The University of Sydney

Faculty of Engineering

Handbook

1995

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Semester and vacation dates 1995

Semester	Day	1995
First Semester and lectures begin	Monday	27 February
Easter recess Last day of lectures Lectures resume	 Thursday Monday	 13 April 24 April
Study vacation—1 week beginning	Monday	12 June
Examinations commence	Monday	19 June
Second Semester and lectures begin	Monday	24 July
Mid-semester recess Last day of lectures Lectures resume	 Friday Tuesday	 22 September 3 October
Study vacation—1 week beginning	Monday	6 November
Examinations commence	Monday	13 November

Access

Potential students, students and their parents, industry and members of the public are invited to contact the Faculty of Engineering as follows:

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Faculty Building J13
The University of Sydney

Student Enquiry Office
Room 226, Faculty Building J13, tel. 351 2534

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  Room 335, CE Bdg J05, tel. 351 2127
- Electrical Engineering Foundation
  Room 606, EE Bdg J03, tel. 351 3659
- Warren Centre for Advanced Engineering
  Level 2, Faculty Building J13, tel. 3513752
- ASIIC (Australian Centre for Innovation and International Competitiveness)
  Level 2, Faculty Building J13, tel. 351 3934
- AGSEI (Australian Graduate School of Engineering Innovation) tel. 299 5699

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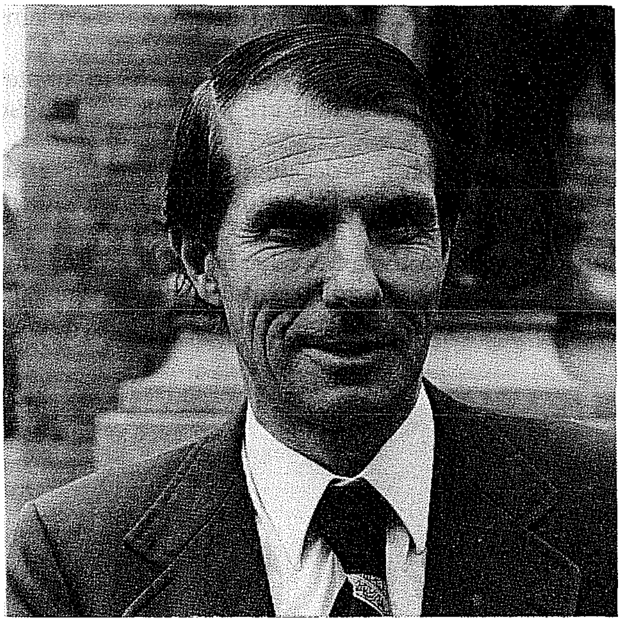
U3.755	MECHS OF FLIGHT 2	AE
U4.750	MECHS OF FLIGHT 3	AE
U4.453	MECHS OF POLYMER PROCESSG	ME
U2.701	MECHS OF SOLIDS 1	ChE
U2.443	MECHATRONIC DESIGN 1	ME/M
U3.067	MICROBIOLOGY	ChE
U1.455	MICROPRCSR CTRL OF MACHPNERY	ME
U4.475	MICROPRCSSRS IN ENGNRD PRODUCTS	ME/M
U4.546	MICROWAVE ENGG	EE/ISE

U4.631	MINERAL PROC. (EX MTLLRGY)	ChE
U4.630	MINERAL PROCXMIN. DRSSNG)	ChE
U3.810	NETWORK PLANNING	PEM
U4.812	OPERNS RES.	PEM
U4.022	OPTICAL FIBRES	EE/ISE
U4.692	OPTIMISN TECHNIQUES	ChE
U4.439	ORTHOPAEDIC ENG.	M
U4.005	PARTIAL DIFFERENTIAL EQUATNS	ME
U1.020	PHYSICS 1	EE
U1.021	PHYSICS IE	ME
U2.020	PHYSICS 2	ME/M
U2.021	PHYSICS 2EE	EE
U4.520	POWER CONVERSION CONTROL	EE/ISE
U3.522	POWER ELECTRONICS & DRTVES	EE/ISE
U4.526	POWER SYSTEM ANAL.	EE/ISE
U4.205	PRACT. EXPERIENCE	CE
U4.486	PRACT. EXPERIENCE	ME
U4.510	PRACT. EXPERIENCE	EE/ISE
U4.600	PRACT. EXPERIENCE	ChE
U4.793	PROBABILISTIC DES.	AE
U3.660	PROCESS CONTROL 1	ChE
U4.660	PROCESS CONTROL 2	ChE
U4.691	PROCESS SYSTEMS ENGG	ChE
U4.485	PROFESSIONAL COMMUNICATION	ME
U4.484	PROFESSIONAL ENGG.	ME/M
U4.697	PROFESSIONAL OPTION	ChE
U4.276	PROFESSIONAL PRACTICE	CE
U3.645	PROJECT ECONS	ChE
U4.640	PROJECT ENGG 2	ChE
U4.293	PROJECT FORMULATION	CE
U4.824	PROJECT FORMULN	PEM
U4.570	PROJECT MANAGEMENT	EE/ISE
U4.274	PROJECT PROCEDURES	CE
U3.212	PROPERTIES OF MATERIALS	CE
U4.770	PROPULSION	AE
U3.626	REACTION ENGG 1	ChE
U4.625	REACTION ENGG 2	ChE
U4.561	REAL-TIME COMPUTER SYSTEMS	ISE
U4.690	RESERVOIR ENGG	ChE
U3.284	RISK AND RELIABIITY ANALYSIS	CE
U4.470	ROBOTIC SYSTEMS	ME/M
U4.790	ROTARY WING AIRCRAFT	AE
U4.553	SATELLITE COMMUNICN SYST.	EE/ISE
U4.780	SEMINAR	AE
U4.632	SEPN. PROCESSES	ChE
U3.512	SIGNALS & SYSTEMS	EE/ISE
U3.562	SOFTWARE ENGINEERING	ISE/EE
U5.243	SOIL ENGG HONS	CE
U3.244	SOIL MECHANICS A	CE
U3.245	SOIL MECHANICS B	CE
U3.570	SPEECH & LANGUAGE PROCNG	EE/ISE
U1.220	STATICS	CE
U2.442	STATISTICS	ME
U3.235	STEEL STRUCTURES 1	CE
U4.238	STEEL STRUCTURES 2	CE
U5.224	STEEL STRUCT. HONS	CE
U3.222	STRUCT. ANALYSIS	CE
U2.290	STRUCT. DESIGN	CE
U4.237	STRUCTURAL DYNAMICS	CE
U5.234	STRUCT. DYNAMICS HONS	CE
U2.221	STRUCTURAL MECHANICS	CE
U3.250	SURVEYING 1	CE
U4.251	SURVEYING 2	CE
U5.253	SURVEYING HONS	CE
U3.450	SYSTEM DYNAMICS & CONTROL	ME
U4.452	SYSTEMS ENGG	ME
U4.420	THERMAL ENGG	Gen
U3.420	THERMO-FLU1D ENGG	ME
U3.421	THERMODYNAMICS	AE
U3.621	THERMODYNAMICS	ChE
U4.481	THESIS	ME
U4.680	THESIS	ChE
U4.202	THESIS 1	CE
U4.203	THESIS 2	CE
U5.204	THESIS HONS	CE
U4.785	THESIS OR DES. PROJECT	AE
U4.585	THESIS/PROJECT	EE/ISE
U3.523	TOPICS IN ELEC. ENG. DESIGN	EE/ISE
U4.699	TRANSPORT OPNS	AE
U3.646	TRANSPORT PHENOMENA	ChE
U3.271	TRANSPORTN ENGG & PLANNING	CE
U1.080	UNDERSTANDING DES.	Gen
U3.610	UNIT OPERNS 1	ChE
U4.610	UNIT OPERNS 2	ChE
U4.822	VALUE ENGG & RISK ANAL.	PEM
U4.266	WATER RESOURCES ENGG	CE

Message from the Dean



Welcome to the Faculty of Engineering of the University of Sydney, which is also known as the P.N. Russell School of Engineering in commemoration of itsmunificentindustrialistbenefactor,Sir Peter Russell. Over the past one hundred and ten years about ten thousand students have preceded you along the path you have chosen to follow towards professional engineering.

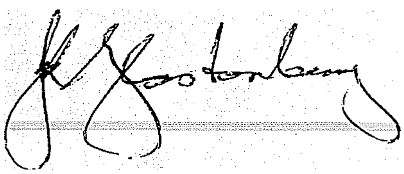
An aim of this faculty is to provide the best possible education for its students, both undergraduate and postgraduate. Undergraduate teaching is one of the highest expressions of education; for us, undergraduate teaching is a great social responsibility as well as an opportunity to produce engineers of the future who are both technically competent and socially aware.

In whichever of the five engineering branches you may choose to enrol, you will find that the engineer is concerned with applying scientific knowledge and exercising social skills. To do so with competence and assurance, we believe he or she should have a strong basis in science. Consequently, during the first two years of your course this scientific basis is laid down. This vital foundation, the soundness of which is the hallmark of the Peter Nicol Russell School, provides you with the ability you will depend on during your future professional career to appreciate the significance of new and developing technologies, and to work with them.

The engineer must operate in the real world of economic forces and social priorities. Engineering is a creative occupation: based on science applied wi th art and skill, and with the economic and social dimensions added.

You may have chosen to take engineering because you enjoy proficiency at mathematics and in the sciences, disciplines you probably find interesting and challenging. You perhaps have a liking for solving problems and making things. These are all characteristics of the engineer. Engineering is about meeting people too, and managing. Many engineers travel extensively; they tend to have high starting salaries and high career mobility; and they are greatly needed by the nation.

The course in engineering includes more classes and laboratory hours than most. It calls for steady and concentrated effort. Above all it is stimulating and exciting. Engineering students are a cohesive group who play hard, win more than their share of sporting trophies, and have a reputation for flair and initiative. This, too, is the essence of engineering. I congratulate you for joining us and I wish you well in your university life and professional career.



John Glastonbury
Dean

Introduction

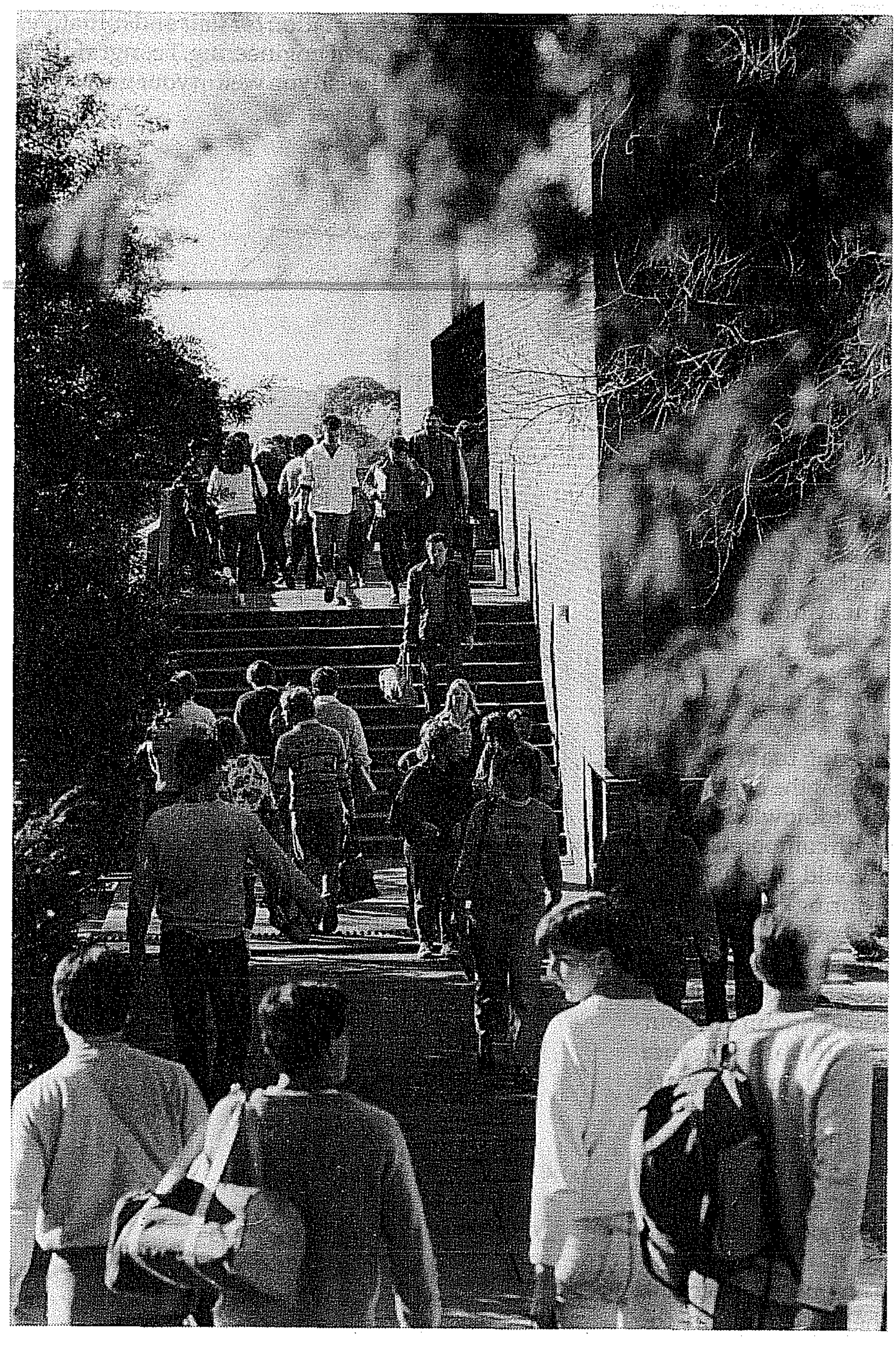
This is the Faculty of Engineering Handbook. In it we hope you will find most of what you need to know about the faculty. In particular, it will help you to know who the people in the faculty are; the requirements for degrees and diplomas in the faculty and the ways that these can be satisfied; what courses are offered, and the books required for them; and where to turn for more information, advice and help.

When making up your mind about your courses of study, look first at chapter 2 dealing with the various branches of engineering, and then at chapter 3, which sets out the requirements for the BE degree and explains how to go about selecting the courses of study.

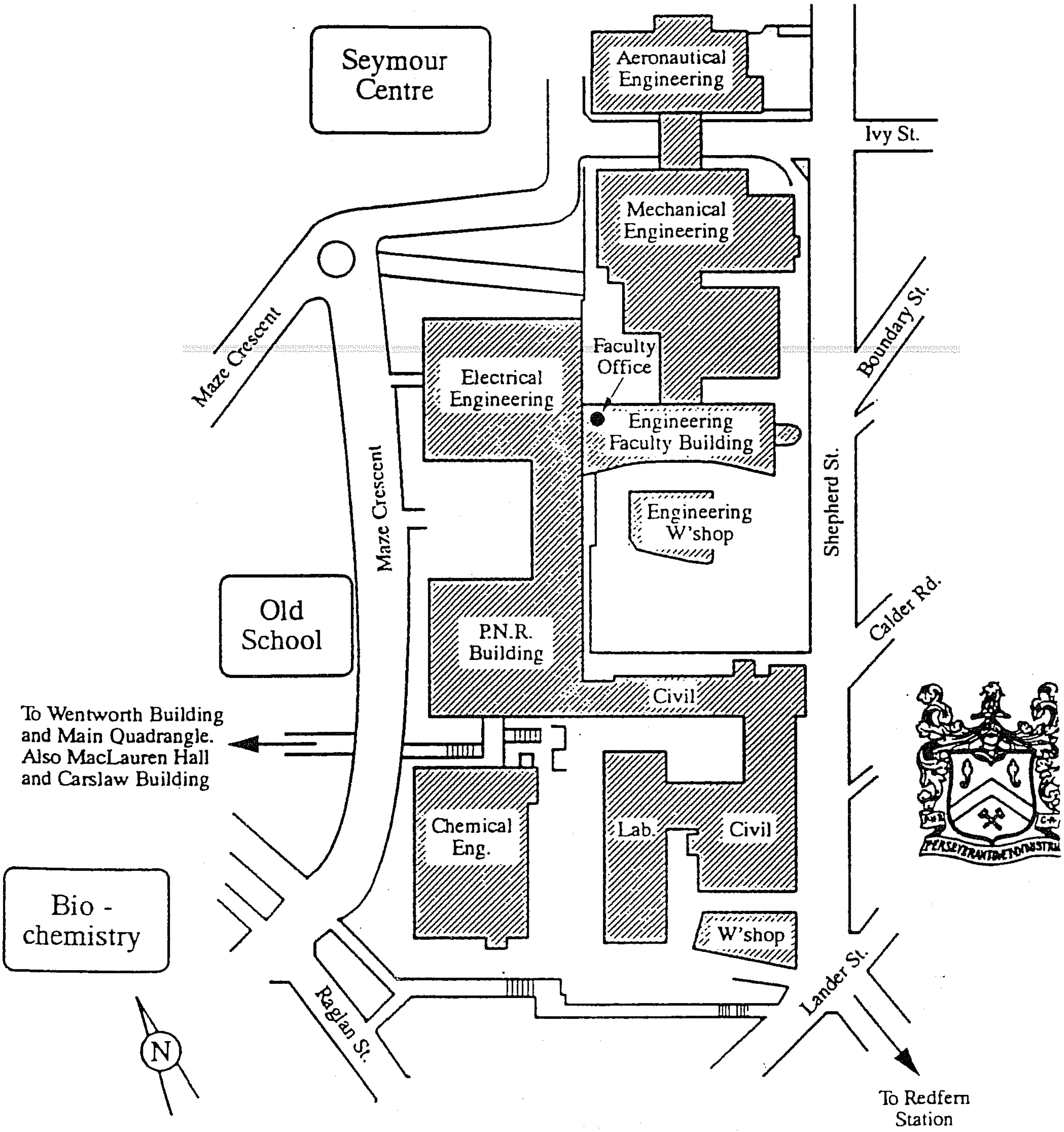
To obtain more detail on any course refer to chapter 4, where the course details are presented in course number order.

You may need help in deciding on the best courses for you to take—advice is available at the Faculty Office, Room 226, Engineering Faculty Building, or from Year Advisers.

Chapter 5 is a collection of other information about the faculty, such as special enrolment instructions, scholarships and prizes available, and professional societies.



The University of Sydney
FACULTY OF ENGINEERING



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1 Staff[1]

FACULTY AND DEPARTMENTS/ SCHOOLS

Dean
Professor John R. Glastonbury, BE MEngSc PhD, FIChemE FAIE MAusIMM FIEAust

Pro Dean
Professor John Robert Booker, BSc PhD DEng

Associate Dean (Research Development)
Professor Y.-W. Mai, Bsc(Eng) PhD *U.K.,* MASME HEAust

Associate Dean (Undergraduate)
Associate Professor Robin J. King, BEng *Sheff.* PhD *Lond.,* MIEE FIEAust FIREE

Advisers to Undergraduate Students
Aeronautical—all years—Professor G.P. Steven
Chemical—Junior and Intermediate—Dr B. Walsh, Dr K.C. Hughes
Senior—Associate Professor G.W. Barton
Senior Advanced—Associate Professor J.P. Barford
Civil—Junior and Intermediate—Mr N.L. Ings
Senior—Associate Professor A. Abel
Senior Advanced—Dr K.J.R. Rasmussen
Electrical—Junior and Intermediate—Ms K. Murphy
Senior—Dr H. Yee
Senior Advanced—Dr D. Pike
Mechanical—Junior—Dr C. Baillie
Intermediate—Mr P. McHugh
Senior—Dr D. Fletcher
Senior Advanced—Dr J.D. Atkinson

Faculty Manager
Ms Jenny Beatson, DipClinBiochem (NZ)

Student Administration Staff
Ms Joanne Lockwood, MA *N.S.W.*
Ms Anne Kwan, BA DipEd *Chinese H.K.*
Mrs Anna Maria Brancato
Mrs Nancy Chandra

Administrative Assistant (Secretary to the Dean)
Ms Josephine Harty, BA *Macq.*

Executive Officer, Engineering Advancement Office
Mr Jeremy M. Steele, BA *Keele*

Chancellor's Scholarships in Engineering Program
Executive Officer: Mrs Lee Jobling, MA

Administrative Assistant

Computer Engineer
Mr Kevin R. Rosolen, MSc *Macq.*

Computer Programmer
Mrs Lila Yassini

Professional Officer Grade II
DidierDebuf, BE *N.S.W.*

Faculty Librarian
Mrs Joan Morrison, BA MSLS *Case Western Reserve*

[1]Staff as known at November 1994

Aeronautical Engineering

Head
Professor Grant P. Steven

Administrative Assistant
Ms Yvonne Witting

Chemical Engineering

Head
Associate Professor Brian S. Haynes

Administrative Assistant
Mrs Kylie Wootton

Civil and Mining Engineering

Head
Professor John Robert Booker

Administrative Assistant
Ms Time Sperling

Electrical Engineering

Head
Professor Trevor W. Cole

Administrative Officer
Ms Kim L. Murphy, BA *N'cle(N.S.W.)* MEdAdmin *N.E.* GradDipSecStudies *C.C.A.E.*

Mechanical Engineering

Head
Associate Professor John Kent

Administrative Officer
Ms Karen Thompson, BA(SportsAdmin) *Canberra*

DEPARTMENTS OR SCHOOLS

Aeronautical Engineering

Lawrence Hargrave Professor
Grant P. Steven, BSc *Glas.* DPhil *Oxf.*
Appointed 1991

Senior Lecturers
Douglass J. Auld, BSc BE MEngSc PhD
Karkenahalli Srinivas, ME PhD *I.I.Sc.*

Lecturers
Daniel M. Newman, BE MEngSc
Kee-Choon Wong, BE PhD

Visiting Lecturer
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Part-time Lecturer
John Blackler, BE

Associate Lecturer
Osvaldo Querin, BE ME(Res)

Professional Officers
John Curtis, PhysicsDip *N.S.W.*
Nikos Pitsis, DipEng *Athens Polytechnic* BE MEngSc

Professional Assistant
Gabriel Gudas, BE *Bucharest*

Chemical Engineering

Professor
Rolf G.H. Prince, BE BSc *N.Z.* PhD, FIChemE HonFIEAust FTS FEng
Appointed 1969

ICI Australia/University of Sydney Professor of Process Systems Engineering
Jose Romagnoli, BE *N.delSur.Arg.* PhD *Minn.*
Appointed 1991

ANSTO/University of Sydney Professor of Risk Engineering
H. Mark Tweeddale, BE MEng *Melb.,* MIChemE MIMechE FIEAust CEng
Appointed 1988

Shell/University of Sydney Professor of Environmental Engineering
Danny D. Reible. BS *Lamar* MS PhD *Caltech* PE *Louisiana*
Appointed 1993

Associate Professors
David F. Bagster, BScApp BSc BE *Qld* PhD *Camb.,* FIEAust FIChemE CEng
John P. Barford, BE PhD *N.S.W.,* MIChemE FIEAust CEng
Geoffrey W. Barton, BE PhD
John R. Glastonbury, BE MEngSc PhD, FIChemE FAIE MAusIMM CEng
Brian S. Haynes, BE PhD *N.S.W.* (Director of Research)

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Barry W. Walsh, BE PhD, MIChemE CEng SPE

Technical Manager
Robert Staker, PhD *Add.*

Professional Officer Grade IV
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Honorary Appointments

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G. DeLeon; PhD, MAIMM GSA
Neville A. Gibson, MSc PhD, MRSChem ARACI FAusIMM CChem
Emeritus Professor Yao T. Tchan, IngAgricole *Grignon* DSc *Paris*

Honorary Associate
Ron F. Cameron, MSc DPhil *Oxf.,* ARCS

Honorary Professional Associate
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Civil and Mining Engineering

Challis Professor of Civil Engineering
Nicholas Snowden Trahair, BSc BE MEngSc PhD DEng, FIEAust
Appointed 1979

Professors
Harry George Poulos, AM, BE PhD DScEng, FIEAust FASCE FAA
Appointed 1982

Bhuslian Lai Karmaloo,BSc(Eng)i?flnc/n'MTechII.r. Bombay PhD *Moscow,* HEAust MASCE MASME
Appointed 1986

John P. Carter, BE PhD, MICE FIEAust
Appointed 1990

Professor of Engineering Mechanics
John Robert Booker, BSc PhD DEng, FIEAust
Appointed 1985

BHP Steel Professor of Steel Structures
Gregory J. Hancock, BE BSc PhD, FIEAust
Appointed 1990

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John P. Papangelis, BE PhD

Consultant for Design Studies
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Honorary Appointments

Emeritus Professor
A.E. Jenkins, BMetE MEngSc PhD *Melb.,* FIM FIEAust MAIMM MAIM

Honorary Associates
Peter T. Brown, BE PhD
Roger J. Enright, BE PhD *N.S.W.* MSc *W.Virginia*
Howard B. Harrison, BE PhD, MIEAust
Ian S.F. Jones, BE *N.S. W.* PhD *Wat.*
Harold Roper, BSc PhD *Witw.* MEngSc, MAIMM
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Electrical Engineering

P.N. Russell Professor
Trevor William Cole, BE *W.Aust.* PhD *Camb.,* FIEAust
Appointed 1980

Professor
David Hill, BE BSc *Qld* PhD *N'clefN.S.W.),* FIEAust HEEE

Associate Professors
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James G. Rathmell, BSc BE PhD, SMIREE
Jonathan B. Scott, BSc BE MEngSc
Hansen Yee, BSc BE PhD, MIEEE

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Mark Hedley, BE BSc PhD
Mark Johnson, BSc BE PhD
Philip Heng Wai Leong, BE BSc PhD
Swamidoss Sathiakumar, BSc *American Coll. India* BE ME PhD *U.Sc.*
Graham E. Town, BE *N.S. W.I.T.* PhD, MIEEE MIREE

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Peter J. Seebacher, BAppSc *N.S.W.IT.* MEngSc
Robert G. Sutton, ME *N.S. W.*

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Michael Rados, BSc BE MEngSc
Ali Raghemi-Azar, BSc *Tehr. Polytechnic* MSc PhD *S'ton*
Gagarin Vasimalla, BTech *Warangal* MTech *I.l.T. Bombay*

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Yew Tai Chieng, BE MES *Melb.*
Geoff Crapps
Victor W. Smith, BE *N.S. W.I.T.* MSc *U.M.I.S.T.*

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Julie Vonwillier, BA PhD *Macq.*
Lin Zhang, BE *Nanking,* IFT
Peiyuan Zhu, MSc *Fudan* PhD

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Hugo K. Messerle, MEngSc DScMe/b. PhD, FTS FIEE FIEAust FIREE FIEEE FAIP

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Peter M. NickoUs, MB BS BSc BE PhD

Research Affiliate
J.J. Lowke, BSc PhD DipEd *AM.*

Mechanical and Mechatronic Engineering

P.N. Russell Professor
Roger Ian Tanner, BSc *Brist.* MS *Calif.* PhD *Mane,* FAA FTS FIEAust MASME MAIChE
Appointed 1975

Professors
Robert WiUiam Bilger, BSc BE *N.Z.* DPhil *Oxf.,* FTS HE Aust
Appointed 1976

Hugh Francis Durrant-Whyte, BSc(Eng) *Lond.* MSE PhD *Perm.*
Appointed 1995

Yiu-Wing Mai, BSc(Eng) PhD *H.K.,* MASME FIEAust
Appointed 1987

Nhan Phan-Thien, BE PhD
Appointed 1991

Associate Professors
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Bryan W. Roberts, BE *N.S. W.* PhD *Camb.,* MAIAA MIEAust

Senior Lecturers
John D. Atkinson, PhD *Cal.Tech.* BSc BE
M. W.M.G. Dissanayake, BSc(Eng) *Peradeniya* MSc PhD *Birm.*
Andrei Lozzi, BSc *N.S.W.* MEngSc PhD
Assaad R. Masri, BE PhD
PaulJ.McHugh,BScBE
Eduardo M. Nebot, BS *Bahia Blanca* MS PhD *Colorado*

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Lecturers
Caroline A. Baillie, BSc PhD *Sur.*
Lynne E. Biston, MSc PhD *Penn.* BE
David F. Hetcher, BSc PhD *Exeter*
John A. Gal, BE BSc MEngSc PhD '
David C. Rye, BE *Adel.* PhD
Lin Ye, BS *Harbin* MS PhD BIAA
Liangchi Zhang, BSc MEng *Zhejiang* PhD *Beijing*

Lecturer (part-time)
John Bladder, BE

Professional Officer
Jonathan P. Woolmington, BE

ARC Research Fellow
Sten H. Starner, BE PhD
Shang-Xian Wu, BS *Nankai* PhD
Jingshen Wu, BSc *U.S.T. China* PhD

Visiting Professor
Michael V. Swain, BSc PhD *N.S. W.*

Adjunct Associate Professor
Robin J. Higgs, St Bartholomew's Hospital Medical School, London

2 The Faculty of Engineering

A short history

A hundred years of engineering education

In 1983 the Faculty of Engineering celebrated one hundred years of engineering education at the University of Sydney.

At the beginning of March 1883 the first classes in engineering were held in the Main Building. Engineering then formed part of the newly created Faculty of Science (1882). The classes were attended at the opening by three matriculated students who were candidates for the engineering certificate and by seven non-matriculated students.

The lecturer in engineering was Mr W.H. Warren, who had been appointed in December 1882 following a decision by the University Senate to carry out significant revisions to the teaching of the University. These revisions, which provided for the establishment of Schools of Medicine, Science and Engineering, were unable to be implemented in 1881 for lack of staff, accommodation, and facilities.

In 1883, when the new engineering curriculum was introduced, the Senate reported that 'great inconvenience [had] been felt during the year, both by the lecturers and the students, through the deficiency in accommodation for lecturing purpose ... the room occupied by the Lecturer in Engineering [was] much too small to contain the apparatus required for the illustration of his lectures...' A temporary structure was erected at the rear of the Main Building, and in 1885 classes moved to a fairly commodious low white building with a verandah facing Parramatta Road, on a site now partly occupied by the Holme Building.

In 1909 the new building for the P.N. Russell School of Engineering was sufficiently completed early in the year for the work of the school to be conducted within its walls. This building — an outcome of the P.N. Russell benefactions described on the pages following — was formally opened by the Governor on 20 September 1909 at the same time as he opened the new Fisher Library building (now MacLaurin Hall). During the course of the next few decades extensions were made to the PNR Building until, with the expansion in student numbers in the 1950s and early 1960s, new facilities were constructed in the Darlington extension area across City Road. Since the mid seventies all departments have been accommodated in this area, although a wind tunnel in the Woolley Building is still in use by Aeronautical Engineering.

Curriculum development

It was the Senate's intention in establishing engineering education at the University in 1882 to award Certificates in Engineering — in Civil Engineering and Architecture, Mechanical, and Mining Engineering. In 1883, however, the Senate adopted revised by-laws to establish two degrees in engineering, those of Bachelor of Engineering and Master of Engineering. In so doing the Senate specified three branches of engineering: Civil Engineering and Architecture; Mechanical Engineering and Machine Construction; and Mining Engineering, Metallurgy, Assaying and Mining Law.

In 1891 Civil and Mechanical were combined. By 1893 Mining had become Mining and Metallurgy and a separate curriculum in Electrical Engineering had been introduced. In 1900 Mechanical and Electrical were combined, and in the same year the degree course in Civil Engineering was extended to four years.

In 1920, in an act of major academic restructuring, the University created six new faculties including Engineering, so separating it off from the Faculty of Science after nearly forty years of association. To this day the two faculties remain closely allied in teaching and outlook. The other faculties created at that time were Agriculture, Architecture, Dentistry, Economics and Veterinary Science.

Administrative arrangements in Engineering remained unchanged until 1926 when Engineering Technology was added as a fourth branch. With the decision of the Senate to introduce teaching in Aeronautical Engineering in 1939, Aeronautical Engineering became the fifth branch. In 1948, on the appointment of Professor T.G. Hunter as the first Professor of Chemical Engineering in Australia, the Department of Engineering Technology was replaced by the Department of Chemical Engineering. In 1957 separate curricula in Mechanical Engineering and Electrical Engineering were developed and implemented.

In 1982 the departments of Civil Engineering and of Materials and Mining Engineering were amalgamated to form the School of Civil and Mining Engineering. This amalgamation recognised the close association that has developed in Australia between civil engineering and the mineral extractive industries; moreover, by providing for wider contacts with the various branches of the industry, it was intended to strengthen the teaching and research activities in the two areas.

The Faculty continued to award separate bachelor's degrees in the five areas of engineering:

Aeronautical	Civil	Mechanical
Chemical	Electrical	

Professor William Henry Warren

At its meeting on 6 December 1882 the Senate appointed Mr W.H. Warren, CE, as Lecturer in Engineering from 1 March 1883.

Warren was born in Bristol in 1852 and obtained his technical and scientific training in the London and Northwestern Railway Works and as a student at the Royal College of Science in Dublin and Owen's College, Manchester. He sailed for Sydney in 1881 and, following nearly two years as an employee of the Public Works Department, took up his university post. He was to hold this, first as lecturer and then, from 1884, as Professor of Engineering, until his retirement at the end of 1925, a record term of 42 years. During his occupancy of his Chair he was also Chairman of the Professorial Board, Dean of the Faculty of Science,and first Dean of the Faculty of Engineering. Professor Warren retired on 31 December 1925 and was made emeritus professor from 1 January 1926.

To his peers Warren was the acknowledged leader of his profession in Australia. His services to the community on royal commissions, on scientific and technical councils, and his work in the Department of Engineering, were widely recognised and respected. His students loved and respected him.

Peter Nicol Russell*

With the transfer of the Faculty of Engineering to the new engineering precinct in Darlington between 1961 and 1974, the Peter Nicol Russell School of Engineering moved from the building in Science Road where it had been housed for over 50 years. That building had been erected primarily through the generosity of a man whose engineering works thrived in Sydney a century ago.

Peter Nicol Russell was born in Scotland in 1816. He came to Australia in 1832 where, with his brothers Robert and John, he helped his father establish a general engineering and foundry business in Hobart Town. In 1838 they moved to Sydney and, just before their father died, commenced a new business, Russell Bros, in Queens Place on the banks of the Tank Stream, later moving to larger premises in Macquarie Place.

Peter Russell left the firm in 1842 when he rented the foundry and ironmongery premises which were part of the estate of James Blanch, located next to the Royal Hotel in George Street, and commenced operations under the name The Sydney Foundry and Engineering Works'. This business quickly flourished and in its second year received contracts for all the iron work required for the Military Barracks at Paddington, and for the Darlinghurst, Maitland and Newcastle Gaols.

Peter was later joined by his brothers, when the firm of Russell Bros was wound up, and in 1855 the partnership of P.N. Russell and Company was formed, comprising the brothers Peter, John and George (the youngest whose business 'George Russell and Company, Engineers' was absorbed in the new partnership) and the works foreman J.W. Dunlop. During the next twenty years the firm grew to such size that the works extended over a large area at Darling Harbour with a big warehouse in George Street.

It soon became the most complete organisation of its kind in Australia and undertook extensive contracts for road and railway bridges, railway rolling stock, steam dredges, gun boats for the Maori War, and crushing and flour milling machinery. Many of the beautiful cast-iron columns and ornamental architectural iron work executed by P.N. Russell & Co.'s foundry could be seen at the entrances and around the balconies of many old Sydney buildings. Bridges over the Macquarie River at Bathurst and over the Yass River at Yass, the latter with a wrought iron superstructure spanning 55m, were constructed by P.N. Russell & Co. in 1870-71.

Peter Nicol Russell returned to London in 1864 and retired as an active member of the firm, but for many years continued to act as overseas representative. He showed sound judgement and foresight by his anticipation of possible future labour troubles in the colony. He repeatedly suggested to P.N. Russell & Co. that they should devote more attention to the importing side of the business rather than continue manufacturing engineering equipment in keen competition with overseas trade, for in those days there was little protection to aid the local manufacturer.

On 30 October 1873 the workmen at the Sydney foundry made a demand for ten hours' pay for eight hours' work, and went on strike. No satisfactory arrangements for the settlement of the strike were reached and the engineering works and warehouses were closed in June 1875, never to be opened again. Thus P.N. Russell & Co. with a capital of £250 000 and employing over 1000 men went out of existence. When Peter Russell revisited Sydney after the closing of the firm which had been his life's work, it is said that he was so distressed that he immediately returned to London; there he lived in retirement until his death in 1905 at the age of 89, having been knighted in 1904. He was buried at St Marylebone cemetery in London, where his grave dominates, marked by a massive monument.

It was in 1895, while on leave in London, that Professor W.H. Warren, the first Professor of Engineering at the University of Sydney, had a fortunate meeting with Peter Russell, which led ultimately to the magnificent endowments totalling £100 000 for Engineering at this University. In 1896 Russell endowed the Department of Engineering by a gift of £50 000, including in the deed of gift a provision that the department should thereafter be styled The Peter Nicol Russell School of Engineering'. In 1904 this gift was followed by a second benefaction of £50 000 as an extension of the first amount, when Sir Peter Russell stipulated that the Government of New South Wales should undertake to hand to the University, within three years, a sum of £25 000 to provide an extension of the buildings of the School of Engineering or to erect new buildings. This the Government agreed to do and a building was erected from designs prepared by the Government Architect.

Thus was founded the Peter Nicol Russell School of Engineering, the new building for which was opened in 1909. It is fitting that the present faculty building in the Darlington engineering precinct should retain the name of this great benefactor, thus preserving for future generations the P.N.R. tradition.

At the ground floor entrance of the Peter Nicol Russell Building may be seen one of the hardwood lintels from the Darling Harbour foundry. An elaborate Royal Coat of Arms, which was cast in the foundry for

*This short biography is based on an article that appeared in the Journal R.A.H.S. Vol. 50 Pt 2.

an exhibition in London in 1851, is on display in the foyer. In the courtyard stands one of the many cast iron building columns made in the P.N. Russell & Co.'s foundry, and nearby is the monument in granite and bronze — a duplicate of Russell's St Marylebone Cemetery memorial—presented to the University by Lady Russell in honour of her husband. A portrait in oils of Charlotte Russell hangs above the main stairway leading from the foyer to the first floor drawing office.

The Warren Centre for Advanced Engineering

The Warren Centre was formed as a permanent addition to the Faculty of Engineering to mark the completion of one hundred years of engineering education at the University of Sydney. The choice of name for the Centre was to honour Professor William Henry Warren, first Professor of Engineering, Head of the Department of Engineering for 42 years, and the first President of the Institution of Engineers, Australia. The Centre was officially opened on 17 May 1983.

The Warren Centre cooperates with industry to promote excellence and innovation in all fields of engineering in Australia. The Centre performs its function mainly by bringing together, under distinguished visiting fellows, project teams comprising selected practising engineers from industry and experts from research and academic institutions, and from government departments. These groups focus on problems important to the developmentofengineering skills inAustralia. Projects are conducted over a 2-year period with an intensive phase of two to three months.

Towards the end of each project seminars are held to disseminate the results. Projectpapers are compiled and made available for purchase.

The Centre is controlled by a board of directors composed of representatives of industry and the University, with the majority of directors from industry. The day-to-day activities of the Centre are carried out by a small staff led by the Executive Director, Professor John Glastonbury. It is funded from project and investment income, from donations from industry and from graduates.

The Warren Centre plays an important role in helping experienced, practising engineers keep abreast of the latest technology and thinking from overseas and within Australia.

The Centre has now completed 13 projects. Recent projects include:

Utilisation of Supercomputers in Science and Engineering (1992)—which demonstrated how high-performance computing can provide a new approach to solving practical problems for industry and government through extensive use of case studies, giving hands-on experience to the project team.

Energy Management in the Process Industries (1990) — which demonstrated that commercially practical applications of modern energy management techniques and technology offer annual savings exceeding $1 billion nationally, and indicated how this might be achieved.

Fire Safety and Engineering (1989)—which established the basis for a new systematic engineering approach to achieve fire safety, which could replace the existing largely empirical regulatory approach, with the prospect of large savings in building construction without any reduction in safety. The key participants are continuing to work together to implement the new approach and also to establish fire safety as a discrete engineering discipline.

Economic Recycling and Conservation of Structures (1989) —which examined the cultural and educational tasks involved and provided important guidelines for future initiatives in technological awareness.

Winning by Design (1987) — which explored the key role that design plays in creating successful value-added products for export markets; it also played an important role in the establishment of the Australian Academy of Design.

Advanced Process Control (1987) — which identified large potential benefits from the application of advanced process control in Australian industry, demonstrated by case studies how these benefits could be achieved, and offered courses in the technology.

President, Board of Directors
C.R. (Sandy) Longworth, BE DIC, FAusIMM FICE FIEAust

Executive Director
Professor T.W. Cole, BE *WAust.* PhD *Camb.,* FIEAust

General Manager
Angus M. Robinson, BSc *Melb.,* FAIM FAusIMM

Administrative Officer
CheonheeSohn, BA*H.U.F.S. S.Korea* MEd*N.S.W.*

Administrative Assistant
Liani Solari, BA *Macq.*

Australian Centre for Innovation and International Competitiveness (ACIIC)

ACIIC was established as a non-profit company in April 1992 and has the status of a department of the Faculty of Engineering. It is dedicated to building bridges between Australia's intellectual capability and the worlds ofbusiness and government. Its mission is to:

- work closely with Australian industry to build international competitiveness;
- support economic and social development using the leverage of technological innovation;
- integrate innovation to capture the benefits of the national investment in science and technology;
- assist the engineering community to understand the forces which are reshaping the requirements of engineering employment and engineering education.

ACIIC delivers a number of services to the Faculty. These include:

- teaching undergraduate and postgraduate courses in engineering management, innovation and environmental engineering and public policy;
- supervision of undergraduate final year theses and PhD students;
- assistance with strategic planning, marketing, the development of new teaching initiatives, and linkages with industry.

It is also engaged in grant and contract-supported research on issues of research, technology and innovation management and commercialism. These include:

- management of innovation in large multi-national firms;
- management and commercial negotiation for CSIRO Divisions;
- new models for research organisation supported by telecommunications;
- linking school education with industry needs and resources.

ACIIC provides a non-engineering capability to the Faculty whichwillassistittopursuerelevant objectives of the strategic plan. Its contribution will be assessed against the quality of the student intake, the visibility and image of the Faculty, the quality and impact of non-engineering education and the strength of and revenue raised for research.

Australian Graduate School of Engineering Innovation (AGSEI)

AGSEI is a national Advanced Engineering Centre promoting an engineering culture which brings together technology, management and marketing, with an overall focus on wealth creation and the introduction of a more effective process of engineering innovation to Australian industry.

AGSEI has been formed jointly by the Engineering Faculties of the University of Sydney and the University of Technology, Sydney, and is located separately from both of them. Its objectives are:

- to ensure that today's engineers, as well as those of tomorrow, are better equipped to take leadership roles in assuring the success of industrial enterprises;
- to educate engineers and others to think and contribute across disciplines in a corporate environment;
- to demonstrate the central role of innovation in achieving competitive advantage;
- to provide industry with convenient access to national and international best practice in engineering management and the application of technology;
- to enhance the capability to commercialise new technology and the results of research and development;
- to foster the creation of new industry through technology transfer and the introduction of appropriate management systems;
- to raiseunderstandingin the professions and society of the role of industry, technology and engineering in the creation of national wealth;
- to educate engineers to understand and contribute to enterprise management, and to educate executive managements to understand and utilise their engineering capability more effectively.

Students

Initially programs are being structured for engineers and other professionals who have been in industry for two to three years after completing their bachelor's degree. Later programs will be developed for undergraduate courses.

The programs

AGSEI offers an array of courses centring on:

Engineering Management
Engineering Innovation
Industrial Systems Engineering

The programs cover topics in:

- quality
- innovation
- technology
- systems engineering
- information technology and management
- computer-aided engineering and logistic support
- human resources and change management
- professional and business ethics
- design and documentation
- manufacturing
- government
- economics
- marketing
- finance
- law

The approach taken is distinctly different from that of an MBA. The MBA programs teach generic management, regardless of what is being managed. AGSEIbuilds specifically on the capability of *engineers,* and is wholly about organisation and application of engineering effort to innovation and business performance—*total engineering,* not total management.

Modules

The basic program element is the module, typically offered over one week and involving intensive material presentation plus workshop and project sessions. Modules may be aggregated, by those who wish to do so, to lead to formal awards at several levels such as graduate certificate or master's degree. Modules will have the following characteristics:

- All modules will be available in stand-alone form, designed expressly to meet the needs of engineers and engineering enterprises.
- All programs require the course content to be trialed in industry, with advice from AGSEI staff, and (where possible) the results to be reported and discussed in workshop sessions.
- Heavy use is made of industry-based project work.
- Wherever possible, modules involve group interaction, normally multi-disciplinary. AGSEI acts not only as a teaching and advisory resource but as a framework in which participants (engineers and other professionals who deal with engineers) learn from each other and from inter-organisation contacts.

More detailed information may be obtained from the AGSEI (tel. 299 5699).

Chemical Engineering Foundation

The Chemical Engineering Foundation within the University of Sydney was established in 1981 with the following objectives:

- to foster good communications between industry and commerce and the Department of Chemical Engineering,
- to advise on courses of instruction in Chemical Engineering,
- to encourage students of high calibre to work in the Department,

- to assist graduates in Chemical Engineering to make appropriate contributions to industry,
- to facilitate and develop research in Chemical Engineering with particular reference to industry oriented projects.

The Chemical Engineering Foundation provides an opportunity for executives in Australian industry to participate in the development of the Chemical Engineering profession. As at July 1994,18 companies are members.

Activities have included financial support to the undergraduate program and research by both postgraduates and staff. Intensive courses have been coordinated, publication of updates on the Department's research activities is undertaken regularly, and emphasis is placed on expanding industry-university collabora don.

Australian Centre of Advanced Risk and Reliability Engineering

The Australian Centre of Advanced Risk and Reliability Engineering Ltd (ACARRE) is a joint venture of the University and the Australian Nuclear Science and Technology Organisation (ANSTO). It is a company limited by guarantee, and has the objective of promoting appropriate application of risk and reliability engineering and management principles in Australia and the near region. It operates in three fields: education, through undergraduate, post-graduate and external courses; research; and consulting for industry and government throughout Australia in a range of industries including the chemical industry, oil refining, transport, storage and distribution. Inundertaking these activities, ACARRE draws on specialist skills from the University, ANSTO and elsewhere. The Executive Director is the ANSTO Professor of Risk Engineering.

The Civil and Mining Engineering Foundation

The Postgraduate Civil Engineering Foundation was established in February 1968, as a development of the already existing links between the Department of Civil Engineering and industry and following the pattern of the early University foundations. The name was changed to the Civil and Mining Engineering Foundation in 1986 following amalgamation of the corresponding departments.

The Foundation actively fosters collaboration between the Civil and Mining Engineering School and the engineering profession and industry. It does so in several important ways:

- by promoting engineering consultation, research, training, public lectures, special short courses and technical reporting,
- by providing direction to undergraduate and post-graduate educational programs,
- by sponsoring research projects in the School and encouraging research links with industry,
- by serving as a focus for the exchange of local and overseas expertise,
- by forming working committees of top engineers from government, consulting practices, the civil and mining industry and the University to study topical issues arising in the engineering profession, and
- by reporting the important results of all these activities to members and the public throughreports and engineering publications. The Foundation is supported by annual subscriptions from its governors, members and by special donors.

Electrical Engineering Foundation

The mission of the Electrical Engineering Foundation is to build a successful partnership between Sydney University Electrical Engineering, industry and the profession which facilitates, in Australia, the achievement of world-class performance through education, research and development.

Membership includes governors, corporate members, personal members, graduate members, retired members and student members. By joining the Foundation, SUEE graduates automatically become members of the Sydney University Electrical Engineering Alumni Association.

Governors are members of the Foundation Board. The Board meets four times a year to advise the University on how it can respond effectively to the needs of the electrical engineering industry. The Governors at the end of 1993 were: Allan Gillespie of Sydney Electricity (President), Gary Lane of Telecom Australia (Deputy President), John Dougall of AWA Limited, Noel Godfrey of BHP Engineering, John Kranenburg of Nortel Australia, John Lancaster of ARC Systems, Ravi Marwaha of IBM Australia, John Sligar of Pacific Power, David Smith (retired) and David Strong of Apple Computer Australia.

The Foundation's industry liaison officer service is available to governors and corporate members. The role of an Industry Liaison Officer is to become involved in the business and research work of a company, to fadlitateinteractionbetween the company and Sydney University Electrical Engineering and to become recognised as the initial point of contact for company people seeking information and guidance from the Department.

All members of the Foundation:

- can have a say in the content of SUEE's undergraduate courses,
- can join the University's heated Olympic pool, Fisher Library and University Club,
- receive information on SUEE's graduates and prize winners,
- have use of the Foundation's Committee Room and Sky Room,
- receive information on SUEE's continuing education courses,
- receive invitations to social evenings with then-peers,
- can hire the University's conference and seminar facilities,
- are kept up-to-date with developments in research and teaching more relevant to the needs of the Australian industry.

For further information: Executive Officer, Electrical Engineering Foundation, Room 606, Electrical Engineering Building, tel. 351 3659, fax 552 4920.

Centre for Geotechnical Research

The Centre was set up within the University of Sydney in August 1987 with the primary aim of promoting industry-university cooperation in furthering knowledge in the theory and application of geotechnics and geomechanics.

It comprises staff and laboratories from the following departments, schools and groups: Civil and Mining Engineering, Geology and Geophysics, Geography, Soil Science, Ocean Sciences, Ocean Sciences Institute and the Coastal Studies Unit.

The objectives of the Centre are:

- to serve as a focus for research in geotechnics and geomechanics within the University of Sydney,
- to undertake specialised research, investigation, consulting, and testing work for industry and government organisations,
- to foster inter-disciplinary research and teaching and geotechnics and geomechanics,
- to develop techniques and equipment for geotechnical testing,
- to disseminate technicalinformationongeotechnics and geomechanics to industry.

Centre for Advanced Structural Engineering

The Centre for Advanced Structural Engineering was established within the University of Sydney to promote the advancement of structural engineering within and beyond the University. The Centre is housed within, and involves University staff and facilities of, the School of Civil and Mining Engineering.

The Centre provides a focus for researchers, industry, government and practising structural engineers for research and the teaching of contemporary structural technology.

The Centre undertakes specialised research, investigation, consulting and testing work for government, consulting engineering, and industry, and disseminates technical information on structural engineering to the profession and industry.

Mechanical Engineering Foundation

The Mechanical Engineering Foundation was established in November 1988 to assist the Senate of the University of Sydney and the Vice-Chancellor on matters associated with education, study and research in mechanical engineering within the University of Sydney and, without restricting the generality of the foregoing, in particular to:

- foster good communications between industry and commerce and the Department of Mechanical and Mechatronic Engineering,
- assist in devising courses of instruction in mechanical engineering,
- encourage students of high calibre to join the Department,
- assist graduates in mechanical engineering to make appropriate contributions to industry, and
- facilitate and develop research in mechanical engineering with particular reference to industry oriented projects.

Centre for Advanced Materials Technology

The Centre was established within the University of Sydney in 1989 and is located in the Department of Mechanical and Mechatronic Engineering with the main objective of promoting industry-University collaborative research on the design, engineering, development and manufacturing technology of advanced materials. The Centre also undertakes specialised research and development projects, consulting and testing activities for industry and government organisations in advanced materials. It comprises staff and research facilities in the Departments of Mechanical Engineering, Civil and Mining Engineering, Aeronautical Engineering, Applied Physics, Operative Dentistry and the Electron Microscope Unit.

Cooperative Research Centre in Aerospace Structures

In 1992 the Cooperative Research Centre in Aerospace Structures started on its program of research in composite aircraft structures. This is aimed at providing a research base for manufacturing in Australia. Cooperatingin the Centre are the University of Sydney, Monash University, the University of New South Wales, the Royal Melbourne Institute of Technology, Aeronautical Research Laboratories, Hawker de Havilland and Aerospace Technologies of Australia. When at full operation it is expected that nearly 30 researchers will be active on the Centre's projects.

Optical Fibre Technology Centre (OFTC)

The OFTC at the University was established in 1989 as an initiative of the telecommunications industry with the primary aim to undertake research and development in the design, fabrication and application of Application Specific Optical Fibres. The key researchers are Dr Ian Bassett (Physics), Dr Simon Poole (Technical Director), Dr Mark Sceats (Chairman, Chemistry), and Associate Professor Tony Stokes (Electrical Engineering). The excellence of the interdisciplinary OFTC research team, which now numbers 15 full-time staff and a similar number of higher degree students, is recognised world-wide. The Centre also provides training courses in optical fibre technology to industry.

Chancellor's Scholarships in Engineering (CSE)

Chancellor's Scholarships in Engineering are open to final year high school students who expect to achieve a TER of at least 96.00 in the HSC or interstate equivalent. They are highly competitive and many applications are received each year for the limited number of places available.

The Scholarships are worth $10 250 in 1995. This is paid in fortnightly instalments for the four years' duration of the normal undergraduate course, subject to continued satisfactory academic performance.

Chancellor's Scholars attend site visits to the sponsoring companies as well as functions at the University designed to promote good relations and personal interaction between the students and the organisations supporting the CSE program.

During the long vacations between first, second and third year, each Scholar is allotted to a sponsoring organisation for industrial education placement (IEP). Unlike other engineering undergraduates who have only one industrial placement during their time at the

University, Chancellor's Scholars have the opportunity to gain experience working in various aspects of industry. Every Scholar works for three different companies and every sponsor sees three different students over the four years of the undergraduate course.

Most scholars expect to, and do join one of the sponsors on graduation, but there is no formal obligation either way.

The CSE Program is controlled by a Steering Committee and administered by the Faculty of Engineering.

Chairman, Steering Committee
Mr P. Moyle (Shell Australia)

Director
Professor R.G.H. Prince

Executive Officer
Mrs Lee Jobling

Administrative Assistant

Sponsoring organisations

ABB Asea Brown Bovery
AGL Sydney Ltd
Alcan Australia Limited
Ansett Airlines
Babcock Australia Limited
Baulderstone Hornibrook
BHP Engineering Pty Ltd
BHP Rod and Bar Products
BHP Slab and Plate Products
Boral Limited
Bull HN Information Systems
Caltex Refining
CIG
Civil Aviation Authority
CMPS&F Pty Ltd
Comalco Rolled Products
Council of the City of Sydney
CRA Adv. Tech. Development
CSR Humes
CSR Refined Sugars
Dow Chemical
DSTO Surveillance Research Laboratories
EPT Limited
Esso Australia
Federal Airports Corporation
Hawker De Havilland
ICI
James Hardie Building Projects
Master Foods of Australia
Metal Manufactures Limited
Optus Pty Ltd
Pacific Power
Pioneer Concrete
Qantas Airways
Rheem Australia Water Heater Div.
Roads and Traffic Authority
Schlumberger Seaco Inc.
Shell Company of Australia Ltd
Shell Refining (Australia) Pty Ltd
State Rail Authority
Sydney Electricity
Telecom
Telestrar
The Readimix Group
Thiess Contractors
Transfield Group
Wang Australia
Water Board

Engineering Advancement Office

Activities on behalf of the Public Relations Committee of the Faculty of Engineering are handled by the Engineering Advancement Office established in 1990. Responsibilities of the office include but are not restricted to preparing brochures, arranging visits to and by schools, organising school mailings, attending careers markets, advertising, coordinating the organisation of faculty public events, contacting industry, preparation of newsletters for staff, students, alumni and the community, fostering staff and student relations with former staff and former students, and fundraising.

