and classification of robot systems: pick and place devices, continuous path manipulators; robot vision, voice actuators, obstacle avoidance, movement strategies; programming and response: from point programming, teach mode programming, space and tool coordinates, programming for flexible manufacture, human factors in the management of robot systems; kinematics of robot arms; multi-degree-of-freedom manipulators; industrial task description and robot requirements; dynamics; six-degree-of-freedom robot arms, non-linear systems, real time dynamics, predicted limits to performance; and control: motion resolvers, passive compliant devices, obstacle avoidance control, force feedback and vision control.

Unit 2, Advanced Computational Mechanics: Upon completion, students should be able to comprehend a wide variety of numerical computational techniques for solving ordinary and partial differential equations frequently encountered in engineering problems and identify the strengths and weaknesses of the various competing computational methods.

Topics covered include modelling engineering systems using ordinary and partial differential equations; finite difference schemes; and weighted residual methods and spectral methods.

Assessment: Two 2-hour examinations (60%); assignments, project and computer work not exceeding 20 pages including computations, diagrams, tables and computer output (40%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-437 Advanced Materials and Testing

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5 **HECS-band:** 2

Semester: Semester 1

Description: Unit 1, Materials: Upon completion students should understand the most common polymer and composite materials and develop an appreciation of the interrelationship between the structure, processing and properties of materials and of key factors in the selection of appropriate materials for specific applications.

Topics covered include basic concepts; the glass transition and secondary relaxations in amorphous and semi-crystalline polymers; fracture mechanics; impact; environmental stress cracking; crazing; creep; rational mechanical design data for polymers and composites; dielectric relaxation spectrometry; polymer blends; and case studies which illustrate the interdependence between component function, material properties, manufacturing processes and design.

Unit 2, Thermography: Upon completion, students should be able to describe the characteristics of common non-destructive materials tests and the role of thermography in NDT; relate the operation of thermographic equipment to the physics of infrared thermal radiation; understand the functioning of industrial infrared radiometers; and obtain meaningful thermograms and analyse the results.

Topics covered include common non-destructive tests; sources of heat; electromagnetic radiation; infrared sub-spectrum; construction of thermographic equipment; performance measures; requirements for quantitative assessment; operation of equipment; and analysis of thermograms.

436-438 Advances In Industrial Automation

Credit points: 12.5 **HECS-band:** 2

Coordinator: Assoc.Prof.S.Halgamuge

Prerequisites: This is an advanced final-year elective. Familiarity with the content of the prescribed subjects in the first four years of the mechatronics course will be assumed.

Contact: Thirty hours of lectures and seminars, 18 hours of industrial contact (*Semester 2*).

Description: Upon completion, students should have gained an appreciation of the state-of-the-art, in the application of mechatronics to industrial automation, current research challenges, and the structure of the industry in Australia and the rest of the world. Site visits and guest lectures from industry personnel are an important component of the subject.

Topics covered include the present status and forecast developments in industrial automation; needs, opportunities and challenges; developing a case for industrial automation and planning for implementation; marketing issues; review of available software and hardware options and development environments; and current developments in selected areas such as the use of machine vision and other advanced sensing in industrial automation, intelligent actuators, distributed sensing and actuation, intelligent highway-vehicle systems, computer and communication networking, the use of multiple agent systems in automation.

Assessment: One 3-hour examination (50%); assignments and seminar presentations not exceeding the equivalent of 30 pages including computations, diagrams, tables and computer output (50%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-450 Mechatronics Design and Laboratory 5

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr.C.Burvill

Prerequisites: 436-371 Mechatronics Design and Laboratory 4 or equivalent

Contact: Eight hours of lectures and 40 hours of design practice classes (*Year long*).

Description: Upon completion students should have learned to liaise with clients, to identify and define complex mechatronic design problems of concern to the client and synthesise solutions to these problems; learned to adopt a professional approach to engineering problem solving through writing proposals, making bids, setting targets and schedules for meeting these targets, managing projects in accordance with agreed schedules and reporting on the results achieved; and have gained an appreciation of the application of theo-

retical and practical knowledge to a wide range of design problems involving the disciplines of mechatronics. The total work content in the engineering project represents approximately 100 person-hours of effort per student.

Topics covered include the design process; invention and innovation, conceptual design; design strategies; topological and mathematical models; reliability, probabilistic methods in design; integration of design and manufacturing; quality and fitness of purpose; and design project management; and concurrent engineering.

Assessment: A professional engineering project report of no more than 8000 words with no more than 40 pages of supporting material in the way of appendices, diagrams, tables, computations and computer output (80%). One lecture assignment not exceeding 400 words (10%). One professional presentation of the work completed in the engineering project (10%).

436-452 Mechatronics Project

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc.Prof.S.Halgamuge

Contact: Forty-eight hours (*Year long*).

Description: Upon completion, students should have gained experience in applying their knowledge in the disciplines of mechatronics to a real engineering investigative problem, working collaboratively, collating background data beyond the scope of coursework, making engineering decisions, and reporting the results of their investigations. The subject involves undertaking a major project requiring an independent investigation and the preparation of a report on an approved advanced topic in mechatronics. The project may be jointly supervised in any of the Departments of Mechanical and Manufacturing Engineering, Electrical and Electronic Engineering and Computer Science.

Assessment: Work during the project (40%); oral presentations (15%) and a written engineering report of no more than 8000 words with no more than 40 pages of supporting material in the way of appendices, diagrams, tables, computations and computer output (45%).

436-466 Renewable Energy

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering

Credit points: 12.5

HECS-band: 2

Coordinator: Dr K Brown

Contact: Thirty-two hours of lectures and 16 hours of practice classes (*Semester 1*).

Description: Upon completion students should understand the distribution and variability of the wind as an energy source, and the limitations of wind energy devices in harnessing this energy; and have developed a comprehension of wind turbine design parameters and skill in performance estimation and component design for a range of applications. Students should also understand the distribution of solar energy and the limitations that this places on the performance of solar energy systems; and comprehend the importance of materials and losses in the systems performance and have knowledge and skill in solar systems selection and design methods.

Topics covered include a selection from nature and availability of wind energy; wind turbines, classification, construction and control; performance evaluation methods; power, efficiency, reliability and cost; load matching; nature and availability of solar radiation; radiation estimations and measuring instruments; materials for solar energy utilisation, radiative properties and thermal transport properties; introduction to non-concentrating collectors, design techniques and performance estimation; solar component and solar system operational characteristics; practical applications of solar energy, special solar devices for developing countries; and desalination, photovoltaics and solar water pumping.

Assessment: One 3-hour examination (60%) and practical work not exceeding 20 pages including computations, diagrams, tables and computer output (40%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-467 Resources Applications & Environment

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5

HECS-band: 2

Coordinator: Prof H Watson

Contact: Thirty-two hours of lectures and 16 hours of practical/tutorial classes (*Semester 2*).

Description: Unit 1, Energy Resources: Upon completion students should comprehend the local and global extent of energy resources including the technical, economic and political limitations; appreciate energy source-to-end-use processes and how these can be improved through technology and societal organisation; understand the concepts of environmental impact stud-

ies in thermal, air pollution and waste disposal; and have an appreciation of advanced energy conversion processes.

Topics covered will include a selection from energy resources; conversion; thermal, solar, nuclear, wind and tidal; alternative fuels; conversion efficiencies; utilisation: efficiencies of conversion systems in current use in transportation, manufacturing processes and heating. Hybrid and stored energy systems; and environmental impact: aspects of air and thermal pollution and waste disposal problems.

Unit 2, Pollution Control: Upon completion, students should understand the basic chemistry of pollutant formation and ways in which changes to the reacting components can be used to control air pollutants; comprehend the difficulties of the measurement process as experimental methods for individual and regional sources; have skill in modelling a limited range of combustion processes; and have knowledge of methods which can be employed to minimise community costs of pollution control.

Topics covered include a selection from the nature of flames; liquid and solid fuel combustion; pollutant formation in combustion processes, parametric effects on concentrations; modelling methods; control measures; measurement methods, driving procedures and dynamometer tests for the emission of gaseous pollutants, particulate matter and air toxins from road vehicles and stationary engines; stationary and mobile emission inventories; modelling the urban mobile emission source; and methodology of least cost strategies for urban and global air pollution control.

Assessment: One 3-hour examination (60%); tests, assignments, practical work and seminars not exceeding 20 pages including computations, diagrams, tables and computer output (40%). Students will be notified of the weighting of the non-examination assessment components at the beginning of semester.

436-469 Refrigeration, A/C & Alternative Fuels

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5

HECS-band: 2

Coordinator: Prof H Watson

Prerequisites: 436-204 Systems Modelling, 436-352 Thermofluids 3 and 436-354 Mechanics 3 or equivalents.

Corequisites: 436-409 Power Generation Systems

Contact: Thirty-two hours of lectures and 16 hours of practice classes (*Semester 2*).