Chair, Public Relations Committee
Associate Professor R.J. Wheen

Executive Officer, Advancement Office
Jeremy Steele

The branches of engineering

From the 18th century onwards all types of engineers, other than military engineers, were known as *civil engineers.* This definition was still valid in the early years of the Institution of Civil Engineers in Britain, whose royal charter granted in 1828 described civil engineering as '. . . being the art of conducting the great sources of power in Nature for the use and convenience of Man'. Professor Warren was trained as a civil engineer in the modern sense, but was able to conduct courses in Mining Engineering and in Mechanical Engineering, in addition to his own area of expertise. The increase in specialisation has reduced the scope of the title *civil engineer,* although it is still the largest branch of the profession in Australia.

Aeronautical Engineering

Opportunities exist for the employment of aeronautical engineers in the fields of design and manufacture, operations and research and development.

The number of aeronautical engineers in Australia is small and the employment situation can be drastically affected by changes in internal policies or external conditions. The flow of projects to the manufacturing industry is intermittent at present and this is being reflected in a steady, though restricted, demand for new graduates.

The operations field also provides opportunities since, as aircraft become more complex, the requirements of the operators for professional engineers tend to increase. Openings exist with the domestic airlines, Qantas and the RAAF. The work includes performance analysis of engine and airframe, structural analysis and the forecasting of future requirements. Many challenging problems arise on the operational side and, as some of these are peculiar to Australia, original thinking is required. Opportunities are not confined to the operators; in particular, the Civil Aviation Authority employs many aeronautical engineers to investigate the air-worthiness and performance of all aircraft operating in Australia.

Research and development work has been centred on the Aeronautical Research Laboratories and the Defence Scientific and Technology Organisation (DSTO). There is some recruitment of new staff. In addition, the extensive basic training which aeronautical engineers receive in fluid and/or solid mechanics places them in a position to take advantage of the research and development openings that occur in these fields outside of aeronautics.

The course in aeronautical engineering at this University is such that the core courses give a good grounding in all the major subjects.

Chemical Engineering

Chemical engineering is concerned with industrial processes in whichmaterialinbulkundergoes changes in its physical or chemical nature. Chemical engineers design, construct, operate and manage these processes and in this they are guided by economic considerations.

Industries employing chemical engineers are generally referred to as the process industries: examples of these are the large complexes at Botany in New South Wales and Altona in Victoria, and the petroleum refineries in all mainland States; other examples are the minerals processing industries that refine Australian ores such as bauxite, nickel sulphides and ruhle to produce alurriinium, nickel and titanium. In addition there are the traditional metallurgical industries, steel, copper, zinc, lead, etc., as well as general processing industries producing paper, cement, plastics, paints, glass, pharmaceuticals, alcohol and foodstuffs. Allied process operations are those involving waste disposal, pollution abatement, power production and nuclear technology.

Chemical engineering studies are based on chemistry, mathematics and physics and the first two are taken to some depth. The chemical engineer must learn something of the language and principles of mechanical, electrical, and civil engineering, and of administration, and industrial relations.

Each student completes a common core of courses, fundamental to the study of chemical engineering, and also takes a number of elective courses, chosen according to his or her particular field of interest from course options listed later. Three of these introduce students to some important industries in the process field.

Minerals Engineering. For students who are interested in gaining some familiarity with the minerals processing industries.

Biochemical Engineering. For those interested in biochemical methods of pollution control or in any of the biochemical industries such as pharmaceuticals, fermentation or food and dairy processing.

Reservoir Engineering. These courses deal with the properties and behaviour of petroleum and natural gas reservoirs, and the strategies used in their development.

Regardless of the option chosen, the graduate will be a fully qualified chemical engineer, well prepared for a career in any of the process industries.

The Departmenthas an overseas exchange program for final year undergraduate students, which has been expanded this year. The exchange with the Royal Institute of Technology, Stockholm continues with two or three of our students in Sweden each year, and two or three Swedish students completing their degree course in Sydney. A new exchange has started with the Ecole Nationale Superieure D'Ingenieurs de Genie Chimique in Toulouse, France, with one or two students studying there each year. Some financial support is provided, by Asea Brown Boveri, the Chemical Engineering Foundation, and the Department.

The majority of chemical engineering graduates enter industry, taking up positions in plant operation, supervision, and eventually management. Others will be engaged in plant design, construction, and commissioning work either for a large process company or one of the specialist construction firms.

There is also scope for research and development work with industry or government organisations.

Chemical engineers are also recruited by many of the larger companies for technical service and sales. Graduates may also be able to obtain positions overseas either directly or through Australian companies with overseas associations..

Civil Engineering

The title Civil Engineer is given to one who invents, contrives, designs and constructs for the benefit of the community. Civil engineering covers a wide range including the conception, design, construction and maintenance of those more permanent structures and services such as roads, railways, bridges, buildings, tunnels, airfields, water supply and sewerage systems, dams, pipelines, river improvements, harbours and irrigation systems. In the broader sense civil engineers are charged with the task of producing structures and systems that give the greatest amenity for the funds expended. They have therefore to optimise their schemes in terms of technological performance, impact upon the environment and the financial resources available.

Civil engineers find employment: in government authorities whose concern is the design, construction and maintenance of public services; with consultants whose main interest is the design of civil engineering works; with contractors who carry out the construction work; and in civil engineering industries which manufacture and supply materials, plant and equipment.

In the junior and intermediate years of the course, the student is given a grounding in mathematics and the sciences with an introduction to structural theory, design, construction, and the properties of materials.

In the senior year, basic courses are given in structures, soil mechanics, surveying, hydraulics, structural design, construction, materials and practice of civil engineering.

In the senior advanced year, the basic courses of the senior year are continued with an additional course which requires the preparation of a thesis. Honours degree students must select courses at honours level from subjects such as: structures, soil mechanics, surveying, fluids, materials and steel and concrete structures. At honours level a more extensive thesis is required. A major segment of final year studies for pass degree students are options in structures, fluid mechanics, engineering management and geo-mechanics.

As civil engineering is a practical profession, attention is given to this aspect throughout the course. Full use is made of the laboratories with students carrying out experiments to obtain a better understanding of behaviour under practical conditions. There is extensive use of computers in design and other exercises. During the vacation between the senior and senior advanced years, every student must obtain practical experience in a civil engineering field andmustsubmitasatisfactoryreport on this experience. During the senior advanced year, students attend a two-week camp for practical surveying experience and to apply surveying methods to a project. Seminars are also held and visits to works in progress are made as opportunities arise. Students are encouraged to take a close interest in current research and investigations.

Electrical Engineering

Electrical effects permeate all matter and space. The electromagnetic force is one of the fundamental forces of nature which hold atoms together. Mobile electric charges — electrons — convey energy along conducting cables for electrical power distribution and for telecommunications. Small quantities of electrical charge and magnetic devices provide memory storage in computers. Electromagnetic waves travel as radio waves into the depths of space, or as light guided by optical fibres.

Electrical engineers are primarily concerned with development and manufacture of components and systems which utilise electrical, magnetic and optical phenomena. They deal with electrical energy conversion, transmission and distribution, and with the representation, storage, transmission and display of information. This wide and expanding discipline of electrical engineering may be conveniently divided in several ways. The title 'electronics engineering' is often used to differentiate the areas associated with electronic devices, such as computers and digital systems and communications, from those associated with electrical energy conversion and control systems. An alternative is to identify communications, computers, digital systems, and signal and image processing as 'information systems engineering'.

With its roots in science, electrical engineering is frequently to be found at the forefront of many new and exciting fields, such as neural computing and superconductivity. Indeed the frontiers of knowledge in all branches of electrical engineering continue to advance very rapidly with new devices, techniques and systems continually appearing. For example, developments in materials technology and solid state physics led to the invention of transistors in the 1940's. The subsequent miniaturisation of transistors in integrated circuits (microelectronics) has led to computer and electronic communication systems of great reliability and information processing power which underpin the 'information technology revolution' of the 1980's. Transistors are also available as high power semiconductors capable of switching and controlling powers exceeding 1MW.

Their initial education and training must provide electrical engineers with the background and confidence to exploit and contribute to these rapid developments. The undergraduate program concentrates initially on the fundamental mathematics and physics which provide the models for electrical engineering circuits and devices, and information and system concepts. The first two years of the course also include computer science and introduce the main areas of electrical engineering as described earlier. The last two years of the course concentrate on developing the principles and practice of the main areas of electrical engineering. The course has a high laboratory and project content in all years. One important additional theme developed in all years of the course is that of design, communication skills and engineering management.

There are two patterns of study in the final two years. In the **'general'** electrical engineering program students study courses in all branches of the discipline: electrical energy conversion, control systems, electronics, digital systems and communications. There is an opportunity to take advanced courses in these areas. Students taking the **'information systems engineering'** program in their final two years concentrate on more advanced material in digital systems and computer engineering, and do not take the electrical energy conversion, or more advanced control systems courses. Both programs offer students the chance to take interdisciplinary electives such as biomedical engineering.

A very wide range of professional opportunities is open to graduates of electrical engineering. They may join organisations concerned with telecommunications or electrical power generation and distribution, such as Telstra and Pacific Power. They may join one of the manufacturers of electronics, communications and control devices and systems, such as AWA, Alcatel Australia and Leeds and Northrup. Others may enter the computer industry, join CSIRO or undertake further study. Like electrical engineering itself, the possibilities are almost limitless.

Mechanical and Mechatronic Engineering

The field of mechanical engineering consists of:

(a) power generation and transmission;
(b) transportation of people and goods;
(c) production and manufacture, including the means of production as well as the product.

The work falls into the broad areas of design, construction, operation, research and investigation, maintenance, management and sales.

This definition is at least sixty years old, but it remains useful even though the end products, materials and means of production have changed radically in the meantime; for example, a major shift towards the use of computingin design and production has occurred and a substantial amount of electronic and computer technology is now an integral part of many 'mechanical' devices. The possible contributions of mechanical engineering to society, for example, personal transportation, power generation and production, need to be recognised, as well as the contribution to the study of environmental effects.

Undergraduate study in mechanical engineering provides a basic training in engineering science, design methods, management, modern computer-aided design and production technology, so that by the end of the senior year a broad field has been covered. Two streams are offered toward this end: one (Mechatronics) contains much more electronics and control work than the other. In the senior advanced year some specialisationis encouraged, so that students may pursue their main interests in more depth. At present there are eight areas offered: thermal, fluids, transportation, materials, machinery, industrial engineering/automation, systems and control, stress analysis, environmental engineering, continuum mechanics.

Mechanical engineers often become company managers and as such they need management skills. Engineering management is an important part of the mechanical engineering undergraduate course to complement the technical education. The Centre for Advanced Materials Technology in the Department of Mechanical and Mechatronic Engineering undertakes research and development activities in advanced materials.

Mechanical engineering has many recognised sub-branches such as production, industrial, automotive, agricultural, naval, air-conditioning, refrigeration and nuclear engineering. Entry into any of these fields is possible with a degree in mechanical engineering regardless of the specialisations taken in the final year. Traditionally,insufficientnumbersof mechanical engineers have been trained in Australia and employment prospects for mechanical engineers are excellent.

Mechatronics (Industrial Automation)

The degree comprises a mixture of mechanical and electrical engineering disciplines. Emphasis is placed on areas such as mechanics, machine design, digital electronics and microprocessors, automatic control, computer-controlled machinery, electric motors and power control, real-time software design, and on the application of these technologies to the design of 'intelligent' products, and in an advanced manufacturing environment.

Entry requirements are the same as for mechanical engineering but prospective students should be aware that this is a very demanding course.

Mining Engineering

NOTE: At its meeting on 2 November 1987, the University Senate gave a general approval to the Quinquennial Plan that had been prepared by the Vice-Chancellor. This plan proposed the phasing out of the teaching of Mining Engineering from a date to be determined after appropriate consultations.

Project Engineering and Management (Civil)

The degree program will be offered when resources to do so become available. As at October 1994 the following description is for information only.

Recent years have seen the dawn of a new era in both the national and international scene. On the one hand there is a perceptible trend to 'globalisation' of engineering and construction businesses. On the other, engineer-constructors and project managers are required to act as forerunners in the export drive.

The onset of the twenty-first century will demand managers with technical skills to act as entrepreneurs. The competitive market forces in the construction and engineering industries will require engineers and contractors to seek alternative ways to secure business, remain viable and experience sustained growth. This demand translates into a need for a class of engineer who can synthesise projects, analyse their impacts and act as the catalyst in their implementation.

Project engineering and management embraces the 'engineering' of all types of projects, from conception and feasibility studies through to construction and commissioning, albeit at the strategic level and through multidisciplinary teamwork. The project engineer-manager is the specialist in project processes and systems, a significant role in a society becoming increasingly dependent on the creation and management of projects to solve its economic, environmental and social problems.

The degree program responds to the need for technologically competent people with financial, organisational and managerial skills to take the lead in Australia's future engineering and technological projects.

The course is virtually identical to the present Civil Engineering curriculum in the first year. In the second year, courses are introduced in such areas as engineering economics, engineering accounting as well as engineering construction. In the third and fourth years subjects such as network planning, contracts formulation and administration, human and industrial relations, operations research, cost engineering and estimating project formulation, value engineering and risk analysis are included.

In addition, up to 20% of all the courses taken will be electives. These are to encourage students to follow their own interests and aspirations, and at the same time expose them to as wide a variety of subjects as possible in order to prepare them as team leaders and communicators.

Graduates will be able to conceptualise, analyse and plan a range of technologies for construction and operation of engineering projects. As agents of advanced technology the graduates will be able to appreciate the human side of projects and processes. Their training will give them a better understanding of individual and group behaviour, organisational concepts, state-of-the-art planning, goal setting and other managerial know-how. In addition, they will possess projectmanagementskillsthatwill encompass techniques for achieving project goals.

Money is the life blood of industry, and engineering is a subset of business and industrial activities. Project engineering graduates will find it intellectually rewarding to initiate projects and/or take part in the economic and monetary processes under which projects arecreated and executed. They will appreciate the world of finance and the intricate ways under which projects are initiated by the private and public sectors of the economy. They will also be competent enough to conduct economic appraisal of proposals, evaluate risks, undertake valuation and depreciation analyses> formulate feasible plans for project funding, and generally sell the proposal to others.

Graduates will have the capability to respond to most challenges in a resourceful manner, virtually from the day of graduation. They will be self-starters, communicators, adaptors, performers.

Employment opportunities for such a group is as diverse as the field of project engineering and construction management itself. As an example, the following organisations will typically find the prospective graduate a valuable asset:

- Construction companies
- Project managers/major consulting engineers/ planners
- Government and public agencies/municipalities and shires
- Property developers/owners/major clients
- Industrial and mining corporations
- Management consultants/investment analysts
- Development and industrial banks.

Constitution of the faculty

Extract from the Resolutions of the Senate

1. The Faculty of Engineering shall comprise the following persons:

(a) the Professors, Readers, Associate Professors, Senior Lecturers, Lecturers and Associate Lecturers in the Departments in the Faculty of Engineering, being full-time permanent or full-time temporary members of the teaching staff;

(b) the Heads of the Schools of Mathematics and Statistics, Physics and Chemistry;

(c) the Heads of the Departments of Geology and Geophysics and Computer Science;

(d) one full-time member of the academic staff of each of the Schools and Departments mentioned in subsections (b) and (c), nominated by the respective Head from time to time;

(e) two persons being full-time members of the academic staff in the Faculty of Architecture, nominated by the Faculty of Architecture;

(f) such Fellows of the Senate as are graduates in Engineering;

(g) not more than three persons distinguished in the field of Engineering appointed by the Senate on the nomination of the Dean with the approval of the Faculty;

(h) not more than five students elected in the manner prescribed by resolution of the Senate;

(i) such other persons, if any, being full-time members of the senior administrative or senior research staff in the Faculty as may be appointed from time to time by the Senate on the nomination of the Faculty;

(j) the Executive Director of the Australian Centre for Innovation and International Competitiveness.

2. (a) The persons nominated under section 1(e) shall hold office for a period of two years from 1 January in the year following their nomination and shall be eligible for renomination;

(b) The persons appointed under section 1(g) shall be appointed for a period of three years and shall be eligible for reappointment for one further period of three years;

(c) The persons, if any, appointed under section 1(i) shall be members of the Faculty for so long as they remain full-time members of the senior administrative or senior research staff in the Faculty.

3 Undergraduate degree requirements

Bachelor of Engineering

There are separate quota arrangements for:

(a) Chemical Engineering;
(b) Electrical Engineering; and
(c) Aeronautical, Civil and Mechanical Engineering.

The requirements for the degree of Bachelor of Engineering are set out in Senate, Academic Board and Faculty resolutions. The Faculty resolutions and extracts from the Senate resolutions are set out later in this Chapter. It is important for candidates to become familiar with these rules and regulations.

A summary of the degree requirements and of many of the rules and regulations is set out below. This is intended to assist students in understanding the rules but is not intended to replace them in any way.

Summary of degree requirements

To become eligible for the award of the degree of Bachelor of Engineering, you must

—complete the core courses of your chosen branch of engineering,
—gain credit for a minimum of 200 units, and
—complete a period of practical experience in engineering.

Core courses and elective courses

For each of the branches of engineering in which a degree is awarded there is a list of prescribed *core* courses and recommended *elective* courses. Many of these are common to more than one branch.

A core course is one that must be passed to fulfil the requirements for the degree. In some cases the Faculty has specified courses that are acceptable alternatives to the core courses, completion of which satisfies the core course requirement. An elective course is one that is acceptable as part of the requirements but is not a compulsory course.

The core courses and the elective courses for each branch of engineering are listed in the tables at the end of this chapter. The first part of the tables summarises the Junior and Intermediate courses; the second, the Senior, Senior Advanced and Honours courses.

Descriptions of each course, in numerical order, are provided in Chapter 4.

Unit value of courses

Each course has a unit value, which is an approximate measure of the time required for lectures, tutorials and practical classes, e.g. four units may mean approximately 4 hours of classes each week for one semester or, alternatively, 2 hours of classes each week throughout the year.

When you pass a course you are credited with the unit value of the course, except where

—it is mutually exclusive with a course you have already passed, or
—you are attempting the course a second time, having gained a terminating pass the first time.

Completion of courses

In order to complete a course you must: attend the lectures, tutorials and laboratory and practical classes prescribed for the course; complete the exercises, practical work and assignments prescribed; and pass the exarriination(s) set for the course.

If you have been absent without leave from moire than ten percent of the classes in any one semester in a particular course, you may be asked to show cause why you should not be deemed to have failed to complete that course. Should you fail to show cause, you shall be deemed not to have completed that course.

Absence from lectures and other classes

If you.are unable to attend lectures and/or practical classes because of illness, accident or for any other reason, you must submit an 'Application for Special Consideration' form. When applicable, a medical certificate or other supporting evidence should be attached. Notification forms for this purpose are available at the Engineering Faculty Office. Please see Chapter 5 for further information on applications for special consideration based on illness and misadventure.

Minimum number of units and rates of progress

To satisfy the requirements for a pass degree you are required to gain not less than 200 units, which must include all the core courses for at least one branch of engineering.

The total of 200 units is the rninirnurn, but many students gain more than this. Some students choose to take extra elective courses and other students change their chosen branch of engineering and therefore have to pick up outstanding core courses for the new branch.

The minimum time in which you can qualify for the degree is four years. If you want to qualify in the minimum four years, you should plan to gain not less than 48 to 52 units each year. Some students take five years to complete the degree requirements. This is usually because of failure in some of the courses attempted, with the consequent need to repeat the courses. Some candidates, however, plan to progress at a slower rate, sometimes so that they can take a number of elective courses.

The BE degree is available on a full-time basis only and students cannot complete the degree requirements on a part-time basis or externally.

Classification into years

Students are classified as being in Junior (First), Intermediate (Second), Senior (Third) or Senior Advanced (Fourth) year according to the year from which the majority of their units are being taken.

Selection of courses

The following advice is intended to help you select your courses. You should become familiar with the courses that are available for the degree and particularly with those that have been prescribed as core courses for the branch or branches of engineering in which you are interested.

The full list of Junior and Intermediate courses for which you may gain units towards the degree in any branch of engineering is to be found in Tables 1(a) and (b) of the Tables of Courses accompanying the Senate resolutions at the end of this chapter.

Tables 2 to 8 set out the core courses prescribed for each of the branches of engineering. Next to each of Tables 2 to 8 is a summary of the Faculty and Department/School resolutions relating to that branch of engineering, showing, e.g., acceptable alternative courses to the core courses listed in the tables. Information about which elective courses are recommended for which branch of engineering and other relevant information is also set out on the pages next to the Tables of Courses.

For detailed descriptions of each course refer to Chapter 4, *Courses of Study.* If, for special reasons, you want to take a course which is not included in the lists of prescribed courses you may apply to the Faculty for permission.

Junior year enrolment

In your first year of attendance you are normally required to enrol in 48,50 or 52 units.

Depending on the choice of elective courses you make in your first year of attendance, you may be able to proceed to the degree in any of the branches of engineering (subject to the separate electrical and chemical engineering quota arrangements).

Students in all branches of engineering study mathematics, chemistry, physics and/or mechanics and computing in their first year. Courses in these basic science subjects form the solid science basis upon which the teaching in the various branches of engineering is later built. First year students also take introductory courses in the branch of engineering towards which they are proceeding.

At enrolment time students are given information about a variety of enrolment menus, which are combinations of courses designed for each of the branches of engineering. Enrolment menus comprise courses which are considered to provide the best possible introduction to the branch of engineering for which they are designed and they will lead to sensible second year enrolments.

For some branches of engineering there is only one Junior (First) year menu, which comprises all the Junior core courses prescribed for that particular branch. In other branches, there is a choice of menus which comprise some or all of the Junior core courses together with a choice of recommended elective courses.

While first year students in the quota for Aeronautical, Civil and Mechanical Engineering must choose an enrolment menu designed for one of these particular branches of engineering, there is sufficient flexibility for students to be able to change their branch of engineering at the beginning of second year and still be able to complete the degree requirements within the nurtimum of four years in most cases. Students who wish to change branches at a later stage may do so but it would probably take them longer than the minimum of four years to complete the degree requirements.

Similarly, students who wish to do so may change from Chemical or Electrical Engineering into one of the other branches. The number of years that it would take them to complete the degree requirements would depend on the stage at which they wish to change and also on which branch of engineering they wish to enter.

Students who wish to transfer from Aeronautical, Civil or Mechanical branches into Chemical or Electrical Engineering must apply through the Universities Admissions Centre.

If you wish to take the opportunity of transferring to the Faculty of Science at the end of your Intermediate (or Senior) BE year, you should study the rules relating to the double degree under Resolution 13. (These rules are set out below.) You will need to fulfil a number of conditions to be eligible to transfer to the Faculty of Science, one of which is the completion of two 16-unit Science courses in your Intermediate BE year. You should therefore ensure that the menu/ courses you take in your first year will enable you to take the appropriate Science courses in your second year.

It is strongly recommended that you enrol in a menu and not in a one-off combination of courses if you wish to complete the degree requirements in the minimum of four years.

Each menu shows the branch of engineering for which it is suitable and also the consequential minimum number of units necessary for Intermediate year to complete all Junior and Intermediate core courses for each branch if all courses on the menu are completed at a satisfactory standard. There is also an indication where the consequential Intermediate enrolment would be very heavy, where it would be excessive and where there would be serious timetabling problems.

A 'one-off enrolment in courses outside the menus can have a number of pitfalls:

—the courses might not timetable,

—the consequential Intermediate Year BE enrolment mighthaveprerequisite/corequisiteproblemsand/ or serious timetabling problems,

—it might result in you needing to spend five years completing the degree requirements.

Intermediate and later year enrolments

The minimum enrolment for re-enrolling students is normally 36 units and the maximum is normally 64 units (unless the Faculty has imposed any special conditions on your re-enrolment because of unsatisfactory progress in the previous year).

Enrolments outside the 36 to 64 unit limits require special Faculty permission. You should note, however, that an enrolment of more than 48 to 52 units is demanding, and only an exceptionally strong student should contemplate an enrolment in the region of 56 to 64 units. Experience has shown that a student who fails a number of units and who then tries to 'catch up' by taking more than 48 to 52 units will perform far worse than if he or she had attempted a more realistic number of units.

Intermediate year students must include in their enrolment any outstanding Junior core courses for their chosen branch of engineering. (Outstanding core courses are courses which a student either did not attempt in the previous year, or attempted but did not complete satisfactorily.) Similarly, Senior students must include in their enrolment any outstanding Junior and Intermediate core courses, etc.

If you received a Terminating Pass for a course in the previous year and if that course is an '(a)' level prerequisite for a higher year core course in your chosen branch, then you would normally be required to repeat that course in your next year of enrolment (unless you were granted permission otherwise).

Your enrolment in outstanding core courses must generally take priority over your enrolment in higher year courses and you must not enrol in courses with timetable clashes.

If you are enrolling, for example, in the Intermediate year and if you are not able to add sufficient Intermediate core courses to your outstanding Junior courses to total the normal minimum enrolment of 36 units, then you should add elective units (from courses that do not cause timetable clashes) or you may apply to the Faculty for special permission to enrol in less than 36 units. Senior and Senior Advanced students should proceed in the same way.

You should note that, generally speaking, timetabling problems with outstanding core courses and current year core courses only occur when students have failed to complete courses at a satisfactory standard and have to repeat courses or when students change their branch of engineering.

If you are thinking about proceeding towards the 'double degree' of BSc BE, then you should include two 16 unit Science courses in your Intermediate year enrolment. If this would result in an excessive number of units, then you should discuss with advisers at enrolment time the feasibility of leaving one or two 4 to 8 unit Intermediate Engineering courses out of your enrolment. There is provision for the Faculty to grant you special permission to 'carry' these 4 to 8 units in a part-time BE enrolment concurrently with your Resolution 13 BSc degree enrolment. There is also provision for the Faculty of Science to allow you to take as part of the BSc enrolment one of the Engineering Science courses (e.g. Mechanical and Aeronautical Engineering Science). (This permission is normally only given if one of your Intermediate Science courses is not prescribed as a core course for the branch of engineering in which you are proceeding.) On completion of the Engineering Science course you could then apply to the Faculty of Engineering for exemption from the Engineering courses which comprise the Engineering Science course.

Advice for students

Advisers are available for all the branches of engineering during the official enrolment periods in February each year. This is generally the appropriate time for students to seek advice and discuss their plans of courses.

If you require further guidance in the selection of your courses, however, or advice on any other matter concerning your studies, do not hesitate to consult a member of staff.

The Dean or Secretary to the Faculty is available throughout the year at the Engineering Faculty Office in the Faculty Building for consultation with Junior and Intermediate year students.

Senior and Senior Advanced students seeking advice on courses should consult the member of staff shown in the list of Advisers to Undergraduate Students at the beginning of Chapter 1.

Result grades

The Board of Examiners of the Faculty of Engineering is the body which determines BE students' examination results. The Board meets in December each year when it considers the results recommended by the examiners of each course for each student. Official examination result notices are then sent to students.

Some teaching departments may release informal results at the end of First Semester, but these are not official, final results.

Satisfactory performance in a course is recognised by the award of the grade of Pass (P). Performance at levels higher than this is recognised by the award of a Credit (Cr), Distinction (D) or High Distinction (HD). If the requirements for a course are not completed then a grade of Fail (XX) may be awarded.

Pass 50-64
Credit 65-74
Distinction 75-84
High Distinction 85-100
Fail below 50

If a student failed a course but the failure was borderline, then the Board of Examiners may award one of the following results instead of a Fail:

Terminating Pass (T) — A Terminating Pass will not permit a student to enrol in further courses in that subject or to use that course as a prerequisite for courses that require a clear pass in their prerequisite courses. (This means that a T Pass does not fulfil '(a)' level prerequisite requirements.)

Terminating Pass, Optional Supplementary (M)—This is a T Pass (see above), with permission to attempt a supplementary examination: if you perform satisfactorily in the supplementary you may be granted a clear pass; if you fail, or do not sit the supplementary, you will be granted a Terminating Pass in the course.

Fail, Supplementary Examination (X)—This means that you have failed the course but have been granted permission to attempt a supplementary examination: if you perform satisfactorily in the supplementary you may be granted a clear pass or you may be granted a Terminating Pass; if you fail, or if you do not sit the supplementary, you will be awarded a Fail in the course.

The Board also uses a concession system where, if a student failed a course but the student's overall performance in all courses reached a certain standard, the Board may award one of the following results instead of a Fail:

Pass, *Concessional* (PCon)—This means that the Board has conceded you a Pass. *A* PCon may be treated as a full, clear pass for progression purposes.

Terminating Pass (Concessional) (TC) — This means that the Board has conceded you a Terminating Pass (see T above).

Terminating Pass, Optional Supplementary(Concessional) (MC) — This means that the Board has conceded you a Terminating Pass, with permission to attempt a supplementary examination (see M above). This affords an opportunity for you to gain a full pass.

Fail, Concessional Supplementary (XC) — This means that you have failed the course but have been granted permission to attempt a supplementary examination: if you perform satisfactorily in the supplementary you may be granted a Pass; you could also be awarded a Concessional or Terminating Pass (see above); or you could be awarded a Fail. If you do not sit the supplementary, you will be awarded a Fail in the course.

If a student has not been able to complete the requirements for a course because of serious ill-health or misadventure (which has been duly attested), the Board may grant the following result:

Supplementary Examination to count as an Annual (XTCA) — This means that you may sit for a supplementary examination, and your result in the supplementary will be treated as though you had obtained it at the annual examination. You may be awarded any of the passing grades (up to and including HD) and if you fail the examination you will be awarded a Fail.

Students who are awarded supplementary examinations for reasons of illness or misadventure and who have already achieved some form of passing grade will have their result achieved indicated, followed by 'SUPP TO CHANGE GRADE'. This gives students the opportunity to attempt a supplementary exam in order to improve their original grade.

Students awarded supplementary examinations should consult the department that teaches the course for information about the form and content of the supplementary examination.

Students who have been awarded a result of Incomplete (I or TXX) or Result to Come (V) should consult the member of staff responsible for the course.

Supplementary examinations should be regarded as privileges and not as rights.

The Board of Examiners meets again each February to determine the results of students who were granted permission to sit for supplementary examinations. Students who pass their supplementary examinations will not be awarded grades of pass higher than Pass (except where an XTCA or other result of STCA — Supplementary to count as Annual—was awarded).

Exemption from attendance at classes

If you enrol in a course which you have previously attempted you may be granted exemption from attendance at laboratory or practical classes. To seek such exemption, apply on the appropriate form *before the course starts.* Application forms are available at the Engineering Faculty Office.

Deferment of enrolment

Deferment of enrolment is only possible from second year onwards. To ensure your place is kept open, you must apply in writing to the Faculty Manager, stating the reasons for your requested deferment. Deferment is normally granted for only one year, although this may be extended in exceptional circumstances which must be detailed in your letter of application.

Practical experience

At an appropriate stage of your training you are required to work as an employee of an approved engineering-related organisation and submit a satisfactory written report of your work. This period of experience, usually about 12 weeks, is normally undertaken after you complete some or all of the prescribed Senior courses and before you enrol for your final year of study. It is possible to undertake all of the work experience at the end of Senior Year, or undertake a part at the end of Intermediate Year and complete the work experience at the end of Senior Year. There is a core course prescribed for each of the branches of engineering which comprises this practical experience requirement. Please refer to the course descriptions later in this Handbook for specific conditions applying in each Department in relation to when the work experience can be undertaken and what type of experience is suitable.

If you are not committed to employment as a cadet or scholarship holder the Careers and Appointments Service of the University is available to help you obtain suitable employment.

Mining engineering candidates are required to spend the major portion of this period employed in primary mineral production. As part of the practical experience requirement they must also obtain a First Aid Certificate before completing their final year of study.

Candidates for the degree in chemical engineering obtain this experience in special vacation practice schools, located in industrial plants and supervised by academic staff, whenever this can be arranged.

Honours degree

If you have made good progress for three years you may apply for admission as a candidate for the honours degree before commencing on your fourth and final year of study.

When you are accepted as a candidate for honours you may be required to enrol, in the final year, in Honours courses specified by the head of the department in which you are a candidate.

Alternatively, if you satisfy the requirements for the award of the pass degree in four years, you may then apply for admission as a candidate for honours. If accepted, you will be required to enrol for a fifth year of study and the award of the degree is deferred for one year.

In both cases the acceptance of an application rests with the head of the department concerned. Applications from students who have taken longer than three or four years, as the case may be, to reach the necessary standard may be considered, but in such cases it is necessary to obtain special approval of the Faculty.

The various Engineering departments use different formulae for determining students' eligibility for the award of Honours. All enquiries about this should be addressed to the relevant department.

The double degree BE/BComm

The double degree of BE/BComm was introduced in 1993. Engineering graduates often end up in management. This isbecause they are trained in solving problems, are good with figures, have learnt to work in teams and to deal with people. A background in commerce is a valuable asset in such progression. The engineer with financial skills can be more useful to his or her employer, and is likely to advance more securely and rapidly in a career headed towards management.

The five-year double degree with Commerce begins with a standard first year in Engineering. If accepted into the program you will spend a further four years studying Engineering and Commerce subjects in parallel.

Engineering workload: The normal Engineering degree consists of about 200 units: 50 units per year over four years. For the double degree with Commerce the total Engineering unit count is about 169. Over Years 2 to 5 of the double degree program the average number of Engineering units per year is 30, or 60% of the standard load. This load may be distributed differently in each department.

Commerce workload: The normal Commerce degree consists of 22 semester courses over three years. For the double degree this is 15. The Engineering equivalent of the Commerce courses is about 108 units spread over Years 2 to 5 of the double degree. The average load of Commerce and Engineering units taken together is 57 per year.

Who is eligible: Students enrolling in Intermediate (second) Year Engineering with a Junior (First Year) weighted average mark (WAM) of at least 62% may be eligible for admission to the Bachelor of Engineering/ Bachelor of Commerce double degree program. Applicants will be selected in order of decreasing WAM. You will also need to have gained credit for at least 48 units towards the Bachelor of Engineering degree (a minimum unit requirement for first year Engineering), and have completed all courses attempted at full pass level or better at the first examination (i.e. you cannot upgrade through supplementary exams).

Who is not eligible: The double degree with Commerce is not available to those who enrol in Aeronautical Engineering and cannot be taken with:

- Information Systems Engineering
- Mechatronics
- The BE BSc double degree

How to apply: Apply to the Faculty of Engineering by 30 November of your first year of attendance, on the application form available at the Faculty of Engineering Office.

The double degree BSc BE

Many Engineering students take the opportunity of gaining the 'double degree' of BSc BE.

If you satisfy certain requirements you may be permitted to transfer to the Faculty of Science for one year in order to complete the requirements for the BSc degree. This one year is additional to the four years required to complete the BE degree. Students who proceed towards the 'double degree' usually transfer to the Faculty of Science after they have completed two years of Engineering, but there is provision for students to do so after they have completed the Senior (or Third) year of the BE degree course. There is also provision for students to complete the BSc degree under Resolution 13 over two years part-time instead of one year full-time. Most students do so full-time, however. There is also provisionfor students to remain in the Faculty of Science for an extra year in order to complete an Honours BSc degree.

After completion of the Science year(s), students then transfer back to the Faculty of Engineering in order to complete their BE degrees.

The rules and regulations relating to the 'double degree' are set out in Resolution 13 of the Resolutions of the Senate relating to the degree of Bachelor of Science and in Resolutions of the Faculty of Science. These rules are set out below and you should study them carefully if you are interested in obtaining the 'double degree' of BSc BE.

A summary of the main points of the rules is also set out below. This summary is intended to assist students to understand the rules but is in no way intended to replace them.

Summary of Resolution 13 rules

In order to be eligible to transfer to the Faculty of Science for the 'double degree', you should normally have:

—completed 96 units at the end of your second year of enrolment in the BE degree course (or 108 units at the end of your third year of enrolment);

—course including at least two 16 unit Intermediate Normal or Intermediate Long Science courses (for example, Chemistry 2, Computer Science 2, Mathematics 2, or Physics 2).

In order to qualify for the BSc degree you are required to complete courses totalling 24 units. The 24 units should normally include at least one 12 unit Senior course (for example, Chemistry 3, Computer Science 3, Pure or Applied Mathematics 3, Physics 3). If only one 12 unit Science course is completed, then at least 8 of the remaining 12 units should be for an Intermediate course. You have the choice of a wide range of subjects in the Faculty of Science, but you must have satisfied the prerequisites laid down in the BSc degree requirements for any course in which you wish to enrol.

If you are interested in proceeding towards the 'double degree' it is essential that you plan your courses carefully in your Junior (First) year, so that you fulfil prerequisite requirements for the two 16 unit Intermediate Science courses which you must take in your Intermediate (Second) year.

Application to transfer to the Faculty of Science under Resolution 13 should be made at the end of your Intermediate (or Senior) year studies (i.e. by the end of December in the year prior to the one in which you wish to undertake the Science year). Applications will close on the last working day in the University prior to the closing of the University for the Christmas break.

Similarly you will need to lodge an application to transfer back to the Faculty of Engineering from the Faculty of Science.

Applications for transfer to and from the Faculty of

Science are available at the Student Centre and the Faculty of Science and Faculty of Engineering Offices.

Resolution 13 rules

1. Pursuant to Resolution 13 of the Resolutions of the Senate governing the degree of Bachelor of Science, students who are of two or three years' standing in the Faculty of Engineering may be admitted to candidature for the degree.

2. To be eligible for admission, such students:

(1) must have gained credit in the Faculty of Engineering for not less than 96 units if of two years' standing in that faculty, or not less than 108 units if of three years' standing in that faculty; and

(2) except with the permission of the Dean of the Faculty of Science, must have completed at full Pass Level or better

(i) all courses attempted in the Faculty of Engineering at their first examination; including

(ii) at least two Intermediate Normal or Intermediate Long courses offered by departments of the Faculty of Science. In some circumstances students may be permitted to count as *one* of the Intermediate courses for this purpose, courses undertaken in the Faculty of Engineering which combined are the equivalent of one of the following courses in the Faculty of Science:
Chemical Engineering Science 2,
Civil Engineering Science 2,
Mechanical and Aeronautical Engineering Science 2.

3. To qualify for the award of the pass degree, candidates after admission under Resolution 13 of the Resolutions of the Senate governing the degree of Bachelor of Science shall complete in one year of full-time study or in two consecutive years of part-time study, courses totalling at least 24 units subject to the provisos:

(1) that at least 12 of the required 24 units shall be for a Senior course and, if only one Senior course is completed, at least 8 of the remaining 12 units shall be for an intermediate course; and

(2) that, except with the permission of the Dean, the 24 units shall not include any units

(i) for courses listed under Senate Resolution 10 Groups (d) or (e) relating to the degree of Bachelor of Science, or

(ii) for any courses already attempted either completely or in part, within the Faculty of Engineering, or

(iii) for all or part of the courses:
Chemical Engineering Science 2,
Chemical Engineering Science 2 Auxiliary,
Civil Engineering Science 2,
Mechanical and Aeronautical Engineering Science 2.

Such permission will be given only if the candidate has not counted one of these courses as an Intermediate course for the purpose of gaining admission under Resolution 13; up to 8 units, taken in one year to complete *one* of the above courses, may then be included. Any one of the 8 unit courses above may then be counted as an Intermediate course for the purposes of part (1) of this resolution provided the whole course is completed in one year.

4. Candidates admitted under Resolution 13 shall comply with Resolution 13 of the Resolutions of the Senate governing the degree of Bachelor of Science.

5. To qualify for admission to Honours courses, such candidates shall comply with Resolution 13 of the Resolutions of the Senate.

There is no provision for students admitted under Resolution 13 to continue in the Faculty of Science after one full-time or two part-time years of study except to complete an Honours course.

Candidates who fail to complete the required 24 units may only be readmitted to the Faculty of Science if a successful application is made at the appropriate time through UAC. Successful applicants will be given credit for courses completed in accordance with Resolution 11 of the Resolutions of the Senate governing the degree of Bachelor of Science.

Admission of BSc graduates

If you are enrolled in the Bachelor of Science degree course at this University and wish to transfer to the Bachelor of Engineering degree course, you must make application through the Universities Admissions Centre by a closing date which is late in September in the year preceding that in which you wish to enrol in the Faculty of Engineering.

Your application will be considered on the basis of academic merit, to the extent that facilities are available. Consideration will be given to your HSC examination results and to your examination results in the Faculty of Science (and to your results in any other tertiary courses you may have completed). The offer of a place in the Faculty of Engineering is NOT automatic and the competition for entry is keen.

If you are a graduand/graduate in the Faculty of Science and if you are offered a place in the Faculty of Engineering, you may be able to complete the BE degree requirements in two further years of full-time study. You would need to have completed appropriate courses in the Faculty of Science so that you could be given credit for/exemption from all or most of the Junior and Intermediate core courses prescribed for that branch of Engineering in which you wish to proceed.

The departments in the Faculty of Engineering have indicated that they would recommend that a science graduand/graduate be given sufficient credit/exemption to enable him or her to complete the BE degree requirements in two years if he or she has completed the courses set out below.

The BSc degree requirements would need to have been completed in the minimum time and in some Engineering departments minimum standards of performance in science courses are required.

For Aeronautical Engineering
Chemistry 1
Computer Science 1
Mathematics 2 (Pure or Applied)
Physics 2
Mechanical and Aeronautical Engineering Science 2

For Chemical Engineering
Mathematics 2 (Pure or Applied)
Chemistry 2 Auxiliary
Chemical Engineering Science 2

For Civil and Mining Engineering
Chemistry 1
Physics 1 or Computer Science 1
Mathematics 2 (Pure or Applied)
Civil Engineering Science 2

For Electrical Engineering
Mathematics 2 (Pure or Applied)
Computer Science 2
Physics 3D (passed at Credit level or better)

For Mechanical and Mechatronic Engineering
Chemistry 1
Computer Science 1
Mathematics 2 (Pure or Applied)
Physics 2
Mechanical and Aeronautical Engineering Science 2

For Mechanical and Mechatronic Engineering, students need to have achieved good grades in the courses listed above. When entering Mechanical Engineering, students will be required to enrol in Mechatronic Design.

If you have completed courses other than those listed above then the Faculty would need to give individual consideration to what credit/exemption you could be given.

TheCommonwealthDepartmentofEducationmay approve the extension of benefits under AUSTUDY for a period of two years for students in the final year of the science degree who proceed to studies in the Faculty of Engineering.

Engineering Talented Students Scheme

The Faculty makes special provision for first year students who have achieved outstanding academic results before coming to the Faculty. Examples of such results would include a TER of 99+, or successful competition in a Maths or Physics Olympiad. The Engineering Scheme links in with the corresponding program in the Faculty of Science since all students undertake a high proportion of Science subjects in their Junior year. Students who are admitted to the scheme undertake flexible course programs which are individually tailored to their needs; talented students can take additional subjects to broaden their knowledge, undertake courses at a more advanced level and accelerate their progress towards the degree. Students can apply to enter the scheme at the time of enrolment in first year.

Discontinuation and variation of enrolment

If you wish to cease attending a course (or all your courses), you are discontinuing your enrolment in that/those courses. You must notify the University of your intention to discontinue by submitting the appropriate form to the Engineering Faculty Office. If you fail to do so, you may be recorded as being Absent Fail in the course(s) at the end of the year.

The rules about discontinuation for the Faculty of Engineering are set out in full in the University's *Statutes and Regulations 1994-95.* The following is a summary of their main points:

There are three categories of discontinuationresults used to record discontinuations in the Faculty of Engineering: 'Withdrawn', 'Discontinued with Permission', and 'Discontinued'.

If your enrolment is 'Withdrawn' (W), then your enrolment is cancelled as though you had never enrolled. This enrolment does not appear on an official transcript of your academic record.

If your enrolmentis T)iscontinued withPermission', it means that you commenced the course(s) and were given permission to discontinue without any penalty or implication of failure whatsoever. The enrolment and the result of 'Discontinued with Permission' (DP) appear on an official transcript of your academic record.

If your enrolment is TMscontinued' (Disc), then it means that the discontinuation counts as a failure. On an official transcript of your academic record, your enrolment appears with the result of TDiscontinued'.

Your discontinuation will be recorded as effective from the date on which you notify your intention of discontinuing (unless you can provide evidence of having discontinued at an earlier date and can give good reasons as to why you did not submit notification of your discontinuation at that time).

Total discontinuation

If you wish to discontinue all your courses, then you must notify the University of this intention by completing and submitting your 'Confirmation of Enrolment' form (together with your student card) to the Engineering Faculty Office. You should note your reasons for discontinuing on this form. If your 'Confirmation of Enrolment' form is not available, then you should obtain an 'On-line variation form' from the Student Centre or Faculty Office and use that instead.

Before 31 March

If you discontinue all your courses before 31 March, then your enrolment will be recorded as 'Withdrawn'.

After 31 March and up to the last day of the seventh week of teaching

If you discontinue all your courses after 31 March but on or before the last day of the seventh week of teaching in the year, then your enrolment will be recorded as 'Discontinued with Permission'.

After the last day of the seventh week of teaching

If you discontinue all your courses after the last day of the seventh week of teaching in the year, then your enrolment will be recorded as 'Discontinued', unless the Dean, on the basis of serious ill health or misadventure, determines that the discontinuation result should be recorded as 'Discontinued with Permission'.

If your enrolment is recorded as 'Discontinued', which means that the discontinuation counts as a failure, then you have failed to make satisfactory progress with your studies and the Faculty may determine that you should be sent a 'Warning Letter' or that you should be asked to 'show cause'. These terms are explained below.

Application procedure to re-enrol in the BE degree course after total discontinuation

New first year students:

If you are a new first year student who totally discontinues his/her enrolment and if you wish to re-enrol in the BE degree course, then generally speaking you will need to apply for re-enrolment through the Universities Admissions Centre (unless you were recorded as 'Discontinued with Permission' and were given 'Repeat status'). ('Repeat status' means that you may enrol in the BE degree course in the next calendar year by completing an internal University 'General application for enrolment' form and that you will not need to compete for a place through UAC for that one calendar year only. If you do not take up that option and then wish to re-enrol in the BE degree course in a future year, you will need to apply for re-admission through UAC.)

UAC applications must be lodged by the closing date late in September/early in October in the year prior to that in which you wish to re-enrol.

Re-enrolling students:

If you are a re-enrolling student in the BE degree course who totally discontinues his/her enrolment and if you wish to re-enrol in the BE degree course, then generally speaking you should apply for re-enrolment by completing an internal University 'General application f or'enrolment' form by 1 October in the year prior to that in which you wish to re-enrol.

Variation of course enrolments

If you wish to vary your enrolment by discontinuing one or more of your courses and/or by adding one or more courses to your enrolment, you should proceed as follows:

Before 31 March

All students should obtain a 'Variation of Enrolment' form from the Faculty Office, discuss your intended enrolment variation with, and get approval from, your Year Adviser, and return the signed and completed form to the Faculty Office for processing. Your new timetable, showing the approved changes, will be available within a few days from the Faculty Office, which will also arrange entry of the change into your official university enrolment record.

After 31 March

If you wish to discontinue one or more courses after 31 March then you must apply to do so on your 'Confirmation of Enrolment' form (or on an 'On-line variation form', which you can obtain from theStudent Centre or Faculty Office). All students should complete this form and then lodge it at the Engineering Faculty Office after obtaining approval from their Year Adviser who should sign the form. If you discontinue a course before the last day of the seventh week of teaching in that course, then it will be recorded as 'Discontinued with Permission'. This applies to all courses, whether they be courses that are taught over the whole year or in one semester only.

If you discontinue a course after the last day of the seventh week of teaching in that course, then it will be recorded as 'Discontinued', unless the Dean, on the basis of serious ill health or misadventure, determines that the discontinuation result should be recorded as 'Discontinued with Permission'. As the result of 'Discontinued' implies that the discontinuationis being counted as a failure, you will be allocated 0 percent for the unit value of the course in the determination of your weighted average mark (WAM). The Faculty takes students' WAMs into consideration when determining whether or not students have made satisfactory progress with their studies, and students are therefore discouraged from discontinuing courses which would be recorded as 'Discontinued'.

Other rules relating to variation of enrolment

You should note that variations of enrolment are subject to all the other rules relating to enrolment in the BE degree course. First year students are normally required to be enrolled in 48 to 52 units, and re-enrolling students are normally required to be enrolled in 36 to 64 units (unless special conditions have been imposed on their re-enrolment). Students are normally required to fulfil prerequisite and corequisite requirements and they are not permitted to enrol in courses with timetable clashes. Students must enrol in outstanding core courses and must give priority to their enrolment in these courses over higher year courses.

Weighted Average Mark (WAM)

The Faculty uses students' weighted average marks (or WAMs) when considering a number of aspects of students' candidatures: Engineering departments use WAM calculations when determining students' eligibility for the award of Honours degrees. The Faculty uses WAM calculations when ranking applicants for scholarships for postgraduate study and for undergraduate prizes and scholarships. The Faculty also takes account of students' WAMs when determining whether or not students have made satisfactory progress with their studies. A WAM is calculated for every studentforeveryyearof enrolment by adding together the products of the marks achieved with the unit value of each course attempted (including courses which have been failed or 'Discontinued') and dividing by the total number of units attempted. Courses which have been 'Withdrawn' or Discontinued with Permission' are not included in the WAM calculation.

Failure to make satisfactory progress and exclusion

If the Faculty considers that you have failed to make satisfactory progress with your studies, the Faculty may exclude you from re-enrolment in the Faculty of Engineering. This process of excluding students is designed to ensure that the resources available in the Faculty are used to teach those students who make the best use of them. Failure to make satisfactory progress cannot be defined precisely in all cases in advance, but generally you will be considered not to have made satisfactory progress if:

—your weighted average mark (WAM) for the year is poor; and/or
—you do not gain at least half of the units for which you are enrolled; and/or
—you fail a major, course more than once; and/or
—you had special conditions imposed on your re-enrolment (usually because of lack of satisfactory progress in the previous year of enrolment) and you fail to meet these conditions.

If the Faculty considers that your progress has not been satisfactory, it may decide that you should be sent a 'Warning Letter', in which you are advised of this and also of certain conditions that you would need to meet in your next year of enrolment in the Faculty. These conditions would normally specify the number of units and particular courses thatyou would need to pass in the next year of enrolment in the Faculty. Failure to meet such conditions would normally result in you being asked to show good cause why you should be allowed to re-enrol in the Faculty of Engineering.

If the Faculty considers that your progress has been most unsatisfactory it may decide that you should be asked to show good cause why you should be allowed to re-enrol in the Faculty of Engineering. This means that you are being asked for an explanation for your failure to make satisfactory progress in your studies. When the Faculty considers students' statements purporting to show good cause, it takes account of illness, accident and/or personal problems.

If the Faculty determines that you have shown good cause (i.e. it accepts your explanation), then it will allow you to re-enrol. In doing so, the Faculty will probably impose certain conditions on your re-enrolment (such as specifying the number of units and particular courses that you must pass in your next year of enrolment). Should you fail to meet these conditions you may be called upon again to show good cause why you should be allowed to re-enrol in the Faculty of Engineering.

If the Faculty considers that you have failed to show good cause (or if no statement is received from you), then the Faculty may exclude you from enrolment. If you are excluded, you have the right of appeal to the Senate. The Senate may either uphold your appeal and allow you to re-enrol in the Faculty of Engineering or it may disallow your appeal and confirm your exclusion.

A student who is excluded from re-enrolment in the Faculty may apply for re-admission to the Faculty after two academic years have elapsed. When considering an application for re-admission, the Faculty takes account of the following: the circumstances that led to the student's failure to make satisfactory progress; how these circumstances have changed; and the student's activities since being excluded.TheFacultywouldnormallyexpectastudent to have undertaken relevant tertiary studies successfully during this period. (You should note, however, that students who are excluded from one Faculty or degree course at this University are finding it increasingly difficult to gain selection into another course at this University and at other tertiary institutions.)

Outcomes of degree programs in the Faculty of Engineering

This sectionprovidesastatementof expected outcomes from the undergraduate degree programs in the Faculty of Engineering.

Outcomes

Outcomes of the undergraduate degree programs can be specified in terms of the attributes of graduates from the Faculty, with two qualifications:

(a) There is a minimum common set of attributes that all Engineering graduates will possess. However, in recognition of the differences between students, the Faculty provides a wide rangeoflearning opportunities so thatstudents can achieve optimum outcomes consistent with their own interests.

(b) The more advanced objectives of teaching in the Faculty can probably only be specified in very general terms. This is appropriate for university-level teaching.

The attributes of our graduates can be divided into three classes:

(1) Knowledge and understanding: Course curriculum descriptions in this Handbook summarise the fields covered, which embrace broad areas of engineering and adjoining disciplines. The courses emphasise understanding of underlying principles and conceptual frameworks rather than rote learning of facts. It is this type of understanding that graduates can carry with them into their future careers.

(2) Abilities: These encompass generic capabilities, such as management and communication skills, as well as specific engineering abilities, such as proficiency in engineering problem-solving and analysis; testing and measurement; and planning and design. Graduates will possess the ability to effectively apply knowledge acquired during the course and, equally importantly, be able to adapt to new environments in engineeringwith confidence. Arange ofpractically-orientated capabilities are developed in the Faculty's programs. These include: the ability to extract key aspects from information; the ability to evaluate the reliability of data; skills in estimation and approximation; the ability to recognise when additional expertise or information is required; and the ability to take the broad view of an engineering task including the non-engineering aspects. To help develop these capabilities, laboratory work is a key element in the Faculty's undergraduate programs. Through laboratory design and project work, students not only acquire up-to-date technical skills (including computer-based skills), but develop attitudes important to the practice of engineering.

(3) Attitudes: Personal characteristics of the graduates include: an understanding of the function of engineers

insociety; an understanding of the roles of scholarship, research, and innovation; a recognition of the importance of continued study to remain up-to-date; an appreciation of professional ethics; and a cognisance of environmental issues.

The Engineering degree is accredited by the Institution of Engineers with Continued Full Recognition. The rigorous periodic accreditation process includes a full review of course structure and content, inspection of Faculty facilities, perusal of examination papers and meetings with students and staff. The Faculty is developing uniform procedures for quality assessment of coures including a common scheme for course evaluation by students and review of examination material.

Statutes

Bachelor of Engineering

Resolutions of the Senate

1. (1) The degree of Bachelor of Engineering shall be awarded in:
   (a) Civil Engineering
   (b) Mining Engineering
   (c) Mechanical Engineering
   (d) Mechanical Engineering (Mechatronics)
   (e) Electrical Engineering
   (f) Electrical Engineering (Information Systems Engineering)
   (g) Chemical Engineering
   (h) Aeronautical Engineering
   (i) Project Engineering and Management (Civil).

   (2) The certificates for the degree shall specify the department or departments of Engineering for which they are awarded.

   (3) (i) Graduates in Engineering in any department may be admitted to the degree examination in any other department or departments on conditions to be prescribed by the Faculty,
   (ii) Upon passing the examination . such candidates shall receive a certificate for such additional department or departments.

1A. For the purpose of these resolutions—
   (i) a 'course' shall comprise such lectures, tutorial instruction, essays, exercises and practical work as the Faculty may provide,
   (ii) to complete a course' means—
   (a) to attend the lectures and the meetings, if any, for tutorial instruction;
   (b) to complete satisfactorily the essays, exercises and practical work, if any; and
   (c) to pass the Annual Examination of the course,
   and derivative expressions shall have a corresponding meaning,
   (iii) 'core course' means a course which must be completed by a candidate in order to qualify for the award of a degree, unless the candidate is granted exemption by the Faculty,
   (iv) 'elective course' means a course other than a core course.
   (v) 'prerequisite' means a course which a candidate must complete before the candidate is permitted to enrol in any course for which that course has been declared a prerequisite,
   (vi) 'corequisite' means a course in which, unless previously completed, a candidate must enrol concurrently with any course for which that course has been declared a corequisite.

(a) The courses which may be taken for the degree are—
   (i) the Junior and Intermediate courses set out in Table 1 of the Tables appended to these resolutions,
   (ii) the Senior and Senior Advanced courses set out in Tables 2 to 8.
   (iii) elective courses, being Senior, Senior Advanced and Honours courses from time to time prescribed by the Faculty; such courses may not be provided in every year,
   (iv) such other course or courses as may be approved by the Faculty in special cases.

(b) (i) The core courses for the degree and their corequisite and prerequisite courses are set out in the Tables as follows:
   In Civil Engineering—Table 2.
   In Mining Engineering—Table 3.
   In Mechanical Engineering—Table4.
   In Mechanical Engineering (Mechatronics)—Table 4A.
   In Electrical Engineering—Table 5.
   InElectrical Engineering (Information Systems Engineering)—Table 5A
   In Chemical Engineering—Table 6.
   In Aeronautical Engineering—Table 7.
   In Project Engineering and Management (Civil)—Table 8.
   (ii) The Faculty may prescribe courses alternative to one or more of the core courses set out in the tables, completion of which shall satisfy the requirement to complete the core course concerned.
   (iii) The Head of the Department or School concerned may accept other work completed by a candidate as the equivalent of a corequisite or prerequisite for any course provided by that Department or School.

(c) The Faculty at the time of prescribing elective courses may also prescribe corequisites and prerequisites for those courses. At the discretion of the Head of the Department concerned, other work completed by a candidate may be accepted as the equivalent of a prerequisite or corequisite prescribed for any course provided by that Department,

(d) A candidate may only enrol in courses in accordance with these resolutions and subject to the exigencies of the timetable. Where a candidate wishes to enrol in two courses given wholly or partly at the same time, the Heads of the Departments or Schools concerned in their discretion may permit the candidate to attend equivalent courses or parts of courses at other times.

3. The courses for the degree shall have a unit value; elective courses prescribed by the Faculty shall have the unit value given them at the time of prescription and all other courses shall have the unit values shown in the Tables.

4. (a) Ah examination called an 'Annual Examination' shall be held for each course.

(b) The Annual Examination may consist of written or oral examinations, exercises, essays or practical work or any combination of these.

(c) A candidate who has been prevented by duly certified illness or misadventure from sitting for the whole or part of the Annual Examination may be tested at such times and in such a way as the Faculty shall determine and this shall not count as a re-examination.

5. (a) A candidate who has completed a course shall have credited to the candidate's degree the unit value of that course except that:

(i) no course may be counted more than once as a qualifying course for the degree;

(ii) a candidate may not have credited for the degree units derived from more than one of such courses as the Faculty may deem to be mutually exclusive; and

(iii) a candidate may not receive credit for an option within a course which is similar in contenttopartofacourse concurrently being taken or previously completed.

(b) (i) In any course at the Annual Examination the Faculty may award a Terminating Pass which entitles the candidate to be credited with the full number of units for that course.

(ii) A candidate who has been awarded a Terminating Pass in a course shall be held to have completed such course except that the Tables prescribe for core courses certain prerequisites in which a terminating pass is not acceptable, and the Faculty may prescribe the same restriction as to prerequisites for an elective course.

(iii) A candidate who is awarded a Terminating Pass in any course may take that course again but on completion of the course the units thereof may not be counted again.

5A. (1) The degree of Bachelor of Engineering shall be awarded in two grades, namely, the Pass degree and the Honours degree.

(2) (i) There shall be three classes of Honours, namely, Class I, Class II and Class III.

(ii) Second-class Honours may be awarded in two divisions.

6. (a) To qualify for the award of a Pass degree a candidate shall unless granted exemption by the Faculty under part (b) of this resolution:

(i) complete all the core courses listed in the Table pertaining to the Department in which the candidate is pursuing the degree, and

(ii) complete additional elective courses as maybe necessary to gaincreditfor a total of not less than 200 units.

(b) In special circumstances the Faculty may grant an exemption from completion of any core course to a candidate. No credit will be allowed for any core course for which an exemption from completion has been granted.

(c) A candidate who, with the prior permission of the Faculty, completes a course or courses at another university or an appropriate institution may be given credit for such of the courses set out in the Tables attached to these Resolutions as the Faculty may determine.

7. Except with the permission of the Faculty, a candidate, in the first year of attendance, shall enrol in Junior courses with a total unit value of not less than 48 units and not more than 52 units.

8. (a) In each subsequent year of attendance after the first, a candidate may enrol in any of the courses for which there is no prerequisite or for which the candidate has completed the prerequisites provided that:

(i) in the second year of attendance the candidate may enrol in Junior and/or Intermediate courses only.

(ii) the candidate shall include amongst the courses in which the candidate enrols such of the core courses for the degree for which the candidate was qualified to enrol in the previous year of attendance and for which the candidate has not yet gained credit, and for which the candidate has not been granted exemption under section 6(b).

(iii) the candidate shall in no case enrol for courses having a total unit value of more than 64, nor enrol for courses having a total unit value of less than 36 unless the candidate already has a credit for 158 or more units.

(iv) once the candidate has gained credit for 28 or more units from Senior or Senior Advanced courses, the candidate shall not enrol in any further such courses until the candidate has obtained such practical experience as the Faculty may require in an Engineering organisation approved by the Faculty.

(b) The Faculty may in special circums tances grant dispensationfrom the above requirements on such conditions as it thinks fit.

(c) A candidate enrolled in a course provided outside the Faculty of Engineering shall as regards that course be governed by the requirements of the Departmentproviding such course.

(d) A candidate who has been enrolled for the degree of Bachelor of Engineering but who has not re-enrolled for a period of one year or more shall complete the requirements for the degree under such conditions as the Faculty may determine.

(a) A candidate who re-enrols in a course which the candidate has previously failed to complete shall, unless exempted by the Faculty, attend all lectures and other classes and complete all written and other work prescribed for the course.

(b) A candidate who presents for re-examination in any course shall not be eligible for any prize or scholarship awarded in connection with such examination.

(a) Graduates in other Faculties of the University of Sydney or graduates of other universities who desire to proceed to the degree of Bachelor of Engineering, may be admitted to candidature with credit for such of the courses set out in the Tables as the Faculty may determine, up to a maximum of 100 units, provided they have completed for their previous degree those courses or a course or courses considered by the Faculty to be equivalent. Such candidates shall then be required to complete, in accordance with these resolutions, the requisite number of courses not already taken to meet the requirements of section 6.

(b) Students who have completed a course or courses in another Faculty or other Faculties of the University of Sydney may apply for permission to enrol as candidates for the degree of Bachelor of Engineering and if granted such permission, may be given credit for any of the courses set out in the Tables which they have completed in the other Faculty or Faculties, or for any course or courses considered by the Faculty to be equivalent, provided they have abandoned credit for such course or courses in the other Faculty or Faculties. Such candidates shall then be required to complete, in accordance with these resolutions, the requisite number of courses not already taken to meet the requirements of section 6.

(c) Students who have completed a course or courses in another university or institution may apply for permission to enrol as candidates for the degree of Bachelor of Engineering and if granted such permission may be given credit for such of the courses set out in the Tables as the Faculty may determine. '

(d) In each of the circumstances of the foregoing subsections, where an applicant for candidature has completed courses which are not comparable with any of the courses set out in the Tables, the Faculty may, either instead of or in addition to giving credit for any course that is so set out, give credit for such number of units, to be designated by the Faculty as Junior, Intermediate, Senior or Senior Advanced, as the Faculty may determine, and all units so credited shall, notwithstanding anything contained in these resolutions, count accordingly towards the satisfaction of the requirements of the degree.

11. (a) To qualify for admission to candidature for the Honours degree, a candidate shall—

(i) be considered by the Head of the Department concerned to have the requisite knowledge and aptitude, and

(ii) except with the permission of the Faculty, be *either* of not more than three years' standing in the Faculty and have gained credit for not less than 48 units from Senior and Senior Advanced courses or of not more than four years' standing in the Faculty and have completed the requirements of the Pass degree.

(b) In the case of a candidate who transfers to the Faculty of Science in accordance with the provisionsof sec tionl3of the Senate resolutions which govern candidature for the degree of Bachelor of Science, the time spentasa candidate in the Faculty of Science shall not be counted in determining the candidate's years of standing in the Faculty of Engineering.

12. (a) To qualify for the award of an Honours degree a candidate shall—

(i) complete the requirements of section 6, and

(ii) complete such Honours courses as are determined by the Head of the Department in which the candidate is pursuing the degree.

(b) The Faculty may prescribe any Senior or Senior Advanced course as a course which may be taken as an Honours course.

(c) Where an Honours course and a core course are deemed by the Faculty to be mutually exclusive, completion of the Honours course will be taken as satisfying the core course.

(d) ExceptwiththepermissionoftheFaculty, a candidate shall not be eligible for the award of an Honours degree unless the candidate has completed all the requirements within one year from admission to candidature.

(e) A candidate for an Honours degree who has failed to be placed in any Honours classification may be awarded a Pass degree.

13. If a candidate graduates with First Class Honours and the Faculty is of the opinion that the candidate's work is of outstanding merit, that candidate shall receive a bronze medal.

14. The provisions of these resolutions came into force on 1 January 1989. All candidates who commenced candidature prior to this date shall complete the degree requirements under such conditions as the Faculty may determine.

Table 1 — Junior and Intermediate courses *[See Resolution 2]*

Table 1(a) — Junior courses

Course No.	Title	Unit value	Assumed standard of knowledge at the HSC examination	Corequisites
U1.000	Mathematics 1	12	Mathematics 3 unit course	
U1.010	Mechanics IE	**6**	Mathematics 3 unit course and either 2 unit Physics or the Physics core of 3/4 unit Science	U1.000
U1.020	Physics 1	12	Mathematics 3 unit course and either 2 unit Physics or the Physics core of 3/4 unit Science	
U1.021	Physics IE	**6**	Mathematics 3 unit course and either 2 unit Physics or the Physics core of 3/4 unit Science. **Note:** See prerequisites for U2.020 Physics 2.	one of U1.010 or U1.400 or U1.710or U1.410
U1.030	Chemistry 1	12	Mathematics 2 unit course and either 2 unit Chemistry or the Chemistry core of 3/4 unit Science	
U1.031	Chemistry IE	**6**	Mathematics 2 unit course and either 2 unit Chemistry or the Chemistry core of 3/4 unit Science	
U1.032	Chemistry IE Supplementary	**6**	Mathematics 2 unit course and either 2 unit Chemistry or the Chemistry core of 3/4 unit Science.	U1.031
U1.040	Computer Science 1	12	Mathematics 3 unit course.	U1.000
U1.050	Geology 1	12		
U1.051	Engineering Geology 1	**5**		
U1.060	Biology 1	12	2 unit Biology or 3 unit Biology or 4 unit Science	
U1.080	Understanding Design	**2**		
For other 12 unit First Year courses offered by the Faculties of Arts, Economics and Science consult the relevant Faculty Handbook for the rules relating to assumed knowledge and mutual exclusiveness.				
U1.100	Manufacturing Technology	**4**		
U1.200	Civil Engineering 1	**4**	For courses U1.100 to U1.710 inclusive: Mathematics 3 unit course and either the Science 4 unit course or the Chemistry 2 unit course and the Physics 2 unit course.	
U1.220	Statics	**4**		U1.000
U1.280	Engineering Programming	**3**		U1.281
U1.281	Computer Graphics	**3**		U1.280or U1.040
U1.410	Mechanical Engineering 1	12		U1.000
U1.445	Engineering Computing	12		U1.000
U1.500	Introductory Electrical Engineering for Civil Engineers	**4**		U1.000
U1.510	Electrical Engineering 1	10		U1.000; and U1.020
U1.610	Chemical Engineering 1	**8**		
U1.620	Chemical Engineering Applications	**4**		U1.610
U1.630	Computing for Chemical Engineers	**2**		
U1.650	Materials and Corrosion 1	**4**		
U1.710	Aeronautical Engineering **1**	12		U1.000

Table (1)(b) — Intermediate courses

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
U2.000	Mathematics 2	16	U1.000		
U2.001	Mathematics 2EE	14	U1.000		
U2.020	Physics 2	16	U1.020	U1.000	
			OR		
			U1.021	U1.000; and U1.010	
			OR		
			U1.021	U1.000; and U1.400	
U2.021	Physics 2EE	12	U1.020	U1.000	
			OR		
			U1.021	U1.000; and U1.010	
			OR		
			U1.021	U1.000; and U1.400	
U2.031	Chemistry 2E	12	U1.030; or U1.031 and U1.032	U1.000	
U2.033	Chemistry 2 Long	20	U1.030; or U1.031 and U1.032	U1.000	
U2.034	Chemistry 2 Auxiliary	8	U1.030; or U1.031 and U1.032	U1.000	
U2.040	Computer Science 2	16	U1.040; and U1.000		
U2.041	Computer Science 2EE	14	U1.040; and U1.000		
U2.042	Computer Science 2A	8	U1.040; and U1.000		
U2.043	Computer Science 2B	6	U1.040;and U1.000		U2.042
U2.050	Geology 2	16	U1.050		
U2.052	Engineering Geology 2	5	U1.051; or U1.050		
U2.065	Biochemistry 2	16	U1.030; or U1.031 and U1.032		8 units of Intermediate Chemistry
U2.066	Biochemistry 2 Auxiliary	8	U1.030;or U1.031 and U1.032		8 units of Intermediate Chemistry
U2.090	Asian Studies 1	8			
U2.210	Introduction to Materials	4	U1.000; and U1.010		
U2.221	Structural Mechanics	5	U1.220; U1.000; U1.010		
U2.261	Fluids 1	5		U1.000	
U2.272	Engineering Communications 1	2			
U2.290	Structural Design	4	U1.220; U1.000; U1.010		U2.221
U2.410	Mechanical Engineering 2	10	U1.410 or U1.710	U1.000	
U2.411	Introductory Thermodynamics	4	U1.410 or U1.710	U1.000	

Table (1)(b) — Intermediate courses (continued)

Course No.	Title	Unit value	Prerequisites? (a)	(b)	Corequisites
U2.412*	Engineering Dynamics	**4**	U1.000 and U1.410 or U1.710		
U2.417	Introductory Mechanics and Materials	8		U1.000	
U2.440	Mechanical Design 1	8			U2.700; or U2.417
U2.441	Mechanical Design 1A	**6**			U2.700; or U2.417
U2.443	Mechatronic Design 1	**2**			U2.441
U2.471	Introductory Mechatronics	6	U1.410		U2.504
U2.502	Electrical Technology	4		U1.000	
U2.504	Electrical and Electronic Engineering	**6**	U1.410		
U2.510	Electrical Engineering 2	16	U1.510		U2.000or U2.001; and U2.020or U2.021
U2.610	Chemical Engineering 2	8		U1.000	U1.610
U2.611	Fundamentals of Environmental Chemical Engineering	**4**	U1.000; and U1.031	U1.610	U2.610
U2.612	Chemical Engineering Computations	4	U1.000; and U1.630		
U2.700	Mechanics and Properties of Solids 1	6		U1.000	
U2.701	Mechanics of Solids 1	4		U1.000	
U2.710	Fluid Mechanics.	4			
U2.770	Engineering Computation	**4**	U1.000; and U1.280; and U1.281		
U2.800	Engineering Construction 1	4		U1.000	
U2.820	Engineering Economics	4			U2.000
U2.821	Engineering Accounting	4			U2.820

[+]Eor prerequisites in Column (a) a Terminating Pass is not acceptable.

Table 2 — Civil Engineering

Candidates for the degree of Bachelor of Engineering in Civil Engineering are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

TJ1.000 Mathematics 1
TJ1.010 Mechanics IE
U1.031 Chemistry IE
TJ1.051 Engineering Geology 1
U1.200 Civil Engineering 1
U1.220 Statics
U1.280 Engineering Programming
U1.281 Computer Graphics
U1.500 Introductory Electrical Engineering for Civil Engineers
TJ2.000 Mathematics 2
TJ2.052 Engineering Geology 2
U2.210 Introduction to Materials
TJ2.221 Structural Mechanics
U2.261 Fluids 1
TJ2.272 Engineering Communications 1
U2.290 Structural Design
U2.800 Engineering Construction 1

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses		-			
U3.212	Properties of Materials	**4**	U2.210		
U3.222	Structural Analysis	**6**	U2.221	U2.000	
U3.232	Concrete Structures 1	**6**	U2.221; and U2.290	U2.000	U3.212; and U3.222
U3.235	Steel Structures 1	**6**	U2.221; and U2.290	U2.000	U3.212; and U3.222
U3.244	Soil Mechanics A	**4**	U2.210; and U2.221	U1.000	
U3.245	Soil Mechanics B	**4**	U2.210; and U2.221	U1.000	U3.244
U3.250	Surveying 1	**4**	U1.000		
U3.262	Fluids 2	**4**	U2.261		
U3.271	Transportation Engineering and Planning	**2**			
U3.275	Engineering Communications 2	**2**	U2.272		
U3.284	Risk and Reliability Analysis	**2**	U2.221; and U2.290	U1.000	
U3.801	Engineering Construction 2	**4**	U2.800		
Senior Advanced courses					
U4.202	Thesis 1	**6**	A Senior core course in the field of the thesis		
U4.205	Practical Experience	**4**	28 units of Senior courses		
U4.214	Materials Aspects in Design	**4**	U3.212		
U4.253	Civil Engineering Camp	**4**	U3.250		
U4.273	Engineering Management	**4**			
U4.276	Professional Practice	**4**			
U4.292	Civil Engineering Design	**4**	U3.232; and U3.235		

Together with not less than 20 units of Senior Advanced courses chosen from the elective courses in Civil Engineering which are available from time to time except that one 4 unit course, other than an Honours course, may be replaced by one course of not less than 4 units which is available elsewhere in the Faculty and which is subject to the approval of the Head of School. Choice of courses is subject to restriction upon combinations as the Head of School may prescribe from time to time.

+ For prerequisites in Column (a) a Terminating Pass is not acceptable

Acceptable alternative courses

Pursuant to Resolution 2, the Faculty has prescribed the following acceptable alternatives to the core courses listed in Table 2:

Core course	*Acceptable alternative*
U1.031 Chemistry IE	TJ1.030 Chemistry 1
TJ1.051 Engineering Geology 1	U1.050 Geology 1
U1.280 Engineering Programming	TJ1.040 Computer Science 1
U1.281 Computer Graphics	TJ2.040 Computer Science 2
U1.500 Introductory Electrical Engineering for Civil Engineers	TJ1.021 Physics IE or TJ1.020 Physics 1 or U2.502 Electrical Technology
TJ2.052 Engineering Geology 2	U2.050 Geology 2
TJ2.800 Engineering Construction 1	U2.040 Computer Science 2
U4.202 Thesis 1	U5.204 Thesis Honours

RESOLUTIONS OF THE SCHOOL OF CIVIL AND MINING ENGINEERING

Recommended elective courses

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Junior elective courses					
U1.021	Physics IE	**6**	See Table 1(a) for the assumed standard of knowledge at the Higher School Certificate Examination for courses U1.021 to U1.100.		One of: U1.010; or U1.400; or Ul!410; or U1.710
U1.040	Computer Science 1	12			U1.000
U1.050	Geology 1	12			
U1.080	Understanding Design	**2**			
U1.100	Manufacturing Technology	**4**			
Intermediate elective courses					
U2.090	Asian Studies 1	**8**			
Senior Advanced elective courses					
U4.071	Human and Industrial Relations	**6**	Credit for 36 units of Senior courses plus completion of work experience		
U4.203	Thesis 2	**4**			U4.202
U4.223	Finite Element Methods	**4**	U3.222		
U4.232	Bridge Engineering	**4**	U3.222; and U3.232; and U3.235		
U4.236	Concrete Structures 2	**4**	U3.232		
U4.237	Structural Dynamics	**4**	U3.222		
U4.238	Steel Structures 2	**4**	U3.235		
U4.246	Environmental Geotechnics	**4**	U3.244;and U3.245		
U4.247	Foundation Engineering	**4**	U3.244; and U3.245		
U4.251	Surveying 2	**4**	U3.250		
U4.260	Environmental Fluids 1	**4**			
U4.265	Environmental Fluids 2	**4**			
U4.266	Water Resources Engineering	**4**			
U4.274	Project Procedures	**4**			
U4.293	Project Formulation	**4**			U4.273
U4.461	Introduction to Operations Research	**2**	U2.000		

Recommended elective courses (continued)

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
U5.204	Thesis Honours	10	A Senior Core course in the field of the thesis		
U5.213	Materials Honours	4			U4.214
U5.224	Steel Structures Honours	4	U3.235		
U5.226	Finite Element Applications Honours	**4**			U4.223
U5.233	Concrete Structures Honours	4	U3.232		
U5.234	Structural Dynamics Honours	4	U3.222		
U5.243	Soil Engineering Honours	4	U3.244; and U3.245		U4.247
U5.253	Surveying Honours	4	U3.250		
U5.267	Environmental Fluids Honours	4	U3.262		
U5.294	Civil Engineering Design Honours	4	U3.232;and U3.235		U4.292

Students must take at least 20 units of elective slubjects at Senior Advanced level.

Honours candidates replace core subject U4.202 Thesis 1 by U5.204 Thesis Honours and also enrol in U4.233 Finite Element Methods, 12 units of elective subjects at Honours level and at least 8 units of other elective subjects at Senior Advanced level..

Elective Streams:

Recommended elective streams are:

Construction Engineering and Management Stream
U4.071, U4.251, U4.274, U4.293, U.4.461

Structural Engineering Stream
U4.232, U4.223, U4.236, U4.237, U4.238

Environmental Engineering Stream
U4.246, U4.260, U4.265, U4.266, U4.694

Geotechnical Engineering Stream
U4.223, U4.246, U4.247

+For prerequisites in column (a), a Terminating Pass is not acceptable.

Table 3 — Mining Engineering (not currently offered)

Candidates for the degree of Bachelor of Engineering in Mining Engineering are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

TJ1.000 Mathematics 1
TJ1.010 Mechanics IE
TJ1.031 Chemistry IE
U1.200 Civil Engineering 1
U1.210 Materials 1
TJ1.220 Statics
TJ1.280 Engineering Programming
TJ1.281 Computer Graphics
TJ1.500 Introductory Electrical Engineering for Civil Engineers
TJ2.000 Mathematics 2
TJ2.051 Engineering Geology A
TJ2.052 Engineering Geology B
TJ2.220 Structures 1
TJ2.290 Structural Design 1
TJ2.800 Engineering Construction 1

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.050	Mining Geology 1#	4			U2.050or U2.052
U3.240	Soil Mechanics 1	6	U1.210; and U2.220		
U3.250	Surveying 1	4			
U3.261	Fluids 1	6			
U3.283	Applied Statistics	4			U2.000
U3.300	Mining Engineering 1	4			U2.050or U2.052
U3.303	Mining and Mineral Economics 1	2			
U3.304	Mining Engineering 2	6			U3.300
U3.500	Industrial Electronics	4	U2.501		
U3.611	Particle and Fluid Systems	6			U2.000
Senior Advanced courses					
U4.050	Mining Geology 2*	4	U2.050 or U2.052		
U4.051	Mining Geology 3*	4	U2.050 or U2.052		
U4.052	Mining Geology 4*	4	U2.050 or U2.052		U3.050
U4.256	Mine Surveying	6	U3.250		
U4.302	Mining Engineering Practice	12	U3.300		
U4.305	Thesis	6	Credit for 36 units of Senior courses		U4.302
U4.307	Mining and Mineral Economics 2	4	U3.303		
U4.310	Practical Experience	8	28 units of Senior courses		
U4.630	Mineral Processing	4			U3.611 or U3.610

[+]For prerequisites in Column (a) a Terminating Pass is not acceptable.

Students who complete an Intermediate or Senior course in Statistics or Mathematics in the Faculty of Science may be granted exemption from this course.

* Completion of particular modules in the courses Geology 2 and Geology 3 may be accepted as alternatives for the core courses U3.050, U4.050, U4.051 and U4.052.

MINING ENGINEERING

At its meeting on 2 November 1987 the University Senate gave a general approval to its Quinquennial Plan that had been prepared by the Vice-Chancellor. This plan proposed the phasing out of the teaching of Mining Engineering from a date to be determined after appropriate consultations.

Table 4 — Mechanical Engineering

Candidates for the degree of Bachelor of Engineering in Mechanical Engineering are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table **1)**

	Unit Value
U1.000 Mathematics 1	12
U1.021 Physics IE	6
U1.031 Chemistry IE	6
U1.410 Mechanical Engineering 1	12
U1.445 Engineering Computing	12

	Unit Value
U2.000 Mathematics 2	16
U2.410 Mechanical Engineering 2	10
U2.417 Introductory Mechanics and Materials	8
U2.440 Mechanical Design 1	8
U2.443 Mechatronic Design 1*	2
U2.504 Electrical and Electronic Engineering	6

* U2.443 (Mechatronic Design 1): Intermediate core course to be taken by Mechanical/Mechatronic Engineering students undertaking the BE/BSc double degree.

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.420	Thermo-fluid Engineering	10	U2.410; and U2.000		
U3.430	Mechanics and Properties of Solids 2	8	U2.000; and either U2.416; or U2.417		
U3.440	Mechanical Design 2	8	U2.440; or U2.441		
U3.450	System Dynamics and Control	8	U2.410; or U2.412; and U2.417		
U3.460	Manufacturing Engineering and Management	10	U1.410; or U1.415		
U3.480	Mechanical Engineering Laboratory	4	36 units of Intermediate courses		U3.420;and U3.430;and U3.450
Senior Advanced courses					
U4.480	Thesis	12	36 units of Senior courses		
U4.484	Professional Engineering	4	U3.460		
U4.485	Professional Communication	4	Completion of industrial experience		
U4.486	Practical Experience	6	28 units of Senior courses		

Together with not less than 30 units of Senior and Senior Advanced level courses chosen from the elective courses available from time to time and subject to restriction upon combinations as the Head of the Department of Mechanical and Mechatronic Engineering may prescribe from time to time.

+For prerequisites in Column (a) a Terminating Pass is not acceptable.

Acceptable alternative courses

Pursuant to Resolution 2, the Faculty has prescribed the following acceptable alternatives to the core courses listed in Table 4:

Core course	*Acceptable alternative*
U1.021 Physics IE	U1.020 Physics 1
U1.031 Chemistry IE	U1.030 Chemistry 1
U2.440 Mechanical Design 1	Both: U2.441 Mechanical Design 1A; and U2.443 Mechatronic Design 1
U1.445 Engineering Computing	U1.040 Computer Science 1

RESOLUTIONS OF THE DEPARTMENT OF MECHANICAL AND MECHATRONIC ENGINEERING

Recommended elective courses

Students are required to complete 30 units of Senior and Senior Advanced elective courses. At least 26 units of these must be chosen from the mainstream electives (starred in the list below):

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Junior elective course					
U1.080	Understanding Design	2			
Intermediate elective course					
U2.090	Asian Studies 1	8			
Senior elective courses					
U3.090	Asian Studies 2	8	U2.090		
U3.271	Engineering Transportation and Planning	2			
U3.505	Biomedical Engineering	4			U3.500 or U3.540 or U2.504
U3.900	Innovation and International Competitiveness	4			
Senior Advanced elective courses					
U4.005	Partial Differential Equations	2		U2.000	
U4.070	Industrial Ergonomics	2			
U4.071	Human and Industrial Relations	6		36 units of Senior courses and completion of industrial experience	
U4.090	Asian Studies 3	8		U3.090	
U4.420	Thermal Engineering*	6		U3.420	
U4.421	Fluids Engineering*	4		U3.420	
U4.422	Computational Methods for Partial Differential Equations*	4		U2.000	
U4.430	Applied Numerical Stress Analysis*	6		U3.430	
U4.433	Advanced Engineering Materials*	6		U3.430 or U3.431	
U4.434	Aerospace Materials Engineering	4		U3.430 or U3.431 and U3.730	
U4.439	Orthopaedic Engineering	4		U3.431; or U3.430	
U4.440	Advanced Design*	6		U3.440	
U4.451	Dynamics and Systems Engineering	6		U3.540; and either U3.500; or U3.790	

Recommended elective courses (continued)

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
U4.452	Systems Engineering*	**4**		U3.450; and either U3.500; or U2.504	
U4.453	Mechanics of Polymer Processing*	**6**	U3.430		
U4.454	Machine Dynamics*	**4**	U3.450		
U4.455	Microprocessor Control of Machinery*	**6**	U3.500; or U2.504		
U4.460	Industrial Engineering*	**6**	U2.000; and U3.460		
U4.461	Introduction to Operations Research	**2**	U2.000		
U4.462	Industrial and Engineering Management	**2**	U3.460; or U3.571; or U3.790 together with completion of the industrial period		
U4.490	Environmental Engineering*	**6**	U3.420		U4.486
U4.491	Environmental Acoustics and Noise Control	**2**	24 units of Senior courses		
U4.694	Environmental Impact Assessment*	**4**	U3.420		

[+]For prerequisites in Column (a) a Terminating Pass is not acceptable.
* Mainstream electives.

Table 4A — Mechanical Engineering (Mechatronics)

Candidates for the degree of Bachelor of Engineering in Mechanical Engineering (Mechatronics) are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

	Unit Value
U1.000 Mathematics 1	12
U1.021 Physics IE	6
U1.031 Chemistry IE	6
U1.410 Mechanical Engineering 1	12
U1.445 Engineering Computing	12

	Unit Value
U2.000 Mathematics 2	16
U2.410 Mechanical Engineering 2	10
U2.417 Introductory Mechanics and Materials	8
U2.440 Mechanical Design 1	8
U2.443 Mechatronic Design 1*	2
U2.471 Introductory Mechatronics	6
U2.504 Electrical and Electronic Engineering	6

*U2.443 (Mechatronic Design 1): Intermediate core course to be taken by Mechanical/Mechatronic Engineering students undertaking the BE/BSc double degree.

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.431	Mechanical Properties of Materials	4	U2.000; and either U2.417; or U2.700; or		
U3.440	Mechanical Design 2	8	U2.440 or U2.441		
U3.450	System Dynamics and Controls	8	U2.410; or U2.412; and U2.417		
U3.460	Manufacturing Engineering and Management	10	U1.415; and U1.4120		
U3.474	Electrical Machines and Drives	4	U2.471; and U2.504		
U3.476	Industrial Electronics	10	U2.471; and U2.504		U3.470
U3.485	Mechanical Engineering Laboratory A	4	36 units of Intermediate courses		U3.415; and U3.470; and U3.431; and U3.450; and U3.476
Senior **Advanced** courses					
U4.480	Thesis	12	36 units of Senior courses		
U4.484	Professional Engineering	4	U3.460		
U4.485	Professional Communication	4	Completion of industrial experience		
U4.486	Practical Experience	6	28 units of Senior courses		

Together with not less than 24 units of Senior and Senior Advanced level courses chosen from the elective courses available from time to time and subject to restriction upon combinations as the Head of the Department of Mechanical and Mechatronic Engineering may prescribe from time to time

+ For prerequisites in column (a) a Terminating Pass is not acceptable.

Acceptable alternative courses

Pursuant to Senate Resolution 2(b)(ii), the Faculty has prescribed the following acceptable alternatives to the core courses listed in Table 4A:

Core course	**Unit Value**	*Acceptable alternative course(s)*	**Unit Value**
U1.021 Physics IE	**6**	U1.020 Physics 1	12
U1.031 Chemistry IE	**6**	U1.030 Chemistry 1	12
U1.445 Engineering Computing	**12**	U1.040 Computer Science 1	12
TJ2.440 Mechanical Design 1	**8**	Both: U2.441 Mechanical Design 1A	6
		and U2.443 Mechatronic Design 1	2

RESOLUTIONS OF THE DEPARTMENT OF MECHANICAL AND MECHATRONIC ENGINEERING

Recommended elective courses

Students are required to complete 24 units of Senior and Senior Advanced elective courses. There are restrictions on the allowable combinations of subjects. These will be determined by the Head of the Department of Mechanical and Mechatronic Engineering.

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior Advanced Mainstream Elective courses					
U4.451	Dynamics and Systems Engineering	6		U3.540; and either U3.500; or U3.790	
U4.452	Systems Engineering	4		U3.450; and either U3.500; or U2.504	
U4.462	Industrial and Engineering Management	**2**	U3.460; or U3.571; or U3.790 together with completion of the industrial period		
U4.470	Robotic Systems	4		U3.450; or U3.470	
U4.471	Machine Tool Technology	4		U3.470; or U3.450	
U4.472	Design of Automatic Machinery	4		U3.460	
U4.474	Computer Integrated Manufacturing	4		U3.460	
U4.475	Microprocessors in Engineered Products	6		U3.476	
U4.476	Computers in Real-time Control and Instrumentation	6		U3.476	
U3.090	Asian Studies 2	8	U2.090		
U3.505	Biomedical Engineering	4		U3.500; or U3.540; or U2.504	
U3.561	Computer Architecture	3	U2.510; or (U2.504 and U2.470)	U3.562	
U3.562	Software Engineering	3	U2.510; or (U2.504 and U2.470)	U3.561	
U4.070	Industrial Ergonomics	2	U2.510; or (U2.504 and U2.470)		
U4.071	Human and Industrial Relations	6		36 units of Senior courses and completion of industrial experience	
U4.440	Advanced Design	6		U3.440	
U4.454	Machine Dynamics	4		U3.450	

[+]For prerequisites in column (a) a Terminating Pass is not acceptable.

Table 5 — Electrical Engineering

Candidates for the degree of Bachelor of Engineering in Electrical Engineering are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

U1.000 Mathematics 1
U1.020 Physics 1
U1.031 Chemistry IE
U1.040 Computer Science 1
U1.510 Electrical Engineering 1
U2.001 Mathematics 2EE
U2.021 Physics 2EE
U2.042 Computer Science 2A
U2.510 Electrical Engineering 2

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.511	Circuit Theory	4	U2.510; and (U2.000; or U2.001)		
U3.512	Signals and Systems	5	U2.510; and (U2.000; or U2.001)		U3.511
U3.521	Energy Systems and the Environment	3	U2.510		
U3.522	Power Electronics and Drives	4	U2.510		
U3.530	Control 1	4	U2.510		U3.511
U3.540	Electronics 1	10	U2.510		U3.511;and U3.512
U3.551	Engineering Electromagnetics	4	U2.510		U3.511
U3.552	Communications 1A	6	U2.510		U3.511; and U3.512; and U3.540;and U3.551
U3.560	Digital Systems 1	4	U2.510		
Senior Advanced courses					
U4.510	Practical Experience	8	28 units of Senior courses		
U4.570	Project Management	3			
U4.580	Laboratory	8	U3.521; and U3.522		Four of the following: U4.520 U4.530 U4.540 U4.550 U4.560
U4.585	Thesis/Project	10			U4.580 or U4.581

A further core requirement is to gain credit for at least 21 units from additional approved Senior Advanced Courses. Of these courses, at least 12 units must be chosen from the following set:
U4.520 (Power Conversion Control)
U4.530 (Control 2)
U4.540 (Electronics 2)
U4.550 (Communications 2)
U4.560 (Digital Systems 2)

The remaining courses are to be chosen from :
(1) other courses in the following table of Recommended Elective Courses for the Bachelor of Engineering in Electrical Engineering;
(2) courses in Table 5A or;
(3) courses in the Table of Recommended Elective Courses for the Bachelor of Engineering in Electrical Engineering (Information Systems Engineering).

+ For prerequisites in Column (a) a Terminating Pass is not acceptable.

Acceptable alternative courses

Pursuant to Senate Resolution 2(b)(ii), the Faculty has prescribed the following acceptable alternatives to the core courses listed in Table 5:

Core course	Unit Value	*Acceptable alternative course(s)*	Unit Value
U2.001 Mathematics 2EE	14	U2.000 Mathematics 2	16
U2.021 Physics 2EE	12	U2.020 Physics 2	16
U2.042 Computer Science 2A	8	U2.040 Computer Science 2	16 or
		U2.041 Computer Science 2EE	14
U3.561 Computer Architecture	3	U2.043 Computer Science 2B	6 or
		U2.041 Computer Science 2EE	14 or
		U2.040 Computer Science 2	16

RESOLUTIONS OF THE DEPARTMENT OF ELECTRICAL ENGINEERING

Recommended elective courses

Course No.	Title	Unit value	Prerequisites (a)	(b)	Corequisites
Intermediate elective courses					
U2.043	Computer Science 2B	6	**U1.040;** and U1.000		U2.042
Senior elective courses					
U3.505	Biomedical Engineering	4			U3.500or U3.540
U3.523	Topics in Electrical Engineering Design	3	U2.510		
U3.553	Digital Signal Processing	4	U2.510		U3.512and U3.522
U3.561	Computer Architecture	3	U2.510		
U3.562	Software Engineering	3	U2.510		
U3.563	C Programming	1			
U3.570	Speech and Language Processing	4			
U3.571	Management for Engineers	3			
Senior Advanced elective courses to satisfy the 12 unit requirement of the Bachelor of Electrical Engineering					
U4.520	Power Conversion Control	3	U3.521 U3.522		
U4.530	Control 2	3	U3.530		
U4.540	Electronics 2	3	U3.540 U3.511 U3.512		
U4.550	Communications 2	3	U3.552 U3.512		
U4.560	Digital Systems 2	3	U3.560 U3.540		
Other Senior Advanced courses					
U4.022	Optical Fibres	3			
U4.525	Advanced Power Electronics ' and Drives	3	U3.522		
U4.526	Power Systems Analysis	3	U3.521		
U4.546	Microwave Engineering	3			U4.540
U4.532	Fuzzy Systems and Applications	3			
U4.531	Adaptive Control	3			U4.530

Honours courses

All Senior Advanced core courses for the degree in Electrical Engineering are prescribed as Honours courses.

Table 5a — Electrical Engineering (Information Systems Engineering)

Candidates for the degree of Bachelor of Engineeringin Electrical Engineering (Information Systems Engineering) are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

TJ1.000 Mathematics 1
U1.020 Physics 1
U1.031 Chemistry IE
U1.040 Computer Science 1
U1.510 Electrical Engineering 1

U2.001 Mathematics 2EE
U2.021 Physics 2EE
U2.042 Computer Science 2A
TJ2.510 Electrical Engineering 2

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.511	Circuit Theory	4	U2.510; and (U2.000; or U2.001)		
U3.512	Signals and Systems	5	U2.510; and (U2.000; or U2.001)		U3.511
U3.530	Control 1	4	U2.510		U3.511
U3.540	Electronics 1	**10**	U2.510		U3.511; and U3.512
U3.551	Engineering Electromagnetics	4	U2.510		U3.511
U3.552	Communications 1A	6	U2.510		U3.511; and U3.512; and U3.540; and U3.551
U3.553	Digital Signal Processing	4	U2.510		U3.512; and U3.552
U3.560	Digital Systems 1	4	U2.510		
U3.561	Computer Architecture	3	U2.510		
U3.562	Software Engineering	3	U2.510		
Senior Advanced courses					
U4.510	Practical Experience	8	28 units of Senior courses		
U4.540	Electronics 2	3	U3.540; and U3.511; and U3.512		
U4.550	Communications 2	3	U3.552; and U3.512		
U4.560	Digital Systems 2	3	U3.560; and U3.540		
U4.561	Real-time Computer Systems	3	U3.560		
U4.565	Digital Systems 3	3	U3.560		U4.560
U4.570	Project Management	3			
U4.581	Information Systems Engineering Laboratory	8	U3.553; and U3.561; and U3.562		U4.560; and U4.540; and U4.550; and U4.561
U4.585	Thesis/Project	10			U4.580; or U4.581

A further requirement is to gain credit for at least 6 units from the Senior Advanced elective courses specified as meeting this requirement in the table of Recommended Elective Courses under the resolutions of the Department for the Bachelor of Engineering in Electrical Engineering (Information Systems Engineering).

[+] For prerequisites in Column (a) a Terminating Pass is not acceptable.

RESOLUTIONS OF THE FACULTY OF ENGINEERING relating to Table 5a - Electrical Engineering

Acceptable alternative courses

Pursuant to Senate Resolution 2(b)(ii), the Faculty has prescribed the following acceptable alternatives to the core courses listed in Table 5a:

Core course	Unit Value	*Acceptable alternative course(s)*	Unit Value
U2.001 Mathematics 2EE	14	U2.000 Mathematics 2	16
U2.021 Physics 2EE	12	U2.020 Physics 2	16
U2.042 Computer Science 2A	8	U2.040 Computer Science 2	16 or
		U2.041 Computer Science 2EE	14
U3.561 Computer Architecture	3	U2.043 Computer Science 2B	6 or
		U2.041 Computer Science 2EE	14 or
		U2.040 Computer Science 2	16

RESOLUTIONS OF THE DEPARTMENT OF ELECTRICAL ENGINEERING FOR THE BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING (INFORMATION SYSTEMS ENGINEERING)

Recommended elective courses for Bachelor of Engineering in Electrical Engineering (Information Systems Engineering)

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Intermediate elective courses					
U2.043	Computer Science 2B	**6**	U1.040; and U1.000		U2.042
Senior elective courses					
U3.505	Biomedical Engineering	**4**			U3.500; or U3.540
U3.521	Energy Systems and the Environment	**3**			
U3.522	Power Electronics and Drives	**4**	U2.510		
U3.563	C Programming	**1**			
U3.570	Speech and Language Processing	**4**			
U3.571	Management for Engineers	**3**			
Senior Advanced elective courses to satisfy the 6-unit requirement of the Bachelor of Engineering in Electrical Engineering (Information Systems Engineering)					
U4.022	Optical Fibres	3			
U4.546	Microwave Engineering	**3**			U4.540
U4.551	Advanced Communication Networks	**3**	U3.552; and U3.553		U4.550
U4.552	Coding Fundamentals and Applications	**3**	U3.552		U4.550
U4.553	Satellite Communication Systems	**3**	U3.552		U4.550
U4.554	Image Processing and Computer Vision	**3**	U3.512; and U3.553		
Other Senior Advanced elective courses					
U4.562	Advanced Real Time Computer Systems	**3**	U3.560		U4.561
U4.566	Adaptive Pattern Recognition	**3**			
U4.567	Machine Intelligence and Pattern Recognition	**3**	U3.553		

[f]For prerequisites in column (a) a Terminating Pass is not acceptable.

Table 6 — Chemical Engineering

Candidates for the degree of Bachelor of Engineering in Chemical Engineering are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

U1.000 Mathematics 1
U1.010 Mechanics IE
U1.030 Chemistry 1
U1.610 Chemical Engineering 1
TJ1.620 Chemical Engineering Applications
U1.630 Computing for Chemical Engineers
TJ1.650 Materials and Corrosion 1

U2.000 Mathematics 2
U2.034 Chemistry 2 Auxiliary
U2.502 Electrical Technology*
U2.610 Chemical Engineering 2
TJ2.611 Fundamentals of Environmental Chemical Engineering
U2.612 Chemical Engineering Computations
U2.701 Mechanics of Solids 1*

*Students who are planning to major in Biochemical Engineering, and who elect to take Biochemistry 2 Auxiliary, will be exempt from the core courses U2.502 and U2.701.

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.610	Unit Operations 1	12	U2.610		
U3.621	Thermodynamics	8			
U3.626	Reaction Engineering 1	4			U3.620
U3.631	Computations and Statistics	4		U2.000	
U3.645	Project Economics	4		U1.610	
U3.651	Materials and Corrosion 2	2			
U3.660	Process Control 1	4		U2.000	U3.630
U3.671	Chemical Engineering Laboratory	6	U2.610		U3.610
Senior Advanced courses					
U4.600	Practical Experience	8	28 units of Senior courses		
U4.640	Project Engineering	4			
U4.681	Thesis	8			U4.610;and U4.625; and U4.685
U4.684	Chemical Engineering Design 1	4	U3.610		
U4.685	Chemical Engineering Design 2	8	U3.610; and U3.620		
U4.696	Hazard Reduction and Assessment	4			

TogetheT with not less than 12 units of Senior Advanced level courses chosen from the elective courses available from time to time and subject to restriction upon combinations as the Head of the Department of Chemical Engineering may prescribe from time to time.

+For prerequisites in Column (a) a Terminating'Pass is not acceptable

Acceptable alternative courses

Pursuant to Resolution 2, the Faculty has prescribed the following acceptable alternatives to the core courses listed in Table 6:

Core course	*Acceptable alternative*
U1.030 Chemistry 1	U1.031 Chemistry IE and U1.032 Chemistry 1ES
U2.034 Chemistry 2 Auxiliary	U2.030 Chemistry 2 or U2.031 Chemistry 2E or U2.033 Chemistry 2 Long

RESOLUTIONS OF THE DEPARTMENT OF CHEMICAL ENGINEERING

Suggested elective courses

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior elective courses					
U3.067	Microbiology 2	**8**			U2.066
U3.090	Asian Studies 2	**8**	U2.090		
U3.646	Transport Phenomena	**4**	U2.610 plus 2nd yr WAM of 60% +		
U3.647	Laboratory Projects in Unit Operations	**4**	U2.610		U3.610
U3.900	Innovation and International Competitiveness	**4**			
Senior Advanced elective courses					
U4.005	Partial Differential Equations	**2**	U2.000		
U4.080	Computer Based Design	**2**			
U4.090	Asian Studies 3	**8**	U3.090		
U4.071	Human and Industrial Relations	**6**	36 units of Senior courses & completion of Industrial Exp.		
U4.625	Reaction Engineering 2	**4**	U3.625		
U4.630	Mineral Processing (Mineral Dressing)	**4**	U3.611 or U3.610		
U4.631	Mineral Processing (Extractive Metallurgy)	**4**		U3.610	
U4.632	Separation Processes	**4**	U3.610		
U4.633	Advanced Particle Mechanics	**4**	U3.610		
U4.634	Advanced Topics in Environmental Engineering A	**4**	U3.610		
U4.635	Advanced Topics in Environmental Engineering B	**4**	U3.610	-	
U4.660	Process Control 2	**4**	U3.660		
U4.690	Reservoir Engineering	**4**		U3.610	
U4.691	Process Systems Engineering	**4**		U3.630; and U3.660	U4.660 or U4.661
U4.692	Optimisation Techniques	**4**	U3.630		
U4.694	Environmental Impact Assessment	**4**		U3.610 or U3.420	
U4.695	Biochemical Engineering	**8**		U2.610	U2.066; and U3.067
U4.697	Professional Option	**2**	credit for 145 units		
U4.698	Advances in Chemical Engineering	**4**	U3.610		

[+]For prerequisites in Column (a) a Terminating Pass is not acceptable.

Biochemical Engineering

Students who wish to specialise in biochemical applications of chemical engineering should choose the following courses:

Intermediate Year—U2.066Biochemistry2Auxiliary (8 units) in place of U2.502 Electrical Technology (4 units) and U2.701 Mechanics of Solids 1 (4 units).

Senior Year—theelectivecourseU3.067Microbiology 2 (8 units). (One or more of the Senior core courses may need to be deferred until the following year.)

Senior Advanced Year — the elective course U4.695 Biochemical Engineering.

Industrial Experience and Perspectives

madditiontoravingtocompletethecourseU4600Practical Experience,sradentsmChemicalEngmeeringarerequired to undertake a number of additional activities during their course designed to increase their understanding and experience of practical Chemical Engineering.

1. Design competition
This is a light-hearted exercise in which students of U2.610 Chemical Engineering 2 design, build and operate a simple device to solve an unusual Chemical Engineering problem. Past problems have included the task of producing separated shell, yolk and white from a whole raw egg. A small entry fee is charged and prizes are awarded.

2. Chemical plant inspection tour
For one week of a vacation period during the Senior Year, students visit a number of chemical plants outside the Sydney area. Tours in the past years have been to Southeastern Queensland, Tasmania, Victoria and the Hunter Valley.

3. Mid-term week exercises
A number of one-week exercises are organised during the teaching periods of the Senior Year. Normal classes are suspended during these weeks.

Senior students spend a week working on selected plant problems on major chemical plants in the Sydney area. In these exercises the students work in small groups in cooperation with plant engineers and academic staff to investigate chemical engineering problems in a plant environment.

RESOLUTIONS OF THE SENATE

Table 7 — Aeronautical Engineering

Candidates for the degree of Bachelor of Engineering in Aeronautical Engineering are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

U1.000 Mathematics 1
U1.010 Mechanics IE
U1.021 Physics IE
U1.031 Chemistry IE
U1.280 Engineering Programming
U1.281 Computer Graphics
U1.710 Aeronautical Engineering 1
U2.000 Mathematics 2
U2.411 Introductory Thermodynamics
U2.412 Engineering Dynamics
U2.441 Mechanical Design 1A
U2.502 Electrical Technology
U2.700 Mechanics and Properties of Solids 1
U2.710 Fluid Mechanics
U2.770 Engineering Computation

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.421	Thermodynamics	**4**	U2.411	U2.000	
U3.431	Mechanical Properties of Materials	**4**	U2.700	U2.000	
U3.720	Aerodynamics 1	**4**	U2.000; and U2.710		U3.725
U3.725	Aerodynamics 2	**4**	U2.710; and U2.000		U3.720
U3.730	Aircraft Structures 1	**4**	U2.000; and U2.700		
U3.735	Aircraft Structures 2	**4**			U3.730
U3.740	Aircraft Design 1	**6**	U2.441; and U2.700		U3.431;and U3.720; and U3.730
U3.750	Mechanics of Flight 1	**4**	U2.000; and U2.412		U3.755
U3.755	Mechanics of Flight 2	**4**			U3.750

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
U3.760	Laboratory	4	U2.770		U3.725, and U3.730
U3.770	Flying Operations	2			U3.750; and U3.755;and 36 units of Senior Aeronautical courses
U3.780	Aviation Technology	4	96 units of Junior and Intermediate courses		
U3.790	Industrial Organisation and Management	4			
Senior Advanced courses					
U4.720	Aerodynamics 3	4	U3.720; and U3.725		
U4.725	Aerodynamics 4	4			U4.720
U4.730	Aircraft Structures 3	8	U3.730; and U3.735		
U4.740	Aircraft Design 2	4	U3.740; and U3.720; and U3.725		
U4.750	Mechanics of Right 3	4	U3.725; and U3.750; and U3.755		
U4.770	Propulsion	4	U3.421; and U3.725		
U4.775	Engineering Experience	4	40 units of Senior courses		
U4.780	Seminar	4	40 units of Senior courses		
U4.785	Thesis	**12**	40 units of Senior courses		

[f]For prerequisites in Column (a) a Terminating Pass is not acceptable.

RESOLUTIONS OF THE FACULTY OF ENGINEERING relating to Table 7 — Aeronautical Engineering

Acceptable alternative courses

Pursuant to Resolution 2, the FacUlty has prescribed the following acceptable alternatives to the core courses listed in Table 7:

Core course	*Acceptable alternative*
U1.201 Physics IE	U1.020 Physics 1
U1.031 Chemistry IE	U1.030 Chemistry 1
U1.280 Engineering Programming	U1.040 Computer Science
U1.281 Computer Graphics	
U4.785 Thesis	U5.785 Honours Thesis

For students who wish to proceed towards the double degree of BSc BE, the following alternatives are acceptable **with permission from the Head of the Department of Aeronautical Engineering:**

TJ2.502 Electrical Technology	
U2.411 Introductory Thermodynamics	U2.020 Physics 2
U2.412 Engineering Dynamics	
U2.770 Engineering Computation	

Recommended elective courses

Course No.	Title	Unit value	Prerequisites (a)	(b)	Corequisites
Senior Advanced elective courses					
U4.422	Computational Methods for Partial Differential Equations	4		U2.000	
U4.434	Aerospace Materials Engineering	4		U3.430 or U3.431 and U3.730	
U4.461	Introduction to Operations Research	2		U2.000	
U4.790	Rotary Wing Aircraft	4		U3.720; and U3.750	U4.720
U4.791	Advanced Rotary Wing Dynamics	2			U4.790
U4.792	Aviation Operation and Management	2			
U4.793	Probabilistic Design	4			U4.740
U4.794	Advanced Aerodynamics	2		U3.725	U4.720; and U4.725
U4.795	Flight Dynamics and Digital Control	3		U3.750; and U3.755 •	U4.750

RESOLUTIONS OF THE SENATE

Table 8 — Project Engineering and Management (Civil)

NOTE: Not offered in 1995

Courses for this degree will be given when funding arrangements are in place. Please check with the School of Civil and Mining Engineering.

Candidates for the degree of Bachelor of Engineering in Project Engineering and Management (Civil) are required to gain credit for the core courses set out below. Any additional credit necessary to satisfy the requirements of Resolution 6 shall be gained by completing other courses from Table 1 and/or from the Senior and Senior Advanced elective courses prescribed by the Faculty from time to time.