Description: Unit 1, HVAC: Upon successful completion, the student should be able to evaluate the suitability of a given heating, ventilating and air conditioning (HVAC) system for specific applications, be able to analyse and design refrigeration and air conditioning systems and understand the design optimisation process for a range of systems.

The content includes topics from applications of refrigeration and air conditioning, psychrometry and conditioning process, indoor air quality, heating and cooling loads, air conditioning and distribution systems, pumps and piping systems, cooling and dehumidifying coils, HVAC system control, acoustic and noise control, design for efficiency, vapour compression refrigeration system, refrigerant, multi-pressure systems, cooling towers, vapour absorption refrigeration systems, absorption systems, heat pumps and energy conservation.

Unit 2, Alternative Fuels: Upon completion, students should comprehend the special requirements for the preparation and burning of alternative fuels compared with their conventional counterparts; and appreciate the difficulties of storing, handling and the safety requirements of alternative fuels and have skill in performance testing of alternative fuels and in specifying designs for several applications.

Topics covered include combustion, emission, storage and other properties of alternative liquid and gaseous fuels as replacements for conventional fossil fuels; the special requirements of alternative fuels in burners, furnaces and in transport; engine-fuel matching, engine mapping as a tool for optimising energy and emissions for vehicle applications; and storage options, fuel degradation, environmental impacts.

Assessment: Two 2-hour examinations (50%); practical and project work not exceeding 20 pages including computations, diagrams, tables and computer output (50%). Weighting of the non-examination assessment components will be made known at the commencement of the subject. Students must pass both examinations and project work.

436-494 Directed Study A

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5

HECS-band: 2

Prerequisites: Selected 300-level subjects to be announced annually.

Contact: Thirty-two hours of lectures and 16 hours of tutorials and project work (*Not Offered*).

Description: Upon completion of this subject, students should be familiar with the basic precepts of a particular research topic in mechanical, manufacturing, mechatronic or environmental engineering.

The content of this subject will change from year to year and will be used to present new research-oriented topics in mechanical, manufacturing, mechatronic and environmental engineering, and will generally be presented by researchers who are visiting the department.

Assessment: One 3-hour examination, practice classes, tests, assignments, and project reports not exceeding 20 pages including computations, diagrams, tables and computer output. Students will be notified of the weighting of assessment components at the beginning of the semester.

436-495 Directed Studies B

Availability: This subject may not be offered every year, please refer to the Department of Mechanical and Manufacturing Engineering.

Credit points: 12.5 **HECS-band:** 2

Prerequisites: Selected 300-level subjects to be announced annually.

Contact: Thirty-two hours of lectures and 16 hours of tutorials and project work (*Not Offered*).

Description: Upon completion of this subject students should be familiar with the basic precepts of a particular research topic in mechanical, manufacturing, mechatronic or environmental engineering.

The content of this subject will change from year to year and will be used to present new research-oriented topics in mechanical, manufacturing, mechatronic and environmental engineering, and will generally be presented by researchers who are visiting the department.

Assessment: One 3-hour examination, practice classes, tests, assignments, and project reports not exceeding 20 pages including computations, diagrams, tables and computer output. Students will be notified of the weighting of assessment components at the beginning of the semester.

436-610 Refrigeration & Air Conditioning

Credit points: 6.25 **HECS-band:** 2

Coordinator: Prof H Watson

Prerequisites: Students are expected to be familiar with the material of 436-205 Computational Mechanics and Programming, 436-306 Dynamics of Machines or equivalent and 436-308 Thermodynamic Plant and Processing

Contact: Twenty-four hours of lectures and 12 hours of tutorials (*Semester 2*).

Description: Upon successful completion, the student should be able to evaluate the suitability of a given heating, ventilating and air conditioning (HVAC) system for specific applications, be able to analyse and design refrigeration and air conditioning systems and understand the design optimisation process for a range of systems.

The content includes applications of refrigeration and air conditioning, psychrometry and conditioning process, indoor air quality, heating and cooling loads, air conditioning and distribution systems, pumps and piping systems, cooling and dehumidifying coils, HVAC system control, acoustic and noise control, design for efficiency, vapour compression refrigeration system, refrigerant, multi-pressure systems, cooling towers, vapour absorption refrigeration systems, absorption systems, heat pumps and energy conservation.

Assessment: A written examination not exceeding three hours at the end of the semester. Project work, producing a report of about 20 pages. Weighting of assessment components will be made known at the commencement of the subject. Students must pass both examinations and project work.