Junior and Intermediate courses (from Table 1)

U1.000 Mathematics 1
U1.010 Mechanics IE
U1.200 Civil Engineering 1
U1.210 Materials 1
U1.220 Statics
U1.280 Engineering Programming
U1.281 Computer Graphics
U1.500 Introductory Electrical Engineering for Civil Engineers

U2.000 Mathematics 2
U2.051 Engineering Geology A
U2.220 Structures 1
U2.290 Structural Design 1
U2.800 Engineering Construction 1
U2.820 Engineering Economics
U2 821 Engineering Accounting

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior courses					
U3.211	Materials 2	6	U1.210	U2.000	
U3.240	Soil Mechanics	6	U1.210; and U2.220	U2.000	
U3.250	Surveying 1	4		U2.000	U3.283
U3.261	Fluids 1	6		U2.000	
U3.271	Transportation Engineering and Planning	2			
U3.283	Applied Statistics*	4		U2.000	
U3.801	Engineering Construction 2	4	U2.800	U2.000	
U3.810	Network Planning	4			
U3.811	Contracts Formulation and Administration	6			

Table 8 — Project Engineering (continued)

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Senior Advanced courses					
U4.071	Human and Industrial Relations	6	36 units of Senior courses and completion of industrial experience		U4.201
U4.201	Practical Experience	6	28 units of Senior courses		
U4.202	Thesis 1	6			
U4.251	Surveying 2	4	U3.250		
U4.252	Civil Engineering Camp	2	U3.250		U4.251
U4.802	Engineering Construction 3	4	U3.801		
U4.812	Operations Research	4		U2.000	
U4.822	Value Engineering and Risk Analysis	4	U2.820		U4.823
U4.823	Cost Engineering	4	U3.811		
U4.824	Project Formulation	4	U2.820; and U2.821		

Together with not less than 4 units of Senior Advanced courses chosen from the elective courses in Civil Engineering which are available from time to time and subject to restriction upon combinations as the Head of School may prescribe from time to time.

+For prerequisites in Column (a) a Terminating Pass is not acceptable.
Students who complete an Intermediate or Senior course in Statistics or Mathematics in the Faculty of Science may be granted exemption from this course.

RESOLUTIONS OF THE FACULTY OF ENGINEERING relating to Table 8 — Project Engineering and Management (Civil)

Courses for this degree will be given when funding arrangements are in place. Please check with School of Civil and Mining Engineering.

Acceptable alternative courses

Pursuant to Senate Resolution 2(b)(ii), the Faculty has prescribed the following acceptable alternatives to the core courses listed in Table 8:

Core course	*Acceptable alternative course*
U1.280 Engineering Programming	U1.040 Computer Science 1
U1.281 Computer Graphics	U2.040 Computer Science 2
TJ1.500 Introductory Electrical Engineering for Civil Engineers	U1.021 Physics IE or U1.020 Physics 1 or U2.500 Basic Electrical Engineering or U2.502 Electrical Technology
U2.051 Engineering Geology A	U1.050 Geology 1
U4.202 Thesis 1	U5.204 Thesis Honours

RESOLUTIONS OF THE SCHOOL OF CIVIL AND MINING ENGINEERING

Recommended elective courses

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
Junior elective courses					
U1.021	Physics IE	**6**	See Table 1(a) for the assumed standard of knowledge at the Higher School Certificate Examination for Junior elective courses		One of: U1.010 or U1.400 or U1.410 or U1.710
TJ1.040	Computer Science 1	12			Ul.10O

Course No.	Title	Unit value	Prerequisites* (a)	(b)	Corequisites
U1.050	Geology 1	12			
U1.100	Manufacturing Technology	4			
Intermediate elective courses					
U2.040	Computer Science 2	16	U1.040; and U1.000		
U2.052	Engineering Geology B	5			U1.031; and U1.050 or U2.051
U2.090	Asian Studies 1	8			
U2.260	Engineering Hydrology	4		U1.000	
Senior elective courses					
U3.090	Asian Studies 2	8		U2.090	
U3.221	Structural Analysis 1	6	U2.220	U2.000; and U2.290	U3.211
U3.230	Structural Behaviour 1	6	U2.220; and U2.290	U2.000	U3.211
U3.291	Structural Design 2	4	U2.220; and U2.290		U3.221 or U3.230
Senior Advanced elective courses					
U4.070	Industrial Ergonomics	2			
U4.203	Thesis 2	4			U4.202
U4.242	Geotechnicai Engineering	4	U3.240		
U4.263	Fluids Engineering	4		U3.801	
U5.204	Thesis Honours	10			

+For prerequisites in column (a) a Terminating Pass is not: acceptable.

Interpretation of Resolution 6(c) of the Resolutions of the Senate relating to the BE degree

In accordance with the provisions of Resolution 6(c) of the Resolutions of the Senate relating to the degree of Bachelor of Engineering, the Faculty resolves as follows:

As a general principle, a student may be permitted by the Faculty of Engineering to undertake courses at another tertiary institution to be credited towards the student's candidature for the degree of Bachelor of Engineering at this University only if that student is undertaking those studies under the aegis of an official student exchange agreement between The University of Sydney and the other institution concerned. Under certain circumstances, however, the Faculty recognises that there may be good reasons for a student to undertake courses at another tertiary institution, and, on the recommendation of the Head of Department concerned, the Faculty may permit that student to complete courses elsewhere under the provisions of Resolution 6(c). In approving such an application from a student, the Faculty will require: (a) a complete course plan which should, as a general rule, be equivalent to one year of full-time study at the University of Sydney; and (b) that such a plan be submitted and approved before the student's departure.

4 Courses of study

Courses are subject to alteration
Courses and arrangements for courses, including staff allocated as stated in this or any other publication, announcement or advice of the University are an expression of intent only and are not to be taken as a firm offer or undertaking. The University reserves the right to discontinue or vary such courses, arrangements or staff allocations at any time without notice.

On the following pages details of the courses are provided in a form which is convenient for reference. Every care has been taken to ensure that the information givenis complete and accurate. However, variations may be made from time to time. These will be announced by the lecturer or posted on the relevant noticeboards. It is the responsibility of students, by attendance at lectures and frequent inspection of the noticeboards, to ensure that they have the latest information on any course.

Textbooks
Changes sometimes occur in the selection of prescribed textbooks, or reference books, owing to supply difficulties, or the publica tion of new and more sui table works. Such changes will be announced by lecturers and it is prudent to check with the relevant lecturer before buying the books you expect to need.

Elective courses in other faculties
The Faculty of Engineering has resolved that students may take any full First-Year Arts, Economics or Science course towards their BE degrees (e.g. Economics 1, Psychology 1, etc.). There is also provision for students to apply to the Faculty of Engineering for special permission to take any other courses which are available in other degree programs towards their BE degrees (e g. Computer Science 3, Economics 2, etc.). Any course which is not listed in the Tables of Courses or in the list of recommended'elective courses in this handbook is referred to as a 'non-listed' course by the Faculty.

If you have a strong interest in taking a particular 'non-listed' course, you should consult the relevant faculty handbook for details about it. You will also need to check whether or not there is a quota for this course or any special assumed knowledge/ prerequisite.

There are potential pitfalls for students who take 'non-listed' courses (as set out in Chapter 3 with reference to 'one-off enrolments). You should therefore discuss the advisability of taking such a course with the advisers at enrolment time.

If you decide that you wish to enrol in a 'non-listed' course other than a First-Year Arts, Economics or Science course, you will need to apply for special permission to do so. Please ask to see the Chairman of the Committee for Undergraduate Studies or the Faculty Secretary at enrolment time for application procedure.

If you proceed with an enrolment in a 'non-listed' First-Year Arts, Economics or Science course or in any other 'non-listed' course for which you have been granted permission, then you will need to consult the Faculty Secretary for enrolment instructions. 'Non-listed' courses are not held in the Engineering enrolment database, in the VAX and enrolments in same have to be added manually on the appropriate form.

Course numbering system

Types of courses
The courses available for the degree are designated Junior, intermediate, Senior, Senior Advanced of Honours. These names indicate the year of attendance in which the course becomes available to you if you are making normal progress.

Course numbers
The letter 'U' prefixes all undergraduate courses.

The first digit of the course number indicates the level of course, as follows:

Number	*Type*	*Available*
1	Junior	in the first or later years
2	Intermediate	in the second or later years
3	Senior	in the third or later years, subject to completion of the prerequisite courses
4	Senior Advanced	
5	Honours	in the final year to Honours candidates

The second digit of the course number indicates the Department responsible for the course, as follows:

0 Departments in the Faculty of Science
1 Departments from outside the University
2 Civil
3 Mining
4 Mechanical
5 Electrical
6 Chemical
7 Aeronautical

The third and fourth digits are serial numbers within the level and department.

For courses taught by departments in the Faculty of Science, the third digit indicates the particular subject:

U-.00 Mathematics
1 Mechanics
2 Physics
3 Chemistry
4 Computer Science
5 Geology
6 Biology, Biochemistry and Microbiology
8 Architectural and Design Science
9 East Asian Studies

The section that follows contains the courses in numerical order:

Courses of study

U1.000 Mathematics 1 — 12 units

Junior core course for the degree in all branches. The course is provided by the School of Mathematics and Statistics.

Assumed standard of knowledge: Mathematics 3-unit course at the HSC. Any student who does not have the assumed knowledge should attend a mathematics bridging course held by the University in February.

Classes: (5 lec and 2 tut)/wk throughout the year.

Assessment: (two 2hr exams and 4 assignments)/sem.

In Semester 1 the course is taught at one level only, but at the beginning of Semester it splits into two levels, called the O and A levels. The content is similar at each level, but the A level proceeds somewhat faster and covers more difficult material.

Syllabus summary:
Sem 1 -— Plane curves, functions of one variable; differentiation and applications, vectors; linear algebra; curves and surfaces in three dimensions; functions of two and. more variables; partial differentiation; discrete mathematics; statistics.
Sem 2 — Integration and applications; Taylor polynomials; complex numbers; discrete ma thema tics; ordinary differential equations and applications; mathematical modelling; linear algebra.

Textbook
Refer to the booklet *Information for Students* issued by the School of Mathematics and Statistics at enrolment time

U 1.010 Mechanics 1E — 6 units

Junior core course for the degree in Aeronautical, Chemical and Civil Engineering and in Project Engineering and Management (Civil). The course is provided jointly by the School of Mathematics and Statistics and the School of Physics.

Assumed standard of knowledge: Mathematics 3 unit course and the Science 4 unit course (or the Physics core of 3/4 unit Science) at the HSC.

Coreauisite: U1.000 Mathematics 1.

Classes: (3 lec and 2 tut)/wk and seven 2hr lab sessions in Sem 1.

Assessment: one 3hr exam at end of Sem 1; lab work will be assessed.

Syllabus summary: Vectors, statics, stability of equilibrium, kinematics, dynamics of a single particle, dynamics of particle systems, collisions, two dimensional rigid body dynamics.

Textbook
None
Lecture notes to be purchased from the University Co-operative Bookshop

Reference book
Bullen *An Introduction to the Theory of Mechanics* (Science Press, 1971)

U 1.020 Physics 1 — 12 units

Junior core course for the degree in Electrical Engineering. Elective course for the other branches. The course is offered at two levels: Physics 1A (advanced level); and Physics 1 (normal). Students should have gained a TER of 96.0 in order to be eligible to enrol in the Physics 1A course.

Assumed standard knowledge: Mathematics 3 unit course and either 2 unit Physics or the Physics core of 3/4 unit Science at the HSC.

Mutually exclusive with: U1.021 Physics IE.

Classes: (3 lec and one 3hr lab or tut)/wk throughout the year.

Assessment: one 3hr exam at end of each sem; an assessment of lab work, project reports and a written lab exam may also be included.

Syllabus summary: Mechanics, relativity, oscillations, waves, optics, electro-statics, current electricity, magnetism, electro-magnetism, thermal physics, quantum physics.

Textbook
Sears, Zemansky and Young *University Physics* 7th edn (Addison-Wesley, 1987)

Reference books
As indicated during classes

U 1.021 Physics 1E — 6 units

Junior core course for the degree in Aeronautical and Mechanical Engineering. Elective course for Chemical and Civil Engineering and for Project Engineering and Management (Civil).

Assumed standard of knowledge: Mathematics 3 unit course and either 2 unit Physics or the Physics core of 3/4 unit Science at the HSC.

Mutually exclusive with: U1.020 Physics 1.

Coreauisite: One of U1.010 Mechanics IE or U1.400 Engineering Mechanics 1 or U1.410 Mechanical Engineering 1 or U1.710 Aeronautical Engineering 1.

Classes: (3 lec and one 3hr lab or tut)/wk in Sem 2.

Assessment: one 3hr exam at end of Sem 2; an assessment of lab work, project reports and a written lab exam may also be included.

Syllabus summary: Waves, electro-statics, current electricity, magnetism, electro-magnetism, quantum physics.

Textbook
Sears, Zemansky and Young *University Physics* 7th edn (Addison-Wesley, 1987)

Reference books
As indicated during classes.

U1.030 Chemistry 1 — 12 units

Junior core course for the degree in Chemical Engineering. The course is offered at two levels: Chemistry 1A (advanced level); and Chemistry 1 (ordinary level). Chemical Engineering students are expected to enrol in U1.030A Chemistry 1A and all other Engineering students are expected to enrol in U1.031 Chemistry IE.

Assumed standard of knowledge: For Chemistry 1: Mathematics 2 unit course and a satisfactory knowledge of 2 unit Chemistry or the Chemistry component of the 3 or 4 unit

Science HSC course. See note below on special preparatory studies. For Chemistry 1A: This course is available to students with a very good school record in Science or Chemistry.

Mutually exclusive with: U1.031 Chemistry IE and U1.032 Chemistry IE Supplementary.

Classes: (3 lec and one 3hr lab)/wk throughout the year.

Assessment: one 3hr exam at end of each sem. At the beginning of the course students are informed about the other factors that contribute to the real assessment.

Syllabus summary: Both Chemistry 1 and Chemistry 1A cover chemical theory, inorganic, physical and organic chemistry. The practical work is the same for both courses and the theory syllabi are similar, but the level of treatment in the 1A course is more advanced and presupposes a very good groundingin the subject at the secondary level. Fully detailed information is available from the School of Chemistry.

Textbooks
A list is available from the School of Chemistry.

Special Preparative Studies
Students who have not achieved a satisfactory standard in HSC Chemistry (in 2 unit Chemistry or in the Chemistry core of 3/4 unit Science) are required to study the following texts before commencing lectures:

Hunter *et al. Chemical Science* (Science Press, 1980)
Boden *Chemtext* (Science Press, 1986)

U1.031 Chemistry 1E 6 units

junior core course for the degree in all branches of engineering except Chemical and Project Engineering and Management (Civil).

Assumed standard of knowledge: Mathematics 2 unit course and a satisfactory knowledge of 2 unit Chemistry or the Chemistry component of the 3 or 4 unit Science HSC course. .

Mutually exclusive with: U1.030 Chemistry 1.

Classes: (3 lec and one 3hr lab/tut session)/wk in Sem 1.

Assessment: one 3hr exam at end of course. At the beginning of the course students are informed of other factors that contribute to the final assessment.

Syllabus summary: Chemistry IE will consist of the following specially selected topics of importance to engineering, together with sufficient fundamental inorganic, organic and physical chemistry to support these topics. A detailed syllabus is available from the School of Chemistry.

Electrochemistry — Fundamental principles of electrochemistry will be considered in relation to corrosion, energy storage and fuel cells.

Polymer chemistry — A discussion of the formation and structure/properties relationships in common types of polymers.

Materials — The correlation between properties and materials and the chemical structure will be discussed with special reference to electrical conductivity.

Textbooks
A textbook list is available from the School of Chemistry

Special Preparative Studies
As for U1.030 Chemistry 1.

U1.032 Chemistry IE Supplementary 6 units

Junior elective course.

This course is designed to satisfy the prerequisite requirements for the Intermediate Chemistry courses provided by the Faculty of Science for students who have completed the course work for U1.031 Chemistry IE. It may only be taken in the same academic year as U1.031 and is only available to students with an excellent record in U1.031 and then only with the permission of the Dean of the Faculty of Engineering and the Head of the School of Chemistry.

The course consists of the lectures and laboratory exercises of Sem 2 of U1.030 Chemistry 1.

Mutually exclusive with: U1.030 Chemistry 1.

Classes: (3 lec and one 3hr lab)/wk in Sem 2.

Assessment: one 3hr exam at end of year. At the beginning of the course students are informed of other factors that contribute to the final assessment.

Syllabus summary: As for the Sem 2 syllabus of U1.030. There will be some repetition of the material given in U1.031.

Textbooks
A detailed textbook list is available from the School of Chemistry

U1.040 Computer Science 1 12 units

Junior core course for the degree in Electrical Engineering. Elective course for the other branches.

Assumed standard of knowledge: Mathematics 3 unit course at the HSC.

Mutually exclusive with: U1.280 Fortran Programming, U1.445 Engineering Computing and U1.630 Computing for Chemical Engineers.

Corequisite: U1.000 Mathematics 1.

Classes: (3 lec, one 2hr workshop/lab and one 1hr tut)/wk throughout the year.

Assessment: (one exam plus prac exam(s)) in each sem.

Syllabus summary:
Computer Science 1 is an introductory course in algorithms, programming, computing machines and systems and computer usage. It is intended primarily as the first course of the Department's professional stream.

Students who wish to undertake the professional stream of courses in Computer Science will need to complete a parallel stream of courses in Mathematics to satisfy the prerequisites for subsequent Computer Science courses.

The three hours of lectures per week will be given in parallel streams.

For further details consult the Departmental Handbook.

U1.050 Geology 1 12 units

Junior elective course. Acceptable alternative to the Civil Engineering and Project Engineering and Management (Civil) core course U2.051 Engineering Geology A.

Mutually exclusive with: U2.051 Engineering Geology A.

Classes: (3 lec and one 3hr lab)/wk throughout the year and several field excursions.

Assessment: exams in June and November.

Syllabus summary: The course presents a balanced coverage of the sciences focused on planet Earth. It serves both those students wishing to broaden their understanding of such contemporary problems as the conservation and utilisation of earth resources and those aiming to undertake later courses leading to professional training in the earth sciences. No prior knowledge of geology is assumed of students entering Geology 1.

A weekly 3-hour lab session is given to study of materials and concepts introduced in the lectures: minerals, rocks, fossils, maps, earth structures, etc.

Several field excursions are run during the year and are an integral part of the course.

Students considering enrolling in Geology 1 should study the pamphlet *Geology 1—1994,* obtainable from the enquiry office in the Edgeworth David Building; it gives details of course content, text and reference books, staffing and other relevant matters.

Registration and Noticeboards: Students taking this course must register with the Department of Geology and Geophysics during orientation week — the time and venue for registration will be in the orientation program. Students should consult the noticeboards regularly — information for Junior: students is posted on the noticeboards in the foyer of the Carslaw Building and in Carslaw Laboratory 1.

111.051 Engineering Geology 1 5 units

Junior core course for the degree in Civil Engineering, unless the course U1.050 Geology 1 has been completed.

Mutually exclusive with: U1.050 Geology 1

Prerequisites: nil.

Corequisites: nil.

Classes: lec: 26hrs, lab: 39hrs. Field excursions in the Sydney region, as appropriate.

Course objectives: To introduce basic geology to civil engineering students.

Expected outcomes: Students should acquire knowledge of the most important rocks and minerals and be able to identify them. They should develop an appreciation of structural geology, as it influences civil engineering works.

Assessment: Practical laboratory work plus a combined theory and practical exam at the end of semester.

Syllabus summary: Basic geological concepts relevant to civil engineering. Introduction to minerals, rocks and soils, their mode of occurrence, formation and significance. General introduction to physical geology and geomorphology, structural geology, tectonics, and hydrogeology. Associated laboratory work on minerals, rocks and mapping.

Textbooks
Press and Seiver *Earth* 4th edn (Freeman)
or
Branagan *Beneath the Scenery* (Science Press)

Reference books
As indicated during classes

Library classifications: 551

U1.060 Biology 1 12 units

Junior elective course for the degree in Chemical Engineering.

Assumed standard of knowledge: 2 unit Biology or 3 unit Biology or 4 unit Science at the HSC.

Classes: (3 lec and one 3hr prac)/wk throughout the year.

Assessment: exam in each sem, prac work and other assignments.

Syllabus summary: The course gives an introduction to six main areas of biological investigation: cell biology, structure and function of organisms, organisms and environment, genetics, developmental biology and evolution.

Registration: All students must register with the School of Biological Sciences by completing a registration card during the first or second practical class of Sem 1. Students should also check the noticeboards outside Laboratory 4 on the 3rd floor of the Carslaw Building regularly.

Textbook
Keeton and Gould *Biological Sciences* 4th edn, IS edn (Norton, N.Y., 1986). Notes to accompany lectures will be issued each semester. Notes for Sem 1 should be obtained from the Carslaw Building during the week before lectures begin. For further details of the course, students should obtain a copy of the booklet *Information for Students in First Year Biology* from the Carslaw Building

U1.080 Understanding Design 2 units

Junior elective course for the degree in all branches. The course is provided by the Key Centre of Design Quality.

Classes: (1 lec and I tut)/wk for one sem.

Assessment: specified assignments, both individual and group.

Syllabus summary: An interdisciplinary approach to understanding design. Lectures are followed by tutorial exercises. Topics covered are: design as an activity, design in/as social context, design problems and formulation, multidisciplinary perspectives of design, design expertise and creativity, design problem-solving, design products, design processes, reverse engineering, models of design, design evaluation, representations and communication, design futures. The course is intended to teach an understanding of design rather than how to design.

Textbook
None

Reference books
As indicated during classes

U1.100 Manufacturing Technology 4 units

Junior elective course.

Mutually exclusive with: U1.410 Mechanical Engineering 1, U1.710 Aeronautical Engineering 1.

Classes: (approx one 3hr lab at Sydney Technical College)/wk for one sem.

Assessment: prac work.

Syllabus summary:
(a) Fitting—Measurement, measuring tools, marking tools, testing tools, holding tools, hammers, cutting tools, bolts and studs, tapping and screwing, reaming and scraping.
(b) Machining — Various metals and their machinability, cutting tool materials, cutting tool shape, the machine tools: lathe, mill grinder, drill, shaper, deburring and finishing operations.
(c) Welding—Various weldingprocesses, distortions, flame cutting, resistance welding. Practical work in gas welding and arc welding.
(d) Heat treatment, blacksmithing and forging—Definition and importance of heat treatment, and the process of forging, normalising hardening, case hardening.
(e) Founding — Materials used in the foundry, moulding and core making, the casting process.

Safety requirements: All students are required to comply with the safety regulations of the Sydney Technical College. Students who fail to do this will not be permitted to enter the workshops. In particular, approved industrial footwear must be worn, and long hair must be protected by a hair net. Safety glasses must be worn at all times.

U1.200 Civil Engineering 1 4 units

Junior core course for the degree in Civil Engineering and Project Engineering and Management (Civil). Elective course for the other branches.

Assumed standard of knowledge: Mathematics 3 unit course and a satisfactory knowledge of 2 unit Chemistry or the Chemistry component of the 3 or 4 unit Science HSC course and of the 2 unit Physics course or the Physics component of the 3 or 4 unit Science HSC course.

Classes: (lec: 13hrs, tut: 13hrs and lab/drawing office: 26hrs) for one sem.

Assessment: specified assignments and one 3hr exam at end of course.

Syllabus summary:
(a) Engineering Projects — Introduction to the planning, design, construction and operation of engineering projects. Economic and non- economic evaluation of projects.
(b) Elements of Engineering Science — Structures, geomechanics, materials, hydraulics and water resources, environment, systems, management.
(c) Communications — Freehand and scale drawing, engineering plans, shop drawings, techniques for producing drawings. Preparation of reports, verbal and written.

Reference books
Krick *An Introduction to Engineering—Concept, Methods and Issues* (John Wiley and Sons)
Morris *Engineering—A Decision Making Process* (Houghton Mifflin Company)
Hoganand Firkins *Economical Structural Steelwork* (Australian Institute of Steel Construction)
Brown *Getting Across* (Edward Arnold)
Institution of Engineers, *AastraliaTJie Australian Engineering Handbook, Part 1 — Basic Principles and Techniques* (I.E. Aust.)
Thompson *Organization and Economics of Construction* (McGraw-Hill)
Strunk and White *The Elements of Style* (Macmillan)
Concrete Institute of Australia *Recommended Practice — Reinforced Concrete Detailing Manual* (CIA)
Dandy and Warner *Planning and Design ofEngineering Systems* (Unwin Hyman)
Eagleson *Writing in Plain English* (Aust. Govt Publishing Service)
Library classification: 620.0023, 658.15, 658.4, 744, 808

U1.220 Statics 4 units

Junior core course for the degree in Civil Engineering and in Project Engineering and Management (Civil).

Assumed standard of knowledge: Mathematics 3 unit course at the HSC.

Mutually exclusive with: U1.410 Mechanical Engineering 1, U1.400 Engineering Mechanics 1, U1.710 Aeronautical Engineering 1 and U2.415 Engineering Mechanics 2.

Corequisite: U1.000 Mathematics 1.

Classes: (lec: 26hrs and tut: 26hrs) in Sem 2.

Assessment: class test during sem and one 2hr exam at end of sem.

Syllabus summary: Basic concepts: scalars and vectors; units. Statics of the rigid body; forces and moments; system isolation; free body diagrams, and equilibrium criteria. Principle of virtual work; friction, distributed force systems; beams with distributed loads, statically determinate pin-jointed structures.

Textbook
Meriam *Engineering Mechanics,* vol. 1, Statics, SI version (Wiley, 1980)

U1.280 Engineering Programming 3 units

Junior core course for the degree in Aeronautical and Civil Engineering and in Project Engineering and Management (Civil). U1.040 Computer Science 1 and U1.445 Engineering Computing are acceptable alternatives.

Mutually exclusive with: U1.040 Computer Science 1 and U1.445 Engineering Computing.

Corequisite: U1.281 Computer Graphics.

Classes: (1 lec and one 2hr computer lab session) / wk in Sem 1.

Assessment: one 1.5hr exam at end of sem plus assessment of computer exercises during sem.

Syllabus summary: Fundamental instruction in a structured computer language using FORTRAN *77* and/or C. Data types, input and output, operators, expressions, control flow, loops, if else statement, switching, files, functions, subroutines, arrays, compilers, linkers.

Textbook
Page, Didday and Alpert *FORTRAN 77 for Humans* 3rd edn (West Publishing Co., 1986)

Reference book
Kernighan and Ritchie *The C Programming Language* 2nd edn (Prentice Hall, 1988)

U1.281 Computer Graphics 3 units

Junior core course for the degree in Aeronautical and Civil Engineering and in Project Engineering and

Management (Civil). U2.040 Computer Science 2 is an acceptable alternative for the degree in Civil Engineering and in Project Engineering and Management (Civil).

Mutually exclusive with: U1.445 Engineering Computing and U2.040 Computer Science 2.

Corequisite: Either U1.280 Engineering Programming or U1.040 Computer Science 1.

Classes: (1 lec and one 2hr computer lab session)/wk in Sem 2.

Assessment: one 2hr exam at end of sem plus assessment of computer exercises during sem.

Syllabus summary: Fundamental instruction in a graphical computer language using the international standard language GKS (Graphical Kernel System).

Graphical control functions, workstation functions, windows and viewpoints, graphical primitives, attribute functions, segments, input functions, graphical outputdevicesincludingplatters and VDU's, graphical input devices including cursers, graphical tablets and mice.

Fundamental instruction in viewing 3-dimensional objects using a 2- dimensional graphics system.

Geometric representation of 3D objects, data structures, perspective projections, 2D translational, scaling and rotational transformations, solid object modelling.

Textbook

Sproull, Sutherland and Ullner *Device Independent Graphics* (McGraw-Hill, 1985)

Reference books

Donald and Hearn *Computer Graphics* (Prentice-Hall, 1986)

SAA AS2880-1986 *Computer Graphics — Graphical Kernel System (GKS) Functional Description*

DEC GKS Fortran Binding Reference Manual

U1.410 Mechanical Engineering 1 12 units

Junior core course for the degrees in Mechanical and Mechatronic Engineering.

Mutually exclusive with: Ul.10O Manufacturing Technology 1, U1.220 Statics, U1.710 Aeronautical Engineering 1, U1.500 Introductory Electrical Engineering for Civil Engineers, U1.510 Electrical Engineering 1, U2.502 Electrical Technology, U2.510 Electrical Engineering 1.

Corequisite: U1.000 Mathematics 1.

Classes: 2 class hours and a 3hr lab at Sydney Technical College per week in Sem 1; 3 lec and one 2hr tut per week and nine 3hr labs during the semester in Sem 2.

Assessment: two 2hr exams at end of Sem 2; also assignments as required.

Syllabus summary: Sem 1—

(a) (i) Professional Engineering: To create an awareness of management issues in professional engineering and to develop communication skills. The structure and management of engineering projects, engineering projectplanning, engineering economics. Introduction to engineering management issues. Total Quality Management, ethics, liability, environment, health, etc. Development of both verbal and written communication skills. Accessing information.

(b) (i) Fitting, (ii) Machining — Lathe, mill grinder, drill, shaper, deburring and finishing operations, (iii) Welding and fabrication—Various welding processes, distortions, flame cutting, resistance welding. Practical work in gas welding and arc welding, (iv) Heat treatment, blacksmithing and forging — Definition and importance of heat treatment, and the process of forging, normalising, hardening, case hardening, (v) Founding—materials used in the foundry, moulding and core making, the casting process.

Safety requirements: Allstudents are required to comply with the safety regulations of the Sydney Technical College. Students who fail to do this will not be permitted to enter the workshops. In particular, approved industrial footwear must be worn, and long hair must be protected by a hair net. Safety glasses must be worn at all times.

Sem 2—

(a) Mechanics: Scalars and vectors; units; units and dimensional homogeneity. Statics of a rigid body; forces and moments; free body diagrams in two and three dimensions; resultants of forces and moments. Equilibrium of rigid bodies; trusses, frames and machines; statically determinate pin-jointed structures. Distributed forces, centroids of lines, areas and volumes; cables. Friction, wedges, screws; flexible belts. Kinetics of a particle, work, energy and momentum^ kinetics of systemsof particles and virtual work.

(b) Electricity: Definition and conventions. SI units. Charge and energy conservation laws. Electrical energy sources. Ohm's law. Voltage and current measurements. Conductivity and resistance. Power dissipation. Kirchoff's laws. Current and voltage dividers. Potentiometers. Measurements of resistances. Thevenin's theorem. Loop currents and node voltages. Reciprocity theorem. Linearity and principle of superposition. Voltage-to-current source conversion. Delta-star conversion. Loading effect of a voltage source. Combined voltage supply circuits. Power measurements. Time varying voltages and currents. Average and effective values. Energy dissipation and storage. Capacitance, inductance. Steady-state DC behaviour of capacitors and inductors. Natural response of first order circuits. Transients. C and L response to square and triangular voltages.

Alternating current qualities. Magnitude, period, frequency and phase. Complex algebra. AC behaviour of resistance, inductance and capacitance. Introduction to AC circuits. RL and RC series circuits. Impedence concept. Phasor and locus diagrams. Equivalent series and parallel impedances. Admittance. Power in AC circuits. Power triangle. Power factor. RLC series circuit behaviour. Series resonance. Introduction to AC network.

Analysis. RLC parallel circuit. Parallel resonance. Series - parallel circuits. Introduction to filters. Single phase transmissionKne. Domestic distribution. Wiring and grounding. Dual-voltage AC supply. Power factor correction. Nonlinear circuit elements. Introduction to semiconductors. Diodes. Transistors. V-I characteristics. Nonlinear circuit analysis. Load line and operating point.

Textbooks

Meriam and Kraige *Engineering Mechanics,* Vol. 1, Statics SI edn (Wiley, 1987)

Electrical: to be announced

U1.445 Engineering Computing 12 units

Junior core course for the degree in Mechanical Engineering. Computer Science 1 is an acceptable alternative. U1.445 Engineering Computing is not an acceptable prerequisite for U2.040 Computer Science 2.

Assumed standard of knowledge: Mathematics 3 unit course at the HSC.

Mutually exclusive with: U1.040 Computer Science 1, U1.440 Computer Science IE, U1.280 Fortran Programming, U1.281 Computer Graphics, U1.620 Chemical Engineering Applications and U1.630 Computing for Chemical Engineers.

Corequisite: U1.000 Mathematics 1.

Classes: (2 lec, 1 tut and one 3hr lab)/wk in Sem 1; (2 lec and 4hr of lab) / wk in Sem 2.

Assessment: assignments and exam at end of each sem.

Syllabus summary: This course introduces computer programming using the FORTRAN 77 language. First Semester provides coverage of the elements and constructs of the language, as well as how to design and implement programs. In parallel with this, aspects of Boolean algebra, logic circuits, number and information representation, and the fundamentals of computer hardware are covered. In Second Semester the course is divided into a graphics module (see U1.281 Computer Graphics for details) and programming. The latter focuses on a major project which is geared towards a practical problem-solving application. Also there will be exposure to some of the other computer languages and applications found in engineering.

U1.500 Introductory Electrical Engineering for Civil Engineers 4 units

Junior core course for the degree in Civil Engineering and in Project Engineering and Management (Civil).

Mutually exclusive with: U1.510 Electrical Engineering 1, U2.500 Basic Electrical Engineering 1, U2.502 Electrical Technology and U2.470 Industrial Automation 1.

Corequisite: U1.000 Mathematics 1.

Classes: (2 lec/wk and nine 3hr lab/tut) for one sem.

Assessment: one 2hr exam at end of sem; lab reports; and mid-sem tests.

Syllabus summary: Definitions and conventions. SI units. Charge and energy conservations laws. Electrical energy sources. Ohm's law. Voltage and current measurements. Conductivity and resistance. Power dissipation. Kirchhoff's laws. Current and voltage dividers. Potentiometers. Measurement of resistance. Thevenin's theorem. Loop currents and node voltages. Reciprocity theorem. Linearity and principle of superposition. Voltage-to-current source conversion. Delta-star conversion. Loading effect of a voltage source. Combined voltage supply circuits. Power measurements. Energy dissipation and storage. Steady state DC behaviour of capacitors and inductors. Natural response of first order circuits and transients.

Time varying voltages and currents. Average and effective values. Alternating current quantities; magnitude, period, frequency and phase. Introduction to AC circuits. Impedance and admittance concepts. Equivalent series and parallel impedances. Phasor and locus diagrams/Power in AC circuits. Power factor. RLC series and parallel circuits. Series and parallel resonance.

Single phase transmission line. Domestic distribution. Wiring and grounding. Dual-voltage AC supply. Power factor correction. Non linear circuit elements. Introduction to semiconductors. Diodes. Transistors. V-l characteristics. Non linear circuit analysis. Load line and operating point.

Library classification: 621.313 - 9

U1.510 Electrical Engineering 1 10 units

Junior core course for the degree in Electrical Engineering.

Mutually exclusive with: U1.500 Introductory Electrical Engineering for Civil Engineers, and U2.502 Electrical Technology, and U1.410 Mechanical Engineering 1.

Corequisites: U1.000 Mathematics 1 and U1.020 Physics 1.

Classes: (2 lec)/wk in Sem 1; (4 lec and one 4hr lab/tut)/wk in Sem 2.

Assessment: one 1hr exam at end of Sem 1; two 2hr exams at end of Sem 2 plus assignments/lab reports.

Syllabus summary: The course consists of three main sections: Communication Skills in Sem 1 and Introductory Electrical Systems plus Introductory Digital Systems in Sem **2.**

Communication skills — Freehand sketching; problem solving; electrical and logic diagrams; computer aids; written reports; oral presentation.

Introductory electrical systems — Introduction and linear DC circuits; DC switching transients; AC circuits; frequency response calculations; non-linear circuits; safety.

Introductory digital systems — Number representation; combinatorial logic design; sequential logic design; registers; counters; ROM and RAM elements; synchronous sequential circuits.

U1.610 Chemical Engineering 1 8 units

Junior core course for the degree in Chemical Engineering. Elective course for other branches.

Assumed standard of knowledge: Mathematics 3 unit course and a satisfactory knowledge of 2 unit Chemistry or the Chemistry component of the 3 or 4 unit Science HSC course and of the 2 unit Physics course or the Physics component of the 3 or 4 unit Science HSC course

Classes: (3hr of lec and one 2hr tut)/wk throughout the year.

Assessment: one 3hr exam at end of Sem 1; project and one 2hr exam at end of Sem 2, continuous assessment of assignments.

Syllabus summary: Introduction to large-scale chemical processing; discussion of typical flowsheets for the manufacture of basic chemicals. The application of physico-chemical principles to materials and energy balance calculations.

A major assignment involves the computation of material and energy balances for a complete flow sheet.

Textbook

Felder and Rousseau *Elementary Principles of Chemical Processes* 2nd edn (Wiley, 1986)

Reference book

Perry and Chilton (eds) *Chemical Engineers Handbook* (McGraw-Hill, 1984)

U1.620 Chemical Engineering Applications 4 units

Junior core course for the degree in Chemical Engineering. Elective course for other branches.

Classes: (2 lec and one 3hr tut or lab)/wk for one sem.

Assessment: lab, tut work and one 2hr exam at end of Sem 1.

Syllabus summary:

(a) What is chemical engineering? A survey of the nature of chemical engineering, of the nature of the Australian process industries, and of the main professional activities of chemical engineers. Lectures are given by invited speakers from government, industry and academia. Visits to works in the Sydney region are undertaken with tutorial exercises based on these visits.

(b) Chemical engineering applications laboratory. An appreciation of: (i) the methods and materials of construction of items of process equipment, (ii) the role of this equipment inbuilding up an entire chemical processing plant, (iii) its operation and maintenance and (iv) safety requirements and procedures. Students will dismantle, reassemble and operate items of process equipment. They will present written answers to questions supplemented by drawings of process flow-sheets, diagrams of dismantled equipment, and discussions of heat and mass balances and of process parameter values.

Reference book

Field *Chemical Engineering: Introductory Aspects* (MacMillan, 1988)

Reference material will be identified during the course

U1.630 Computing for Chemical Engineers 2 units

Junior core course for the degree in Chemical Engineering.

Mutually exclusive with: U1.040 Computer Science 1 and U1.445 Engineering Computing.

Classes: (1 lec and one 2hr tut)/wk for one sem.

Assessment: assignments and one 1hr exam.

Syllabus summary: Introduction to personal computers, MS-DOS, Lotus 123 and other applications packages. Application to chemical engineering problems.

U1.650 Materials and Corrosion 1 4 units

Junior core course for the degree in Chemical Engineering.

Mutually exclusive with: U1.210 Materials 1, U1.410 Mechanical Engineering 1, U1.710 Aeronautical Engineering 1 and U2.416 Introductory Mechanics and Materials.

Classes: (2 lec and one 2hr tut/lab)/wk for one sem.

Assessment: one 3hr exam plus assignments.

Syllabus summary:

(a) Structure of solids, metals, ceramics and glasses.

(b) Phase transformations and phase equilibria. Applications: especially Fe-C; other alloys.

(c) Surface chemistry, especially colloids, emulsions and friction problems.

(d) Mechanical properties including elasticity, hardness, stress/strain. Relationship with phases present.

(e) Corrosion: wet and dry corrosion; electrochemical nature. Surface coatings.

U1.710 Aeronautical Engineering 1 12 units

Junior core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U1.100 Manufacturing Technology, U1.210 Materials 1, U1.400 Engineering Mechanics 1, U1.410 Mechanical Engineering 1, U1.415 Mechanical Engineering 1A and U2.415 Engineering Mechanics 2.

Corequisite: U1.000 Mathematics 1.

Classes: (one 3hr lab at Sydney Technical College)/wk in Sem 1; (5 lec, one 2hr tut and one 1hr tut)/wk (and two 3hr labs during the Sem) in Sem 2.

Assessment: prac work in Sem 1; one 3hr, one 2hr and one 1.5hr exam at end of Sem 2; also coursework as required.

Syllabus summary:

(a) Classification of aircraft — fixed wing, rotary wing, aerostats, surface effect vehicles. Glossary of terms for aircraft and their components. Elementary mechanics of flight. Elementary aerodynamics of aircraft. Elements of airframes and materials.

(b) (i) Fitting — Measurement, measuring tools, marking tools, testing tools, holding tools, hammers, cutting tools, bolts and studs, tapping and screwing, reaming and scraping, (ii) Machining—Various metals and their machinability, cutting tool materials, cutting tool shape, the machine tools: lathe, mill grinder, drill, shaper, deburring and finishing operations, (iii) Welding — Various welding processes, distortions, flame cutting, resistance welding. Practical work in gas welding and arc welding, (iv) Heat treatment, blacksmithing and forging — Definition and importance of heat treatment, and the process of forging, normalising, hardening, case hardening, (v) Founding—Materials used in the foundry, moulding and core making, the casting process.

Safety requirements: All students are required to comply with the safety regulations of the Sydney Technical College. Students who fail to do this will not be permitted to enter the workshops. In particular, approved industrial footwear must be worn, and long hair must be protected by a hair net. Safety glasses must be worn at all times.

(c) Basic concepts: scalars and vectors; units; the SI system. Statics of the rigid body; forces and moments; systems isolation; free body diagrams, and equilibrium criteria. Elementary principles of virtual work. Elementary kinematics and dynamics of the rigid body: angular and linear velocity; plane curvilinear motion of a particle; absolute and relative motion. Distributed force systems: beams with distributed loads; statically determinate, pinjointed structures.
(d) Materials classification. Materials cycle, energy content of materials, relative price of materials, consumption of resources.

The mechanical properties of materials. Elastic moduli; stress and strain. Yield and tensile strength, hardness, testing methods, data. Plastic deformation. Fracture and toughness. Fatigue failure. Creep deformation and fracture; temperature effect, testing, diffusion aspects. Friction and wear; lubrication. Ceramic materials.

Materials in hostile environments; types of environments; role of temperature, presence of oxygen, aqueous media, other gaseous media, liquids other than water, radiation. Aqueous corrosion, oxidation, creep.

Textbooks

Ashby and Jones *Engineering Materials—An Introduction to their Properties and Applications* (Pergamon, 1981)
Crawford *Basic Engineering Processes* IS edn (Hodder and Stoughton)
Cutler *Understanding Aircraft Structures* (BSP Professional, 1988)
Jane's All the World's Aircraft (Annual)
Meriam *Engineering Mechanics* Vol. I Statics IS edn (Wiley, 1980)
Stinton *The Anatomy of the Aeroplane* (Collins, 1985)
Van Vlack *Materials for Engineering — Concepts and Applications* (Addison-Wesley, 1982)

U2.000 Mathematics 2 — 16 units

Intermediate core course for the degree in all branches (except Electrical, who do U2.001). The course is available at both Pass <P) and Honours (H) levels.

Prerequisite: U1.000 Mathematics 1.

Classes: 8hrs/wk throughout the year.

Assessment: exams at end of sem for each option. Compulsory assignments in all options. Full details are provided in the Mathematics 2 Handbook, which is available from the School of Mathematics and Statistics at the beginning of the year.

Syllabus summary: In Sem 1, students take 2 options, each involving 4 contact hours (lectures, tutorials and computer lab classes) per week. In Sem 2, students take 1 option of 4 contact hours and 2 options of 2 contact hours each. There are tutorials, assignments and exams for each option.

The course is available at both Pass and Honours levels. In order to be eligible to enrol in the Honours course, students should have gained a Credit or better in the Honours stream of U1.000 Mathematics 1 or a Distinction or better in the Pass stream or be given special permission (in writing) by the Class Coordinator.

Students who enrol in the Honours course in Mathematics 2 must take all the Honours options. Students wishing to change from an Honours option to the corresponding Pass option during the semester should consult the Class Coordinator and also vary their enrolment to the Pass course through the Engineering Faculty Office.

Students who enrol in the Pass course would normally take all Pass options, but could apply to the Class Coordinator for permission to take one or more Honours options instead of Pass options.

Students who enrol in U2.000H Mathematics 2 (Honours course) will have this Honours enrolment recorded on their academic records and transcripts.

The table of options (with weekly contact hours) is set out below:

Semester 1

Pass course

Vector calculus and complex variables (4)
Linear equations and eigen-value theory (4)

Honours course

Functions of several variables and of a complex variable (4)
Linear algebra (4)

Semester 2

Pass course

Ordinary and partial differential equations and Fourier series (4)
Linear programming and inner products spaces (2)
Numerical methods (2)

Honours course

Analysis including ordinary and partial differential equations and Fourier series (4)
Qualitative theory of differential equations (2)
Numerical methods (2)

U2.001 Mathematics 2EE — 14 units

Intermediate core course for the degree in Electrical Engineering. The course is available at both Pass (P) and Honours (H) levels.

Mutually exclusive with: U2.000 Mathematics 2.

Prerequisite: U1.000 Mathematics 1.

Classes: an average of 8hr/wk in sem. 1,6 hr/wk in sem 2.

Assessment: exams at end of sem for each option. Generally there will be a smaller assessment component based on assignments in each option. Full details are available in the Mathematics 2 Handbook, which is available from the School of Mathematics and Statistics at the beginning of the year.

Syllabus summary:
In Sem 1, students take 2 options of 4 contact hours (lectures, tutorials and computer lab classes), per week. In Sem 2, students take 1 option of 4 contact hours and 1 option consisting of 2 contact hours.

The course is available at both Pass and Honours levels. In order to be eligible to enrol in the Honours course, students should have gained a Credit or better in the Honours stream of U1.000 Mathematics 1 or a Distinction or better in the Pass stream or be given special permission by the Class Coordinator.

Students who enrol in the Honours course in Mathematics 2 must take all the Honours options.

Students wishing to change from an Honours option to the corresponding Pass option during the semester should consult the Class Coordinator and also vary their enrolment to the Pass course through the Engineering Faculty Office.

Students who enrol in the Pass course would normally take all Pass options, but could apply to the Class Coordinator for permission to take one or more Honours options instead of Pass options.

Students who enrol in U2.001H Mathematics 2EE (Honours course) will have this Honours enrolment recorded on their academic records and transcripts.

The options (with unit value in square brackets) are set out below:

Semester 1

Pass course

Vector calculus and complex variables (4)

Matrix applications (4)

Honours course

Multivariable analysis (4)

Linear algebra (4)

Semester 2

Pass course

Fourier series, ordinary and partial differential equations (4)

Numerical methods (2)

Honours course

Analysis (4)

Numerical methods (2)

U2.020 Physics 2 — 16 units

Intermediate elective course for the degree in Electrical Engineering.

Mutually exclusive with: U2.475 Physics for Automation.

Prerequisites: One of: U1.020 Physics 1 and U1.000 Mathematics 1; or U1.021 Physics IE and both U1.000 Mathematics 1 and U1.010 Mechanics IE; or U1.021 Physics IE and both U1.000 Mathematics 1 and U1.400 Engineering Mechanics 1.

Classes: (4 lec and one 4hr lab)/wk throughout the year.

Assessment: two 2hr papers at end of each sem. Class assignment and lab work are assessed and count in the final result also.

Syllabus summary: The lecture courses indicated by an asterisk may be taken at a normal or an advanced level: electromagnetic theory (*), gas discharges, optics, quantum physics (*), thermodynamics, solid state devices, electromagnetic waves.

Textbooks

French and Taylor *An Introduction to Quantum Physics* (Nelson, 1979)

Griffiths *Introduction to Electrodynamics* (Prentice-Hall, 1989)

Reference books

Hecht *Optics* 2nd edn (Addison-Wesley, 1987)

Pierrot *Semiconductor Fundamentals* (Addison-Wesley, 1983)

U2.021 Physics 2EE — 12 units

Intermediate core course for the degree in Electrical Engineering.

Mutually exclusive with: U2.020 Physics 2

Prerequisites: one of: U1.020 Physics 1 and U1.000 Mathematics 1; or U1.021

Physics IE and U1.000 Mathematics 1 and U1.010 Mechanics IE; or U1.021

Physics IE and U1.000 Mathematics 1 and U1.400 Engineering Mechanics 1.

Classes: Sem 1: (3 lec & 4hr prac)/wk; Sem 2:3 lec/wk, (4hr prac & 2hr microlab)/wk for part semester.

Assessment: two 2.5hr exam/sem, 4 assignments/sem, 2 prac reports, microlab (report & test)/sem.

The lecture course includes the following topics: introductory electrodynamics*, physical optics* and optics for communication, quantum physics, and solid state devices. The topics marked with (*) are offered at both advanced and normal levels. Entry to the advanced streamis restricted to students who achieved a grade of Credit or better in Physics 1 (or equivalent). The principal difference between the two streams is that material is covered in greater depth and at a higher level of abstraction in the advanced stream.

Computational physics is taught in two-hour sessions in a PC-based computing laboratory. Sessions are held once per week for ten weeks in second semester only. The material for this course is drawn from one of the concurrent lecture courses (quantum physics). Students work in teams of three. Each team does a short project in the last two sessions and submits a short report. There is also a one-hour test which is administered individually.

Experimental physics is taught as a laboratory course of four-hour sessions for most of the year, and includes experiments in the areas of instrumentation, quantum physics and properties of matter. The course is based on mastery of the material* with marks awarded on completion of each experiment. Assessment is also based on reviews of the students' logbooks and written reports on selected experiments.

Full details of course structure, content and assessment are provided in the handbook *Information for Students* available at the time of enrolment.

Textbooks

R.EisbergandR.Resnick Quantum P/zysicso/*Atoms, Molecules, Solids, Nuclei, and Particles* (Wiley, 1985)

D.J. Griffiths *Introduction to Electrodynamics* (Prentice Hall, 1989)

Reference books

E. Hecht *Optics* (Addison-Wesley, 1987)

U2.031 Chemistry 2E — 12 units

Intermediate elective course. Acceptable alternative to the core course U2.030 Chemistry 2 for the degree in Chemical Engineering.

Mutually exclusive with: any other Intermediate courses in Chemistry.

Prerequisites: Either U1.030 Chemistry 1 or both U1.031 Chemistry IE and U1.032 Chemistry IE Supplementary; U1.000 Mathematics 1.

Classes:

Lectures: 26 lectures in inorganic chemistry, 34 lectures in organic chemistry, 29 lectures in physical and theoretical chemistry given at the rate of 3-4 lectures per week throughout the year.

Practical work: One 3hr session per week for 24 weeks, consisting of 9 weeks in physical chemistry and 9 weeks in inorganic chemistry, followed by 6 weeks in organic chemistry during weeks 5 to 10 of Sem 2. Students must ensure that one afternoon per week, free from other practical work commitments, is available for practical work. The particular afternoon will be allocated by the School of Chemistry.

Assessment: Consult the School of Chemistry.

Syllabus summary: See the fully detailed booklet available at the School of Chemistry.

Registration: All students enrolling in Chemistry 2E must register with the School of Chemistry by the Thursday in orientation week.

Textbooks
Inorganic
Fritz and Scherik *Qualitative Analytical Chemistry* (Allyn and Bacon, 1987)
Shriver, Atkins and Langford *Inorganic Chemistry* (Oxford, 1990)
Organic
Streitwieser andHeathcock/nfrodwcfron to *Organic Chemistry* 3rd edn (Collier Macmillan, 1985).
Physical/Theoretical
Atkins *Physical Chemistry* (O.U.P., 1990)
or
Moore *Basic Physical Chemistry* (Prentice-Hall, 1983)

Reference books
Physical/Theoretical
Banwell *Fundamentals of Molecular Spectroscopy* 2nd edn (McGraw-Hill, 1972)
Barrow *Introduction to Molecular Spectroscopy* (McGraw Hill, 1972)
Lowe *Quantum Chemistry* (Academic Press)
Murrell *et al. The Chemical Bond* 2nd edn (Wiley)
Smith Basic *Chemical Thermodynamics* 2nd edn (O.U.P., 1977)
Yates *Huckell Molecular Orbital Theory* (Academic Press)

U2.033 Chemistry 2 Long 20 units

Intermediate elective course. Acceptable alternative to the Intermediate core course U2.030 Chemistry 2 for the degree in Chemical Engineering.

Mutually exclusive with: any other Intermediate courses in Chemistry.

Prerequisites: Either U1.030 Chemistry 1 or both U1.031 Chemistry IE and U1.032 Chemistry IE Supplementary; U1.000 Mathematics 1.

Classes:
Lectures: 27 lectures in inorganic chemistry, 44 lectures in organic chemistry, 34 lectures in physical and theoretical chemistry given at the rate of 4 lectures per week throughout the year.

Practical work: A course of 6 hours per week throughout the year, consisting of 9 weeks in each of inorganic, organic and physical chemistry laboratories. Students must ensure that two afternoons per week, free from other practical work commitments, are available for practical work. The particular afternoons will be allocated by the School of Chemistry.

Assessment: Consult the School of Chemistry.

Syllabus summary: See the fully detailed booklet available at the School of Chemistry.

Registration: All students enrolling in Chemistry 2 Long must register with the School of Chemistry by the Thursday in orientation week.

Textbooks
Inorganic
Fritz and Schenk *Quantitative Analytical Chemistry* (Allyn and Bacon, 1987)
Shriver, Atkins and Langford *Inorganic Chemistry* (Oxford, 1990)
Organic
Streitwieser and Heathcock*Introduction to Organic Chemistry* 3rd edn (Collier Macmillan, 1985)
Physical/Theoretical
Atkins *Physical Chemistry* (O.U.P., 1990) (recommended for students intending to proceed to Senior Chemistry)
or
Moore *Basic Physical Chemistry* (Prentice-Hall, 1983)

Reference books
Physical/Theoretical
Banwell *Fundamentals of Molecular Spectroscopy* 2nd edn (McGraw-Hill, 1972)
Barrow *Introduction to Molecular Spectroscopy* (McGraw Hill, 1972)
Lowe *Quantum Chemistry* (Academic Press)
Murrell *et al. The Chemical Bond* 2nd edn (Wiley)
Smith *Basic Chemical Thermodynamics* 2nd edn (O.U.P., 1977)
Yates *Huckell Molecular Orbital Theory* (Academic Press)

U2.034 Chemistry 2 Auxiliary 8 units

Intermediate core course for the degree in Chemical Engineering.

Mutually exclusive with: any other Intermediate courses in Chemistry.

Prerequisites: Either U1.030 Chemistry 1 or both U1.031 Chemistry IE and U1.032 Chemistry IE Supplementary; U1.000 Mathematics 1.

Classes:
A course of 58 lectures and 9 tutorials: 34 lectures in organic chemistry, and 24 lectures and 9 compulsory tutorials in physical and theoretical chemistry given at the rate of 2-3 contact hours per week in Sem 1, and 2 contact hours per week in Sem 2.

Practical work: A course of 3 hours per week for 12 weeks (the first 6 weeks of Sem 1 and weeks 5-10 inclusive in Sem 2). Students must ensure that one afternoon per week, free from other practical work commitments, is available for practical work at the above times. The particular afternoon will be allocated by the School of Chemistry.

Assessment: Consult the School of Chemistry.

Syllabus summary: See the fully detailed booklet available at the School of Chemistry.

Registration: All students enrolling in Chemistry 2 Auxiliary must register with the School of Chemistry by the Thursday in orientation week.

Textbook
Organic
Streitwieser and Heathcock *Introduction to Organic Chemistry* 3rd edn (Collier Macmillan, 1985)

Reference books
Physical/Theoretical
Atkins *Physical Chemistry* (O.U.P., 1990)
Moore *Basic Physical Chemistry* (Prentice-Hall, 1983)

U2.040 Computer Science 2 16 units

Mutually exclusive with: U2.042 Computer Science 2A, U2.043 Computer Science 2B, and U2.041 Computer Science 2EE.

Prerequisites: U1.040 Computer Science 1 and U1.000 Mathematics 1.

Classes: (4 lec, 2 tut, unsupervised practical work)/wk throughout the year.

Assessment: Computer Science 2 is taught in four lecture modules and two large programming project modules. Marks will be awarded for each module on the basis of practical exercises, assignments and the results of examinations held at the end of the semester in which the module is taught. The relative weighting of marks from these sources varies from module to module, and will announced on course noticeboards at the start of each semester. The final mark for the course will be determined primarily by the weighted sum of the module marks. However, students are required to demonstrate reasonable proficiency in the material of *each* module, as shown by satisfactory performance on both examinations and practical work.

Module tide	Semester	Weight
Design and Data Structure (DDS)	1	20%
Computer Systems (CSys)	1	20%
Large Programming Project 1 (LPP1)	1	10%
Logic and Languages (LL)	2	20%
Programming Practice with Unix (PP)	2	20%
Large Programming Project 2 (LPP2)	2	10%

Information about modules:

Design and Data Structures

Classes: (2 lec & 1 tut)/wk in Sem 1.

Topics: The main data structures (including the array, linked list, binary tree, B-tree, hash table, heap, adjacency matrix, and adjacency lists). Implementation, verification, analysis. Design of large programs using data abstraction.

Textbook

J.H. Kingston *Algorithms and Data Structures: Design Correctness Analysis* (Addison-Wesley, 1990)

Computer Systems

Classes: (2 lec & one 2hr.workshop)/wk in Sem 1.

Topics: The organisation of a computer central processing unit (CPU) and the assembly and machine language commands that control it; two's complement integers and floating point data and their operations (the teaching will be through the vehicle of a particular computer, the MIPS-2000). The low-level organisation of system software including the organisation and action of a simple compiler and its run-time environment, and the system call and interrupt handling mechanisms.

Textbook

J. Hennessy and D. Patterson *Computer Organization and Design* (Morgan Kaufmann, 1993)

Large Programming Project 1

Classes: a few introductory lectures, and unsupervised laboratory work in Sem 2.

The large programming project implements a system using the Pascal programming language and abstract data types.

Note: This module is assessed partly by testing the program and partly by a practical examination, held during the normal examination period. A student who has completed the project successfully should find this exam straightforward.

Logic and Languages

Classes: (2 lec & 1 tut)/wk in Sem 2.

Topics: Formal languages, grammars, automata, circuits, logic; the relationships between these formalisms. In particular regular languages, regular expressions, finite-state automata, context-free languages, push-downautomata,propositionallogic, combinational circuits, sequential circuits, first-order logic.

Textbook

A. Aho and J. Ullman *Foundations of Computer Science* (Computer Science Press, 1992)

Programming Practice with Unix

Classes: (2 lec & 1 tut)/wk in Sem 2.

Topics: Software development practice. C programming; use of tools for software development (e.g. awk, sh, sed).

Textbook

P.S. Wang *An Introduction to ANSI C on UNIX* (Wadsworth, 1992)

Large Programming Project 2

Classes: a few introductory lectures, and unsupervised laboratory work in Sem 2.

The large programming project implements a system using the C programming language and data structures. The project gives students an opportunity to develop their own system which meets a requirements specification. Students will write user and system documentation and will justify the design decisions they make. Students will be responsible for devising a test suite which convincingly demonstrates the effectiveness of their program.

Note: This module is assessed partly by testing the program and partly by a practical examination, held during the normal examination period. A student who has completed the project successfully should find this exam straightforward.

U2.041 Computer Science 2EE 14 units

Intermediate elective course for the degree in Electrical Engineering. Superceded by combination of U2.042 and U2.043.

Mutually exclusive with: U2.040 Computer Science 2 and U1.281 Computer Graphics.

Prerequisites: U1.040 Computer Science 1 and U1.000 Mathematics 1.

Classes and assessment: as for U2.040 Computer Science 2 except that students will be exempted from attendance at the Digital Logic section of the course.

U2.042 Computer Science 2A 8 units

Intermediate core course for the degree in Electrical Engineering.

Mutually exclusive with: U2.040 Computer Science 2, and U2.041 Computer Science 2EE, and U1.281 Computer Graphics.

Prerequisites: U1.040 Computer Science 1 and U1.000 Mathematics 1.

Classes: (2 lec, 1 tut, unsupervised prac work)/wk throughout the year.

Assessment: Computer Science 2A is taught in two lecture modules and one large programming project module. Marks will be awarded for each module on the basis of practical exercises, assignments, and the results of examinations held at the end of the semester in which the module is taught. The relative weighting of marks from these sources varies from module to module, and will be announced on course noticeboards at the start of each semester. The final mark for the course will be determined primarily by the weighted sum of module marks. However, students are required to demonstrate reasonable proficiency in the material of each module, as shown by satisfactory performance on both examinations and practical work.

Module title	Semester	Weight
Design and Data Structure (DDS)	1	40%
Programming Practice with Unix (PP)	2	40%
Large Programming Project (LPPee)	2	20%

Information about each module:

Design and Data Structures

Classes: (2 lec & 1 tut)/wk in Sem 1.

Topics: The main data structures (including the array, linked list, binary tree, B-tree, hash table, heap, adjacency matrix, and adjacency lists). Implementation, verification, analysis. Design of large programs using data abstraction.

Textbook

J.H. Kingston *Algorithms and Data Structures: Design, Correctness, Analysis* (Addison-Wesley, 1990)

Programming Practice with Unix

Classes: (2 lec & 1 tut)/wk in Sem 2.

Topics: Software development practice. C programming; use of tools for software development (e.g. awk, sh, sed).

Textbook

P.S. Wang *An Introduction to ANSI C on UNIX* (Wadsworth, 1992)

Large Programming Project (ee)

Classes: a few introductory lectures, and unsupervised laboratory work in Sem 2.

The large programming project implements a system using the C programming language and data structures. The project gives students an opportunity to develop their own system which meets a requirements specification. Students will write user and system documentation and will justify the design decisions they make. Students will be responsible for devising a test suite which convincingly demonstrates the effectiveness of their program.

Note: This module is assessed partly by testing the program and partly by a practical examination, held during the normal examination period. A student who has completed the project successfully should find this exam straightforward.

U2.043 Computer Science 2B — 6 units

Intermediate elective course for the degree in Electrical Engineering.

Mutually exclusive with: U2.040 Computer Science 2, U2.041 Computer Science 2EE, and U3.561 Computer Architecture, and U1.281 Computer Graphics.

Prerequisites: U1.040 Computer Science 1 and U1.000 Mathematics 1.

Corequisites: U2.042 Computer Science 2A.

Classes: (2 lec, 2 lab or 1 tut, unsupervised prac work)/wk throughout the year.

Assessment: Computer Science 2B is taught in two lecture modules. Marks will be awarded for each module on the basis of practical exercises, assignments and the results of examinations held at the end of the semester in which the module is taught. The relative weighting of marks from these sources varies from module to module, and will be announced on course noticeboards at the start of each semester. The final mark for the course will be determined primarily by the weighted sum of module marks. The final mark for the course will be determined primarily by the weighted sum of module marks. However, students are required to demonstrate reasonable proficiency in the material of each module, as shown by satisfactory performance on both examinations.and practical work.

Module title	Semester	Weight
Computer Systems (CSys)	1	50%
Logic and Languages (LL)	2	50%

Information about each module:

Computer Systems

Classes: (2 lec & 2hr workshop)/wk in Sem 1.

Topics: The organisation of a computer central processing unit (CPU) and the assembly and machine language commands that control it; two's complement integers and floating point data and their operations (the teachingwill be through the vehicle of a particular computer, the M3PS-2000). The low-level organisation of system software including the organisation and action of a simple compiler and its run-time environment, and the system call and interrupt handling mechanisms.

Textbook

J. Hennessy and D. Patterson *Computer Organisation and Design* (Morgan Kaufmann, 1993)

Logic and Languages

Classes: (2 lec & 1 tut)/wk in Sem 2.

Topics: Formal languages, grammars, automata, circuits, logic; the relationships between these formalisms. In particular regular languages, regular expressions, finite-state automata, context-free languages, push-down automata prepositional logic, combinational circuits, sequential circuits, first-order logic.

Textbook

A. Aho and J. Ullman *Foundations of Computer Science* (Computer Science Press, 1992)

U2.050 Geology 2 — 16 units

Intermediate elective course for the degree in Civil Engineering.

Prerequisite: U1.050 Geology 1.

Classes: (4 lec and two 2hr prac)/wk throughout the year. Also 2 compulsory field excursions, each of about one week's duration, in late February and in July.

Assessment: exams in June and November. Field reports.

Syllabus summary: This course presents a theoretical and practical development of basic subject matter encountered in the Junior course and introduces some fresh topics. It includes crystal chemistry, optical mineralogy, geochemistry, metamorphic, igneous and sedimentary petrology, structural geology, stratigraphy, applied palaeontology, palaeoecology, geochronology, ore rocks, fuels, petrophysics, geological and geophysical methods.

Registration and Noticeboards: Students taking this course must register with the Department of Geology and Geophysics during orientation week. They should also consult the noticeboards in the foyer and corridor of the Edgworth David Building regularly.

U2.052 Engineering Geology 2 — 5 units

Intermediate core course for **the** degree in Civil Engineering, unless the course U2.050 Geology 2 has been completed.

Mutually exclusive with: U2.050 Geology 2, U2.052 Engineering Geology B.

Prerequisites: either U1.050 Geology 1 or U1.051 Engineering Geology 1.

Corequisites: nil.

Classes: lec: 26hrs, lab: 39hrs. Field excursions in the Sydney region, as appropriate.

Course objectives: To introduce and emphasise the role of geology in civil engineering projects.

Expected outcomes: Students should gain an appreciation of the importance of geology in the planning and execution of civil engineering projects, and be able to apply their knowledge of geology to the solution of soil and rock engineering problems.

Assessment: Practical laboratory work plus one 3hr exam at the end of the semester. Assignment work may also be included in the final assessment, as advised at the commencement of the course.

Syllabus summary: Application of geological principles and practices to solving problems in civil engineering. Surface and sub-surface geological, geophysical and remote sensing techniques for evaluation of ground conditions. Introductory rock mechanics, clay mineralogy and behaviour. Natural materials for construction purposes.

Reference books
F.C. Beavis *Engineering Geology* (Blackwell)
A.B.A. Brink *Engineering Geology of South Africa*
P.J.N. Pells (ed.) *Engineering Geology of the Sydney Region* (Balkema)

Library classifications: 552,624.15

U2.065 Biochemistry 2 — 16 units

Intermediate elective course for the degree in Chemical Engineering.

Prerequisite: U1.030 Chemistry 1 or both U1.031 Chemistry IE and U1.032 Chemistry IE Supplementary.

Corequisite: 8 units of Intermediate Chemistry.

Classes: (3 lec and 6hr prac)/wk throughout the year.

Assessment: one 3hr theory exam at end of each sem; one 2hr theory of prac exam at end of each sem; prac reports.

Syllabus summary: Protein structure and function. Enzymes. Nucleic acid and protein synthesis. Detailed study of carbohydrate, fatty arid and amino acid metabolism. Electron transport and generation of ATP. Metabolic integration and control of metabolism.

Registration: Students taking this course must register with the Department of Biochemistry during orientation week.

Textbooks
Stryer *Biochemistry* 3rd edn (Freedman, 1988)
Schaum *Outline of Biochemistry* (McGraw-Hill, 1988)

U2.066 Biochemistry 2 Auxiliary — 8 units

Intermediate elective course for the degree in Chemical Engineering.

Prerequisite: U1.030 Chemistry 1 orbothU1.031 Chemistry IE and U1.032 Chemistry IE Supplementary.

Corequisite: 8 units of Intermediate Chemistry.

Classes: 3 lec/wk throughout the year plus audiovisual work at convenient times.

Assessment: one 3hr exam at end of each sem.

Syllabus summary: Protein structure and function. Enzymes. Nucleic acid and proteinsynthesis. Detailed study of carbohydrate, fatty acid and amino acid metabolism. Electron transport and generation of ATP. Metabolic integration and control of metabolism.

Registration: Students taking this course must register with the Department of Biochemistry during orientation week.

Textbook
Stryer *Biochemistry* 3rd edn (Freeman, 1988)

U2.090 Asian Studies 1 — 8 units

Intermediate elective course.

Prerequisite: nil

Classes: one 2hr class/wk in the early evening throughout the year and a 3-week full-time intensive course in the July vacation. Attendance is required at all lectures and classes.

Assessment: oral tests, written assignments, and one 2hr written exam in each of June and November.

Syllabus summary: language study (75%), general culture (15%), business culture (10%) for the country chosen.

U2.210 Introduction to Materials — 4 units

Intermediate core course for the degree in Civil Engineering.

Mutually exclusive with: U1.210 Materials 1

Classes: lec: 40hrs and lab approx. 12hrs

Course objectives: To develop an understanding of the microstructure and mechanical properties of metals, ceramics, polymers and their composites.

Course outcomes: Ability to describe the influence of microstructure of metals, ceramics, polymers upon their strength, elastic, plastic and creep behaviour.

Assessment: one 3hr exam at end of course. Satisfactory lab work is a requirement for passing the course and it is included in the final assessment.

Syllabus summary: Microstructure and bonding of metals, ceramics, polymers and composites and their influence upon the mechanical properties of these materials (i.e. strength, elasticity, plasticity, creep, etc.).

Textbooks
To be advised

Reference books
van Vlack *Materials for Engineering — Concepts and Applications* (Addison-Wesley, 1982)
Ashby and Jones *Engineering Materials—An Introduction to their Properties and Applications* (Pergamon, 1981)
Flinn and Trojan *Engineering Materials and their Applications* (Houghton-Miflin, 1981)
Wulf *et al. The Structures and Properties of Materials* Vols I to IV (Wiley, 1965)
Ralls *et al. Introduction to Materials Science* (Wiley, 1976)
Jastrzebski *The Nature and Properties of Engineering Materials* (Wiley, 1977)

Library classification: U620.11-19, U668.4, U669 (Fisher Library)

U2.221 Structural Mechanics 5 units

Intermediate core course for the degree in Civil Engineering.

Mutually exclusive with: U2.220 Structures 1.

Prerequisites: U1.000 Mathematics 1, U1.010 Mechanics IE and U1.220 Statics.

Corequisites: nil.

Classes: lec: 39hrs, tut: 26hrs.

Course objectives: To provide a basic understanding of the principles of elementary stress and stiffness analyses of simple structural elements under static loading and to be able to use these principles to analyse simple structural elements using hand computation methods.

Expected outcomes: Proficiency in basic methods of simple structural analysis and interpretation of results.

Assessment: class assignments and one 3hr closed-book exam covering the whole syllabus at the end of semester.

Syllabus summary: Review of basic statics; elementary elasticity, geometric properties of plane areas, axial loading, flexure in beams, shear stresses in beams, uniform torsion, bending deflections, elementary instability, influence lines, triangulated frames and trusses, combined stresses, continuum mechanics — stresses and strains in 2D, failure theories for materials.

Textbook
Megson *Strength of Materials for Civil Engineering* 2nd edn (Arnold)

Reference books
Gordon *Structures* (Penguin, 1978)
Shanley *Mechanics of Materials* student edn (McGraw-Hill, 1967)

Library classification: U624.17 (Fisher Library)

U2.261 Fluids 1 5 units

Intermediate core course for the degree in Civil Engineering.

Mutually exclusive with: U3.261 Fluids 1.

Prerequisites: U1.000 Mathematics 1.

Corequisites: nil.

Classes: lec: 26hrs, lab/tut: 39hrs.

Course objectives: To develop an understanding of: patterns of movement of fluid particles and associated force and energy relationships; applications of basic concepts to cases of fluids in containers and conduits.

Expected outcomes: Students should gain the ability: to determine fluid movements and forces in pipes and open channels and around bodies in fluid streams.

Assessment: one 3hr exam covering the whole syllabus at the end of semester. Satisfactory laboratory and tutorial performance is also a requirement. Credit will be given for laboratory and tutorial submissions, as indicated at the commencement of the course.

Syllabus summary: Equations of motion. Velocity patterns. Flow similitude and models. One-dimensional flow principles. Flow measurements. Viscous and turbulent flow. Resistance to flow of fluids. Flow in closed conduits. Open channel flow.

Textbooks
Hydraulics Data Sheets (School of Civil and Mining Engineering, University of Sydney)
Rouse *Elementary Mechanics of Fluids* (Dover)
or
Streeter and Wylie *Fluid Mechanics* (McGraw-Hill)
or
Douglas, Gasiorek and Swaffield *Fluid Mechanics* (Pitman)
or
Vennard and Street *Elementary Fluid Mechanics* (Wiley)

Library classification: 532

U2.272 Engineering Communications 1 2 units

Intermediate core course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: nil.

Classes: lec: 12hrs, discussion/oral presentation: 14hrs.

Course objectives: To develop effective written and oral communication skills.

Expected outcomes: Ability to make written and oral presentations on topics of general, technical and/or social significance to small peer groups.

Assessment: based on three written reports and three oral presentations. Extra credit for some or all oral presentations may be given for verifiable public speaking activities with the students' section of the Institution of Engineers, Australia, the University of Sydney Debating Society or equivalent organisation. Students are encouraged to engage in these activities.

Syllabus summary: 12 hours of lectures on effective report writing and oral presentation. Written reports and oral presentation on three topics of general, technical and/or social significance of 5, 10 or 15 minutes' duration. Oral presentation in groups of eight students in a lecture or round-table discussion format.

Reading material
According to chosen topic in consultation with academic staff

U2.290 Structural Design 4 units

Intermediate core course for the degree in Civil Engineering.

Mutually exclusive courses: nil.

Prerequisites: U1.000 Mathematics 1, U1.010 Mechanics IE and U1.220 Statics.

Corequisites: U2.221 Structural Mechanics.

Classes: lec: 26hrs, design classes: 26hrs.

Course objectives: To provide a basic understanding of design concepts and the design of steel and concrete elements to current code criteria.

Expected outcomes: Proficiency in the design of simple structural elements in steel and concrete.

Assessment: design class assignments and one 3hr closed-book exam covering the whole syllabus on steel and concrete design at the end of semester.

Syllabus summary

Textbooks
SAA HB2.2 — *Australian Standards for Civil Engineering Students: Part 2: Structural Engineering*
or
SAA AS4100 — *Steel Structures Code*
SAA AS3600 — *Concrete Structures Code* and
SAA AS1170 — *Loading Code, Parts land II*
Buckle *The Elements of Structures* 2nd edn (Pitman International)
Schodek *Structures* (Prentice-Hall)

Reference books
Cowan *The Design ofReinforced* Concrete student edn (Sydney U.P.)
Ferguson *Reinforced Concrete Fundamentals* student edn (Wiley)
Gordon *Structures—or Why Things Don't Fall Down* (Pelican)
Park and Paulay *Reinforced Concrete Structures* (Wiley)
Trahair and Bradford *Behaviour and Design of Steel Structures* 2nd edn (Chapman and Hall)
Warner, Rangan and Hall *Reinforced Concrete* (Pitman)

Library classification: U624.182: U624.183 (Fisher Library)

U2.410 Mechanical Engineering 2 10 units

Intermediate core course for the degree in Aeronautical, Mechanical and Mechatronic Engineering.

Mutually exclusive with: U2.412 Engineering Dynamics 2.

Prerequisites: U1.000 Mathematics 1 and either U1.410 Mechanical Engineering 1 or U1.710 Aeronautical Engineering 1.

Classes: (3 lec and one 3hr lab or tut)/wk in Sem 1 and (2 lec and one 3hr lab or tut)/week in Sem 2.

Assessment: one 3hr exam at end of Sem 1; one 2hr exam at end of Sem 2; and associated coursework over course.

Syllabus summary:
Semester 1—
(a) Thermodynamics — concepts, work and heat, property of substances, 1st law of thermodynamics, control mass and control volume analysis of power and refrigeration cycles; thermal efficiency, entropy and 2nd law of thermodynamics, reversible and irreversible processes, isentropic efficiency,
(b) Fluids — fluid properties, pressure, shear, hydrostatics, forces, moments, buoyancy, stability, continuity equations, streamlines, Euler, Bernoulli equations, linear momentum, propulsion, angular momentum, turbomachinery, dimensional analysis, boundary layers, pipe flow and friction.

Semester 2—
Kinematics of bodies; frames of reference, velocity and acceleration; angular velocity and acceleration; rotating frame of reference; relative velocity and acceleration; gyroscopic acceleration. Kinetics of rigid bodies;linearinornenturnandEuler'sfirstlaw;angular momentum and Euler's second law; centre of mass; moments of inertia; parallel-axis and parallel-plane theorems; principal axes and principal moments of inertia; rotation about an axis; impulse and momentum; work and energy; kinetic and potential energies. Applications to orbital and gyroscopic motion. Planar mechanisms; linkages; mobility; instant centres of rotation; Kennedy's theorem, velocity and acceleration polygons. Introduction to Lagrangian methods.

Reference books
Smith and Smith *Mechanics* 2nd edn (Wiley, 1990)
Mabie and Reinholtz *Mechanisms and Dynamics of Machinery* 4th edn (Wiley, 1987)
Shigley and Vicker *Theory of Machines and Mechanisms* International Edn (McGraw-Hill, 1981)

U2.411 Introductory Thermodynamics 4 units

Intermediate core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U2.410 Mechanical Engineering 2.

Prerequisites: U1.000 Mathematics 1; and either U1.410 Mechanical Engineering 1 or U1.710 Aeronautical Engineering 1.

Classes: (2 lec and one 3hr lab/tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1 and associated coursework over course.

Syllabus summary: Thermodynamics—concepts, work and heat, property of substances, 1st law of thermodynamics, control mass and control volume analysis of power and refrigeration cycles; thermal efficiency, entropy and 2nd law of thermodynamics, reversible and irreversible processes, isentropic efficiency.

Textbook
Van Wylen and Sonntag *Fundamentals of Classical Thermodynamics* SI edn (Wiley)

U2.412 Engineering Dynamics 4 units

Intermediate core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U2.410 Mechanical Engineering 2.

Prerequisites: UI.000 Mathematics 1; and either U1.410 Mechanical Engineering 1 or U1.710 Aeronautical Engineering 1.

Classes: (2 lec & one 3hr lab or tut)/wk in Sem 2.

Assessment: exam at end of Sem 2.

Syllabus summary: Kinematics of bodies; frames of reference, velocity and acceleration; angular velocity and acceleration; rotating frame of reference; relative velocity and acceleration; gyroscopic acceleration. Kinetics of rigid bodies; linear momentum and Euler's first law; angular momentum and Euler's second law, centre of mass, moments of inertia; parallel-axis and parallel plane theorems; principal axes and principal moments of inertia; rotation about an axis; impulse and momentum, work and energy; kinetic and potential energies. Applications to orbital and gyroscopic motion. Planar mechanisms; linkages; mobility; instant centres of rotation; Kennedy's theorem; velocity and acceleration polygons. Introduction to Lagrangian methods.

Reference books

Smith and Smith *Mechanics* 2nd edn (Wiley, 1990)

Mabie and Reinholtz *Mechanisms and Dynamics of Machinery* 4th edn (Wiley, 1987)

Shigley and Vicker *Theory of Machines and Mechanisms* International Edn (McGraw-Hill, 1981)

U2.417 Introductory Mechanics and Materials 8 units

Intermediate core course for the degrees in Mechanical and Mechatronic Engineering.

Mutually exclusive with: U1.210 Materials 1; U1.650 Materials and Corrosion; U1.710 Aeronautical Engineering 1; U2.700 Mechanics and Properties of Solids 1 and U2.701 Mechanics of Solids 1.

Prerequisite: U1.000 Mathematics 1.

Classes: (5 lec and 3hrs tut)/wk in Sem 1.

Assessment: one 3hr exam at end of Sem 1 plus assignment work.

Syllabus summary: Materials classification; understanding materials properties and their relation to structure as a function of forrning methods and treatment process; materials behaviour in service; selection criteria for engineering applications. Properties of engineering materials. Simple stress systems and material response in tension and shear. Elastic and inelastic behaviour. Relation of mechanical behaviour to structure. Fracture and toughness. Materials and corrosions.

Textbooks

Crandall *et al. An Introduction to the Mechanics of Solids* 2nd edn (McGraw-Hill, 1978)

Ashby and Jones *Engineering Materials 1 — An Introduction to their Properties and Applications* (Pergamon, 1981)

Ashby and Jones *Engineering Materials 2 — An Introduction toMicrostructures,ProcessingandDesign(Pergamon,1986)*

U2.440 Mechanical Design 1 8 units

Intermediate core course for the degree in Mechanical and Mechatronic Engineering.

Mutually exclusive with: U2.441 Mechanical Design 1A and U2.443 Mechatronic Design 1.

Prerequisite: nil.

Corequisites: U2.700 Mechanics and Properties of Solids 1 or U2.417 Introductory Mechanics and Materials.

Classes: (4 lec/tut, one 2hr and one 3hr drawing office sessions)/wk in Sem 2.

Assessment: assignments and quizzes.

Syllabus summary:

(a) Machine Drawing—freehand sketching of machine components. Drafting techniques and standard drawing methods. Orthogonal projections and sections. Dimensioning, tolerancing, conventional symbols, detail and assembly drawings and descriptive geometry.

(b) Machine Design — engineering innovation, creativity. Teamwork. Design process, problem specification, conceptual techniques and design evaluation. Ergonomic manufacturing and assembly considerations.

Detail design of components including: design loads, failure and factor of safety; calculation approach and presentation conventions; stress effects in shape definition and material selection; introduction to engineering hardware including fasteners, bearings and mechanical power transmission. Introduction to involute gears and gear trains (including epicyclic).

(c) Mechatronic Design — Introduction to design of mechatronic systems. Elements of mechatronic systems; actuators, sensors, interfacing electronics. Industrial examples.

Textbooks

Boudny *Engineering Drawing* (McGraw-Hill)

Shigley *Mechanical Engineering Design* (McGraw-Hill)

U2.441 Mechanical Design 1A 6 units

Intermediate core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U2.440 Mechanical Design 1.

Prerequisite: nil.

Corequisite: U2.700 Mechanics and Properties of Solids 1 or U2.417 Introductory Mechanics and Materials.

Classes: (2 lec and one 2hr and one 3hr drawing office sessions)/wk in Sem 2.

Assessment: assignments and quizzes.

Syllabus summary:

(a) Machine Drawing — Freehand sketching of machine components. Drafting techniques and standard drawing methods. Orthogonal projections and sections. Dimensioning, tolerancing, conventional symbols, detail and assembly drawings and descriptive geometry.

(b) Machine Design — Engineering innovation, creativity. Teamwork. Design process, problem specification, conceptual techniques and design evaluation. Ergonomic manufacturing and assembly considerations.

Detail design of components including: design loads, failure and factor of safety; calculation approach and presentation conventions; stress effects in shape definition and material selection; introduction to engineering hardware including fasteners, bearings and mechanical power transmission. Introduction to involute gears and gear trains (including epicyclic).

Textbooks
Boudny *Engineering Drawing* (McGraw-Hill)
Shigley *Mechanical Engineering Design* (McGraw-Hill)

U2.443 Mechatronic Design 1 2 units

Intermediate core course for Mechanical/Mechatronic Engineering students doing the Bachelor of Engineering/Bachelor of Science double degree.

Mutually exclusive with: U2.440 Mechanical Design 1.

Prerequisite: nil.

Corequisite: U2.441 Mechanical Design 1A.

Classes: (one 2hr lec/tut)/wk in Sem 2.

Assessment: assignments and quizzes.

Syllabus summary: Introduction to design of mechatronic systems. Elements of mechatronic systems; actuators, sensors, interfacing electronics. Industrial examples.

U2.471 Introductory Mechatronics 6 units

Intermediate core course for the degree in Mechanical Engineering (Mechatronics).

Mutually exclusive with: U2.501 Basic Electrical Engineering 2; U2.510 Electrical Engineering 2; and U3.500 Industrial Electronics.

Prerequisite: U1.410 Mechanical Engineering 1.

Corequisite: U2.504 Electrical and Electronic Engineering.

Classes: (3 lec and one 3hr lab/tut)/wk in Sem 2).

Assessment: one 2hr exam at end of Sem 2 plus lab reports and mid-semester tests.

Syllabus summary:
Circuit theory. Linear network analysis: complex frequency representation; complete response; special circuits; complex power; network functions; stability.

Aspects of machine control: review of electric mo tor types (DC and SC) and their characteristics; protection of machines: thermal overload switches, relays, fuses, circuit breakers and electronic protection; electronic control: SCRs, Triacs, GTOs, IGBTs. Controlled rectifiers and inverter circuits; harmonics, power factor; application of power control to electric motor drives.

Digital systems: concepts in digital design; combinational circuit design; sequential circuit design; algorithms and architectures; design decisions and implementation; computer aids and design process.

U2.502 Electrical Technology 4 units

Intermediate core course for the degrees in Chemical and Aeronautical Engineering.

Mutually exclusive with: U1.500 Introductory Electrical Engineering for Civil Engineers, U1.510 Electrical Engineering 1, U2.471 Introductory Mechatronics, U2.500 Basic Electrical Engineering 1, U2.501 Basic Electrical Engineering 2, U2.510 Electrical Engineering 2.

Prerequisite: U1.000 Mathematics 1.

Classes: (2 lec/wk and nine 3hr tut/lab sessions) for one sem.

Assessment: one 2hr exam at end of sem; lab reports; and mid-sem tests.

Syllabus summary: Basic AC and DC circuits. Elementary electronics. Operational amplifiers. Diodes and transistors. Electromechanical energy conversion. Principles of electric energy generation and distribution. Elementary digital systems.

U2.504 Electrical and Electronic Engineering 6 units

Intermediate core course for the degrees in Mechanical and Mechatronic Engineering.

Mutually exclusive with: U3.500 Industrial Electronics, U2.510 Electrical Engineering 2.

Prerequisite: U1.410 Mechanical Engineering 1.

Classes: (3 lec & 3hrs lab/tut)/wk in Sem 1.

Assessment: one 3hr exam at end Sem 1 plus lab reports and mid-semester tests.

Syllabus summary: Polyphase energy generation. Three phase systems. Star and delta connected systems. Balanced and unbalancedloads.Magneticfields.Solenoid and toroid. Magnetic circuit calculations. AC excitations of a rnagnetic circuit. Magnetising curve. Hysteresis and eddy current losses. Ideal and real transformers. Model and phasor diagram of a transformer.

Principle of electromagnetic energy conversion. Production of a rotating magnetic field. Principles of AC machines. Synchronous machines. Induction motors. Equivalent circuits. Slip-torque characteristics. Methods of starting and speed control. DC machines. Shunt-existed generator. Shunt- and series-connected motors. Efficiency of DC machines.

Semiconductor devices: Diode, BJT and FET characteristics. Small-signal models. Basic circuits. Amplifiers and biasing; rectifiers. Linear power supplies. Thyrisor devices, applications to motor control.

Operational amplifiers: Characteristics, ideal and real. Feedback. Design with op amps: inverting, non-inverting and differential amplifiers; integrator and differentiator; simple filters, comparator and Schmitt trigger.

Digital electronics: Numbering systems. Gates and combinational logic. Latches, synchronous and asynchronous counters. Flip-flops and memory. TTL and CMOS logic families. Practical design examples.

Microprocessor fundamentals: architecture of a standard 8-bit microprocessor. Instruction set and addressing modules. Assembly language programming. Clock and reset circuits. Memory and I/O interfacing.

Textbooks
To be advised by Electrical Engineering

U2.510 Electrical Engineering 2 16 units

Intermediate core course for the degree in Electrical Engineering.

Mutually exclusive with: U2.471 Introductory Mechatronics, U2.502 Electrical Technology, U2.504 Electrical and Electronic Engineering.

Prerequisite: U1.510 Electrical Engineering 1.

Corequisites: U2.000 Mathematics 2 or U2.001 Mathematics 2EE, and U2.020 Physics 2 or U2.021 Physics 2EE.

Classes: (5 lec/wk plus 36hrs of lab and 36hrs of tut) throughout the year.

Assessment: two 2hr exams plus lab reports and assignments in each sem.

Syllabus summary: The course consists of the following six sections.

Intermediate electronics—Basics of semiconductors; diodes; transistors; advanced transistor and FET circuits; operational amplifiers.

Introductory circuit theory—Linear network analysis; complex frequency representation; complete response; special circuits; complex power; network functions; stability; transformers.

Engineering development and structure (1 lec per week) — Engineering in history; early electrical engineering; engineering in Australia; industry and the economy; Australian economy in a world context; electrical engineering and economic development.

Intermediate electric power—Electric power circuit calculations; magnetic circuit calculations; insulation; transformers; power distribution; electromechanical energy conversion.

Intermediate digital systems — Computer architecture and assembly language programming; digital systems; concepts in digital design; enabling technologies; combinatorial circuit design; arithmetic circuits; circuits with memory; sequential circuit design; algorithms and architectures; design decisions and implementation; computer aids and design process.

Product innovation—The innovation process; role of the engineer in innovation; study of the engineer in innovation; study of innovation.

U2.610 Chemical Engineering 2 8 units

Intermediate core course for the degree in Chemical Engineering.

Prerequisite: U1.000 Mathematics 1.

Corequisite: U1.610 Chemical Engineering 1.

Classes: (2 lec and 1 tut)/wk throughout the year; plus 5 lab sessions in Sem 2.

Assessment: lab reports; assignments; and 2 exam papers, one at end of each sem.

Syllabus summary: An integrated introductory treatment of the transport of momentum, heat and mass.

Fluid statics: application to pressure measurement and forces on storage vessels. Inviscid flow theory: application to flow measurement and enlargement losses. Laminar flow of Newtonian fluids in pipes: derivation of velocity profile, flow rate and frictional loss. Turbulent flow in pipes: application of dimensional analysis, friction factors; energy balances for pipe flow systems. Pumps: theory of reciprocating and centrifugal pumps; cavitation and NPSH.

Heat conduction: rectilinear and cylindrical geometry. Convection: concept and use of the heat transfer coefficient. Dimensional analysis and dimensionless correlations for heat transfer in pipe flow. Natural convection. Simple heat exchangers.

Diffusion models and examples. Convection and dilute diffusion. Diffusion coefficients in gases, liquids and polymers. Mass transfer coefficients, interfacial conditions. Dimensional analysis, correlations. Heat and mass transfer analogies. Absorption of dilute and concentrated vapours. Heat and mass transfer, wet-bulb temperature.

Design competition

This is a light-hearted exercise in which students of U2.610 Chemical Engineering 2 design, build and operate a simple device to solve an unusual Chemical Engineering problem. Past problems have included the task of producing separated shell, yolk and white from a whole raw egg. A small entry fee is charged and prizes are awarded.

Textbooks

Hewitt, Shire and Bott *Process Heat Transfer* (CRC Press, Begel House, 1994)

Others as advised during classes

U2.611 Fundamentals of Environmental Chemical Engineering 4 units

Intermediate core course for the degree in Chemical Engineering.

Prerequisites: U1.000 Mathematics 1, U.031 Chemistry IE, U1.610 Chemical Engineering 1.

Corequisites: U2.610 Chemical Engineering 2.

Classes: 4 hours (lectures and tutorials) per week for one semester.

Assessment: tutorial assignments and one 2hr exam at end of course.

Objectives: to acquaint the student with environmental pollutants .and their effects; to introduce the application of engineering concepts to the analysis of pollution problems and their control; to introduce common processes and technologies designed to reduce pollution or its impact on the environment.

Syllabus summary: History of environmental pollution. Introduction to environmental pollutants and their regulation. Engineering concepts of importance to the analysis and resolution of environmental problems. Environmental transport processes. Environmental processes of air pollutants. Air pollution source control technologies. Environmental processes of water pollutants. Water pollution source control technologies. Environmental processes of soil/sediment pollutants. Soil/sediment pollution remediation and control.

Textbook

Course notes (Department of Chemical Engineering) based on: Reible *Fundamentals of Environmental Engineering* (in preparation)

U2.612 Chemical Engineering Computations 4 units

Intermediate core course for the degree in Chemical Engineering.

Prerequisites: U1.000 Mathematics 1, U1.630 Computing for Chemical Engineers.

Corequisites: nil.

Classes: 4 hours (lectures and tutorials) per week for one semester.

Assessment: tutorial assignments and one 2hr exam at end of course.

Syllabus summary: The need and role of numerical computations in chemical engineering. Solution of linear and non-linear algebraic equations. Numerical differentiation and integration. Solution of ordinary differential equations. Linear programming and optimisation. Use of software packages. Review of extension of first-year statistics and computing (with an emphasis on chemical engineering applications).

Textbook
Course notes (Department of Chemical Engineering)

U2.700 Mechanics and Properties of Solids 1 6 units

Intermediate core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U2.701 Mechanics of Solids 1 or U2.417 Introductory Mechanics and Materials.

Prerequisite: U1.000 Mathematics 1.

Classes: (3 lec and one 2hr tut)/wk (plus three 3hr lab sessions) in Sem 1.
Assessment: one 3hr exam at end of course.

Syllabus summary:
Mechanics of Solids — Concepts of equilibrium, compatibility, stress and strain; study of internal stress systems due to tension, bending, torsion and shear; statistically determinate and indeterminate structural elements; concepts of energy methods, displacement analysis; simple buckling. Presentation and emphasis based on type of structure common to mechanical, aeronautical, mining and engineering in general.

Properties of Materials — Dislocation in materials; heat treatment and metalworking processes; fundamentals of corrosion and oxidation.

Textbook
Fenner *Mechanics of Solids* (Blackwell Scientific Publication, 1989)

Reference books
There are about 30 different texts in the Engineering Library with titles such as 'Strength of materials', 'Mechanics of Solids' and 'Properties of Materials'. Students will see from perusal of these, different ways of describing the contents of this course
Bailey *The Role of Microstructure in Metal* (Metallurgical Services, 1966)
Bailey *Introductory Practical Metallography* (Metallurgical Services)
Bailey *The Structure and Strength of Metals* (Metallurgical Services)
Fontana and Green *Corrosion Engineering* (McGraw-Hill, 1967)
Hull and Bacon *Introduction to Dislocations* (Pergamon, 1984)
John *Understanding Phase Diagrams* (Macmillan, 1974)
Popov *Mechanics of Material's* IS edn (Prentice-Hall, 1978)

Library classification: 620.11

U2.701 Mechanics of Solids 1 4 units

Intermediate core course for the degree in Chemical Engineering.

Mutually exclusive with: U2.700 Mechanics and Properties of Solids 1.

Prerequisite: U1.000 Mathematics 1.

Classes: (2 lec and one 2hr tut)/wk in Sem 1.

Assessment: one 2hr exam at end of course.

Syllabus summary: Concepts of equilibrium, compatibility, stress and strain; study of internal stress systems due to tension, bending, torsion and shear; statistically determinate and indeterminate structural elements; concepts of energy methods, displacement analysis; simple buckling. Presentation and emphasis based on type of structure common to mechanical, aeronautical, mining and Engineering in general.

Textbook
Fenner *Mechanics of Solids* (Blackwell Scientific Publication, 1989)

Reference books
There are about 30 different texts in the Engineering Library with titles such as 'Strength of Materials', 'Mechanics of Solids' and 'Properties of Materials'. Students will see from perusal of these, different ways of describing the contents of this course
Bailey *The Role of Microstructure in Metals* (Metallurgical Services, 1966)
Bailey *Introductory Practical Metallography* (Metallurgical Services)
Bailey *The Structure and Strength of Metals* (Metallurgical Services)
Fontana and Green *Corrosion Engineering* (McGraw-Hill, 1967)
Hull and *BaconIntroduction to Dislocations* (Pergamon, 1984)
John *Understanding Phase Diagrams* (Macmillan, 1974)
Popov *Mechanics of Materials* IS edn (Prentice-Hall, 1978)

Library classification: 620.11

U2.710 Fluid Mechanics 4 units

Intermediate core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U2.410 Mechanical Engineering 2.

Corequisite: none.

Classes: (1 lec/wk and associated tutorials) in Sem 1; (2 lec/wk and associated tutorials) in Sem 2.

Assessment: one 1.5hr exam at end of Sem 1; one 2hr exam at end of Sem 2.

Syllabus summary: Properties of a fluid; definition of pressure, temperature, density, viscosity, surface tension, etc., perfect gas laws. Definition of a continuum; Newtonian and non-Newtonian fluid behaviour; flow similitude and governing non-dimensional parameters; Reynolds number; Froude number; Weber number; Mach number.

Fluid statics. Basic hydrostatic equations; buoyancy; stability of floatingbodies.Pressuremeasuringdevices; barometers; manometers. Properties of the atmosphere.

Fluid dynamics. Conservation of mass, momentum and energy equations. Continuity equation; Bernoulli equation; Euler equation. Applications in flow rate and velocity measuring devices; venturi; pitot-static tube; orifice plate. Velocity potential equation for flow modelling; internal flows, external flows around immersed bodies and ground-water flows. Equations for steady flow in open channels; calculation of free surface; hydraulic jump; critical flow rate.

Viscosity and compressibility effects. Skin friction: boundary layer flows; laminar and turbulent flows; flow in pipes and ducts; friction losses. Speed of sound of waves in a fluid medium; effects of Mach number; introduction to supersonic flow; shock waves.

Reference books

Houghton and Brock *Aerodynamics for Engineering Students* (Edward Arnold, 1988)

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Sabersky, Acosta and Hauptmann *Fluid Flow* (Macmillan, 1989)

Streeter and Wylie *Fluid Mechanics* (McGraw-Hill, 1981)

U2.770 Engineering Computation 4 units

Intermediate core course for the degree in Aeronautical Engineering.

Prerequisites: U1.280 Engineering Programming and U1.281 Computer Graphics.

Classes: 1 lec and one 3hr computer lab session per week in Sem 2.

Assessment: one 2hr exam at the end of Sem 2 and computer programming assignments during sem.

Syllabus summary:
Application of numerical solution techniques to solve problems in engineering. Numerical techniques for matrix multiplication; matrix inversion; solution of simultaneous linear equations. Calculation of eigenvalues and eigenvectors; discrete Fourier transforms. Procedures for iteration; numerical integration and differentiation. The sotirage of data in ef fi cient file or memory structure; data retrieval; sorting algorithms. Randomnumbergenerationand statistical analysis.

The use and evaluation of package software; benchmarking; determination of limits and applicability. Usage of spreadsheets, databases, word processors, mathematical symbol manipulation; CAD/CAM, graphing programs and engineering analysis programs. Definitions for user-friendly interfaces; output format requirements.

Students will be required to carry out programming examples, in a variety of programming languages. These sample applications will cover topics such as the numerical solution of governing equations for fluid statics and fluid dynamics; numerical calculations of structural behaviour and force equilibrium; numericalsimulationofmemotionofsimplekinematic systems; numerical modelling of simple thermodynamic cycles.

Reference books

Press *et al. Numerical Recipes, the Art of Scientific Computing* (Cambridge Press, 1986)

The Student Edition of MATLAB (Prentice-Hall, 1992)

U2.800 Engineering Construction 1 4 units

Intermediate core course for the degree in Civil Engineering and in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisite: U1.000 Mathematics 1.

Classes: (lec: 26hrs and tut: 26hrs) for one sem.

Assessment: one 3hr exam at end of course and assignments.

Syllabus summary: Introduction to construction engineering fundamentals. Techniques for analysis of construction systems; productivity and cost evaluation. Selection and evaluation of plant and methods. Materials handling with special reference to earth and rock moving.

Library classification: 624.068

U2.820 Engineering Economics 4 units

Intermediate core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisite: nil.

Corequisite: U2.000 Mathematics 2.

Assessment: coursework and written, examination.

Syllabus summary: Engineering economy problems and alternatives, the decision making process, equivalence, discounted cash flow analyses, introduction to depreciation accounting, inflation, break-even analysis, probability in economy studies, appraisal of public projects, introduction to risk analysis.

U2.821 Engineering Accounting 4 units

Intermediate core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisite: nil.

Corequisite: U2.820 Engineering Economics.

Assessment: coursework and written examination.

Syllabus summary: Accounting fundamentals, business and accounting procedures, taxation, financial statements, financial ratios, management uses of financial information, cash flow and profitability management.

U3.067 Microbiology 2 8 units

Senior elective course for the degree in Chemical Engineering, biochemical option.

Prerequisite: nil.

Corequisite: U2.066 Biochemistry 2 Auxiliary.

Classes: (3 lec plus 1 tut/demonstration)/wk throughout the year.

Assessment: one 3hr paper at end of each sem.

Syllabus summary: Topics covered include: history and scope of microbiology; methodology; comparison of major groups of microorganisms, a detailed study of bacteria including structure and function; aspect of applied microbiology such as food and industrial microbiology, microbial ecology (soil, aquatic, agricultural) and microbial pathogenicity (including virology and immunology).

Reference books
To be announced

U3.090 Asian Studies 2 — 8 units

Senior elective course.

Prerequisite: U2.090 Asian Studies 1.

Classes: one 2hr class/wk throughout the year and a three-week study tour of the country being studied in the July vacation. Students unable to participate in the study tour will have alternative classwork assigned.
Attendance is required at all lectures and classes.

Assessment: oral tests, written assignments and one 2hr written exam in each of June and November.

Syllabus summary: language study (60%), general culture (15%), business culture (25%) for the country chosen.

U3.212 Properties of Materials — 4 units

Senior core courses for the degree in Civil Engineering.

Mutually exclusive with: U3.211 Materials 2

Prerequisites: U2.210 Introduction to Materials

Classes: lec: 40hrs and lab 12hrs

Course objectives: To develop an understanding of the relationship between microstructure and mechanical properties of metals, cement-based materials, timber and masonry.

Course outcomes: Ability to select the material best suited for a particular design application.

Assessment: one 3hr exam covering the whole syllabus. Satisfactory lab work is a prerequisite for passing the exam.

Syllabus summary: Relationship between micro-structure and mechanical properties of metals, hardened cement paste, mortar, concrete, timber, masonry. In particular, properties of structural steels, welding and hydrogen embrittlement, cements and their hydration, minerals and other admixtures in concrete, mix design.

Textbooks
Campbell-Allen and Roper *Concrete Structures: Materials* Ate'ntewawceandRepair (Longman Scientificand Technical) — preferred text
Soroka *Portland Cement Paste and Concrete* (Macmillan Australia, 1979)
Akroyd *Concrete—Its Properties and Manufacture* (Pergamon) and/or
Troxell *Composition and Properties of Concrete* 2nd edn (McGraw Hill)
U.S. Bureau of Reclamation *Concrete Manual*
Czernin *Cement Chemistry and Physics for Civil Engineers* (Lockwood)
Relevant SAA Specifications

Reference books
Taylor *Concrete Technology and Practice* (Angus & Robertson)
Lea and Desch *Chemistry of Cement and Concrete* (Arnold)
Dieter *Mechanical Metallurgy* 3rd edn (McGraw-Hill)
Popov *Mechanics of Materials* (Prentice-Hall)
Jaeger and Cook *Fundamentals of Rock Mechanics* (Methuen)
Reiner (ed.) *Building Materials: their Elasticity and Inelasticity* (North-Holland)
Polakowski and Ripling *Strength and Structure of Engineering Materials* (Prentice-Hall)
Honeycombe *The Plastic Deformation of Metals* (Arnold)
Easterling *Introduction to the Physical Metallurgy of Welding* (Butterworths)
Library classification: 620.11-19

U3.222 Structural Analysis — 6 units

Senior core course for the degree in Civil Engineering.

Prerequisites: U2.221 Structural Mechanics and U2.000 Mathematics 2

Classes: lec: 42hrs, tut: 42hrs

Assessment: one 3hr exam at end of semester plus assessment of assignments.

Course objectives: To provide an understanding of the principles of (a) the force and displacement methods for analysing redundant trusses and beams, and (b) the lower and upper bound methods for the plastic analysis of beams and frames. To be able to apply computer methods to structural analysis and to check the validity of such solutions.

Expected outcomes: To be able to apply the manual methods of analysis taught in the course to simple structures. To be able to apply and check computer analyses of structures.

Syllabus summary: Analysis of statically redundant trusses and frames using the force and displacement methods. Internal forces and deflections of statically redundant trusses and frames. Lack of fit. Virtual work principles: principle of virtual forces and principle of virtual displacements. Computer methods for analysing plane frames and trusses. Programs PRFSA and PTSA. Plastic analysis of beams and frames. Upper and lower bound theorems.

Textbooks
Rasmussen *Structural Analysis 1* (University of Sydney)
Popov *Introduction to the Mechanics of Solids* (Prentice-Hall)
Parkes *Braced Frameworks* (Pergamon)
Timoshenko and Young *Theory of Structures* (McGraw-Hill)
Library classification: 624.17

U3.232 Concrete Structures 1 — 6 units

Senior core course for the degree in Civil Engineering.

Prerequisites: U2.000 Mathematics 2, U2.221 Structural Mechanics and U2.290 Structural Design.

Corequisites: U3.212 Properties of Materials and U3.222 Structural Analysis.

Classes: lec: 42hrs, tut/lab/drawing office: 42hrs.

Assessment: two 3hr exams plus design project.

Course objectives: To provide a basic understanding of the behaviour of reinforced concrete members and structures; to provide a basic understanding of standard methods of analysis and design of reinforced concrete behaviour ((including an understanding of capabilities and limitations); to provide basic design training in a simulated professional engineering environment.

Expected outcomes: Proficiency in basic methods of reinforced concrete analysis and interpretation of results; proficiency in basic reinforced concrete design.

Syllabus summary: The behaviour and design of reinforced concrete members and structures.

Behaviour — introduction, material properties, 'elastic' analysis (stresses/deformations), ultimate strength of beams (flexure/shear/torsion), ultimate strength of columns (short and slender), introduction to behaviour of reinforced concrete slabs, introduction to prestressed concrete.

Design—design of typical elements of a reinforced concrete building, structural modelling, analysis of load-effects (incl. earthquakes), design criteria (for durability, fire^resistance, serviceability and strength), design calculation procedures, reinforcement detailing, structural drawings.

Textbooks

Warner *el al. Reinforced Concrete* (Pitman)

Standards Australia Specifications — current editions
AS1170 *Loading Code — Parts 1,2 &4*
AS3600 *Concrete Structures Code*
AS HB2.2 *Structural Engineering Standards*

Reference books

Park and Paulay *Reinforced Concrete Structures*
Warner and Faulkes *Prestressed Concrete* (Longman Cheshire)
Concrete Design Handbook (Cement and Concrete Association of Australia)
Reinforcement Detailing Handbook (Concrete Institute of Australia)

Library classification: 624.183

U3.235 Steel Structures 1 — 6 units

Senior core course for the degree in Civil Engineering.

Prerequisites: U2.221 Structural Mechanics, U2.290 Structural Design and U2.000 Mathematics 2.

Corequisites: U3.212 Properties of Materials and U3.222 Structural Analysis.

Classes: lec: 42hrs, tut/lab/drawing office: 42hrs

Assessment: one 2hr exam at the end of each semester plus assessment of design assignments.

Course objectives: To provide a basic understanding of the behaviour and design of steel members and structures.

Expected outcomes: The development of some of the skills required for the design of practical steel structures.

Syllabus summary: The behaviour and design of steel members and structures — design concept loads and load combinations, strength, stability and serviceability criteria, safety and reliability, practical steel structures, properties of cross-sections, local buckling, elastic beams, plastic beams, tension members, compression members, effective lengths and elastic in-plane frame buckling, lateral buckling of beams, in-plane bending of beam-columns, lateral buckling of beam-columns, biaxial bending of beam-columns, bolted and welded connections.

Textbooks

BHP *Hot Rolled and Structural Products Handbook*
Bradford, Bridge and Trahair *Worked Examples for Steel Structures* (AISC, 1992)
Standards Australia Specifications — current editions
AS1170 *Parts 1 and 2 Loading Code,* and
AS4100 *Steel Structures Code;* or
AS HB2.2 *Structural Engineering Standards*
Trahair and Bradford *Behaviour and Design of Steel Structures* (Chapman and Hall, 1991)

Reference books

AISC *Design Capacity Tables for Structural Steel*
Bresler *et al. Design of Steel Structures* (Wiley)
Gaylord and Gaylord *Design of Steel Structures* IS edn (McGraw-Hill)
Lothers *Advanced Design in Steel Structures* (Longmans)
McGuire *Steel Structures* (Prentice Hall)
Other books as indicated in classes

Library classification: 624.17,624.182

U3.244 Soil Mechanics A — 4 units

Senior core course for the degree in Civil Engineering.

Mutually exclusive with: U3.240 Soil Mechanics, U4.241 Soil Engineering.

Prerequisites: U2.210 Introduction to Materials, U2.221 Structural Mechanics, U1.000 Mathematics 1.

Corequisite: nil.

Classes: lec: 26hrs, lab/tut: 26hrs.

Course objectives: To develop an understanding of: the nature of soils as engineering materials; the common soil classification systems; the importance of water in the soil and the engineering effects of water movement; the factors controlling soil settlements.

Expected outcomes: Students should gain the ability: to predict the engineering behaviour of soils based on soil classification; to quantify the effects of water in the soil; to predict soil settlement.

Assessment: one 3hr exam covering the whole syllabus at the end of semester. Satisfactory laboratory performance is also a requirement. Credit will be given for laboratory and tutorial submissions, as indicated at the commencement of the course.

Syllabus summary: Soil structure and engineering classification of soils. Compaction. Effective stress concept. Analysis of steady state seepage. One-dimensional consolidation theory. Stresses beneath loaded areas. Analysis of soil settlement.

Textbook

Soil Mechanics Data Sheets (School of Civil and Mining Engineering, University of Sydney)

Reference books

Scott *An Introduction to Soil Mechanics* (Applied Science)
or
Lambe and Whitman *Soil Mechanics* (Wiley)

Library classification: 624.151.

U3.245 Soil Mechanics B — 4 units

Senior core course for the degree in Civil Engineering.

Mutually exclusive with: U3.240 Soil Mechanics, U4.241 Soil Engineering.

Prerequisites: U2.210 Introduction to Materials, U2.221 Structural Mechanics, U1.000 Mathematics 1.

Corequisites: U3.244 Soil Mechanics A.

Classes: lec: 26hrs, lab/tut: 26hrs.

Course objectives: To develop an understanding of the concept of soil strength, and how this can be used in estimating the stability of soil constructions.

Expected outcomes: Students should gain an understanding of: the strength of soil masses and the factors that control the strength; the basic theories of bearing capacity and slope stability. In particular, students should gain the ability: to interpret soil strength tests; to predict the strength and stability of soil.

Assessment: one 3hr exam covering the whole syllabus at the end of semester. Satisfactory laboratory performance is also a requirement. Credit will be given for laboratory and tutorial submissions, as indicated at the commencement of the course.

Syllabus summary: Shear strength of soils. Earth pressure theories. Elementary bearing capacity theory. Slope stability analysis.

Textbook
So/7 *Mechanics Data Sheets* (School of Civil and Mining Engineering, University of Sydney)

Reference books
Scott *An Introduction to Soil Mechanics* (Applied Science)
or
Lambe and Whitman *Soil Mechanics* (Wiley)

Library classification: 624.151

U3.250 Surveying 1 — 4 units

Seniorcorecourse'for the degree in Civil Engineering.

Mutually exclusive with: U3.250 Surveying 1.