436-621 Air Pollution From Combustion Processes

Credit points: 6.25 **HECS-band:** 2

Coordinator: Professor H. C. Watson

Contact: Twenty-four hours of lectures and 12 hours of practice classes (*Semester 2*).

Description: Upon completion, students should understand the basic chemistry of pollutant formation and ways in which changes to the reacting components can be used to control air pollutants; comprehend the difficulties of the measurement process as experimental methods for individual and regional sources; have skill in modelling a limited range of combustion processes; and have knowledge of methods which can be employed to minimise community costs of pollution control.

Topics covered include the nature of flames; liquid and solid fuel combustion; pollutant formation in combustion processes, parametric effects on concentrations; modelling methods; control measures; measurement methods, driving procedures and dynamometer tests for the emission of gaseous pollutants, particulate matter and air toxins from road vehicles and stationary engines; stationary and mobile emission inventories; modelling the urban mobile emission source; and methodology of least cost strategies for urban and global air pollution control.

Assessment: Two, 1-hour written tests; assignments, practice class and laboratory work to a maximum of 5000 words.

436-805 Solar Energy Engineering

Credit points: 6.25 **HECS-band:** 2

Coordinator: Dr K Brown

Contact: Sixteen hours of lectures and eight hours of practice classes (*Semester 1*).

Description: Upon completion students should understand the distribution of solar energy and the limitations that this places on the performance of solar energy systems; comprehend the importance of materials and losses in the systems performance; and have knowledge and skill in solar systems selection and design methods.

Topics covered include nature and availability of solar radiation; radiation estimations and measuring instruments; materials for solar energy utilisation, radiative properties and thermal transport properties; introduction to non-concentrating collectors, design techniques and performance estimation; solar component and solar system operational characteristics; and practical applications of solar energy, special solar devices for developing countries: desalination, photovoltaics and solar water pumping.

Assessment: One examination not exceeding 3-hours and practical work to a maximum of 5000 words or equivalent. Students will be notified of the weighting of assessment components at the beginning of semester.

436-807 Utilisation Of Alternative Fuels

Credit points: 7.14 **HECS-band:** 2

Coordinator: Professor H. C. Watson

Corequisites: 436-409 Power Generation Systems

Contact: Twenty-four hours of lectures and 12 hours of practice classes (*Semester 2*).

Description: On completion students should comprehend the special requirements for the preparation and burning of alternative fuels compared with their conventional counterparts; to appreciate the difficulties of storing, handling and the safety requirements of alternative fuels; and have skill in performance testing of alternative fuels and in specifying designs for several applications.

Topics covered include the combustion, emission, storage and other properties of alternative liquid and gaseous fuels as replacements for conventional fossil fuels; the special requirements of alternative fuels in burners, furnaces and in transport; engine-fuel matching, engine mapping as a tool for optimising energy and emissions for vehicle applications; and storage options, fuel degradation, environmental impacts.

Assessment: One examination not exceeding three hours and practical work to a maximum of 5000 words or equivalent. Students will be notified of the weighting of assessment components at the beginning of semester.

620-121 Mathematics A (Advanced)

See full subject details on page 4.

620-122 Mathematics B (Advanced)

See full subject details on page 4.

620-123 Applied Mathematics (Advanced)

See full subject details on page 4.

620-141 Mathematics A

See full subject details on page 5.

620-142 Mathematics B

See full subject details on page 5.

620-143 Applied Mathematics

See full subject details on page 5.

620-160 Experimental Design & Data Analysis

See full subject details on page 6.

620-201 Probability

See full subject details on page 6.

620-231 Vector Analysis

See full subject details on page 7.

620-232 Mathematical Methods

See full subject details on page 7.

620-252 Analysis

See full subject details on page 8.

620-331 Applied Partial Differential Equations

See full subject details on page 10.

620-332 Integral Transforms & Asymptotics

See full subject details on page 10.

620-370 Statistics for Mechanical Engineers

See full subject details on page 13.

640-121 Physics A (Adv)

See full subject details on page 2.

640-122 Physics B (Adv)

See full subject details on page 2.

640-141 Physics A

See full subject details on page 2.

640-142 Physics B

See full subject details on page 3.

730-104 Torts and the Process Of Law

See full subject details on page 1.

730-105 History and Philosophy of Law I

See full subject details on page 1.

730-115 History and Philosophy of Law II

See full subject details on page 1.

730-202 Contracts

See full subject details on page 1.