Prerequisites: U1.000 Mathematics 1.

Classes: lec: 32hrs, field work/tutorials: 20hrs.

Course objectives: To introduce students to basic distance, angle, and height measurement; to give students sufficient knowledge to achieve basic computational, analytical, and interpretational skills based on the measurements; to introduce students to basic electronic field equipment; to give students an insight into future trends in measurement technologies.

Expected outcomes: Students should gain ability to: undertake basic angle and distance measurement; undertake appropriate calculations and checks involving observed data; understand errors associated with measurement; select the correct measurement alternatives for simple measurement problems.

Assessment: fieldwork, reports, tutorials, and one 3hr exam at the end of the course.

Syllabus summary: Introduction to engineering surveying, distance measurement (steel band), angle measurement (theodolite), levelling, measurement errors, traversing, topographic surveys, optical distance measurement, error analysis, electronic surveying equipment, future surveying technologies.

Textbook
Fryer and Elfick *Elementary Surveying* 7th edn (Harper & Row)
or
Uren and Price *Surveying for Engineers* 2nd edn (Macmillan)

Library classification: 526.9.

U3.262 Fluids 2 — 4 units

Senior core course for the degree in Civil Engineering.

Mutually exclusive with: U4.262 Fluids 2.

Prerequisites: U2.261 Fluids 1.

Corequisites: nil.

Classes: lec: 26hrs, prac work/tut: 26hrs.

Course objectives: To develop an understanding of: theory and practical aspects of analysis of fluid behaviour in pipes and open channels, and of fluid machines. •

Expected outcomes: Students should gain the ability: to calculate heads and flows through pipe and open channel systems for steady and for unsteady conditions; and to determine machine requirements for various systems.

Assessment: one 3hr exam covering the whole syllabus at the end of semester. Credit will be given for practical work and tutorial submissions, as indicated at the commencement of the course.

Syllabus summary: Open channel flow. Pipe networks. Floating vessels. Hydro and aero-foils. Pumps and turbines. Compressible flow. Unsteady flows.

Textbooks
As for U2.261 Fluids 1

U3.271 Transportation Engineering and Planning — 2 units

Senior core course for the degree in Civil Engineering and in Project Engineering and Management (Civil). *Senior elective course* for the degree in Mechanical Engineering.

Prerequisite: nil.

Classes: lec: 26hrs.

Assessment: one 2hr exam and assignments.

Syllabus summary: Elementary transport economics: capital and operating costs; capital recovery. Mode characteristics. Costs and benefits of road improvements. Parking. Functions of railway track components and track properties. Modern rail classification yards. Airport general layout, runway and terminal design. Design of ports and port structures in relation to ships and cargo handling. Containerisation and container facilities. Data collection and presentation for transport planning; gravity models. Environmental factors. Geometric design of roads. Road pavement design: flexible and rigid.

Reference books
Hay *Introduction to Transportation Engineering* (Wiley)
Wright and Ashford *Transportation Engineering—Planning and Design* (Wiley, 1989)

Library classification: 385, 625.

U3.275 Engineering Communications 2 — 2 units

Senior core course for the degree in Civil Engineering.

Prerequisites: U2.272 Engineering Communications 1.

Corequisites: nil.

Classes: discussion/oral presentation: 26hrs.

Course objectives: To develop effective written and oral communication, and advocacy and interpersonal skills.

Expected outcomes: Ability to argue in writing and orally for (or against) topics of general, technical and/or social significance to large peer groups.

Assessment: based on two written reports and two oral presentations. Extra credit for one or both oral presentations may be given for verifiable public speaking activities with students' section of the Institution of Engineers, Australia, or the University of Sydney Debating Society, or equivalent organisation. Students are encouraged to engage in these activities.

Syllabus summary: Written reports and oral presentations on two topics of general, technical and/ or social significance. Oral presentation in a formal meeting or debating format. Each student is assigned to a group of four which argues both for and against a motion (topic) on two separate occasions each of 30 minutes' duration.

Reading material
According to chosen topic in consultation with academic staff

U3.284 Risk and Reliability Analysis 2 units

Senior core course for the degrees in Civil Engineering.

Mutually exclusive with: U3.281 Applied Statistics.

Prerequisites: U1.000 Mathematics 1, U2.221 Structural Mechanics, U2.290 Structural Design.

Corequisites: nil.

Classes: lec: 16hrs; tut: 12hrs.

Assessment: one 3hr exam plus assignments.

Course objectives: To provide a basic understanding of the principles of statistical decision theory, probabilistic risk assessment and structural reliability analysis; to develop proficiency in basic methods of risk and reliability analysis, including event trees, fault trees and decision trees and First Order Second Moment methods of structural reliability analysis; to develop an understanding of the principles of reliability-based design.

Expected outcomes: Proficiency in basic methods of risk and reliability analysis and interpretation of results.

Syllabus summary: Review of basic statistical methods of analysis (including significance testing, and linear regression); probability concepts, Bayes' Theorem, statistical decision theory, preposterior analysis; probability measures, types of uncertainty, principles of probabiKstic risk assessment, event trees, risk acceptance criteria; structural safety and reliability; First Order Second Moment methods of reliability analysis, the Safety Index, the design point, reliability-based design, simulation methods, system effects.

Reference books
Blockley (ed.) *Engineering Safety* (McGraw-Hill, 1992)
Madsen, Krenk and Lind *Methods of Structural Safety* (Prentice-Hall, 1986)
Melchers *Structural Reliability Analysis and Prediction* (Ellis Horwood/Wiley, 1987)

Library classification: 624.171

U3.420 Thermo-fluid Engineering 10 units

Senior core course for the degree in Mechanical Engineering.

Mutually exclusive with: U3.421 Thermodynamics.

Prerequisites: U2.410 Mechanical Engineering 2 and U2.000 Mathematics 2.

Classes: (3hrs/wk of lec and tut) in Sem 1; (5hrs/wk) in Sem 2; plus lab work.

Assessment: one 2hr exam at end of each component of the course.

Syllabus summary:
Thermodynamics — Availability, statistical entropy and second law of thermodynamics, generalised charts for properties, engine characteristics, gas mixtures, psychrometry, air conditioning and refrigeration, thermodynamics of combustion.

Heat transfer — Plane and cylindrical conduction convection, thermal networks, fins, heat exchangers, LMTD and NTU methods, unsteady conduction, forced and natural convection heat transfer coefficients, dimensional analysis, radiation introduction.

Fluid mechanics
Navier-Stokes equations — derivation, significance and fundamental importance.
Closed solutions — Poiseuille flow, Couette flow, lubrication theory.
Potential flow — stream function and potentials, Laplace's Equation, some basic building blocks. Flow around a cylinder, lift, drag, etc.
Boundary layers — derivation of equations, solution procedures for Laminar case, introduce the concept of turbulence, transition.
Turbulence—concept, properties of turbulence, eddy viscosity, more advanced approaches.
Turbulent flow near a wall — law of the wall, pipe flow velocity profiles, turbulent jet entrainment.
Channel flow — flow in a channel, weir, hydraulic jump, etc.
Compressible flow — sound waves, normal shock, nozzle flow, shock tube.

Textbooks
Cengel and Boles *Thermodynamics, an Engineering Approach* (McGraw-Hill)
Incropera and *DeWMFundamentab of Heat and Mass Transfer* (Wiley)
Sabersky, Acosta and Hauptmann *Fluid Flow — a First Course in Fluid Mechanics* (Macmillan)

U3.421 Thermodynamics 4 units

Senior core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U3.420 Thermo-fluid Engineering.

Prerequisites: U2.411 Introductory Thermodynamics and U2.000 Mathematics 2.

Classes: (3hrs/wk of lec and tut) in Sem 1; plus lab work.

Assessment: one 2hr exam at end of course.

Syllabus summary: Thermodynamics—Availability, statistical entropy and second law of thermodynamics, generalised charts for properties, engine characteristics, gas mixtures, psychrometry, air conditioning and refrigeration, thermodynamics of combustion.

Textbook
Cengel and Boles *Thermodynamics, an Engineering Approach* (McGraw-Hill)

U3.430 Mechanics and Properties of Solids 2 8 units

Senior core course for the degree in Mechanical Engineering.

Mutually exclusive with: U3.431 Mechanical Properties of Materials, U3.730 Aircraft Structures 1.

Prerequisites: U2.000 Mathematics 2 and either U2.700 Mechanics and Properties of Solids 1 or U2.417 Introductory Mechanics and Materials.

Classes: 4 lec/wk in Sem 1 and associated tut and lab classes.

Assessment: one 2hr exam at end of course with associated tutorials.

Syllabus summary: Concepts: stress and strain, linear elasticity. Thermal strains. Plastic deformation. Examples in axisymmetric systems: thin shells. Thick walled cylinders, interference fits, auto-frettage. Rotating discs. Circular plates. Introduction to energy methods and computer methods for stress analysis.

The structure-property relationship of metals, ceramics, glasses, polymers and composite materials. The failure of materials by fracture, fatigue, creep, impact and stress corrosion cracking.

Textbooks
Materials (Scientific American Book, 1967)
Gordon *The New Science of Strong Materials* (Pelican Original, 1968)

Reference books
Harris *Engineering Composite Materials* (The Institute of Metals, 1986)
Kinloch and Young *Fracture Behaviour of Polymers* (Applied Science Publishers, 1983)
Davidge *Mechanical Behaviour of Ceramics* (C.U.P., 1979)
Ewalds and Wanhill *Fracture Mechanics* (Edward Arnold, 1985)
Kelly *Strong Solids* (O.U.P., 1973)

Library classification: 620,624,666-679

U3.431 Mechanical Properties of Materials 4 units

Senior core course for the degree in Aeronautical Engineering and Mechanical Engineering (Mechatronics).

Mutually exclusive with: U3.430 Mechanics and Properties of Solids 2.

Prerequisites: U2.000 Mathematics 2 and either U2.700 Mechanics and Properties of Solids 2 or U2.417 Introductory Mechanics and Materials.

Classes: 2 lec/wk in Sem 1 and associated tut and lab classes.

Assessment: one 2hr exam at end of course with associated tutorials.

Syllabus summary: The structure-property relationship of metals, ceramics, glasses, polymers and composite materials. The failure of materials by fracture, fatigue, creep, impact and stress corrosion cracking.

Textbooks
Materials (Scientific American Book, 1967)
Gordon *The New Science of Strong Materials* (Pelican Original, 1968)

Reference books
Harris *Engineering Composite Materials* (The Institute of Metals, 1986)
Kinloch and Young *Fracture Behaviour of Polymers* (Applied Science Publishers, 1983)
Davidge *Mechanical Behaviour of Ceramics* (C.U.P., 1979)
Ewalds and Wanhill *Fracture Mecliancs* (Edward Arnold, 1985)
Kelly *Strong Solids* (Q.U.P., 1973)

Library classification: 620, 624,666-679

U3.440 Mechanical Design 2 8 units

Senior core course for the degrees in Mechanical and Mechatronic Engineering.

Prerequisite: U2.440 Mechanical Design 1 or U2.441 Mechanical Design 1A.

Classes: (2 lec and two 3hr drawing office sessions)/wk in Sem 1.

Assessment: assignments and quizzes.

Syllabus summary: In this course selected components and whole machines are examined. Their uses, functions and evolution are considered. A synthesis of modelling, stress and deflection analysis, together with practical considerations, is emphasised in arriving at design solutions. Moderate scale realistic problems areultimatelyintroducedrequiringinventivesolutions and comprising several detail designs and assemblies selection. The material covered includes: welded and bolted joints, power screws, shafts, flexible mechanical elements and other torque transmission components, brakes and clutches, rolling element and hydrodynamic bearing, springs, involute and cycloidal gears and scheduling. CAD (computer aided drafting and designing) is used in several problems, highlighting areas of advantage. Application to programming in CAD is introduced.

The importance of management in design is highlighted where relevant, i.e. relationship with drafting and manufacturing personnel, effective communication with suppliers and subcontractors, planning and scheduling a project. Aspects of acceptable design for the client. Product reliability and quality.

Textbook
Shigley *Mechanical Engineering Design* (McGraw-Hill)

Reference books
Orlov *Fundamentals of Machine Design* (M.I.R.)
Deutschman *et al. Machine Design* (Collier-Macmillan)
Groover and Zimmers *CAD/CAM Computer Aided Design and Manufacturing* (Prentice-Hall)
Reference may also be made to other texts during lectures

Library classification: 621.815,001.6443

U3.450 System Dynamics and Control 8 units

Senior core course for the degrees in Mechanical and Mechatronic Engineering.

Mutually exclusive with: U3.470 Mechatronics 2 and U3.750 Mechanics of Flight 1.

Prerequisites: U2.410 Mechanical Engineering 2 or (U2.412 Engineering Mechanics 2 and U2.417 Introductory Mechanics and Materials).

Classes: (2 lec and 2 tut/wk) throughout the year.

Syllabus summary:
(a) Review and extensions of planar mechanisms. Synthesis of linkages, curve matching; graphical and analytical methods. Computer tools in mechanism analysis and design. Machine kinetics; static forces; linkage force analysis; application of equivalent masses.
(b) Mechanical, electrical, pneumatic and hydraulic systems. Modelling and linearisation of systems. Laplace transform and Fourier methods of solution. Transfer functions. State space representation for dynamic systems. Linear system analysis in frequency and time domain. Computer simulations of systems; matrix formulation; modal analysis. Introduction to distributed systems, shaft whirl, vibrations of beams and simple structures.
(c) Modelling and linearisation. Feedback control systems. Basic control actions. Performance and stability criteria. Linear system design and analysis via root locus. Bode diagrams and Nyquist methods. Computer simulation.

Reference books
Mabie and Reinholtz *Mechanisms and Dynamics of Machinery* 4th edn (Wiley, 1987)
Shigley and Vicker *Theory of Machines and Mechanisms* International edn (McGraw-Hill, 1981)
Rao *Mechanical Vibrations* (Addison-Wesley, 1986)
Ogata *System Dynamics* 2nd edn (Prentice-Hall, 1992)

U3.460 Manufacturing Engineering and Management 10 units

Senior core course for the degree in Mechanical Engineering and Mechanical Engineering (Mecha tronics).

Prerequisite: U2.410 Mechanical Engineering I, or U2.410 and U2.417.

Classes: lec: 3hrs/wk in Sem 1; 3hrs/wk in Sem 2; plus an average of 2hrs/wk throughout the year for tut, lab and works visits, the latter mainly in Sem 2.

Assessment: to be advised at beginning of course.

Syllabus summary:
Manufacturing processes — several manufacturing processes will be considered'from the points of view of fundamentals of the process, limitations on the productionrates and runs and product quality, general purpose and specialised machinery, automation, numerical control and computer-aided manufacture. Processes considered include machining, casting, powder metallurgy, metal working, welding, cutting, polymer processing, bending and composite manufacture.

Manufacturing systems—economics of automation, flexible manufacturing, Justin Time, group technology, materials requirements planning, quality control, introduction of new technology, human factors, plant layout.

Industrial hazards — (a) Recognition of hazards presented by chemical and physical agents: nature, mode of entry and effects of toxic substances; adverse effects of noise, work physiology and thermal stress, (b) Evaluation of hazards: survey design, hygienic standards and interpretation of results, (c) Principles of hazard control: industrial ventilation, personal protective equipment, safety organisation and the prevention of industrial accidents, stress in the workplace.

Industrial organisation and management — Micro-economics, the Australian business environment, the role of government, accounting systems and procedures, the accounting cycle, financial statements, internal performance, financial structures, intellectual property, contract law, legal obligations of business, capital budgeting and investment analysis, introduction to contract administration. Social responsibility in engineering, including professional responsibility and liability, social and environmental issues and ethics of engineering practice.

Textbooks
Samson *Management for Engineers* (Longmans, 1990)
Clark *Student Economics Brief* (Fairfax)

Reference books
Stanley How *to Read and Understand a Balance Sheet* (Schwartz & Wilkinson, Melbourne)
The Small Business Handbook (Small Business Development Corporation, Victoria)
Eyre *Mastering Basic Management* (Macmillan)
Stoner, Collins, Vetton *Management in Australia* (Prentice-Hall)
Blank and Tarquin *Engineering Economy* (McGraw-Hill)

U3.474 Electrical Machines and Drives 4 units

Senior core course for the degree in Mechanical Engineering (Mechatronics).

Mutually exclusive with: U3.522 Power Electronics and Drives.

Prerequisites: U2.471 Introductory Mechatronics and U2.504 Electrical and Electronic Engineering.

Classes: (2 lec and one 3hr lab/tut)/wk in Sem 2.

Assessment: to be advised by EE.

Syllabus summary: Applications and historical context, principles of electronic control of power flow, power semiconductors, phase-controlled rectifiers and derivatives, AC-DC phase control, DC-DC converters.

Electromagnetic transducers, rotating magnetic field principles, synchronous machines, induction machines, DC and AC servo motors, electronically-controlled machine operation.

Textbook
To be advised by EE

U3.476 Industrial Electronics 10 units

Senior core course for the degree in Mechatronic Engineering.

Mutually exclusive with: U3.540 Electronics 1, U3.560 Digital Systems 1.

Prerequisites: U2.471 Introductory Mechatronics and U2.504 Electrical and Electronic Engineering.

Classes: (3 lec and 1 x 3hr lab/tut)/ wk in Sem 2 (Electronics); (2 lec and 1 x 2hr lab/tut)/wk in Sem 1 (Digital Systems).

Assessment: 1 x 3hr exam at end of Sem 1 and Sem 2, plus Lab reports and mid-semester tests.

Syllabus summary: BJT and FET amplifiers, coupling, stability, multi-stage amplifiers, FETs as digital and analogue switches. Differential amplifiers, current source, active load. Power amplifiers: class A, B, AB, C, D. Power MOSFETs. Operational amplifiers: practical examples of design of linear and non-linear circuits. Feedback in amplifiers — BJT, FET and op-amp. Frequency response, stability and compensation. High frequency and low noise amplifiers, power op-amps.

Filters — passive RC and LC filters, design of high-order active filters, time and phase circuits.

Oscillators — A/D and D/A converters; sample and holds; applications.

Transducers — principles of operation, signal conditioning and interfacing for measurement of position, velocity, pressure, strain, force and temperature.

Optoelectronics — LED and displays, photodiode, phototransistor, optocouplers and isolation.

Electromagnetic noise — EMI control, guarding, earthing.

Power supplies—linear unregulated and regulated, thermal design and protection, switch-mode power supplies.

Technologies for the development of application-specific integrated circuits.

Programmable logic devices: computer architecture, abstraction levels for the description of the design, high-level description languages, design of a bus-structured computer, design of a computer with a serial internal architecture, implementation with programmable logic devices, introduction to design automation.

Real-time computer systems — event processing, priority interrupts, classificationinto data-acquisition, supervisory, direct-digital-control and hierarchical systems, process control examples, hardware, software, reliability and fault tolerance, micro-processor-based event recorder.

Advanced microprocessors — architecture of 16-bit and 32-bit microprocessors, bit-slice micro-processors, support chips, multiprocessing, reduced instruction set architectures, digital signal processors.

Microcontrollers — hardware and software, architecture of 8-bit and 16-bit microcontrollers. Assembly language programming, interfacing and expansion.

Textbooks
To be advised by Electrical Engineering

U3.480 Mechanical Engineering Laboratory 4 units

Senior core course for the degree in Mechanical Engineering.

Mutually exclusive with: U3.485 Mechanical Engineering Laboratory A.

Prerequisite: 36 units of Intermediate courses.

Corequisites: U3.420 Thermo-fluid Engineering, U3.430 Mechanics and Properties of Solids 2 and U3.450 Mechanical Systems.

Classes: approx. twenty 3hr lab sessions over the year.

Syllabus summary: A range of experimental investigations to complement the Senior Year courses. The course includes training in written communication and report presentation. Several detailed reports need to be prepared.

U3.485 Mechanical Engineering Laboratory A 4 units

Senior core course for the degree in Mechanical Engineering (Mechatronics).

Mutually exclusive with: U3.480 Mechanical Engineering Laboratory.

Prerequisite: 36 units of Intermediate courses.

Corequisites: U3.431 Mechanical Properties of Materials and U3.450 Systems Dynamics and Control and U3.476 Industrial Electronics.

Classes: approx. twenty 3hr lab sessions in Sem 2.

Syllabus summary: As for U3.480 Mechanical Engineering Laboratory.

U3.505 Biomedical Engineering 4 units

Senior elective course.

Corequisite: Either U3.500 Industrial Electronics or U3.540 Electronics 1.

Classes: (2 lec and one 3hr tut or lab)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1.

Syllabus summary: Physiology and anatomy of respiratory, cardiovascular, central nervous and musculo-skeletal systems. Cell biology — membrane physiology and biochemistry, glucose metabolism. Operational amplifiers, active filters, electrodes. Electrocardiogram, vector cardiogram, defibrillation, pacemakers. Electrical safety and hazards of biomedical instruments. Blood pressuremeasurement and transducers. Respiratory system, flow and pressure measurements. Electroencephalogram, electromyogram, electroneurogram. Diagnostic imaging systems — principles of CT scanning, ultrasonic, nuclear and magnetic resonance imaging.

U3.511 Circuit Theory 4 units

Senior core course for thedegree in ElectricalEngineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisites: U2.510 Electrical Engineering 2 and U2.000 Mathematics 2 or U2.001 Mathematics 2EE.

Corequisite: U3.512 Signals and Systems.

Classes: (2 lec and one 2hr tut)/wk in Sem 1.

Syllabus summary: Matrices of mesh impedence, node admittance, indefinite admittance, multiterminal equivalent networks.

Complex frequency models: R, L, C controlled sources, ideal op-amps, ideal transformers, ideal gyrators, mutual inductance, parasitics of 'practical' transformers. Stability.

Two-port parameters and characterising matrices; multiterminal and multiport networks; network polynomials.

Problem solution techniques, normalising and scaling. Relations among total solution, initial-value response, initiated-forced response, transients, long-term forced response.

Steady-state frequency response, dimensionless parameters, response from pole-zero configuration, templates of long-magnitude and phase.

Single-sided Laplace transform, Laplace transforms of delays, repetitions, convolutions; models for circuit elements.

Power, energy; lossless elements and networks. Foster and Cauer realisation of 1-ports; Hurwitz polynomials; overview of lossless multiports and active/passive filter design.

Reference books

Brief notes will be issued. No textbook will be employed. Numerous references will be given to a wide range of books

U3.512 Signals and Systems 5 units

Senior core course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U2.510 Electrical Engineering 2; and U2.000 Mathematics 2 or U2.001 Mathematics 2EE.

Corequisite: U3.511 Circuit Theory.

Classes: (2.5 lec and 2.5hr lab/tut)/wk in Sem 1.

Syllabus summary:

Part A—Signals: classification, basic signals and their properties, representation of signals using orthogonal functions. Fourier series: definition, finding the coefficient and basic operation, effects of symmetry. Fourier transform: definition of Fourier integral, properties of Fourier transform, examples! Linear systems: modellingof electrical system, time-invariant, time-varying, causal and non-causal systems, impulse response and frequency response of the linear time-invariant system, convolution theorem, time convolution and frequency convolution, properties of convolution, cross-correlation and linear systems, power signals and linear systems. Filters: types of filters, ideal filters and causality, specifications of filters, phase response and group delay. Linear modulation: type of modulation, amplitude (DSB-LC and DSB-SC), frequency and phase modulation, frequency domain analysis of AM modulation, power of a modulated signal. Discrete-time systems: Z-transform — region of convergence, properties of Z-transform, inverting Z-transform, frequency response of discrete time system, convolution of discrete system. Discrete transforms: discrete-time Fourier transform —its properties, finite length, sequency and frequency resolution, discrete Fourier transform—decimation-in-time, decimation-in-frequency, spectral estimation, spectral leakage and windowing, digital filtering.

Part B — stochastic systems — Introduction to probability and random variables: probabilities of random events, axioms, joint and conditional probability, statistical independence. Cumulative distribution function, probability density function, statistical averages, standard distributions (uniform, binomial, Poisson, Gaussian), transformations or random variables, joint and conditional density functions, correlation between random variables. Power and energy spectral sensitivities. Random processes — stationary and ergodic processes, autocorrelation and power spectra, cross correlation. Statistical representation of random noise.

Introduction to sampled data systems and ideal reconstruction, spectrum of sampled signal, aliasing. Sampled data systems—linear, time-invariant, causal, impulse response, finite difference equations, FIR and IIR systems.

U3.521 Energy Systems and the Environment 4 units

Senior core course lor the degree in Electrical Engineering. *Senior elective course* for ISE stream.

Prerequisite: U2.510 Electrical Engineering 2.

Classes: (2 lec and one 2hr lab/tut)/wk in Sem 2.

Syllabus summary: Conventional and alternative renewable/non-renewable energy sources, fossil fuels, energy conversion to electricity, co-generation, environmental aspects of generation and conversion. Objectives of power system management.

Power flow in a network, power transformers, electricity transmission and distribution including environmental aspects. Harmonics, transients, suburban substations, introduction to system faults and protection.

End-use conversion efficiency, demand management, energy tariffs.

U3.522 Power Electronics and Drives 4 units

Senior core course for the degree in Electrical Engineering. *Senior elective course* for ISE stream

Prerequisite: U2.510 Electrical Engineering 2.

Classes: (2 lec and one 2hr lab/tut)/wk in Sem 2.

Syllabus summary: Applications and historical context, principles of electronic control of power flow, power semiconductors, phase controlled rectifiers and derivatives, AC-AC phase control, DC-DC converters, DC-AC converters.

Electromagnetic transducers, rotating magnetic field principles, synchronous machines, induction machines, electronically controlled machine operation.

U3.523 Topics in Electrical Engineering Design 3 units

Senior elective course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U2.510 Electrical Engineering 2.

Corequisite: nil.

Classes: (2 lec and one 1hr tut)/wk in Sem 2.

Syllabus summary: Illumination concepts, photometric units, the lumen method, lighting design, ferro-magnetics, ferrites, magnetic information storage, transformer design. Thermal design, heat loss mechanisms, finned structures. Protection design, the electricarcmckcmtmterruption,fuses,circuitbreakers.

U3.530 Control 1 4 units

Senior core course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Mutually exclusive with: U3.450 System Dynamics and Control.

Prerequisite: U2.510 Electrical Engineering 2.

Corequisites: U3.511 Circuit Theory, U3.512 Signals and Systems.

Classes: (2 lec and 2hrs of lab or tut work)/wk in Sem 2.

Assessment: one 2hr exam at end of sem, plus assessment of lab work.

Syllabus summary: History and review of control.

Modelling of physical processes, state variables and differential equations. Dynamic response, review of Laplace transform, transfer functions and block diagrams, poles and zeros, design specifications in the time domain.

Basic feedbackprinciples, closed loop systems, effect of feedback on sensitivity and disturbance rejection, steady state accuracy, stability, the Routh criterion, basic proportional, integral and derivative control.

Design using the root locus, rules for sketching root locus, lead and lag compensators, analogue and digital implementation of controllers.

Frequency response design methods, review of Bode diagrams, designspecifications, Nyquiststability criterion, gain and phase margins, closed loop frequency response, compensator design.

Study of some design applications.

An introduction to state space, equations for single input single-output systems, relation to transfer functions, eigenvalues, brief description of state variable feedback.

U3.540 Electronics 1 10 units

Senior core course for thedegree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Mutually exclusive with: U3.476 Industrial Electronics.

Prerequisite: U2.510 Electrical Engineering 2.

Corequisites: U3.511 Circuit Theory, U3.512 Signals and Systems.

Classes: (2 lec and one 3hr lab class or tut)/wk throughout the year.

Assessment: one 3hr exam at end of each sem plus lab report marks.

Syllabus summary: Revision of devices, diode, BJT, FET, MOSFET circuits and op. amps, measuring instruments and techniques. Advanced device models. Differential pair, Darlington pair, cascode, multitransistor amps. Bootstrapping. IC bias. Frequency response, gain-bandwidth product. Feedback, effect on input and output impedances and gain, stability, compensation, gain and phase margins. Oscillators sinusoidal, phase-shift, Wien bridge, Colpitis, multivibrators, crystal oscillators. Power supplies/power electronics—linear, switched mode, protection. Tuned amplifiers, simple op. amp. filters. Power amplifiers, class A,B,AB,C, protection, output driver power dissipation. SPICE models. IC layout and fabrication, analogue IC design HF amplifier and oscillator design, s-parameters, striplines.

U3.551 Engineering Electromagnetics 4 units

Senior core course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U2.510 Electrical Engineering 2.

Corequisite: U3.511 Circuit Theory.

Classes: (2 lec and 2 hi lab/tut)/wk in Sem 1.

Assessment: Tutorials, quizzes and assignments: 25%, end of semester exam: 75%.

Syllabus summary: Transmission lines (in which circuit theory is used to derive EM wave phenomena in distributed circuits) — revision of circuit elements and static fields; distributed circuits, characteristic impedance, waves, reflections, VSWR, impedance transformation, and matching; use of the Smith chart.

Fields and waves (in which Maxwell's equations are used to derive EM wave phenomena in general and the interaction of EM waves with various materials such as conductors, dielectrics, etc.) — revision of vector algebra, static fields and boundary problems; Maxwell's equations, plane EM waves in various media; reflections of waves at boundaries, electromagnetic comparability, atmospheric wave propagation; waveguides and components (RF and optical); antennas and arrays, numerical methods.

Textbook

Narayana Rao *Elements of Engineering Electromagnetics* (Prentice Hall)

U3.552 Communications 1A 6 units

Senior core course for thedegree inElectricalEngineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U2.510 Electrical Engineering 2.

Corequisites: U3.511 Circuit Theory, U3.512 Signals and Systems, U3.540 Electronics 1, U3.551 Engineering Electromagnetics.

Classes: (3 lec and 3 hr lab/tut)/wk in Sem 2.

Assessment: 3 lab /assignment reports (30%) and one 3hr exam at the end of Sem 2 (70%).

Syllabus summary: Components of communication systems — basic properties of signals and communication channels; analog modulation — amplitude and frequency modulation principles and common applications; baseband transmission of binary digital signals, equalisation, transmission coding and introductory error control coding; introduction to modulated carrier data transmission; digital transmission of analog signals — pulse code modulation and delta modulation; performance of modulation schemes in noise; information theory.

Textbooks

Gibson *Principles of Digital Analog Communications* (Maxwell Macmillan, 1990)

Stremler *Introduction to Communication Systems* (Addison Wesley, 1990)

Reference books

Lathi *Modern Digital and Analog Communication Systems* (Holt-Saunders International, 1983)

Traub, Schilling and Lathi *Principles of Communication Systems* (McGraw-Hill, 1986)

Skier *Introduction to Digital Communications* (Prentice-Hall, 1987)

U3.553 Digital Signal Processing 4 units

Senior core course for the degree in Electrical Engineering (Information Systems Engineering) and *Senior elective course* for the degree in Electrical Engineering.

Prerequisite: U2.510 Electrical Engineering 2.

Corequisites: U3.512 Signals and Systems, U3.552 Communications 1A

Classes: (2 lec and 2hr lab/tut)/wk in Sem 2.

Assessment: 3 lab/assignment reports (30%) and one 2.5hr exam at the end of Sem 2 (70%).

Syllabus summary: Introductory revision: discrete-time signals and z-transform. Fourier analysis of discrete-time signals. DFT, FFT, FIR and IIR digital filter design. Digital signal processing algorithms, and real-time implementations on DSP integrated circuits. Time, frequency and statistical properties of speech. 2-D images and video signals. Signal processing techniques for bandwidth compression, waveform coding, DCT, vector quantisation methods. Applications and implementation of DSP techniques.

U3.560 Digital Systems 1 4 units

Senior core course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Mutually exclusive with: U3.476 Industrial Electronics.

Prerequisite: U2.510 Electrical Engineering 2.

Corequisite: nil.

Classes: (2 lec and 2hrs of lab or tut)/wk in Sem 1.

Assessment: lab reports and one 2hr exam at end of Sem 1.

Syllabus summary: Technologies for the development of application specific integrated circuits.

Programmable logic devices: architecture, characteristics, applications, development tools, survey of devices.

Computer design: computer architecture, abstraction levels for the description of the design, high-level description languages, design of a bus-structured computer, design of a computer with a serial internal architecture, implementation with programmable logic devices, introduction to design automation.

Real-time computer systems: event processing, priority interrupts, classification into data-acquisition, supervisory, direct-digital-control and hierarchical systems, process control examples, hardware, software, reliability and fault tolerance, micro-processor-based event recorder.

Advanced microprocessors: architecture of 16-bit and 32-bit microprocessors, bit-slice microprocessors, support chips, multiprocessing, reduced instruction set architecture, digital signal processors.

High-speed arithmetic: high-speed semiconductor devices, arithmetic pipe-lines, parallel structures, introduction to residue arithmetic.

U3.561 Computer Architecture 3 units

Senior core course for the degreeinElectrical Engineering (Information Systems Engineering) and *Senior elective course* for the degree in Electrical Engineering.

Mutually exclusive with: U2.043 Computer Science 2B.

Prerequisite: U2.510 Electrical Engineering 2.

Classes: (2 lec and one 1hr tut)/wk in Sem 2.

Assessment: assignments: 20%; and one 2hr exam (80%) at end of the course.

Syllabus summary: Fundamentals of computer design — the job of a computer designer; quantitative principles of computer design; performance; cost. Instruction set design — classifying instruction set architectures; memory addressing; operant storage in memory; operations in the instruction set; type and size of operants; high level languages and compilers; instruction set measurements. Basic processor implementation techniques — processor data pass; basic steps of execution; hardwired control; microprogrammed control; interrupts and other entanglements. Pipelining — the basic pipeline for DLX; making the pipeline work; pipeline hazards control; other problems with implementation of pipelining; pipelining for multicycle operations. Memory-hierarchy design — general principle of memory hierarchy; components of memory hierarchy; protection of virtual memory; optimisations based on program behaviour. Input/output — system performance prediction; I/O performance measures; types of I/O devices; buses; interfacing; I/O system design. Future directions.

U3.562 Software Engineering 3 units

Senior core course for the degree inElectrical Engineering (Information Systems Engineering). *Senior elective course* for ISE stream.

Prerequisite: U2.510 Electrical Engineering 2.

NOTE: Also Senior elective course for the degree in Mechatronics Engineering.

Prerequisites: U2.510 Electrical Engineering 2 or (U2.504 Electrical and Electronics Engineering and U2.470 Introductory Mechatronics).

Classes: (1 lec and one 2hr tut/lab)/wk in Sem 2.

Assessment: one 2hr exam at the end of the course plus assignment(s).

Syllabus summary: Concept exploration and requirements specification; software design process; program readability; UNIX system and tools; C language and structured programming; software testing and quality assurance; software maintenance and configuration management.

U3.563 C Programming 1 unit

Senior elective course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U1.040 Computer Science 1.

Classes: 1 lec/wk in Sem 1.

Assessment: one assignment and exam.

Syllabus summary: Arithmetical operations; control structures—conditionals and loops; functions; arrays; pointers; types — basic types; structures and unions; data structures; C preprocessor; command line processing; file processing.

References

J. Kay and B. Kummerfeld C *Programming in a UNIX Environment* (Addison-Wesley, 1989)

B.W.Kernighan and D.M. Richie *The C Programming Language* (Prentice-Hall, 1988)

B.W. Kernighan and R. Pike *The UNIX Programming Environment* (Prentice-Hall, 1984)

U3=570 Speech and Language Processing 4 units

Senior elective course for the degree in Electrical Engineering (Information Systems Engineering).

Classes: (2 lec and 1 tut)/wk in Sem 2.

Assessment: a major component of the assessment will be interdisciplinary group work on computing-based projects.

Syllabus summary: An interdisciplinary course on speech and language for students interested in language cognition, computational linguistics and speech technology.

Introductory lectures will cover the fundamentals in computing and signal representations (for Linguistics students) and phonetics and phonology (for Engineering students). (3 weeks)

Speech recognition principles—signal processing, segmentation, phonology and acoustic phonetics — and engineering implementations. (2 weeks)

Speech synthesis—segmental and supr asegmental aspects. Implementationofelectroruc formatsynthesis. (1 week)

Knowledge representation — a review of alternatives, and an intensive study of LOOM, used in the PENMAN language representation system. (1 week)

Grammar, syntax and parsing—unificationmodels, and practical techniques. (4 weeks)

Text generation — using the PENMAN system. (2 weeks)

U3.571 Management for Engineers 3 units

Senior elective course for the degree in Electrical Engineering and also the ISE stream.

Prerequisite: nil.

Corequisite: nil.

Classes: (2 lec and one 1hr tut)/wk in Sem 1.

Assessment: class participation and an exam at the end of Semi.

Syllabus summary: Engineers and management, micro-economics, macroeconomics, managerial decision analysis, management science models, behaviour of people in organisations, human resource management for engineers, strategic management, accounting and management, operations management, marketing for engineers, the legal environment of business, industrial relations.

Chemical Engineering — Core requirements for Senior and Senior Advanced students

Chemical plant inspection tour

For one week of a vacation period during the Senior Year, students visit a number of chemical plants outside the Sydney area. Tours in the past years have been to south-eastern Queensland, Tasmania, Victoria and the Hunter Valley.

Mid-semester week exercises

One or two one-week exercises are organised during the teaching periods of the Senior Year. Normal classes are suspended during these weeks.

Senior students spend a week working on selected plant problems on major chemical plants in the Sydney area. In these exercises the students work in small groups in cooperation with plant engineers and academic staff to investigate chemical engineering problems in a plant environment.

U3.610 Unit Operations 1 12 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: U2.610 Chemical Engineering 2.

Classes: (3 lec and 3hrs of tut)/wk throughout the year.

Assessment: tut assignments and exams at end of each sem.

Syllabus summary: The course is conducted in four main parts. Two parts will be taught and examined each semester.

(a) Mass transfer —
Distillation: history and introduction; VLE in ideal systems; VLE in non-ideal systems; Tx, Hx diagrams; theoretical single stage; thermodynamic efficiency; flash distillation; Ponchon-Savarit, reflux; nunimum reflux, total reflux; McCabe-Thiele; overall column efficiency; heat loads, cost, short cuts; flooding; batch distillation; Naphtali-Sandholm method, computer methods.

Extraction: immiscible systems; McCabe-Thiele construction; partially miscible; Janecke diagrams; application in processing industries; leaching.

Gas absorption: packed columns; volumetric MT coefficients; depth of packing; flooding.

(b) Heat transfer —
Forced convection: dimensionless groups, correlations.

Heat exchanger performance analysis and effectiveness — NTU approach. Design and raring problems.

Shell-and-tube heat exchangers: 1-2,2-4 and other contacting schemes. Thermal analysis. Heatrecovery. Estimation of heat transfer rates and pressure drop. Fouling. Practical considerations in design and selection.

Condensation heat transfer mechanisms: Nusselt analysis. Correlations. Design and practical applications.

Boiling heat transfer mechanisms: nucleate and flow boiling. Evaporators. Reboilers.

Radiation fundamentals: black and non-black radiation and absorption. Radiation interchange between black and grey bodies. Electrical analogues. Reradiating surfaces. Gas radiation. Furnace calculations.

(c) Particle mechanics —
Introduction to particulate systems, particle size and shape parameters, size distributions and statistical properties, test sieve analysis. Screening, particle-screen mechanics, efficiency of screening. Size reduction, energy requirements, classical laws, product size distribution. Motion of a particle in a fluid, terminal velocity, hindered settling. Phase separations, classification, elutriation, thickening, gas and liquid cyclones, centrifuging. Motion of fluids in particle beds, two phase flow in packings, filtration, batch and rotary filters, fluidisation concepts. Methods of sub-sieve sizingincluding sedimentation, photo-extinction, direct counting and gas absorption methods.

(d) Fluid mechanics —
Compressible flow: isothermal and adiabatic flow in pipes; choking. Non-Newtonian flow: classification of fluids; measurement of model parameters; application to laminar and turbulent flow. Mixing and agitation: dimensional analysis; power curves; mixing time. Two-phase flow: flow regimes; models of two-phase flow; calculations for two-phase flow in pipelines.

Textbooks.
Perry and Green *Chemical Engineers Handbook* 6th edn (McGraw-Hill, 1984)

for (a)
Furzer *Distillation for University Students* (published by the author, Department of Chemical Engineering, The University of Sydney)

for(b)
Hewitt, Shire and Bott *Process Heat Transfer* (CRC Press — Begel House, 1994)
Coulson, Richardson and Sinnott *Chemical Engineering, Vol.* 6 (Pergamon, 1985)

for (c)
Coulson and Richardson *Chemical Engineering, Vol. 2* (Pergamon, 1983)

for (d)
Coulson and Richardson *Chemical Engineering, Vol. 2* (Pergamon, 1990).

Reference books
for (a)
Kister *Distillation Design* (McGraw-Hill, 1990)

for (b)
Ozisik *Heat Transfer — A Basic Approach* (McGraw-Hill, 1985)

for (c)
Allen *Particle Size Measurement* (Chapman and Hall, 1981)
Svarovsky *Solid-Liquid Separation* (Butterworths, 1977)

for (d)
Levenspiel *Engineering Flow and Heat Excltange* (Plenum, 1986)
Wallis *One Dimensional Two-Phase Flow* (McGraw-Hill, 1969)

U3.621 Thermodynamics 8 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: nil.

Classes: (2 lec and one 1hr tut) / wk throughout the year.

Assessment: tut assignments and one 3hr exam at the end of each sem.

Syllabus summary:
First and Second Law applications; energy equations for steady flow and transients in process systems; thermochemistry; compressible flow; heat engines; refrigeration cycles, liquefaction processes; availability; isentropic and polytropic efficiencies for compressions and turbines.

Estimation of thermodynamic properties: (i) using simple fluid models (ideal gas, incompressible liquid), (ii) using charts and tables, (iii) using equations of state.

P-V-T relationships for real gases; relationship between thermodynamic properties; calculation of residual anthalpies, entropies, etc. based on a V-explicit equation of state; application of P-explicit equations of state in computer methods for property prediction.

Partial molal properties; fugacity. Solution properties; chemical potential; activity; solution models.

Equilibrium criteria. Phase equilibrium: cases involving fluids for which a single equation of state is valid; cases where separate liquid and gas models are used. Computer methods.

Chemical equilibrium: homogeneous and heterogeneous reactions.

Textbook
Smith and Van Ness *Introduction to Chemical Engineering* (McGraw-Hill, 1987)

U3.626 Reaction Engineering 1 4 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: nil.

Corequisite: U3.620 Thermodynamics.

Classes: 12 lec & 6 tut over 9 wks in Sem 2.

Assessment: tut assignments, project and one 3hr exam at end of course.

Syllabus summary: Reaction kinetics. **Homogeneous** reactions: development of a rate expression, elementary and non-elementary reaction, reaction mechanism, typical kinetics of important industrial reactions. **Chemical equilibrium:** estimation of equilibrium constants; equilibrium in multireaction systems. Rate data **analysis:** integral and differential method of data analysis, methodologies for rate data analysis and interpretation. Heterogeneous reactions: chemical kinetics, catalysis, rate expressions, rate controlling step. Role of mass transfer, internal and external diffusion, effectiveness factor; multiple products. Ideal reactors: ideal batch and continuous (tubular and stirred tank) reactions. Steady-state behaviour of ideal reactors. Non-isothermal reactors: energy balance, equilibrium effects; kinetics.

Textbook
Fogler *Elements of Chemical Reaction Engineering* (Prentice-Hall, 1990)

U3.631 Computations and Statistics 4 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: U2.000 Mathematics 2.

Corequisite: nil.

Classes: (6hrs of lec/tut)/wk for one sem.

Assessment: tut assignments and one 3hr exam.

Syllabus summary: Probability, random variables; distributions and functions. Statistical inference; hypothesis tests; estimation theory. Simple and multiple linear regression. Analysis of variance. Applications to the chemical process industries. Model formulation. Linear algebraic equations. Numerical differentiation and integration. Ordinary differential equations. Optimisation. Use of software packages.

Textbooks
Walpole and Myers *Probability and Statistics for Engineers and Scientists* 4th edn (Collier Macmillan)
Gerald and Wheatley *Applied Numerical Analysis* 3rd edn (Addison-Wesley, 1984)

Reference books
As indicated during classes

U3.645 Project Economics 4 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: U1.610 Chemical Engineering 1.

Classes: (4hrs of lec/tut)/wk in Sem 1.

Assessment: one 3hr exam at end of course plus assignments.

Syllabus summary: Project evaluation—cashflows, time value of money, economic criteria, depreciation and taxation, capital and operating costs, comparison of alternatives, risk and uncertainty, project finance.

Reference book
Helfert *Techniques of Financial Analysis* (Irwin, 1982)

U3.646 Transport Phenomena 4 units

Senior elective course for the degree in Chemical Engineering

Prerequisites: U2.610 Chemical Engineering 2; plus second year WAM > 60%.

Classes: (4hr lec/rut)/wk in Sem 2.

Assessment: assignments plus one 3hr exam at end of course.

Syllabus summary: Constitutive equations for momentum, heat and mass transfer. Momentum, heat and mass transfer analogies. The nature of diffusion; time-dependent diffusion. Diffusion and convection; forced convection, Stefan flow. Boundary-layer theory; boundary-layer development. Dispersion and turbulence; eddy viscosity; Reynolds stress; averaging; closure. Mass transfer: models; influence of reaction, solubility, stirring.

Reference books
Cussler *Diffusion: Mass Transfer in Fluid Systems* (C.U.P., 1984)
Brodkey and Hershey *Transport Phenomena: A Unified Approach* (McGraw Hill, 1988)

U3.647 Laboratory Projects in Unit Operations 4 units

Senior elective course for the degree in Chemical Engineering.

Prerequisite: U2.610 Chemical Engineering 2.

Corequisite: U3.610 Unit Operations 1.

Classes: 5hr/fn throughout Sem 2.

Assessment: lab reports, oral presentation and general skill shown in planning and executing lab experiments.

Syllabus summary: This laboratory course extends the range of experiments illustrating the principles of mass transfer, heat transfer and particle mechanics. Three lab experiments will be undertaken by students during the semester. Two written reports and one oral presentation will be required from each student. Each student will carry out a laboratory class every two weeks. The same level of preparation is required for this course as for U3.670 Chemical Engineering Laboratory. Specifically, students are required to: (1) familiarise themselves with the background theory; (2) understand the operation of the experimental apparatus and the correspondence between the apparatus and thatdescribed in the background theory; and (3) define the experimental aim, range of measurements to be made and how these measurements will be processed in the light of the background theory and the aim.

The analysis and interpretation of the experimental data are of great importance in the assessment, as is the ability to present the results clearly, logically and precisely either as a technical report or an oral presentation.

Textbook
Printed laboratory notes
Perry and Green *Chemical Engineer's Handbook* (McGraw-Hill, 1984)

Reference books
Reference documentation appropriate to each laboratory exercise is available for borrowing

U3.651 Materials and Corrosion 2 2 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: nil.

Classes: 2hr of lec & tut)/wk for one sem.

Assessment: one 2hr exam.

Syllabus summary: The major forms of corrosion and the mechanisms by which they occur. Aqueous corrosion. Chemical and electrochemical thermodynamics of corrosion, stability diagrams. Electrode kinetics. Polarisation. Application to corrosionkinetics. Passivation. Corrosion types protection and case studies. Materials selection and design. High temperature corrosion and oxidation.

Textbook

Fontana *Corrosion Engineering* 3rd edn (McGraw-Hill, 1986)

Reference books

Uhlig and Revie *Corrosion and Common Control* 3rd edn (Wiley, 1985)

Pourbaix AtZas *of Electrochemical Equilibria in Aqueous Solutions* (NACE, 1974)

U3.660 Process Control 1 — 4 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: U2.000 Mathematics 2.

Corequisite: U3.630 Computations and Statistics.

Classes: (4hrs of lec, tut and lab work)/wk for one sem.

Assessment: tut assignments, lab reports and one 3hr exam.

Syllabus summary: The role of control in chemical processes. Development of dynamic models. Analytical and numerical solution of dynamic models. Laplace Transform. Transfer functions. Dynamic analysis of first order, second order and higher order systems. Introduction to feedback control. Types of controllers, closed-loop fundamental equations. Stability analysis, controller design. Process reaction curve method. Use of MATLAB.

Textbook

Stephanopoulos *Chemical Process Control: An Introduction to Theory and Practice* (Prentice-Hall, 1984)

Reference books

As indicated during lectures

U3.671 Chemical Engineering Laboratory — 6 units

Senior core course for the degree in Chemical Engineering.

Prerequisite: U2.610 Chemical Engineering 2.

Corequisite: U3.610 Unit Operations 1.

Classes: 7hr/fn in Sem 1.

Assessment: lab reports and oral presentation, plus general skill shown in planning and executing lab experiments.

Syllabus summary: This laboratory course complements the course U3.610 Unit Operations 1 on the principles of mass transfer, heat transfer and particle mechanics.

As part of the preparation for an experiment, the student will be expected specifically to:

1. familiarise himself or herself with the background theory;
2. understand the operation of the experimental apparatus; and
3. define the experimental aim, range of measurements to be made and how these measurements will be processed.

Considerable importance is attached to the analysis and interpretation of the experimental data and to the writing of a clear, logical and concise technical report.

Textbooks

Perry and Green *Chemical Engineer's Handbook* 6th edn (McGraw-Hill, 1984)

Printed laboratory notes

Reference books

As indicated during classes

U3.720 Aerodynamics 1 — 4 units

Senior core course for the degree in Aeronautical Engineering.

Prerequisites: U2.000 Mathematics 2 and U2.710 Fluid Dynamics.

Corequisite: U3.725 Aerodynamics 2.

Classes: (4 lec/wk and associated tutorials) in Sem 1.

Assessment: written exam at end of sem.

Syllabus summary: An introduction to the technology of aeronautics. Aerodynamic characteristics of air craft components. Lift, drag and pitching moment behaviour of fuselage, wings and aerofoils. Two-dimensional aerofoil theories; conformal mapping; Joukowski transformation; thin aerofoil theory.

Introduction to aircraft performance. General aircraft performance; steady level fight force balance, take-off, climb, landing and cruise performance. Range calculations. Manoeuvre performance.

Basic equations governing aerodynamics. Reynolds and Mach numbers; dimensional analysis; continuity; momentum and energy equations; Bernoulli, Euler and Navier-Stokes equations.

Potential flow solutions for Laplace equation. Vortirity; circulation; modelling of solid bodies in two-dimensional flow. Prediction of lift; Kutta-Joukowski law.

Reference books

McCormick *Aerodynamics, Aeronautics and Flight Mechanics* (Wiley, 1979)

Streeter and Wylie *Fluid Mechanics* (McGraw-Hill, 1981)

Houghton and Brock *Aerodynamics for Engineering Students* (Edward Arnold)

Dommasch *Airplane Aerodynamics* (Pitman)

Hale *Aircraft Performance Selection and Design* (Wiley, 1987)

Milne-Thomson *Theoretical Aerodynamics* (Macmillan, 1966)

Rutowski *Energy Approach to the General Aircraft Performance Problem* (Douglas A/C Co., 1990)

U3.725 Aerodynamics 2 — 4 units

Senior core course for the degree in Aeronautical Engineering.

Prerequisites: U2.000 Mathematics 2 and U2.710 Fluid Mechanics.

Corequisite: U3.720 Aerodynamics 1.

Classes: (4 lec/wk plus associated tutorials) in Sem 2.

Assessment: written exam at end of Sem 2.

Syllabus summary: Introduction to three-dimensional flow; Biot-Savart law; horse-shoe vortex.

Basic gas dynamics; steady one-dimensional flow including friction and heat transfer; shock waves. Introduction to steady two-dimensional supersonic flow.

Viscous effects; introduction to boundary layer theory; heat transfer and skin friction. Prediction of aerodynamic drag.

Energy approach to general aircraft performance; climb rates; energy envelope; cruise performance. Excess power and specific energy calculation. Range calculations. Manoeuvring flight with increased load factor. Aircraft excess power comparisons.

The aerodynamics of control surfaces; introduction to aerodynamic derivatives; theory and applications.

Reference books

McCormick *Aerodynamics, Aeronautics and Flight Mechanics* (Wiley, 1979)
Liepmann and Roshko *Elements of Gasdynamics* (Wiley, 1957)
Houghton and Brock *Aerodynamics for Engineering Students* (Edward Arnold)
Schlichting *Boundary Layer Theory* (McGraw-Hill, 1960)
Hale *Aircraft Performance, Selection and Design* (Wiley, 1987)
Bertin and Smith *Aerodynamics for Engineers* (Prentice Hall, 1979)
Rutowski *Energy Approach to the General Aircraft Performance Problem* (Douglas A/C Co., 1990)

U3.730 Aircraft Structures 1 4 units

Senior core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U3.430 Mechanics and Properties of Solids 2 and U4.432 Mechanics and Properties of Solids 2A.

Prerequisites: U2.000 Mathematics 2 and U2.700 Mechanics and Properties of Solids 1.

Classes: (3 lec/wk with associated tutorials) for one sem.

Assessment: course assignments and written exam at end of sem.

Syllabus summary:
(a) Solid mechanics: stress and strain, linear elasticity, strain energy. Plane stress systems. Elastic vibration and buckling.
(b) Structural analysis: airframe structure. Loads and reactions in airframes. Analysis of multi-cell box beams and tubes. Analysis of rings.

Reference books

TimoshenkoStrengthofMaterials,PartsIandn(y cinNosirand)
Langtiaar *Energy Methods in Applied Mechanics* (Wiley)
Bruhn *Analysis and Design of Flight Vehicle Structures* (Tri-State Offset)
Megson *Aircraft Structures for Engineering Students* (Arnold, 1972)

Library classification: 620.11, 628.13,629.13, 630.1

U3.735 Aircraft Structures 2 4 units

Senior core course for the degree in Aeronautical Engineering.

Corequisite: U3.730 Aircraft Structures 1.

Classes: (3 lec/wk and associated tutorial work) for one sem.

Assessment: course assignments and written exam.

Syllabus summary:
(a) Solid mechanics: thermal stresses and plasticity; applications in plane stress systems.
(b) Structural analysis: elementary analysis of plates and stiffened panels and shells. Analysis of complex frameworks: introduction to displacement methods of analysis.

Reference books

Drucker *Introduction to the Mechanics of Deformable Bodies* (McGraw-Hill)
Bruhn *Analysis and Design of Flight Vehicle Structures* (Tri-State Offset)

Library classification: 620.11,629.13,630.1

U3.740 Aircraft Design 1 6 units

Senior core course for the degree in Aeronautical Engineering.

Prerequisites: U2.441 Mechanical Design 1A and U2.700 Mechanics and Properties of Solids 1.

Corequisites: U3.431 Mechanical Properties of Materials, U3.720 Aerodynamics 1 and U3.730 Aircraft Structures 1.

Classes: (1 lec plus 2 or 3hrs of tutorial and design activity)/wk throughout the year.

Assessment: tut assignments plus minor and major design projects.

Syllabus summary:
(a) Introduction to design: theprocessofaircraftdesign; safety and its implications; component design; structural analysis.
(b) Optimisation; design for manufacture; joints and fasteners; vibration; fatigue; human factors, the art of design; social responsibilities.

Reference books

Svennson *Introduction to Engineering Design* (U.N.S.W.P., 1981)
Bruhn *Analysis and Design of Flight Vehicle Structures* (Tri-State Offset)

U3.750 Mechanics of Flight 1 4 units

Senior core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U3.450 Mechanical Systems.

Prerequisites: U2.000 Mathematics 2 and U2.412 Engineering Dynamics.

Corequisite: U3.755 Mechanics of Hight 2.

Classes: (3 lec/wk with tutorials) in Sem 1.

Assessment: Written exam at end of sem and course assignments.

Syllabus summary:
Aircraft static equilibrium and stability. Effects of symmetry on rigid-body aircraft equations of motion. Origins of forces and moments in the plane of symmetry. Effect of wings, stabilisers, fuselages and powerplants. Aerodynamics of trailing edge controls. Trimmed equilibrium condition. Effects on performance of trimmed equilibrium. Static longitudinal stability and the concept of static margin. Effects of reversible controls on static longitudinal stability. Manoeuvering longitudinal stability and the concept of manoeuvre margin. Effects of reversible controls on manoeuvering longitudinal stability.

Analytic idealisation of single and multiple degree of freedom physical systems. The state-space form of equations of motion. Non-linear differential equations. Linearisation about trim conditions. Fourier and Laplace transforms and their application to aeronautical dynamics problems. Eigenvalues, eigenvectors and their relation to the behaviour of physical systems. Time domain and frequency domain descriptions of aeronautical dynamics problems. Computational applications of the time domain and frequency domain models. Measurement of dynamic characteristics of aeronautical systems.

Reference books
Nelson *Flight Stability and Automatic Control* (McGraw-Hill, 1989)
Etkin *Dynamics of Atmospheric Flight* (Wiley, 1972)
Roskem *Airplane FlightDynamics and Automatic Flight Controls* (RoskamA&EC,1979)
Seckel *Stability and Control of Airplanes and Helicopters* (Academic Press, 1964)
McCormick *Aerodynamics, Aeronautics and Flight Mechanics* (Wiley, 1979)
Moler Little *et al. PC-MATLAB User's Guide* (TheMathworks Inc., 1990)

U3.755 Mechanics of Flight 2 — 4 units

Senior core course for the degree in Aeronautical Engineering.

Corequisite: U3.750 Mechanics of Flight 1.

Classes: (4 lec/wk with associated tutorials) in Sem 2.

Assessment: written exam at.end of sem and course assignments.

Syllabus summary: Static lateral/directional stability, weathercock stability; roll stiffness. Introduction to lateral/directional control.

Linear approximation of aerodynamic derivative influence of aircraft components on stability derivatives.

Dynamic longitudinal stability; dynamic lateral/ directional stability. Approximate solutions for the flight path of a rigid-body aircraft; response to control input.

Reference books
Nelson *Flight Stability and Automatic Control* (McGraw-Hill, 1989)
Roskem *Airplane Flight Dynamics and Automatic Flight Controls* (Roskam A&EC, 1979)
Etkin *Dynamics of Atmospheric Flight* (Wiley, 1972)
Seckel *Stability and Control of Airplanes and Helicopters* (Academic Press, 1964)
Babister *Aircraft Dynamic Stability and Response* (Pergamon, 1980)
McCormick *Aerodynamics, Aeronautics and Flight Mechanics* (Wiley, 1979)
NATO AGARD *Flight Test Manual Vol. 2 — Stability and Control* (Pergamon, 1963)
Perkins and Hage *Airplane Performance Stability and Control* (Wiley, 1949)

U3.760 Laboratory — 4 units

Senior core course for the degree in Aeronautical Engineering.

Corequisites: U3.725 Aerodynamics 2 and U3.730 Aircraft Structures 1.

Prerequisite: 152.770 Engineering Computation.

Classes: approximately twenty-five 3hr lab sessions.

Assessment: lab assignments.

Syllabus summary: A series of laboratory experiments are arranged in conjunction with the Senior courses. Students are evaluated orally during each experiment and are required to complete several detailed reports.

The course also involves a computer laboratory section where students are expected to develop a piece of useful engineering software.

Reference books
Bradshaw *Experimental Fluid Mechanics* (Pergamon, 1964)
Pankhurst and Holder *Wind Tunnel Techniques* (Pitman, 1965)

Library classification: 532; 532.54; 629.130725

U3.770 Flying Operations — 2 units

Senior core course for the degree in Aeronautical Engineering.

Prerequisite: nil.

Corequisite: 36 units of Senior courses.

Classes: part-week course held mid-semester vacation.

Assessment: a written report.

Syllabus summary:
Students are given flying instruction on powered aircraft and gliders, as well as experience of cross country flight and night flight. The flying experience is linked in with the Mechanics of Flight course.

U3.780 Aviation Technology — 4 units

Senior core course for the degree in Aeronautical Engineering.

Prerequisite: 96 units of Junior and Intermediate coursework.

Classes: 2 lec/wk and associated tut and lab work throughout the year.

Assessment: based on assignments submitted during the year, plusone 2hr exam/Sem 1, one 2hr exam/Sem 2.

Syllabus summary: Survey of currentpracticeinaviation measurement and instrumentation. Introduction to pressure, force, velocity and displacement transducers; accelerometers; electronic anemometers; temperature sensors; strain gauges. Use of electronic sensors as part of computer data logging system; signal generation; amplification; filtering; analogue to digital conversion. Digital data formats; storagerequirements and accuracy limitations. Post-processing; calculation of mean and standard deviation for dynamic signals; analysis using fast Fourier transforms; random decrement. Calibration of sensors.

Manufacturing processes; automated machining processes; techniques for manufacture of non-metal components; composite materials; sealants and adhesives. Aeronautical fastening techniques. Introduction to CAD and NC machining.

Aeronautical material and hardware standards. Civil aviationregulations and airworthiness directives. Aircraft weight and balance control. In-service structural integrity checking. Systems standards.

Reference books

Students taking this course should become familiar with the Australian Civil Aviation Authority's Civil Aviation Orders, Parts 100 through 103, as well as the related British and United States Aviation authority documents

Cutler *Understanding Aircraft Structures* (PSP Professional, 1988)

U3.790 Industrial Organisation and Management 4 units

Senior core course for the degree in Aeronautical Engineering.

Classes: to be announced.

Assessment: to be announced.

Syllabus summary (Preliminary):
Microeconomics, the Australian business environment, the role of government, accounting systems and procedures, the accounting cycle, financial statements, internal performance, financial structures, intellectual property, contract law, legal obligations of business, capital budgeting and investment analysis, introduction to contract administration.

Reference books

Stanley *How to Read and Understand a Balance Sheet* (Schwartz & Wilkinson, Melbourne)

The Small Business Handbook (Small Business Development Corp., Victoria)

Eyre *Mastering Basic Management* (Macmillan)

Stoner, Collins and *VettonManagement in Australia* (Prentice-Hall)

Blank and Tarquin *Engineering Economy* (McGraw-Hill)

U3.801 Engineering Construction 2 4 units

Senior core course for the degree in Civil Engineering and in Project Engineering and Management (Civil).

Prerequisite: U2.800 Engineering Construction 1.

Classes: (lec: 26hrs and tut: 26hrs) for one sem.

Assessment: one 3hr exam at end of course and assignments.

Syllabus summary: Synthesis of systems for the construction of building and civil engineering projects. Advanced techniques for the evaluation of productivity and cost in production systems such as for concrete and asphalt. Economic analysis in planning the execution of heavy construction projects such as tunnelling and marine projects.

Library classification: 624.068

U3.810 Network Planning 4 units

Senior core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisite: nil.

Assessment: coursework, project submission and written examination.

Syllabus summary: Fundamentals of project planning and control, simplified and manual methods for planning: bar charts, S-curves and other graphics, work breakdown structure, precedence and arrow networks; PERT/CPM methods, resource allocation/levelling, integrated cost/schedule techniques and network-based schedule and cost control.

U3.811 Contracts Formulation and Administration 6 units

Senior core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisite: nil.

Assessment: essay, coursework, assignments and written examination.

Syllabus summary: Themakingof a contract, precontract negotiation, nature and purpose of model conditions of contract, standard forms, contract administration and performance, enforcing liabilities and obligations, dispute resolution through effective negotiation, mediation, arbitration and litigation, claims preparation and investigation.

U3.900 Innovation and International Competitiveness 4 units

Senior elective course for the degree in all branches of Engineering.

Prerequisite: nil.

Classes: (one lec/one seminar)/wk for one sem.

Assessment: essay, group project case study, assignments and written examination.

Syllabus summary: The course is designed to provide students with an understanding of the forces of international competition that are setting the rules for the future of private and public sector organisations in which engineers are employed. Introduction to challenges of modern management; understanding of the new rules of international competitiveness; effects of globalisation on Australia's economic performance; the competitiveness of Australian firms; the generation of employment and wealth; the changing requirements on the engineer; the engineer as manager and strategist; the role of innovation in business management; product innovation and commercialisation.

Text and reference books

See list supplied by lecturer

U4.005 Partial Differential Equations 2 units

Senior Advanced elective course for the degree in Mechanical Engineering.

Mutually exclusive with: some options in the Senior Mathematics courses in the Faculty of Science.

Prerequisite: U2.000 Mathematics 2.

Classes: 2hrs/wk in Sem 2.

Assessment: assignments and one 2hr exam at end of course.

Syllabus summary: Occurrence of partial differential equations in engineering problems; types. Solution methods: separation of variables; series expansions; transform methods. Special functions. Applications of computer algebra.

Reference books

Consult lecturer

U4.022 Optical Fibres 3 units

Senior Advanced elective course for the degree inElectrical Engineering and the ISE stream.

Classes: 20 lectures and 2 seminars in Sem 1.

/Issessmenf; one 2hr exam at end of Sem 1.

Syllabus summary: A review will be given of optical fibre theory and practice, emphasising construction methods and design possibilities.

U4.070 Industrial Ergonomics 2 units

Senior Advanced elective course.

Mutually exclusive with: U4.460 Industrial Engineering.

Prerequisite: nil.

Classes: (2 lec/wk plus associated lab work) in Sem 2.

Assessment: course assignment.

Syllabus summary:
(a) Lectures — History and scope of ergonomics; biomechanics; receiving and processing information; presentation of information; anthropometry and seating; ergonomic aspects of noise; human factors in safety; selection, skill and training; industrial lighting; fatigue, shiftwork and the organisation of work; absenteeism; mental health and automation; design of equipment and workspace; biomechanics of handling materials; ergonomic job analysis; personal factors in work performance.
(b) Laboratory—Demonstration of protective clothing and equipment. Methods of measurement of work environment. Climatic chamber.

Reference books
As advised during classes

Library classification: 150,331.1,611,612, 620,658

U4.071 Human and Industrial Relations 6 units

Senior Advanced core course for the degree in Project Engineering and Management (Civil); *elective course* for the degree in Mechanical and Mechatronic Engineering.

Prerequisite: credit for 36 units of Senior courses and completion of the required industrial employment.

Classes: 3hrs/wk throughout the year. The course will be highly participative, comprising mostly small-group tutorials and workshops, supplemented by 1 lec/wk.

Assessment: assignments, participation, plus two 2hr exams during the course.

Syllabus summary: Most graduate engineers have relational difficulties in their early careers in industry. This is widely recognised and the National Committee on Engineering Management of The Institution of Engineers, Australia has prepared specific guidelines to assist new graduates in this respect. This workshop-based course has been tailored to explore relevant issues and perspectives, and to provide a foundation upon which subsequent workplace experience can build.

Theories and practical applications of individual, organisational and industrial behaviour are considered, with a view to the acquisition of broad basic understanding and the development of important basic skills: theories of motivation, management and organisation; relationships on and off the job; individual and corporate goals, goal congruence, participation; successful organisations — work and non-work; personal success; personal skills — listening, communicating, negotiating, delegating; the nature and causes of conflict at the personal level, in the work place and in a wider context; the history, structure and role of employee and employer associations in Australia; the statutory background to Australia's industrial relations.

Contemporary issues are also discussed, emphasising the range of perspectives and the situations in which engineers are often placed.

Practitioners from industry are Important contributors, and often an industrial barrister fulfils a substantial continuing role. Guest speakers may be drawn from unions, employer bodies or government, and appropriate use of audio-visual material is included as a resource for discussion of practical terms.

Reference material

National ConxtriitteeonEngineeringManagementlndustriflZ *Relations Guidelines for New Graduate Engineers* (I.E., Aust., 1988)
Deery and Plowman *Australian Industrial Relations* (McGraw-Hill, 1985)
Ford *et al. Australian Labour Relations Readings* (Macmillan, 1980)
Ford and Plowman *Australian Unions—an Industrial Relations Perspective* (Macmillan, 1983)
Hunt *Managing People at Work* (McGraw-Hill, 1979)
Koontz, O'Donnell and Weihrich *Management* IS edn, 7th edn (McGraw-Hill Kogakusha, 1980)
Lansbury and Spillane *Organisational Behaviour: the Australian Context* (Longman Cheshire, 1983)
Peters and Waterman In *Search of Excellence* (Harper & Row (A'asia), 1984)

U4.080 Computer-based Design 2 units

Senior Advanced elective course for the degree in all branches. The course is provided by the Key Centre of Design Quality.

Classes: (1 lec and 1 tut)/wk for one semester.

Assessment: semester-long project completed by an interdisciplinary group of students using various computer-based design tools.

Syllabus summary: This course addresses the various roles and types of computer-based tools used during design. The aim of this course is to broaden the student's understanding of computer-based tools beyond the software available in the individual departments and to introduce the needs and tools for integrated computer-based design. Topics include: computer-based analysis, modelling, synthesis, data exchange standards, database management systems, integrated design environments in industry.

Textbook
None

Reference books
As indicated during classes

U4.090 Asian Studies 3 — 8 units

Senior Advanced elective course.

Prerequisite: U3.090 Asian Studies 2.

Classes: two 2hr classes/wk throughout the year, one on language and general culture and the other on business culture. Attendance is required at all lectures and classes.

Assessment: oral tests, written assignments and one 2hr written exam in each of June and November.

Syllabus summary: language (40%), general culture (10%), business culture (50%) for the country chosen.

U4.202 Thesis 1 — 6 units

Senior Advanced core course for the degree in Civil Engineering and in Project Engineering and Management (Civil). The course U5.204 Thesis. Honours (10 units) may be substituted for this core course.

Prerequisite: nil.

Corequisite: A senior core course in the field of the thesis.

Classes: literature survey and experimental work.

Assessment: submitted typed thesis and oral presentation.

Syllabus summary: A study, in groups of 2 or 3 students, of a selected topic in Civil Engineering. Detailed information sheets are available from the School of Civil and Mining Engineering at the beginning of Sem 1.

U4.203 Thesis 2 — 4 units

Senior Advanced elective course for the degree in Civil Engineering and in Project Engineering and Management (Civil).

Prerequisite: nil.

Corequisite: U4.202 Thesis 1.

Classes: 52hrs of study in Sem 2.

Assessment: submitted typed thesis and oral presentation.

Syllabus summary: Additional study of the topic selected for U4.202 Thesis 1.

U4.205 Practical Experience — 4 units

Senior Advanced core course for the degree in Civil Engineering and in Project Engineering and Management (Civil).

Prerequisite: 28 units of Senior courses.

Corequisite: nil.

Classes: 12 weeks of practical work experience (375 hours minimum).

Assessment: a written report.

Syllabus summary: Each student is required to work as an employee of an approved engineering organisation and to submit a satisfactory written report of his or her work. Normally 12 weeks of practical work experience (375 hours minimum) is required and this is undertaken after the completion of some or all of the prescribed Senior core courses and before enrolment in the final year of study. The University Careers and Appointments Service is available to assist students to obtain suitable employment.

Reference book

Eagleson *Writing in Plain English* (Aust. Govt Publishing Service)

U4.214 Materials Aspects in Design — 4 units

Senior Advanced core course for the degree in Civil Engineering.

Mutually exclusive with: U4.212 Materials 3.

Prerequisite: U3.212 Properties and Materials.

Corequisite: nil.

Classes: lec: 40hrs, lab: 12hrs.

Course objectives: To relate the mechanical properties of metals and cement-based materials to the design of structures made from these materials.

Course outcomes: Ability to predict the influence of material properties upon the response of the structure under service conditions.

Assessment: one 3hr exam covering the whole syllabus

Syllabus summary: Fracture aspects in the design and use of concrete and reinforced concrete structures. Fracture, fatigue, fire and corrosion aspects in the design and use of metal structures. Durability and serviceability aspects in the design and use of concrete and reinforced concrete structures. Two laboratory sessions on failure modes of RC beams, one laboratory session on electron microscopy, one field trip.

Textbooks and reference books

As for U3.212 Properties of Materials

U4.223 Finite Element Methods — 4 units

Senior Advanced core course for the degree in Civil Engineering.

Prerequisite: U3.222 Structural Analysis.

Corequisite: nil.

Classes: (lec: 26hrs and tut: 26hrs) for one sem.

Assessment: classwork, assignments and one 3hr exam.

Syllabus summary: Introduction to finite elements, analysis of bars, beams and assemblages. Analysis of elastic continua, in plane stresses in plates, plane strain problems, plate bending. Elastic settlement analysis. Finite element analysis of vibrations and stability, use and testing of finite element packages.

Textbooks

As prescribed during the course

Reference books

Zienkiewicz *The Finite Element Method* 3rd edn (McGraw-Hill, 1977)

Bathe and *WHsonNumericalMethods in Finite Element Analysis* (Prentice Hall, 1976)

Cook *Concepts and Applications of Finite Element Analysis* (John Wiley, 1974)

Library classification: 624.176, 624.02

U4.232 Bridge Engineering — 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisites: U4.222 Structural Analysis 2 and U4.231 Structural Behaviour 2.

Classes: 26 lec and 26hrs of tut.

Assessment: based on submitted work, seminar presentations and one 3hr exam.

Syllabus summary: Highway and railway bridge loading; influence lines; analysis; traverse load distribution; computer modelling of bridges; effects of movements due to temperature. Elastic shortening and concrete creep and shrinkage; bridge bearings; selection of structural forms; standardised bridge systems, skew and curved bridges, bridge foundations; construction methods; case studies of significant bridges.

Reference books
NAASRA *Bridge Design Specification*
Australian and New Zealand Railway Conferences *Railway Bridge Design Manual*

Library classification: 624.2-8

U4.236 Concrete Structures 2 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U5.233 Concrete Structures Honours.

Prerequisite:U3.232 Concrete Structures 1.

Corequisite: nil.

Classes: lea 28hrs, tut: 28hrs.

Assessment: one 3hr exam plus assessment of selected assignments.

Course objectives: To develop a depth in understanding of the fundamental behaviour and design of concrete and composite members and structures.

Expected outcomes: The development of design skills that will lead to reliable and economical designs of both practical and more complex structures.

Syllabus summary: Practical aspects of reinforced concrete, prestressed concrete and composite steel-concrete members and structures — non-linear behaviour, load-moment-curvature relationships, strength of beams, columns and beam columns, moment redistribution, ultimate strength of concrete slabs, yield line analysis of slabs, strip equilibrium analysisof slabs, me analysisof time-dependent effects in concrete structures, models of concrete creep and shrinkage, design of composite T-beams, design of composite slabs incorporating profiled steel sheeting, design of composite columns.

Textbooks
Warner *et ah. Reinforced Concrete* (Pitman)
Warner and Faulkes *Prestressed Concrete* (Longman Cheshire)
Standards Australia Specifications — current editions
AS2327 Part 1 *Composite Structures Code*
AS1170 Parts 1 and 2 *Loading Code,* and
AS3600 *Concrete Structures Code,* or
AS HB2.2 *Structural Engineering Standards*

Reference books
Lin and Burns *Design of Prestressed Concrete Structures* (Wiley)
Park and Gamble *Reinforced Concrete Slabs* (Wiley)
Other books as indicated in classes

Library classification: 624.17, 624.183

U4.237 Structural Dynamics 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: U3.222 Structural Analysis.

Corequisite; nil.

Mutually exclusive with: U5.234 Structural Dynamics Honours.

Classes: lec: 26 hrs, tut: 26 hrs.

Course objectives: To provide an understanding of the dynamic behaviour of structural systems and wind loads on structures.
Expected outcomes: To be able to determine the natural frequency of simple structural systems manually and complex systems using computer analyses; to be able to perform analyses for the effects of forced vibration and structural damping; to be able to perform wind analyses on low and high rise structures.

Assessment: one 2hr exam and assignments.

Syllabus summary: Introductory structural dynamics, natural frequency, free and forced vibration, structural damping, single and multi-degree of freedom systems, finite element dynamic analysis, consistent mass matrix, damping matrix, free vibration, forced vibration, wind loading on structures.

Reference book
Thomson *Theory of Vibrations with Applications* (Allen & Unwin, 1981)

U4.238 Steel Structures 2 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U5.224 Steel Structures Honours.

Prerequisite: U3.235 Steel Structures 1.

Corequisite: nil.

Classes: lec: 28 hrs, tut: 28 hrs.

Assessment: one 3hr exam at end of the semester plus assessment of assignment work.

Course objectives: To develop a working knowledge of the behaviour and design of steel structures beyond a basic competency.

Expected outcomes: Proficiency in the design of steel structures.

Syllabus summary: Three of the 4 subjects will be available: (1) Torsion in steel structures—behaviour, analysis and design; (2) Local buckling behaviour and design; (3) Flexural-torsional buckling — behaviour and design of beams; (4) Shell structures—behaviour and membrane analysis.

Textbooks
Trahair and Bradford *Behaviour and Design of Steel Structures* (Chapman & Hall, 1991)
Trahair *Flexural-Torsional Buckling of Structures* (Spon, 1993)
Standards Australia AS4100 — *Steel Structures* (1990)
Gibson *Thin Shells* (Pergamon, 1980)
Vinson *The Behaviour of Plates and Shells* (Wiley, 1974)

Reference books
Bulson *Stability of Flat Plates* (Chatto & Windus, 1970)
Hancock *Design of Cold-Formed Structures* (AISC, 1994)
Kraus *Thin Elastic Shells* (Wiley, 1967)
Calladine *Theory of Shell Structures* (CUP, 1983)
Other books as indicated during classes
Library classifications: 624.17,624.182

U4.246 Environmental Geotechnics 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U4.242 Geotechnical Engineering.

Prerequisites: U3.244 Soil Mechanics A, U3.245 Soil Mechanics B.

Corequisite: nil.

Classes: lec/tufc 52hrs.

Course objectives: To develop understanding of the goetechnical aspects of the design and management of industrial and domestic waste disposal systems.

Expected outcomes: Students should gain an understanding of: the role of geotechnics in the design of waste management systems; current design methods and technologies. In particular, they should be able to predict likely interactions between waste and soil, and pollutant movement in the ground, and should be able to evaluate strategies for the containment of industrial and domestic wastes and mine tailings.

Assessment: tutorial and assignment submissions, as indicated at the commencement of the course.

Syllabus summary: Landfill design, including clay mineralogy, effects of chemicals on soil permeability, flow rates through membranes, effect of punctures, composite liners, mechanisms of mass transport, diffusion, dispersion, advective transport, sorption, predicting transport time, solutions to advectipn-dispersion equation, design of liners, stability of clay liners on slopes, design of covers, infiltration rates. Tailings disposal, including types of tailings dams, design of dams, water balances, rehabilitation.

Reference books
To be advised

Library classification: 624.151

U4.247 Foundation Engineering 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U4.242 Geotechnical Engineering.

Prerequisites: U3.244 Soil Mechanics A, U3.245 Soil Mechanics B.

Corequisite: nil.

Classes: lec/tut: 52hrs.

Course objectives: To develop understanding of: current methods used in the investigation and design of foundations on soils and rocks; the limitations of these methods.

Expected outcomes: Students should gain an understanding of: the design process in foundation engineering; the role of site investigation and field testing; the need to deal with uncertainty. In particular, they should develop the ability to: interpret the results of a site investigation; use soils data to design simple foundations; and develop an appreciation of the interaction between soils, the foundation system and the supported structure.

Assessment: one 3hr exam covering the whole syllabus at the end of semester. Credit will be given for tutorial and assignment submissions, as indicated at the commencement of the course.

Syllabus summary: Site investigation and field measurements. Stress-strain behaviour of soils. Behaviour, selection and design of shallow foundations. Strip and raft foundations. Pile foundation analysis and design. Foundations on rock.

Reference books
Tomlinson *Foundation Design and Construction* (Pitman)
Peck *et al. Foundation Engineering* (Wiley)
Poulos and Davis *Pile Foundation Analysis and Design* (Wiley)
Fleming *et al. Piling Engineering* (Halstead Press)
Das *Principles of Foundation Engineering* (PWS — Kent)
Library classification: 624.151

U4.251 Surveying 2 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U4.250 Surveying.

Prerequisite: U3.250 Surveying 1.

Classes: lec: 32hrs, fieldwork and tut: 20hrs.

Assessment: fieldwork, reports, tutorials, and one 3hr exam at the end of the course.

Course objectives: To introduce students to precise measurement technologies, processes, computational procedures, and interpretive skills; to give students a high level of understanding of automated electronic measuring systems; to introduce students to data handling, manipulation, and presentation at a project level.

Expected outcomes: Students should gain the ability to: undertake precise measurement procedures for determining position, extent and stability of points and structures; use advanced electronic measurement equipment; handle and manipulate data in electronic form; analyse data and determine the magnitude of errors.

Syllabus summary: CAD and database applications, horizontal and vertical curves, electronic distance measurements, precise angle measurement, high precision engineering surveys, geodetic surveying, global positioning systems, geographic information systems^ photogrammetry.

Textbooks
Fryer and Elfick *Elementary Surveying* 7th edn (Harper & Row)
or
Uren and Price *Surveying for Engineers* 2nd edn (Macmillian)

Library classification: 526.9

U4.253 Civil Engineering Camp 4 units

Senior Advanced core course for the degree in Civil Engineering.

Prerequisites: U3.250 Surveying 1.

Corequisites: nil.

Classes: the civil engineering camp is carried out over a 10-day period at a nominated location off-campus.

Course objectives: To give students experience at gathering dimensional information and using that information in design considerations; to give students experience in project design in a practical situation; to give students the opportunity to experience project management in a practical situation; to develop student skills in working as a group member on an engineering project team; to develop oral and written presentation skills.

Expected outcomes: Students should develop an understanding of: dimensional control in a project situation; total project management considerations; real world design problems; project presentation skills; group relationships; time management skills.

Assessment: no formal exam; assessment is based on field work activities, oral presentations and reports which are submitted during the camp period.

Syllabus summary: The activities involve work directed towards an integrated civil engineering project. A number of survey tasks are carried out to provide the necessary designinformation. At the camp, each group will be given responsibility for one component of an overall project. Oral presentation and design submissions form anintegralpartof the camp activities.

U4.260 Environmental Fluids 1 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U2.260 Engineering Hydrology.

Prerequisite: nil.

Classes: lec: 26hrs, tut: 26hrs.

Course objectives: To develop an understanding of: basic meteorological principles; the principles of hydrology; the importance of flood routing; the principles of flood mitigation; irrigation requirements; evaporation and reservoir design.

Expected outcomes: Students will be able to: list the key factors which affect the climate of Australia; describe intensity-frequency-duration curves and explain their use; calculate design rainfall intensities; calculate peak flows from catchments; determine runoff hydrographs for various storm durations and intensities; state the principles of flood routing and perform flood routing calculations; assess surface runoff and infiltration in catchments; list and utilise design procedures for storage and service reservoirs; calculate reservoir safe yield; determine evaporation from reservoirs and evapo-transpiration from catchments.

Assessment: one 3hr exam covering the whole syllabus at the end of the semester. Satisfactory performance in tutorials is also a requirement. Credit will be given for tutorial submissions, as indicated at the beginning of the course.

Syllabus summary: Elements of meteorology; precipitation measurement and analysis; design rainfall intensities; hydrographs; peak discharge calculations; evaporationand transpiration;infiltration and groundwater; surface runoff; flood routing.

Textbook
Australian Rainfall and Runoff (I.E. Aust., 1987)

Reference books
Raudkivi *Hydrology* (Pergamon)
Raudkivi and Callander *Analysis of Groundwater Flow* (Edward Arnold)

Library classification: 551.48

U4.265 Environmental Fluids 2 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U4.263 Fluids Engineering.

Prerequisite: nil.

Classes: lec: 26hrs, tut: 26hrs.

Course objectives: To develop an understanding of: ocean wave generation, transmission and coastal effects; the principles of sediment transport; breakwater design, fluid-structure interaction; flood detention basins and advanced flood routing techniques.

Expected outcomes: Students will be able to: list and describe the major parameters affecting ocean wave generation; describe the processes of ocean wave transmission; calculate energy transfer by waves; describe the behaviour of waves in shallow water; explain the fundamental principles of sediment transport; describe sediment transport processes in rivers; describe coastal sediment transport processes; explain basic performance requirements for breakwaters, and factors considered in their design; describe several fluid structures, together with associated fluid-structure interaction, including, but not limited to, spillways, stilling basins, bridge piers, water supply intakes; describe design considerations for flood detention basins; explain the principles of river routing and discuss the applications of flood modelling techniques and programs.

Assessment: one 3hr exam covering the whole syllabus at the end of the semester. Satisfactory performance in class assignments is also a requirement. Credit will be given for assignment submissions, as indicated at the beginning of the course.

Syllabus summary: Coastal processes. Sediment transport. Breakwater design. Fluid structure interaction. Flood effects.

Reference books
To be advised during the course

Library classification: 627.58,551.36

U4.266 Water Resources Engineering 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: nil.

Classes: Lee: 26 hours, Tut: 26 hours in one semester.

Course objectives: To develop an understanding of: the assessment methods for water quality; physical, biological and chemical treatment methods; water storage and distribution systems; management principles for water resources, including water re-use; irrigation techniques and demands; hydro-power systems.

Expected outcomes: Students will be able to: state the requirements of water quality for various purposes; detail the physical methods of water treatment; detail the biological methods used in water treatment; detail the chemical methods used in water treatment; design multi-node water distribution networks; explain the design principles of water supply for high-rise buildings; describe water conservation methods and management principles for water use, including storm water detention and treatment; explain 'grey water' re-use techniques and their applications; describe various irrigation methods and associated hydraulic design; design small-scale hydro-power installations.

Assessment: one 3hr exam covering the whole syllabus at the end of the semester. Satisfactory performance in class assignments is also a requirement. Credit will be given for assignment submissions, as indicated at the beginning of the course.'

Syllabus summary: Water quality; water purification methods; water reticulation, water resource management; irrigation and hydro-power.

Reference books
As indicated during classes.

Library classification: 628.1

U4.273 Engineering Management 4 units

Senior Advanced cor course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: nil.

Classes: lec: 26hrs, tut: 26hrs.

Course objectives: To develop an understanding of conceptualisation and management of engineering and construction projects including: economic modelling, appraisal and optimisation; economic analysis of public sector projects; project sensitivity and risk analysis and risk management techniques; value engineering; work study and related techniques; planning, scheduling and cost engineering of project; project documentation design and presentation.

Expected outcomes: Students should develop an understanding of the fundamentals of project conceptualisation, appraisal, planning and optimisation plus ability to: model and analyse basic economic problems in engineering and construction projects including formulation of objective criteria; analyse, interpret and present the results; quantitatively evaluate field productivity and method study, aspects of team management and design and presentation of professional documentation.

Assessment: one 3hr written examination at the end of the semester, covering the whole syllabus; a major project assignment covering the project planning and documentation segment; class test during the semester and credit which may be given for any coursework as advised at the commencement of the course.

Syllabus summary: Introduction to project conceptualisation and development; stages in project life cycle; techniques of project appraisal including comparison of alternatives, valuation, depreciation and capitalisation method; sensitivity and risk analysis and management of risks; value engineering; work study and related concepts and techniques; pre- and post-tender planning, cost engineering, critical path method of scheduling; resource levelling and associated project management techniques.

Textbook
Organisation and Management of[Construction (School of Civil and Mining Engineering, University of Sydney)

Reference books
Grant, Ireson and Leavenworth *Principles of Engineering Economy* (J. Wiley & Sons)
Thompson *Organisation and Economics of Construction* (McGraw-Hill)
Turner *Handbook of Project-based Managemen t* (McGraw-Hill)

Library classification: 624.068, 658.01518, 692.5-8

U4.274 Project Procedures 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: nil.

Classes: lec: 26hrs and tut: 26hrs.

Assessment: based on submitted work and one 3hr exam.

Syllabus summary:
(a) Cost engineering and estimating—Elemental estimating for cost planning and value engineering, work measurement and bills of quantities; computer aided estimating; cost monitoring of construction projects; tender preparation and documentation.
(b) Industrial legislation and awards. ,
(c) Contract law and documentation.

Reference books
Tagg *et al. Civil Engineering Procedure* (Thomas Telford)
Wearne *Civil Engineering Contracts* (Thomas Telford)

Library classification: 331,343,346,347.692.5

U4.276 Professional Practice 4 units

Senior Advanced core course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: nil.

Classes: lec: 26hrs, tut: 26hrs.

Course objectives: To provide final year students with an appreciation of professional matters which will influence the way they will work as professional engineers.

Expected outcomes: Knowledge of occupational health and safety act; knowledge of procedures for quality assurance both in design and construction; understanding of industrial relations issues; understanding of basic civil engineering contracts; awareness of social responsibility of engineers; understanding of the importance and means of preparation of environmental impact statements; awareness of ethical issues related to the engineering profession.

Assessment: project and assignment work including an oral presentation.

Syllabus summary: The lectures will be delivered by practising engineers and other experts in the following subject areas: (a) Social responsibility in engineering, social and environmental issues and ethics of engineering practice; (b) Industrial relations, legal contracts and law; (c) Occupational health and safety, and quality assurance.

Reference material
As advised during course

U4.292 Civil Engineering Design 4 units

Senior Advanced core course for the degree in Civil Engineering.

Prerequisites: U3.291 Structural Design 2, U3.211 Materials 2, U3.221 Structural Analysis 1 and U3.230 Structural Behaviour

Corequisites: nil.

Classes: lec: 13hrs and 39hrs of drawing office work.

Assessment: no formal exam; assessment will be based on submissions.

Syllabus summary: The design sequence including definition, value and criteria selection; generation of proposals; analysis of proposals; selection of design; development of details of a particular design selected. Feasibility studies and examination of existing works. Study of design projects by stages, including details of some aspects.

The course is under the direction of engineers in professional practice in cooperation with members of the academic staff. Lectures on specific aspects of design are supplemented by visits to construction, testing and manufacturing sites. Lectures and exercises on architectural design and practice and their relationship to civil engineering are included in the course.

Reference books

The course is of a wide-ranging nature, and all text and reference books previous and current courses have relevance. In addition, reference will be made to many codes and guides to practice, of which the following list covers only the structural field:

Current SAA Codes, Manuals and Specifications, particularly

AS4100 — *Steel Structures Code*

AS3600 — *Concrete Structures Code*

AS1554 — *Manual Welding, Part I*

AS1170 — *Loading Code, Parts I and 11*

AS1511 —*High Strength Structural Bolting Code*

MAI Steel Structures

N.A.A.S.R.A. *Bridge Design Specification*

AS1720 — *Timber Engineering Code*

(Purchase of separate codes is recommended)

Library classification: 624.15,624.177,624.18,624.25,625.72, 627.2, 627.3, 627.8

U4.293 Project Formulation 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: U4.292 Civil Engineering Design, U4.273 Engineering Management.

Classes: lec: 13hrs and 39hrs of drawing office work.

Assessment: no formal exam; assessment will be based on submitted work and oral presentation.

Syllabus summary: This course will integrate the technical, commercial and managerial aspects of the civil engineering project.

Students will be cast in the role of entrepreneurs faced with the exploitation of a civil engineering business opportunity. They will assess the technical and financial feasibility of the project and appropriate legal and managerial arrangements and corporate structure for the enterprise.

Engineering design of the project will be carried to the point where it can be shown that the concept is technically sound.

The course will culminate with the presentation of a project to a board of review.

U4.420 Thermal Engineering 6 units

Senior Advanced elective course.

Prerequisite: U3.420 Thermo-fluid Engineering.

Classes: 2hrs/wk in Sem 1 and 4hrs/wk in Sem 2.

Assessment: tut work, projects and three 2hr exams.

Syllabus summary: The course will comprise two or three of the following components dependent on the availability of lecturers from year to year:

Engineering Heat Transfer — Convective heat and mass transfer in laminar and turbulent flow. Analogies between heat, mass and momentum transfer. Phase change: boiling, condensation, melting. Radiation heat transfer

Air conditioning technology—Heat load estimation, applied psychometrics, air handling equipment, refrigeration equipment, systems, control, energy conservation and management in buildings.

Gas turbine technology — Cycles, compressors, turbines, combustors, performance, economic considerations.

Steam power plant technology — Cycles, turbo alternators, boilers, economic considerations.

Combustion engineering — Mass and energy balances, equilibrium, partial equilibrium and non-equilibrium products, simple reactor theory, chemical kinetics, premixed and diffusion flames, heterogeneous combustion, pollutant formation, combustion systems.

Reference books

As advised during classes

U4.421 Fluids Engineering 4 units

Senior Advanced elective course.

Prerequisite: U3.420 Thermo-fluid Engineering.

Classes: 2hrs/wk of lec and tut throughout the year.

Assessment: tut work, projects and one 2hr exam at end of each sem.

Syllabus summary: The course will comprise one or more of the following components dependent on the availability of lecturers from year to year.

Computational fluid dynamics: Conservation equations of fluid flow; boundary conditions, classification of flow problems. Numerical solution schemes based on pressure correction; the SIMPLE algorithm and its variants, convection schemes. Solution of the resulting algebraic equations. Turbulence modelling; implementation of boundary conditions in turbulent flow. Coupled heat transfer: convection, combustion, radiation heat transfer. Multiphase flow. Introductions to compressible flow, the physical significance of hyperbolic equations; characteristic based methods; FCT and TVD schemes. Pitfalls to avoid in CFD.

Fans and pumps — The design of incompressible fluid machines; specific speed; cavitation; mechanical construction.

Industrial aerodynamics—Practical flow categories; building aerodynamics; wind characteristics; wind loading; Australian wind code and design; vehicle aerodynamics; drag and stability; wind tunnel testing.

Reference books

Computational fluid dynamics and heat transfer

Fletcher *Computational Techniques for Fluid Dynamics, vols I and 2* (Springer, 1988)

Patankar *Numerical Heat Transfer and Fluid Flow* (Hemisphere, 1983)

Fans and pumps — as advised during classes

Industrial aerodynamics

Aynsley, Melbourne and Vickery *Architectural Aerodynamics* (Applied Science Publishers, 1977)

Hucho (ed.) *Vehicle Aerodynamics* (Butterworths, 1987)

U4.422 Computational Methods for Partial Differential Equations 4 units

Senior Advanced elective course.

Prerequisite: U2.000 Mathematics 2.

Classes: 2 lec/wk with associated tut and prac sessions in Sem 1.

Assessment: assignments.

Syllabus summary: Finite difference techniques for elliptic, parabolic and hyperbolic partial differential equations. Method of weighted residuals (Galerkin, least-squares, etc.). The use of the finite element, boundaryelement and finite difference methods in the effective computer solution of engineering problems in fluid dynamics, heat transfer and other areas.

Reference books

Press *et al. Numerical Recipes* (Cambridge, 1986)

Zienkiewicz and *MorganFinite Elements and Approximations* (Wiley, 1983)

U4.430 Applied Numerical Stress Analysis 6 units

Senior Advanced elective course.

Mutually exclusive with: U4.730 Aircraft Structures 3.

Prerequisite: U3.430 Mechanics and Properties of Solids 2.

Classes: 2 lec/wk plus prac classes in Sem 1.

Assessment: one 2hr exam at end of course. Class work is assessed.

Syllabus summary: The finite element method. Philosophy. Matrix algebra. Matrix analysis of structures. Generalisation of the finite element method in elasticity for static, dynamic and thermal analysis. Rod elements. Beams. Triangular elements for plane stress. Natural coordinate systems. Introduction to plate and shell theory. Theories and analysis in structural stability. Three dimensional elements. Modelling strategies. Isoparametric elements, accuracy and convergence. Applications of finite element modelling in solid mechanics. Practical modelling of real structures will be done; a 'hands-on' approach will be taken.

Reference book

Cook *Concepts and Applications of Finite Element Analysis* (Wiley, 1989)

U4.433 Advanced Engineering Materials 6 units

Senior Advanced elective course.

Mutually exclusive with: U4.434 Aerospace Materials Engineering.

Prerequisites: U3.430 Mechanics and Properties of Solids 2 or U3.431 Mechanical Properties of Materials.

Classes: 4 hrs/wk in Sem 1 and 2hrs/wk in Sem 2 with associated tut and lab classes.

Assessment: one 2hr exam at end of Sem 1 plus assignment and project work in Sem 2.

Syllabus summary: Engineering applications of advanced materials.

Linear elastic fracture mechanics: Plane strain/stress fracture, crack growth resistance, residual strength, fatigue crack growth, stress corrosion cracking, damage tolerance.

Advanced topics on fracture and fatigue: Postyield fracture mechanics, crack tip opening displacement and J-integral, short and long cracks, random and spectrum loading fatigue, fatigue from notches and plastic fatigue, residual stress on, fatigue crack growth.

Creep and creep rupture in engineering materials. Case study: remnant life prediction of electrical power plant components. Structural reliability of materials and case studies.

Failure analysis and case studies.

Advanced polymers and fibre composites: Processing, toughening mechanisms, high temperature polymers, adhesives, fracture and fatigue, impact damage, degradation and time dependent failure.

Advanced ceramics and composites: Processing, tougheningmechanisms, reliability, high temperature behaviour, thermal shock, degradation and time dependent failure, medical applications. Metal matrix composites and laminated metal/resin composites.

Thin film materials: Processing, properties and applications, wear resistance, adhesion.

Crack resistance curves for advanced engineering materials: Toughening mechanisms, theoretical models, experimental evaluation.

Reference books

Atkins and Mai *Elastic and Plastic Fracture* (Ellis Horwood, 1985)

Lawn and Wilshaw *Fracture of Brittle Solids* (C.U.P., 1975)

Broek *Elementary Fracture Mechanics* (Noordhoff, 1974)

Margolis (ed.) *Engineering Thermoplastics Properties and Applications* (M. Dekker, 1985)

Williams *Fracture Mechanics of Polymers* (Ellis Horwood, 1984)

Kinloch *Adhesion and Adhesives Science and Technology* (Chapman and Hall, 1987)

Harris *Engineering Composite Materials* (Institute of Metals, 1986)

Chawala *Composite Materials* (Springer-Verlag, 1987)

Davidge *Mechanical Behaviour of Ceramics* (C.U.P., 1979)

Richerson *Modern Ceramic Engineering* (M. Dekker, 1982)

U4.434 Aerospace Materials Engineering 4 units

Senior Advanced elective course for the degree in Aeronautical and Mechanical Engineering.

Mutually exclusive with: U4.433 Advanced Engineering Materials.

Prerequisites: U3.430 Mechanics and Properties of Materials 2 or U3.431 Mechanical Properties of Materials and U3.730 Aircraft Structures 1.

Classes: 4 hrs/wk with associated tut and lab classes in Sem 1.

Assessment: one 2hr exam at end of course; plus assignment work.

Syllabus summary: Advanced materials in aerospace applications.

Linear elastic fracture mechanics: Plane strain/ stress fracture, crack growth resistance, residual strength, fatigue crack growth, stress corrosion cracking, damage tolerance.

Advanced polymers and fibre composites: Processing, toughening mechanisms, high temperature polymers, adhesives, fracture and fatigue, impact damage, degradation and time dependent failure.

Advanced ceramics and composites: Processing, toughening mechanisms, reliability, high temperature behaviour, degradation and time dependent failure.

Metal matrix and laminated metal/resin composites.

Reference books

Atkins and Mai *Elastic and Plastic Fracture* (Ellis Horwood, 1985)
Lawn and Wilshaw *Fracture or Brittle Solids* (C.U.P. 1975)
Broek *Elementary Fracture Meclmnics* (Noordhorf, 1974)
Margolis (ed.) *Engineering Thermoplastics Properties and Applications* (M. Dekker, 1985)
Williams *Fracture Mechanics of Polymers* (Ellis Horwood, 1984)
Kinloch *Adhesion and Adhesives Science and Technology* (Chapman and Hall, 1987)
Harris *Engineering Composite Materials* (Institute of Metals, 1986)
Chawala *Composite Materials* (Springer-Verlag, 1987)
Davidge *Mechanical Behaviour of Ceramics* (C.U.P. 1979)
Richerson *Modern Ceramic Engineering* (M. Dekker, 1982)

U4.439 Orthopaedic Engineering 4 units

Senior Advanced elective course for the degree in Mechanical Engineering.

Prerequisites: U3.430 Mechanics and Properties of Solids 2 or U3.431 Mechanical Properties of Materials.

Classes: 4hrs of tut/lab classes/wk in Sem 2.

Assessment: one 2hr exam at the end of Sem 2.

Syllabus summary: Introduction to the musculoskeletal systems including physics and forces acting on it; energy, work and power of the human body; pathomechanics of injury; tissue response to materials; materials used for bone and joint replacement; prosthetic design; stress analysis of total joint replacement, friction, lubrication and wear; mechanical aspects of fixation of prosthetic joints; manufacture of orthopaedic implants; physics of diagnostic imagining; physics of radiation therapy.

U4.440 Advanced Design 6 units

Senior Advanced elective course for the degree in Mechanical and Mechatronic Engineering.

Prerequisite: U3.440 Mechanical Design 2.

Classes: 3hrs/wk throughout year.

Assessment: projects will be assessed.

Syllabus summary: The course draws together the various subjects studied and introduces the student to the practical aspects of design in the commercial environment, with the encouragement of direct industry contacts. As well as design for function and mechanical and structural integrity, consideration is given to manufacturing possibilities, to economic, environmental and human aspects, and to professional responsibility and liability. Students will complete a major design and possibly some smaller designs. Students will be required to submit written material, calculations and drawings to support their designs.

U4.451 Dynamics and Systems Engineering 6 units

Senior Advanced elective course for the degree in Mechanical and Mechatronic Engineering.

Mutually exclusive with: U4.452 Systems Engineering and U4.454 Machine Dynamics.

Prerequisites: U3.450 System Dynamics and Control and either U3.500 Industrial Electronics or U2.504 Electrical and Electronic Engineering.

Classes: 6hr/wk including associated practical sessions for one semester.

Assessment: one 3hr exam or two 2hr exams plus assignments.

Syllabus summary: Review of dynamics, including modal analysis of lumped and continuous systems, aspects of applied problems, especially the dynamics of rotating machinery, the measurement of vibration and condition monitoring of machines. Some aspects of random vibrations, including measurement and prediction of failure.

Review of the analysis and dynamics of mechanisms. Dynamics of cams, gears and gear trains. Analytical mechanics. Spatial mechanisms and robotics. Rotor dynamics.

System modelling. Review of single-loop control system behaviour and root-locus design methods. State-variable approach to linear systems' behaviour; multiloop systems. Design methods for analogue systems. Simulation. Sample-data systems and discrete-time modelling. Z-transform. Digital implementation; direct digital control. Discussion of optimal control.

Reference books

Franklin, Powell and Emami-Naeini *Feedback Control of Dynamic Systems* (Addison-Wesley, 1986)
Friedland *Control Systems Design* (McGraw-Hill, 1987)

U4.452 Systems Engineering 4 units

Senior Advanced elective course for the degree in Mechanical and Mechatronic Engineering.

Mutually exclusive with: U4.451 Dynamics and Systems Engineering.

Prerequisites: U3.450 System Dynamics and Control, either U3.500 Industrial Electronics or U2.504 Electrical and Electronic Engineering.

Classes: 2hrs/wk throughout the year.

Assessment: one 3hr exam at end of course.

Syllabus summary: System modelling. Review of single-loop control system behaviour and root-locus design methods. State-variable approach to linear systems behaviour; multiloop systems. Design methods for analogue systems. Simulation. Sampled-data systems and discrete-time modelling. Z-transform. Digital implementation; direct digital control. Discussion of optimal control.

Reference books
Franklin, Powell and Emami-Naeini *Feedback Control of Dynamic Systems* (Addison-Wesley, 1986)
Friedland *Control Systems Design* (McGraw-Hill, 1987)

U4.453 Mechanics of Polymer Processing 6 units

Senior Advanced elective course for the degree in Mechanical Engineering.

Prerequisite: U3.430 Mechanics and Properties of Solids 2.

Classes: (6hrs of lec and prac work)/wk in Sem 1.

Assessment: assignments and prac work.

Syllabus summary: The subject matter will consist of an introduction to the general mechanics of continua and will then concentrate on non-Newtonian fluid mechanics with applications to polymer processing.

Cartesian tensors: basic mechanics of continua; formulation of contributive equations for polymers. Linear viscoelasticity. Non-linear materials with memory. Experimental aspects of polymer flow. Effective methods of computation, includingboundary and finite element techniques. Temperature effects in flow.

Applications to extrusion, spinning and calendaring of polymers. Introduction to injection moulding problems.

Reference books
Jeffreys *Cartesian Tensors* (C.U.P., 1961)
Tanner *Engineering Rlieology* paperback edn (O.U.P., 1988)

U4.454 Machine Dynamics 4 units

Senior Advanced elective course.

Mutually exclusive with: U4.451 Dynamics and Systems Engineering.

Prerequisite: U3.450 System Dynamics and Control.

Classes: 2 lec/wk plus associated prac sessions for one sem.

Assessment: one 2hr exam plus assignments.

Syllabus summary: The course will begin with a review of dynamics, including modal analysis of lumped and continuous systems and will then consider several aspects of applied problems especially the dynamics of rotating machinery, the measurement of vibration and conditionmonitoringofmachines. The simulation and computation of robot dynamics will be used to illustrate methods in the solution of spatial dynamics problems. Some aspects of random vibrations, including measurement, and prediction of failure will be addressed. Finally, a thorough treatment of non-linear phenomena in simple systems will be presented including some aspects of chaotic dynamics.

Reference books
To be advised

U4.455 Microprocessor Control of Machinery 6 units

Senior Advanced elective course for the degree in Mechanical Engineering.

Mutually exclusive with: U3.476 Industrial Electronics A.

Prerequisite: U3.500 Industrial Electronics or U2.504 Electrical and Electronic Engineering.

Classes: (2 lec and 3hrs of lab work)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1; plus assignment and project work.

Syllabus summary: An overview of some topics central to industrial automation, with emphasis on the use of single-board computers for embedded control of machinery and other products.

Sensors: inductive proximity sensors; optoelectronics and optical proximity sensors, optical encoders; synchro resolver; LVDT; tachogenerator; sensors for pressure and temperature measurement, including monolithic devices.

Actuators: overview of industrial pneumatics and hydraulics; review of some types of electric motors and their drives.

Basic interface electronics, and special-purpose interface ICs.

. Design of a standard 8-bit microprocessor system will be discussed in detail: CPU; ROM and RAM, and address decoding; I/O interface chips; interrupts. The Zilog Z80 family will be used as an example system. Assembly language programming; problem definition, program design, project documentation; development systems; man-machine and machine-machine communication.

The course will involve considerable laboratory work, including a major project. The project will entail some assembly language programming, together with the design and bread boarding of simple interface circuitry to allow a single board computer to control external mechanical hardware.

Reference books
An extensive list of references will be distributed in class

U4.460 Industrial Engineering 6 units

Senior Advanced elective course.

Mutually exclusive with: U4.070 Industrial Ergonomics, U4.461 Introduction to Operations Research, and U4.462 Industrial and Engineering Management.

Prerequisites: U2.000 Mathematics 2 and U3.460 Manufacturing Engineering and Management and completion of industrial experience period.

Classes: 3 lec/wk plus associated tut and lab work and industrial visits in Sem 1.

Assessment: assignments plus one 3hr exam.

Course objectives: Understanding of the principles and practices of industrial and engineering management; effects of globalisation on Australia's economic performance, the competitiveness of Australian firms; insight into the importance of innovation; roles appropriate to governments.

Syllabus summary:
Industrial ergonomics — refer to syllabus summary for U4.070 Industrial Ergonomics.
Operations research—refer to syllabus summary for U4.461 Introduction to Operations Research.
Industrial and Engineering Management — total quality management, production planning and control, costing and pricing, inventory management and control, management reporting systems, value analysis, problem resolution strategies, dispute management, project management, contract administration, marketing management, business planning, the management of engineering enterprises, professional engineering skills.

Textbook
Samson *Management for Engineering* (Longmans)

Reference books
As for U4.070 and U4.461
Hicks *Introduction to Industrial Engineering and Management Science* (McGraw- Hill, 1977)
Harding *Production Management* 2nd edn (MacDonald & Evans, 1974)
Hussey *Introducing Corporate Planning* (Pergamon, 1972)
Currie *Work Study* 4th edn (Pitman, 1977)
Heyde *Concise MODAPTS* (AAPTS&R, 1975)
Koontz *et al. Management* 7th edn (McGraw-Hill, 1980)
Hunt *Managing People at Work* (McGraw-Hill, 1979)
BlakemoreT7teQiwZitySoZuh'on(AustralianBusiness Library, Vic.)
Kotler, Fitzroy, Shaw *Australian Marketing Management* (Prentice-Hall)
Macnamara *Australian Marketing and Promotion Handbook* (Australian Business Library)
Case Studies in Australian Strategic Management
Other books may be advised during the course

U4.461 Introduction to Operations Research 2 units

Senior Advanced elective course. A component of the course U4.460 Industrial Engineering.

Mutually exclusive with: U4.460 Industrial Engineering.

Prerequisite: U2.000 Mathematics 2.

Classes: 1 lec and 1 tut/wk in Sem 1.

Assessment: one 2hr paper at end of course plus assignments.

Syllabus summary: Method and history of operations research: broad aims; general problem approach.

Inventory control problems, with constant and random demand. Allocation problems; linear programming; transportation problem. Introduction to reliability analysis; component and system reliability; effect of maintenance and repair. Discrete event simulation with applications to inventory control and maintenance.

Reference books
Daellenbach, George and McNickle *Introduction to Operations Research Techniques* (Allyn and Bacon, 1984)
or
Taha *Operations Research — An Introduction* (Macmillan, 1976)
Lewis *Introduction to Engineering Reliability* (Wiley, 1987)
Library classification: 658

U4.462 Industrial and Engineering Management 2 units

Senior Advanced elective course for the degree in Mechanical and Mechatronic Engineering.

Mutually exclusive with: U4.460 Industrial Engineering.

Prerequisites: U3.460 Manufacturing Engineering and Management or U3.571 Management for Engineers or U3.790 Industrial Organisation and Management; together with completion of the industrial experience period.

Classes: 2hrs of lec and tut/wk plus industrial visits in Sem 1.

Assessment: assignments and one 2hr exam.

Syllabus summary: Total quality management, production planning and control, costing and pricing, inventory management and control, management reporting systems, value analysis, problem resolution strategies, dispute management, project management, contract administration, marketing management, business planning, the management of engineering enterprises, professional engineering skills.

Textbook
Samson *Management for Engineering* (Longmans)

Reference books
As for U4.460

U4.470 Robotic Systems 4 units

Senior Advanced elective course for the degree in Mechanical Engineering (Mechatronics).

Prerequisite: U3.450 System Dynamics and Control.

Classes: (2 lec and one 3hr lab/tut)/wk in Sem 1.

Assessment: one 3hr exam at end of Sem 1; plus assignment, project and lab work.

Syllabus summary: Overview of robotics: definitions, arm configurations. Kinematics and dynamics of robot manipulators. Control of robots. Programming of languages. Robot vision; tactile sensing. Robot applications. System design, and integration of robots with other automated machinery.

U4.471 Machine Tool Technology 4 units

Senior Advanced elective course for the degree in Mechanical Engineering (Mechatronics).

Prerequisite: U3.470 Mechatronics 2 or U3.450 System Dynamics and Control.

Classes: (3 lec and one 2hr lab/tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1; plus assignment and project work.

Syllabus summary: The first part of the course will concentrate on tools for metal cutting.

Static and dynamic characteristics of machine tools: rigidity, bearings, spindle mounting; accuracy;

vibration. Control of machine tools. Numerical control: NC, CNC, DNC. Computer aided manufacturing.

Installation techniques; communication.

Non-conventional machining processes: EDM, ECM, ultrasonic machining, laser cutting and welding.

U4.472 Design of Automatic Machinery 4 units

Senior Advanced elective course for the degree in Mechanical Engineering (Mechatronics).

Prerequisite: U3.440 Mechanical Design 2.

Classes: (3 lec and one 2hr lab/tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1; plus assignment and project work.

Syllabus summary: Automatic machinery: classification by function and configuration. The design process. Actuator and drive system principles; sensing. Work stations: design of machinery for parts feeding, clamping, machining, assembly, and inspection. Machine control systems; pneumatic logic; relay logic; programmable logic controllers. Practical aspects of design for automated manufacture: machining, assembly, materials handling. A number of case studies will be presented to illustrate common problems and their solutions.

U4.474 Computer Integrated Manufacturing 4 units

Senior Advanced elective course for the degree in Mechanical Engineering (Mechatronics).

Prerequisite: U3.460 Manufacturing Engineering and Management.

Classes: (3 lec and one 2hr lab/tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1; plus assignment and project work.

Syllabus summary: Overview of computers in design and manufacture. Data bases. Computers in process planning and factory management. Flexible manufacturing systems and automated factories.

U4.475 Microprocessors in Engineered Products 6 units

Senior Advanced elective course for the degree in Mechanical Engineering (Mechatronics).

Prerequisite: U3.476 Industrial Electronics.

Classes: (3 lec and one 2hr lab/tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1; plus assignment and project work.

Syllabus summary: Specific requirements for microprocessor-based products. Problem definition and system design. CPU, memory and interface circuits. Tools for design, development and testing of prototype systems. The course will include a major project, where groups of students design, develop and commission a microprocessor-based product.

U4.476 Computers in Real Time Control and Instrumentation 6 units

Senior Advanced elective course for the degree in Mechanical Engineering (Mechatronics).

Prerequisite: U3.476 Industrial Electronics.

Classes: (3 lec and one 2hr lab/tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1; plus assignment and project work.

Syllabus summary: Review of sensing, analogue and digital electronics. Signal conditioning and data acquisition. Overview of the IBM PC architecture. Programming for interactive control using both assembly language and the high level language C. Timers, interrupts. Asynchronous tasks; data communication. Structured data; structures in C. Cooperative multi-tasking, real time operating systems. Design of interactive graphical displays;man-machine communication.

U4.480 Thesis 12 units

Senior Advanced core course for thedegree inMechanical and Mechatronic Engineering.

Prerequisite: 36 units of Senior courses.

Syllabus summary: In the Senior Advanced year of the course, each candidate works towards and writes an undergraduate thesis, at least one copy of which should be submitted in completed form (see below) before a date to be announced, which is normally not later than the last day in November.

Towards the end of each academic year a list of suggested topics and supervisors for thesis work is published for the information of current Senior year students. Each prospective Senior Advanced year student is then required to indicate his or her first, second, and third choices of topics after consultation with some or all of the prospective supervisors. Before the beginning of the next academic year, on the basis of Senior year results and other considerations, a topic and supervisor is advised to eachnew Senior Advanced year student, and work on the thesis may begin.

In the normal course of events some or all of the theoretical, developmental, and experimental aspects of research or design work are expected in a thesis. These aspects may be either directed by the supervisor or of a partly original nature, but in any event the student is directly responsible to his or her supervisor for the execution of his or her practical work and the general layout of the thesis itself.

Theses should be typewritten — with text, diagrams, graphs, photographs, etc., properly displayed — and notlessthanonecopy should be submitted, permanently bound betweenhard covers for the departmental library, on or before the due date. Students are responsible for supplying their own paper, typewriting, diagrams, and binding, but in certain circumstances assistance may be given with the more difficult problems of photography, diagram duplication, etc. It is recommended that the size of the paper be A4.

It is customary in most investigational work for the worker to develop a set of index cards to keep track of his or her references.

Each thesis writer may be called upon at the year's end to show some evidence of his or her activities in this respect.

The Charles Kolling Prize may be awarded for the best graduation thesis.

U4.484 Professional Engineering 4 units

Senior Advanced corecourse for the degree in Mechanical and Mechatronic Engineering.

Prerequisites: U3.460 Manufacturing Engineering and Management.

Classes: lectures/consultations/student presentations — 4hr/week for one semester.

Assessment: assessment of student assignments/ presentations and 2hr exam at end of semester.

Course objectives: To impart knowledge resulting in a more global approach, to the practice of engineering and engineering management, as well as to provide a vehicle for improving communication skills.

Syllabus summary: Projectmanagement: specific aspects of project managementincludinginitial establishment of projects and design criteria, and capital cost estimating. Design management: topics will cover design integration, codes and standards, specification preparation, and sources of information. Plant engineering management: the areas will include decision making, computerised maintenance, understanding unit operations, environment protection measures, engineering as an element in the cost of production, continuous improvement, provision of plant and ancillary services, and the engineer as a trainer.

U4.485 Professional Communication 4 units

Sen iorAdvanced core course for the degree in Mechanical and Mechatronic Engineering.

Prerequisite: completion of industrial experience (see U4.486).

Classes: some instructional sessions will be arranged to provide basic techniques for preparation and presentation of technical material to an audience by audio-visual means and in report writing.

Assessment.' satisfactory performance in the seminar as assessed by the participants and in a written report on industrial experience.

Syllabus summary: During the latter part of the year, one or two whole days are set aside for the presentation of student addresses at a public conference. Each final year student, usually in consultation with his or her thesis supervisor, prepares an abstract of the seminar for distribution one week in advance of the conference. Althoughit is not obligatory, the subject for the seminar is normally closely related to the student's thesis work; thusittends to deal in depth withsomerelatively narrow technical field. At the conference (where the audience comprises senior, senior advanced and postgraduate students, departmental staff and visitors), oral presentation of the thesis is followed by critical discussion under formal chairmanship.

The industrial experience reportmust be submitted early in Semester 1. The report is assessed on content and presentation in accordance with details that are distributed in theprevious semester. Thereport should contain a section on management.

U4.486 Practical Experience 6 units

Senior Advanced core course for the degree in Mechanical and Mechatronic Engineering.

Prerequisite: 28 units of Senior courses.

Classes: 12 weeks of practical work experience.

Assessment: will be on a Pass/Fail basis. Marks will not be given. (Course will not contribute to the weighted averages used to determine Honours.)

Syllabus summary: Each student is required to work as an employee of anapproved engineering organisation and to submit a satisfactory written reportof his or her work.Nonriallyl2weeksofpracticalworkexperience (375 hours minimum) is required and this is undertaken after the completion of some or all of the prescribed Senior core courses and before enrolment in the final year of study. The University Careers and Appointments Service is available to assist students to obtain suitable employment. This course must be passed in order to graduate.

U4.490 Environmental Engineering 6 units

Senior Advanced elective course.

Mutually exclusive with: U4.491 Environmental Acoustics and Noise Control if Acoustics forms part of U4.490; mutually exclusive with U4.694 Pollution Control Engineering if Environmental Impact Assessment forms part of U4.490.

Prerequisite: U3.420 Thermo-fluid Engineering.

Corequisite: U4.486 Practical Experience.

Classes: 5hrs/wk in Sem 1 plus 2 Saturday field-trips.

Assessment: assignments and one 2hr exam at end of each sem.

Syllabus summary: The course will consist of the following components depending on availability of lecturers.

Environmental acoustics and noise control — Basic acoustics theory, sound generation and propagation, impedance, absorbing materials, industrial noise sources, isolationmethods of noise control, enclosures, instrumentation and measurement, frequency analysis, noise regulations. Computational methods in acoustics.

Environmental impact assessment — The nature of environment protection, fundamentals of air, water and noise pollution, solid waste disposal, limnology, marine and terrestrial ecology, aesthetics, urban and regional planning. Social and economic factors, legislation and its administration, preparation of environmental impact reports. Air pollution and its control — sources, dispersion, meteorology, photochemicalsmog formation, measurements,introduction to modelling, particles and aerosols, control equipment.

• Textbook

Porges *Applied Acoustics* (Arnold, 1977)

Reference books
Crocker and Price Noise *and Noise Control* (CRC Press)
Groome *Noise, Buildings and People* (Pergamon, 1977)
Faulkner *Handbook of Industrial Noise Control* (Industrial Press)
Taylor HandbookofNoise Measurements (General Radio, 1978) *Acoustic Noise Measurement* (Bruel and Kjaer, 1988)
Other books as advised during classes

U4.491 Environmental Acoustics and Noise Control 2 units

Senior Advanced elective course.

Mutually exclusive with: U4.490 Environmental Engineering if Acoustics forms part of U4.490.

Prerequisite: 24 units of Senior courses.

Classes: 2 lec and 1 tut/wk in Sem 2.

Assessment: one 1.5hr exam at end of Sem 2.

Syllabus summary: Basic acoustics theory, sound generation and propagation, impedance, absorbing materials, industrial noise sources, isolation methods of noise control, enclosures, instrumentation and measurement, frequency analysis, noise regulations. Computational methods in acoustics.

Textbook
Bies and Hansen *Engineering Noise Control* (Allen & Unwin, 1988)

Reference books
Crocker and Price Noise *and Noise Control* (CRC Press)
Croome *Noise, Buildings and People* (Pergamon, 1977)
Doelle *Environmental Acoustics* (McGraw-Hill)
TaylorHandbookofNoiseMeasurements (General Radio, 1978) *Acoustic Noise Measurement* (Bruel & Kjaer, 1988)

U4.510 Practical Experience 8 units

Senior Advanced core course for the degree in Electrical Engineering and the ISE stream.

Prerequisite: 28 units of Senior courses.

Assessment: Assessment in this course is by the submission, within the first two weeks of First Semester, of a written (hand or typed) report of about 2500 words of the industrial experience undertaken in accordance with regulations. This report is to be general in nature, indicating the overall structure of the company, the areas that the student became familiar with and their relationship to the firm and finally, what the student did. Detailed material may be incorporated as appendices if desired, and the student should have the report vetted beforehand by a responsible officer of the company.

Syllabus summary: It is necessary for the student to obtain industrial experience of 12 weeks' duration before entering 4th Year (Senior Advanced Year). The work which is acceptable to the Faculty may range from process-type work in a large industrial complex, where many different engineering processes and labour management relations may be observed, to semi professional or research work with small specialist companies.

The responsibility rests with the student to obtain work acceptable to the Faculty, although the University, through the Department of Electrical Engineering and the Careers and Appointments Service, will assist as much as possible. The student is required to inform the Department of Electrical Engineering of any work arrangements made and to obtain approval of these arrangements from the Department.

STUDENTS ENROLLED IN THE BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING MUST GAIN CREDIT FOR AT LEAST FOUR OF THE FOLLOWING FIVE SUBJECTS: U4.520, U4.530, U4.540, U4.550, U4.560.

U4.520 Power Conversion Control 3 units

Senior Advanced elective course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U3.521 Energy Systems and the Environment and U3.522 Power Electronics and Drives.

Classes: (2 lec and one hr tut)/wk in Sem 1.

Assessment: Assignments and one 2hr exam at end of Sem 1.

Syllabus summary: Concepts of electric drive static and dynamic response, integration of motor and controller, DC machine drive components: transfer functions; phase controlled rectifier as a controllable power supply; system characteristics; chopper controllers, DC machine drive, control static torque, speed, position control; dynamic control; P, PI, PID controllers, stability, adaptive controls, digital control, microcontrollers, shaft sensors, control algorithms, Drive optimisation; flux current balance, dynamics of flux versus current voltage control, power supply ratings, thermal considerations, protection.

Application of control theory to power systems. Power system control; voltage and frequency. Synchronous machine transient theory. Power system transient behaviour, power system dynamics, transient and steady-state stability Detection and removal of system faults, protection relaying schemes, circuit interruption.

U4.525 Advanced Power Electronics and Drives 3 units

Senior Advanced elective course for the degree in Electrical Engineering and the ISE stream.

Prerequisite: U3.522 Power Electronics and Drives.

Classes: (2 lec and one hr tut)/wk in Sem 2.

Assessment: one 2hr exam at end of Sem 2 and assignments.

Syllabus summary: Modern power semiconductor devices 'smart power'; design analysis and simulation of power electronic circuits, digital firing control; recent machine developments; DC and AC drives, analysis, control; digital techniques for control, protection and data logging; applications.

U4.526 Power System Analysis 3 units

Senior Advanced elective course for the degree in Electrical Engineering and the ISE stream.

Prerequisite: U3.521 Energy Systems and the Environment.

Classes: (2 lec and one hr tut)/wk in Sem 2.

Assessment: one 2hr exam at end of Sem 2 and assignments.

Syllabus summary: Types of study, power system components and models, load flow, voltage control, fault calculations, protection design, steady state stability, voltage regulator design transient stability, critical fault clearing time.

U4.530 Control 2 3 units

Senior Advanced elective course for the degree in Electrical Engineering and the ISE stream.

Prerequisite: U3.530 Control 1.

Classes: (2 lec and one hr tuf)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1.

Sy/ZflbMSSwmmfln/.Statevariabledescriprionof systems, canonical forms, relation to transfer functions, solution of the state equation, eigenvalues and eigenvectors. Regulator design using state feedback, controllability. State estimators/observability. Design of servo-mechanisms with non-zero command inputs. Introduction to optimal regulator design.

Analysis of non-linear systems. Describing functions, limit cycles. Phase plane analysis, trajectories, linearisation of non-linear differential equations, equilibrium points and their classification. Introduction to Lyapunov's direct method.

Sampled data systems. Discrete signals and sampling, discrete transfer functions. Discrete equivalents for continuous controller. Discrete models for sampled data systems, pulse transfer functions for feedback systems. Direct digital design by transform methods.

U4.531 Nonlinear and Adaptive Control 3 units

Senior Advanced elective course for the degrees in Electrical Engineering and Electrical Engineering (Information Systems Engineering).

Prerequisite: U3.530 Control 1.

Classes: 2 lec/wk and 14hrs of lab/tut in Sem 2.

Syllabus summary: Modelling by physical equations and input-output structures; concepts of linear, nonlinear, optimal, adaptive and robust control. Nonlinear systems analysis review and extensions, stability theory, oscillations and geometric concepts. Feedback linearisation, sliding mode and passivity-based control. Model-reference adaptive control and self-tuning regulators. Other advanced control strategies, supervisory control, fuzzy control and neural networks. How to choose a strategy. Applications to electrical and mechanical systems including drives, power systems, robotic and vehicle systems.

Textbook

Slotine and Li *Applied Nonlinear Control* (Prentice-Hall, 1991)

Reference books

Astrom and Wittenmark *Adaptive Control* (Addison Wesley, 1989)

Kosko *Neural Networks and Fuzzy Systems* (Prentice-Hall, 1992)

Isidori *Nonlinear Control Systems* 2nd edn (Springer-Verlag, 1989)

Vidyasagar *Nonlinear Systems Analysis* 2nd edn (Prentice-Hall, 1993)

U4.532 Fuzzy Systems and Applications 3 units

Senior Advanced elective course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Classes: 2 lec/wk and 14 hrs lab/tut in Sem 1 or Sem 2.

Assessment: one 2hr exam at end of course.

Syllabus summary: Mathematical backgrounds: ordinary set theory, uncertainty and linguistic variables, fuzzy sets, algebra of fuzzy sets, membership functions. Fuzzy control; approximate reasoning, fuzzy logic, fuzzification, denazification, fuzzy associative memory, fuzzy system design, a fuzzy controlled vehicle, adaptive fuzzy systems. Other applications: fuzzy pattern recognition, fuzzy image transform coding, fuzzy knowledge based systems.

Reference books

Kaufmann *Fuzzy Mathematical Models in Engineering and Management Science* (North Holand, 1988)

Bezdek *Pattern Recognition with Fuzzy Objection Function Algorithms* (Plenum Press, 1981)

Pedrycz *Fuzzy Control and Fuzzy Systems* (Research Studies Press, Wiley, 1989)

Koskok *Neural Networks and Fuzzy Systems* (Prentice Hall, 1992)

U4.540 Electronics 2 3 units

Senior Advanced elective course for thedegreeinElectrical Engineering and *core course* for the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U3.540 Electronics 1; and U3.511 and U3.512.

Classes: (3 lec and one 1hr tut)/wk for one semester.

Assessment: one 2hr exam at end of Sem 1.

Syllabus summary: Prototyping; the design cycle; component parasitics; various current sources and mirrors, distortion, band hap references; function converters, multipliers and mixers, discriminators and limiters; oscillators and voltage controlled oscillators; phase locked loops; high frequency amplifiers; analog filter realisation; practical operation amplification, macromodelling, composite amplifier design; audio amplifier design; ampling and sample-and-hold circuits, guarding, analog/digital converters; seitchmode circuit design, noise, shielding and interference.

Textbook

No required text specified

U4.546 Microwave Engineering 3 units

Senior Advanced elective course for thedegree in Electrical Engineering and the ISE stream.

Corequisite: U4.540 Electronics 2.

Classes: (2 lec and one 2hr lab)/wk for one semester.

Assessment: one 2hr exam at end of course.

Syllabus summary: Review of travelling waves/planar transmission lines, passive microwave components, hybrids, connectors and transitions, directional couplers, matching, S parameters, network analyser measurements, active microwave components, microwave CAD.

U4.550 Communications 2 3 units

Senior Advanced elective course for the degree in Electrical Engineering and *core course* for the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U3.552 Communications lAandU3.512 Signals and Systems.

Classes: (2 lec and one hr tut)/wk in Sem 1.

Assessment: 3 laboratory/assignment reports (30%) and one 3hr exam at end Semester 1.

Syllabus summary: Orthogonal signal representations applied to modulated carrier data transmission, M-ary modulation, error control coding — block codes, cyclic codes, convolutional codes, trellis coded codulation, radio and optical communication systems design; time, frequency and code division multiplexing public and private networks for data communications; introduction to queuing theory and traffic theory and system reliability; local area network applications, ISDN and future trends in communication networks.

Textbooks

Skiar *Introduction to Digital Communications* (Prentice-Hall, 1987)

Stallings *Data and Computer Communications* 3rd edn. (Maxwell Macmillan 1991)

Reference book

Dickson and Lloyd *Open Systems Interconnection* (Prentice-Hall, 1992)

U4.551 Advanced Communication Networks 3 units

Senior Advanced elective course for the degree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisites: U3.552 Communications 1A; U3.553 Digital Signal Processing: Principles and Applications.

Corequisite: U4.550 Communications 2.

Classes: (2 lec and 1hr tut)/wk in Sem 2.

Assessment: 2 assignments/reports (30%) and one 2hr exam, end Semester 2 (70%).

Syllabus summary: ISDN architecture and organisation, common channel signalling system 7. Concepts of briadband, metropolitan and wide area networks. Network technologies, asynchronous mode transfer, fast packet switching, FDDI, DQDB. Multimedia communications networks. Telecommunications and computer network software design, network standards, and management. Principles, design and practice of terrestrial mobile networks, GSM, CPT and PCN. System and network reliability. Future trends in network demand and technologies.

Textbooks

To be determined

Reference books

Stallings *Data and Computer Communications* 3rd edn (Maxwell Macmillan, 1991)

Schwartz *Telecommunication Networks* (Addison Wesley, 1987)

dePrycker *Synchronous Transfer Mode* (Ellis Horwood, 1991)

Ronayne *The Integrated Services Digital Network* (Pitman 1987)

Dickson and Lloyd *Open Systems Interconnection* (Prentice Hall, 1992)

U4.552 Coding Fundamentals and Applications 3 units

Senior Advancedelectivecourseiorihedegree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U3.552 Communications 1A.

Corequisite: U4.550 Communications 2.

Classes: (2 lec and 1hr tut)/wk in Sem 1.

Assessment: Assignment (25%) and exam at end Semester 1 (75%).

Syllabus summary: Error control coding principles, linear algebra, linear block codes, cyclic codes, BCH codes, Reed-Solomon codes, burst-error correcting codes, design of codecs for block codes, applications of block codes in communications and digital recording, convolutional codes, Viterbu algorithm, design of codecs for convolutional codes, applications of convolutional codes in communications, trellis coded modulation, block coded modulation, design of codecs for trellis codecs, application of trellis codes in data transmission, coding for spread spectrum, applications of spread spectrum techniques.

U4.553 Satellite Communication Systems 3 units

Senior Advanced elective course for thedegree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U3.552 Communications 1 A.

Corequisite: U4.550 Communications 2.

Classes: (2 lec and one 1hr tut/lab)/wk in Sem 2 (evenings).

Assessment: Assignment (25%) and end of semester exam (75%).

Assignment schedule: one assignment towards the end of Sem 2.

Syllabus summary: Introduction to satellite communication, satellite link design, propagation characteristics of fixed and mobile satellite links, channel modelling, access control schemes, system performance analysis, system design, mobile satellite services, global satellite systems, national satellite systems, mobile satellite network design, system reliability, channel signalling, digital modern design, speech code design, error control code design, low earth orbit communication satellites.

Textbook

Miller, Vucetic and Berry *Satellite Communication Techniques* (Kluwer, 1993) (in press)

Reference books

Evans *Satellite Communication Systems* (Pergrinus, 1987)

Bhargava *et al. Digital Communications by Satellite* (J. Wiley and Sons, 1981)

Spiker *Digital CommunicationsSatellite* (Prentice-Hall, 1977)

U4.554 Image Processing and Computer Vision 3 units

Senior AdvancedelectivecourseioTthedegree in Electrical Engineering and the degree in Electrical Engineering (Information Systems Engineering).

Prerequisite: U3.512 Signals and Systems and U3.553 Digital Signal Processing.

Classes: (2 and one 1hr tut/lab)/wk in Sem 1.

Assessment: assignments (25%) and one 2hr exam (75%), end of semester.

Syllabus summary: Mathematical preliminaries: two-dimensional (2D) signals and systems, image models and image transformation, image digitalisation; visual perception, sampling, quantisation and colour representation. Image enhancement and restoration; histogram modelling, spatial and transform operations, filtering, deconvolution and extrapolation. Image compression: predictive methods, transform coding, vector quantisation and fracta based methods. Image reconstruction: Radon transform and projection theorem computer tomography (CT) and magnetic resonance imaging (MRI) systems and three-dimensional (3D) imaging. Image analysis and computer vision; edge detection and boundary extraction, region and object representation, image segmentation and pixel classification, texture analysis and scene detection and matching.

U4.560 Digital Systems 2 3 units

Senior Advanced elective course for thedegreeinElectrical Engineering and *core course* for the degree in Electrical Engineering (Information Systems Engineering).

Prerequisites: U3.560 Digital Systems 1 and U3.540 Electronics 1.

Classes: (2 lec and ihr tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1.

Syllabus summary: Digital systems design process. Processor bus architectures, I/O interfacing, bus interconnections, synchronous and asynchronous buses, parallel and serial interfacing. Static and dynamic memory design, memory interfacing, bus arbitration, shared memory systems. Hardware description languages, digital systems compilers. VLSI design (Silicon Run Video), VLSI design methodologies. CMOS logic, CMOS performance evaluation, CMOS systems design (data path design). Design for testability techniques. Fault tolerant designs. High speed digital systems designs.

Textbooks

Weste and Eshraghian *Principles of CMOS Design* 2nd edn (Addison-Wesley, 1993)

Fulcher *Microcomputer Systems* (Addison-Wesley, 1989)

U4.561 Real-time Computer Systems 3 units

Senior Advanced core course for the degree in Electrical Engineering (Information Systems Engineering) and *Senior Advanced elective course £*or the degree inElectrical Engineering.

Prerequisite: U3.560 Digital Systems 1.

Classes: (2 lec and one 1hr tut and 1hr lab))/wk in Sem 1.

Assessment: one 2hr exam at the end of the course.

Syllabus summary: The emphasis in this course will be placed on hard real time and embedded systems, as applied to engineering, manufacturing and automation. Controller vs controlled system. Timing: periodic vs aperiodic; hard vs soft deadlines, predictability and determinancy, granularity. Scheduling theory: rate monotortic scheduling. Introduction to real-time software; real-time languages and their features: Modula 2, Ada. Real time operating systems: tasking and scheduling, memory management, re-entrancy, interrupts, binding, modularity, determinancy, threads> synchronisation, semaphores, message passing, user interface, user control, I/O, drivers and interfaces. Real time standards — languages and operating systems. Real time software design: modelling, state based design, data flow, real time OOD. Embedded systems: overview, signal flow—A/D, D/A filters, samplers, muxes. Reliability and fault tolerance: hardware: power, grounding, protection; software: error detection and recovery, checkpointing, fail safe, fail soft, watchdogs, memory protection, encryption, authentication, formal design and safety. Systems: micro, mini and maxi systems. SCADA, DCCS, LANs, WANs, Client/Server, Frontends, distributed OS. Some case studies.

U4.562 Advanced Real Time Computer Systems 3 units

Senior Advanced elective course for the degree in Electrical Engineering (Information Systems Engineering) and for the degree in Electrical Engineering.

Prerequisite: U3.560 Digital Systems 1.

Corequisite: U4.561 Real Time Computer Systems.

Classes: (2 lec and one 1hr tut)/wk in Sem 2.

Assessment: one 2hr exam at the end of the course.

Syllabus summary: Modelling of real-time systems, design techniques, analysis and prediction of real-time behaviour, advanced scheduling techniques, simulation, verification and validation, communications, distributed real-time systems, reliability and fault tolerance, hardware architectures, CASE tools for real-time systems.

U4.565 Digital Systems 3 3 units

Senior Advanced core course for the degree in Electrical Engineering (Information Systems Engineering) and *Senior Advanced elective course iot* the degree in Electrical Engineering.

Prerequisite: U3.560 Digital Systems 1.

Corequisite: U4.560 Digital Systems 2.

Classes: (two lec and 1hr tut/lab)/wk in Sem 2.

Assessment: laboratory work, one mid-semester quiz and one 2hr exam at end of Sem 2.

Syllabus summary: Introduction and video (Silicon Run II), review of CMOS subsystem design, CMOS designmethods and economics, CMOS testing, CMOS datapath design, CMOS memory design, CMOS I/O and control design. Fundamentals of high-speed digital design, high-speed properties of logic gates, measurement techniques. Digital transmission lines, ground planes and layer stacking, terminations, vias, power systems and connectors, clock distribution and oscillators.

Textbooks .

Weste and Eshraghian *Principles of CMOS Design* 2nd edn. (Addison-Wesley, 1993)

Johnson and Graham *High-Speed Digital Design* (Prentice-Hall, .1993)

U4.566 Adaptive Pattern Recognition 3 units

Senior Advancedelective course for thedegreeinElectrical Engineering and the ISE stream.

Prerequisite: U3.553 Digital Signal Processing.

Corequisite: nil.

Classes: (one 2hr lec and one 1hr lab/tut)/wk in Sem 2.

Assessment: one 2hr exam at end of Sem 1.

Syllabus summary: Mathematical preliminaries: probability theory, random vectors, decision theories.

Statistical approaches: feature extraction, nonlinear mapping, quadratic and linear classifiers, nonparametric estimation and classification. Fuzzy set approach: operations on fuzzy sets, the use of fuzzy sets in pattern recognition. Neural-net implementations: generalised perception, associative memories, self-organised neural nets, integrated neural-net computing environment, linking of symbolic and numeric processing.

U4.567 Machine Intelligence and Pattern Recognition 3 units

Senior Advanced elective course for the degree inElectrical Engineering and the ISE stream.

Prerequisite: nil.

Corequisite: nil.

Classes: 3hr/wk in Sem 2.

Assessment: one assignment, one group-based project, and tutorial attendance and participation.

Syllabus summary: Introduction to artificial intelligence, review of symbolic techniques, review of artificial neural network techniques. Application of AI in electrical engineering, diagnosis, design and signal analysis as application domains. Symbolic AI, knowledge representation techniques; predicate logic; procedural representation; semantic networks; production systems; rule-based systems. Expert systems, knowledge engineering, machine learning. Designing a rule-based system: a case study. Limitations of symbolic techniques, cognition, introduction to artificial neural networks. Fundamentals of artificial neural networks, basic neuron, synapses, activation functions, feedforward and recurrent networks. Teaching artificial neural networks, supervised and unsupervised techniques, learning as an optimisation problem. Pattern recognition using artificial neural networks. Perceptrons, neo-cognitrons, multi-layer perceptrons, Kohonen networks. Machine vision using neural networks, Fukushima networks. Fuchsia unsupervised learning algorithm, self-organising networks, Fukushima networks, Fukushima unsupervised learning algorithm, self-organising networks. Speech pattern recognition, generic block diagram of a speech recognition system, time shift, time delay neural networks, Kohonen maps. Signal classification using neural networks; a case study.

U4.570 Project Management 3 units

Senior Advanced core course for the degree in Electrical Engineering and the ISE stream.

Classes: (2 lec and one 1hr tut)/wk in Sem 1.

Assessment: one 2hr exam plus assignments.

Syllabus summary: The organisation of research and development; estimating costs and resources; financial appraisal techniques for selection and appraisal; project planning and control; the management of human resources; problem specification and decision making; innovation; patents.

U4.580 Laboratory 8 units

Senior Advanced core course for the degree in Electrical Engineering.

Prerequisites: U3.521 or U3.522.

Corequisites: At least four of the five following subjects: U4.520 Power Conversion Control, U4.540 Electronics 2, U4.530 Control 2, U4.550 Communications 2 and U4.560 Digital Systems 2.

Mutually exclusive with: U4.581.

Classes: 9hrs/wk in Sem 1.

Assessment: an exam at end of Sem 1; lab performance, notebook-keeping and submitted reports will also be assessed.

Syllabus summary: Students must complete a prescribed number of laboratory experiments in at least 4 of the following 5 areas: power, control, electronics, communications and digital systems.

U4.581 Information Systems Laboratory 8 units

Senior Advanced core course for the degree in Electrical Engineering (Information Systems Engineering).

Mutually exclusive with: U4.580 Laboratory.

Prerequisites: U3.553 Digital Signal Processing: Principles and Applications; U3.561 Computer Architecture; U3.562 Software Engineering.

Corequisites: U4.540 Electronics 2; U4.550 Communications 2; U4.560 Digital Systems 2; U4.561 Real time Computer Systems.

Classes: 9hrs/wk in Sem 1.

Assessment: an exam at the end of Sem 1; laboratory performance, notebook-keeping and submitted reports will also be assessed.

Syllabus summary: Students must complete a prescribed number of laboratory experiments in each of information systems engineering, communications, electronics and digital systems.

U4.585 Thesis/Project 10 units

Senior Advanced core course for the degree in Electrical Engineering and the ISE stream.

Corequisite: U4.580 Laboratory or U4.581 ISE Lab.

Assessment: essay, project, report and seminar.

Syllabus summary: Each student is required to select an approved topic, and will submit an essay based on the theoretical background to the topic and a report on the experimental work carried out. In addition, each student will present a short seminar describing the project and the results obtained. The subject requires a consistent and significant effort equivalent to about 2 days per week in Sem 2.

U4.600 Practical Experience 8 units

Senior Advanced core course for the degree in Chemical Engineering.

Prerequisite: 28 units of Senior courses.

Classes: There are no formal classes. Students are required to obtain 12 weeks' practical work experience before entering their Senior Advanced Year.

Assessment: by submission of a report of approximately 2500 words on the industrial experience undertaken. The report will cover the nature of the industry, the company's organisational relationships both internally and externally and a technical section devoted to the work performed by the student. The report is to be submitted before the end of the first week of the Senior Advanced academic year.

Syllabus summary: Each student is required to work as an employee of an approved organisation and to submit a report on that work. The employment undertaken must be relevant to Chemical Engineering and should be discussed before acceptance with a member of the Department of Chemical Engineering. While the responsibility for obtaining satisfactory employment rests with the student, the Department, through the Chemical Engineering Foundation, and the Careers and Appointments Service will assist where possible.

U4.625 Reaction Engineering 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: U3.625 Reaction Engineering 1.

Classes: (3 hrs of lec/tut)/wk in Sem 1.

Assessment: one 3hr exam at end of course plus assignments.

Syllabus summary: Homogeneous reactors: non-isothermal design; unsteady state operation and multiple steady-states; reactor stability. Diffusion and reaction in porous catalysts: packed bed reactors and chemical vapour deposition. Multiple reactions: net reaction rate and stoichiometric multiple steady states. Multiphase reactors: slurry and bioreactors. Residence time distribution, non ideal reactors. Reactor optimisation.

Textbook

Fogler *Elements of Chemical Reaction Engineering* (Prentice-Hall, 1990)

Reference book

Levenspiel *Chemical Reaction Engineering* (Wiley, 1972)

U4.630 Mineral Processing (Mineral Dressing) 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: U3.610 Unit Operations 1.

Classes: 4hrs/wk of lec, lab and tut classes for one sem; and field trips as arranged.

Assessment: tut assignments, lab reports and one 2hr exam at end of course.

Syllabus summary: Mineralogy and its relationship to mineral beneficiation, liberation. Metallurgical balances. Data reconciliation. Mineral processing unit operations, principles—conrminution, concentration, heavy media separation, jigging, magnetic separation, electrodynamic and electrostatic separation, tabling and film concentrators. Flotation—surface chemistry. Collector, modifier action. Electrokinetic phenomena. Oxide and sulphide ore flotation. Depressants and selective flotation. Flotation kinetics. Ore sorting. Tailings dams.

Reference books

Gaudin *Principles of Mineral Dressing* (McGraw-Hill, 1939)
Taggart *Elements of Ore Dressing* (Wiley, 1964)
Wills *Mineral Processing Technology* (Pergamon, 1992)

U4.631 Mineral Processing (Extractive Metallurgy) 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: U3.610 Unit Operations 1.

Classes: 2hrs/wk of lec, lab and tut classes for one sem; and field trips as arranged.

Assessment: tut assignments, lab reports and one 2hr exam at end of course.

Syllabus summary: Mineral beneficiation and its relationship to smelting practice. Principles of extraction and recovery in pyro-metallurgy, hydrometallurgy and electrometallurgy. Alternatives in mining and minerals beneficiarion—in situ leaching, dump and heap leaching. Mineral stability. Thermodynamics of reduction. Ellingham diagrams. Roasting of sulphides. Matte smelting and converting. Refining. Hydrometallurgy and electrometallurgy.

Reference books
Gilchrist *Extraction Metallurgy* (Pergamon, 1989)
Moore *Chemical Metallurgy* (Butterworths, 1981)
Pehlke *Unit Process in Extractive Metallurgy* (Elsevier, 1972)
Newton *Extractive Metallurgy* (Wiley, 1967; Pergamon, 1967)
RosenquistPrfncipZes *of Extractive Metallurgy* (McGraw-Hill, 1975)

U4.632 Separation Processes 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisites: U3.610 Unit Operations 1.

Classes: 4hrs/wk for one semester.

Assessment: one 2hr exam plus assignments.

Syllabus summary: Multicomponent distillation: history and introduction. Phase equilibria inmulticomponent systems. K values for ideal and non-ideal systems. Computer methods of solution including Naphtali-Sandholm method. Flowsheeting packages for multicomponent distillation. Overall column efficiencies. Tray layout. Optimal column design. Membrane separation: introduction, types of membranes, separating ability and equipment. Packed distillation columns: capacity and HETP. Environmental applications; steam stripping of volatile organic componentfromaqueous waste liquids. Flowsheeting packages and phase equilibria in environmental systems. Practical distillation for tray and packed columns following the Kister methods.

Textbooks
Furzer *Distillation for University Students* (published by the author, Department of Chemical Engineering, University of Sydney, 1986)
Kister *Distillation Design* (McGraw-Hill, 1992)

Reference book
Perry and Green *Chemical Engineer's Handbook* 6th edn (McGraw-Hill, 1984)

U4.633 Advanced Particle Mechanics 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: U3.610 Unit Operations 1.

Classes: (3hrs of lec and tut)/wk for one semester.

Assessment: assignments, etc., and one 3hr exam at end of course.

Syllabus summary: Bulk solids flow: properties of bulk granular material; stress analysis of solids; testing of granular material; flow properties; design of bunkers; flow rate predictions; calculation of flow parameters of hoppers. Fluidisation: Applications; types of fluidisation; incipient fluidisation; theory of bubble rise; bubble formation; fluid-bed reactors. Pneumatic conveying of solids: regimes, models and equipment (including blowers). Hydraulic conveying: regimes, models and equipment (including pumps).

Reference books
Shamlou *Handling of Bulk Solids* (Butterworths, 1988)
Coulson and.Richardson *Chemical Engineering, Vol. 2* (Pergamon, 1983)
Davidson and Harrison *Fluidised Particles* (CUP, 1963)

U4.634 Advanced Topics in Environmental Engineering A 4 units
U4.635 Advanced Topics in Environmental Engineering B 4 units

Senior Advanced elective courses for the degree in Chemical Engineering.

Prerequisite: U3.610 Unit Operations 1.

Classes: 3hr/wk for one semester (each course).

Assessment: tutorials and assignments; one 3hr exam at the end of the semester (each course).

Syllabus summary: These two courses are focused on the application of chemical engineering fundamentals to developing quantitative descriptions of environmental fate and transport processes. These processes include chemical partitioning, reactions, and advective/dispersive transport in air, water and soil. Syllabuses for each subject will be defined annually.

Specific course topics will be drawn from: sources and type of air and water pollution; atmospheric chemistry and ozone pollution; control of sulphur and nitrogen oxides; transport, dispersion and reaction in the atmosphere; vapour emissions from landfills and surface impoundments; water pollution: physiochemical and biological treatment processes; equilibrium in aqueous phase systems; groundwater movement and solute transport; oily phase migration in soils; in situ remediation of contaminated soils and sediments.

U4.640 Project Engineering 4 units

Senior Advanced core course for the degree in Chemical Engineering.

Classes: approximately 4hrs/wk for lectures, seminar and discussions for one sem.

Assessment: tutorial assignments, seminar and one 3hr exam at end of sem.

Syllabus summary: Principles of project management, management of large projects and a portfolio of small projects including planning techniques, organisation and control. Management of commissioning and start up of process plant, and of maintenance. Preparation and deliveryof oral presentations on technical subjects. Introduction to occupational safety, safety management systems, management of environmental performance, safety during shutdowns, quality assurance and principles of Total Quality Management. The concept of 'completed staff work'. Introductiontoprocessplantproductionmanagement. Individual and in-team approaches to solving standard and open-ended problems.

Textbook
Lock *Project Management* 4th edn (Open University/Gower U.K.,1989)

U4.660 Process Control 2 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: U3.660 Process Control 1.

Classes: (4hrs of lec, tut and lab work)/wk for one sem.

Assessment: tut assignments, lab reports and one 3hr exam.

Syllabus summary: Frequency response analysis. Distributed parameter systems. Controller characteristics and tuning — stability analysis of feedback loops, measuring instruments and control hardware. Control valve characteristics and sizing. Multivariable control. Batch control. Programmable logic controllers. Instrumentation and control scheme implementation for industrial processes.

Textbook

Stephanopoulos *Chemical Process Control: An Introduction to Theory and Practice* (Prentice-Hall, 1984)

Reference books

As indicated during classes

U4.681 Thesis 8 units

Senior Advanced core course for the degree in Chemical Engineering.

Prerequisitesfcorequisites: Students should have completed or be enrolled in all other Senior Advanced core courses.

Classes: no formal classes. The thesis supervisor will be available for discussion at agreed times but the student is expected to work on his or her own initiative.

Assessment: written thesis and seminar.

Syllabus summary: Students are asked to write a thesis, based on a modest, but significant research project, which is very often some aspect of a staff member's research interests. Most projects will be experimental in nature, but some may be largely theoretical or mathematical. Other topics may involve computer programming, feasibility studies, or the design, construction, and testing of equipment.

In undertaking the project, the student will learn how to examine published and experimental data, set objectives, organise a program of work, and analyse results and evaluate these in relation to existing knowledge. The thesis will be judged on the extent and quality of the student's original work and particularly how critical, perceptive, and constructive he or she has been, in assessing his or her own work and that of others.

Students are asked to nominate preferences from a list of available topics. Topics are allocated according to these preferences wherever possible. Deadlines are fixed each year for the submission of a thesis draft, and for the submission of the final thesis, typed and bound in an approved manner. Students are required to give a seminar, explaining the aims and achievements of their thesis.

U4.684 Chemical Engineering Design 1 4 units

Senior Advanced core course for the degree in Chemical Engineering.

Prerequisite: U3.610 Unit Operations 1.

Classes: (3hrs of lec and tut)/wk in Sem 1.

Assessment: one 2hr exam at end of Sem 1, plus assignments.

Syllabus summary: Introduction to process design. Design of pressure vessels and associated equipment. Process flowsheeting. Sequential modular and equation-oriented approaches. Flowsheeting packages: structure, unit model libraries, thermodynamics and physical properties models. Units and flowsheet degrees of freedom. Performance and design calculations. Process synthesis and analysis: conceptual design. Preliminary process optimisation. Short-cut design procedures.

Textbooks

Douglas *Conceptual Design of Chemical Processes* (McGraw-Hill, 1988)

Westerberg *el al. Process Flowsheeting* (CUP, 1979)

Reference book

Wells and Rose *The Art of Chemical Process Design* (Elsevier, 1986)

U4.685 Chemical Engineering Design 2 8 units

Senior Advanced core course for the degree in Chemical Engineering.

Prerequisites: U3.610 Unit Operations 1, U3.621 Thermodynamics and U3.645 Project Economics.

Corequisite: U4.684 Chemical Engineering Design 1.

Classes: approximately 8hrs/wk of informal classes, design and library work in Sem 2.

Assessment: design report and contribution made to design group.

Syllabus summary: The preparation of a detailed design project: flowsheet selection, heat and mass balances, detailed equipment design and costing, hazard assessment and hazard operability studies, environmental impact and project financial analysis.

U4.690 Reservoir Engineering 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: U3.610 Unit Operations 1.

Classes: 4hrs/wk for one sem.

Assessment: one 3hr exam at end of course plus assignments.

Syllabus summary: This course discusses the mathematical techniques that are commonly used to solve the partial differential equations describing the flow of oil and gas throughreservoir rocks. The applications are drawn from reservoir engineering, but the solution methods apply more generally to multiphase flow through porous media. Equations for single phase flow in porous media. Steady state flow in 1 and 2 dimensions; aerial sweep efficiencies in regular well arrays. Miscible displacement processes: the convective-dispersion equation. Equations of flow for two-phase displacement processes in porous media. Linear one-dimensional flow: the Buckley Leverett solution to the two phase convection equation; shock front solutions; simulation methods. Application of the method of characteristics to partially miscible displacements involving two or three components.

Reference books

Dake *Fundamentals of Reservoir Engineering* (Elsevier, 1978)

Douglas *Conceptual Design of Chemical Processes* (McGraw Hill, 1988)

U4.691 Process Systems Engineering 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisites: U3.630 Computations and Statistics and U3.660 Process Control 1.

Corequisite: U4.660 Process Control 2.

Classes: (3hrs of lec/tut)/wk in Sem 2.

Assessment: 2.5hr exam at end of course plus assignments.

Syllabus summary: Computer applications in process design, operationand control. Steady-state anddynamic process simulation. Process modelling. Process optimisation theory and applications including: on-line optimisation, linear and nonlinear programming. Available computer packages for process modelling and optimisation. Large scale flowsheet optimisation. Process control systems synthesis.

Reference books

Edgar and Himmelblau *Optimisation of Chemical Processes* (McGraw-Hill, 1988)

Stephanopoulos *ChemicalProcess Control* (Prentice-Hall, 1984)

Douglas *Conceptual Design of Chemical Processes* (McGraw-Hill, 1988)

Reklaitis, Ravindran and Ragsdell *Engineering Optimisation: Methods and Theory* (John Wiley and Sons, 1983)

U4.692 Optimisation Techniques 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Mutually exclusive with: U4.691 Process Systems Engineering.

Prerequisite: U3.630 Computations and Statistics.

Classes: 4hrs lec and tut/wk for one sem.

Assessment: tut assignment on specific topics and one 2hr exam at end of course.

Syllabus summary: Problem formulation, objective functions and constraints. Analytical and numerical search methods for single variable and multivariable systems. Linear systems, linear prograrrirning, network and distribution problems. Discrete sequential problems and dynamic programming. Flowsheeting programs and optimisation. Stochastic processes, queues, simulation, Monte Carlo methods.

Textbook

Edgar and Himmelblau *Optimization of Chemical Processes* (McGraw-Hill, 1988)

Reference books

Gill, Murray and Wright *Practical Optimization* (Academic Press, 1981)

Fletcher *Practical Methods of Optimization, vol. I, Unconstrained Optimization* (John Wiley & Sons, 1980)

Fletcher *Practical Methods of Optimisation, vol. II, Constrained Optimization* (John Wiley & Sons, 1981)

U4.694 Environmental Impact Assessment 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Mutually exclusive with: U4.490 Environmental Engineering if Environmental Impact Assessment forms part of U4.490.

Prerequisite: U3.610 Unit Operations 1 or U3.420 Thermofluid Engineering or U3.271 Transport Engineering and Planning.

Classes: one 3hr lec/wk for one sem; field trip and student seminar session; tutorials as arranged.

Assessment: tut assignments, report and one 2hr exam at end of course.

Syllabus summary: The nature of environmental protection; air, water, noise pollution and waste disposal; hazard analysis; limnology, marine and terrestrial ecology; urban and regional planning; aesthetics; economic framework; social and political factors; environmental legislation and its implementation; environmentalimpactreports, case studies; field work.

Reference book

Berthoeux and Rudd *Strategy of Pollution Control* (Wiley, 1977)

U4.695 Biochemical Engineering 8 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: U2.610 Chemical Engineering 2.

Corequisites: U2.066 Biochemistry 2 Auxiliary and U3.067 Microbiology 2.

Classes: 4 lec/wk, six 1hr tut sessions and four all-day lab sessions of 8-10hrs duration in one sem.

Assessment: assignments, lab reports and one 3hr exam at end of course.

Syllabus summary: Evolution of biochemical engineering. A microorganism as a physio-chemical system. Evolution of microorganisms. Structure and function of microbial growth. Biochemistry revision: structure of metabolism, major catabolic pathways, major anabolic pathways, metabolism of facultative aerobes. Integrated metabolism: rate-limiting sequences in microbial growth, transport into microbial cells and organelles, mass and energy balances, control of small metabolite concentrations (NADH and ATP), control of enzyme concentrations. Primary control of carbohydrate metabolism: catabolite repression, Pasteur effect, Crabtree effect. Environmental factors and microbial growth: growth requirements, concepts of limiting substrate, dissolved oxygen and carbon dioxide evolution, temperature and pH effects. Control of environmental factors; elementary instrumentation. Energetics of microbial growth; energetic requirements for the manufacture of cellular components, concepts of yield, maintenance energy, PO ratio, entropy and free-energy relationships, prediction of yield. Kinetics of microbial and animal and plant cell growth: single cell growth, cell cycle of bacteria, yeast and mammalian cells, typical batch growth curve. Continuous culture systems; chemostat, turbidostat, pH stat, continuous culture with recycle, multistage systems, plug flow reactors, enzyme reactors. Biological reactor design. The quantification of microbial growth; general principles for modelling complex systems, empirical and mechanistic models, Monod model, extensions to the Monod model including maintenance energy, viability, product inhibition, pH, etc. Unit operations in biochemical engineering: aeration and agitation, sterilisation and cleaning, fermenter design, product recovery scale-up. Industrial process: baker's yeast production, cheese manufacture, alternative fuels, food engineering, single cell protein, brewing, wine making, genetic engineering, amino acid production. Downstream processing. Economic analysis of the bioprocessing industry.

Textbook

Bailey and Ollis *Biochemical Engineering Fundamentals* IS edn (McGraw-Hill, 1986)

Reference books

Wang *et al. Fermentation and Enzyme Technology* (Wiley, 1979)
Pirt *Principles of Microbe and Cell Cultivation* (Blackwell, 1975)
Aiba *et al. Biochemical Engineering* (Academic Press, 1973)
Mandelstam and McQuillan *Biochemistry and Bacterial Growth* (Blackwell, 1976)
Blakebrough *Biochemical and Biological Engineering Science, Vols 1-2* (Academic Press, 1968)
Solomons *Materials and Methods in Fermentation* (Academic Press, 1969)
Whi ttaker and Stanbury *Principles ofFermentation Technology* (Pergamon, 1985)
Journal articles as indicated during.classes

U4.696 Hazard Assessment and Reduction 4 units

Senior Advanced core course for the degree in Chemical Engineering.

Classes: 4hrs/wk in Sem 2, involving 3hrs of lec/tut and discussions.

Assessment: tut assignments and one 3hr exam.

SyMabws swmmary.Tnevitability of risk, types of hazard to people, the environment and property. Risk criteria or targets. Systematic hazard identification. Etaiensions of risk. Quantification of consequences and frequency of hazardous incidents. Assessment of risks, risk contours. Role of the human factor. Inherent safety, and risk reduction by engineering and management approaches. Insurance, community and legal relationships. Case studies.

Reference book

Lees *Loss Prevention in the Process Industries* (Butterworths)

U4.697 Professional Option 2 units

Senior Advanced elective course for the degree in Chemical Engineering.

Prerequisite: credit for 145 units.

Syllabus summary: Each student is required to carry out an assignmentrelated to the profession of Chemical Engineering; this will normally consist of a discussion of the design or operation of ah industrial process. The discussion will be presented in the form of a written report, as a seminar, or both.

U4.698 Advances in Chemical Engineering 4 units

Senior Advanced elective course for the degree in Chemical Engineering.

Classes: 4hrs/wk for one sem.

Assessment: assignments, reports and one 3hr exam at end of course.

Syllabus summary: This course will discuss the impact of current research and new technology on the profession of chemical engineering; it will address the changes that are taking place in industrial processes as a result of new technologies.

The syllabus details will change from time to time as specialist lecturers become available.

U4.720 Aerodynamics 3 4 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Prerequisite: U3.725 Aerodynamics 2.

Classes: (4 lec/wk with associated tutorials) in Sem 1.

Assessment: written exam at end of Sem 1 plus course assignments.

Syllabus summary: Lifting-line theory for three dimensional wings. Steady flow panel methods for aerofoil sections. Linearised compressibility corrections; wind tunnel corrections; the effects of aspect ratio and sweepback.

Aerofoil section boundary layer theory; pressure gradients; laminar to turbulent boundary layer transition; laminar separation bubbles; aerofoil stall. Calculation of aerofoil drag.

Steady two-dimensional supersonic flow; shock waves; method of characteristics. Two-dimensional supersonic aerofoils. Introduction to three-dimensional effects.

' Reference books

McCormick *Aerodynamics, Aeronautics and Flight Medianics* (Wiley, 1979)
Milne-Thomson *Theoretical Aerodynamics* (Macmillan, 1966)
Bertin and Smith *Aerodynamics for Engineers* (Prentice Hall, 1985)
John *Gas Dynamics* (Allyn & Bacon, 1984)
Abbott and Von Doenhoff *Theory of Wing Sections* (Dover, 1959)
Schlichting *Boundary Layer Theory* (McGraw-Hill, 1960)
Pankhurst and Holder *Wind Tunnel Technique* (Wiley)
Jones and Cohen *High Speed Wing Sections* (Dover)
Anderson*Fundamentals of Aerodynamics* (McGraw-Hill, 1986)

U4.725 Aerodynamics 4 4 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Corequisite: U4.720 Aerodynamics 3.

Classes: (3 lec/wk with associated tuts) in Sem 2.

Assessment: written exam at end of Sem 2 plus course assignments.

Syllabus summary: Three dimensional panel methods; lift distribution for arbitrary wing planforms; effects of fuselage and control surfaces. Unsteady subsonic aerodynamics; introduction to flutter and divergence

Unsteady supersonic one-dimensional flow. Hypersonic flow; real gas effects. Rarefied gas flow.

Introduction to transonic aerodynamics.

Reference books

Houghton and Brock *Aerodynamics for Engineering Students* (Edward Arnold)
LiepmannandRoshko *Elements ofGasdynamics* (Wiley, 1957)
Bertin and Smith *Aerodynamics for Engineers* (Prentice Hall, 1985)
John *Gas Dynamics* (Allyn & Bacon, 1984)
Bisplinghoff and Ashley *Principles of Aeroelasticity* (Dover, 1962)
Dowell *AModern Course in* /lerodastfcih/(SijthoffNoordhoff, 1978)
Thompson *Compressible Fluid Dynamics* (McGraw-Hill)
Anderson *Fundamentals of Aerodynamics* (McGraw-Hill, 1986)

U4.730 Aircraft Structures 3 — 8 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Mutually exclusive with: U4.430 Applied Numerical Stress Analysis.

Prerequisites: U3.730 Aircraft Structures 1 and U3.735 Aircraft Structures 2.

Classes: 4 lec/wk throughout the year.

Assessment: tutorial work assignments and two 2hr exams.

Syllabus summary: Plates and shells. Optimum structures. Buckling of bars, plates and shells; imperfection sensitivity. Structural dynamics. Structural fatigue; principles and practice. Finite element analysis; static and dynamic, for bars, plates and shells.

Reference books

Timdshenko and Woinowsky-Krieger *Theory of Plates and Shells* (McGraw-Hill-Kogakusha)
Cox *Design of Structures of Least Weight* (Pergamon, 1965)
Shanley *Strength Analysis of Aircraft Structures (Dover)*
Brush and Almroth *Buckling of Bars, Plates and Shells* (McGraw-Hill)
Cook *Concepts and Applications of Finite Element Analysis* (Wiley, 1981)
Roark *Formulas for Stress and Strain* (McGraw-Hill-Kogakusha)
Madag *Metal Fatigue: Theory and Design* (Wiley)
Zienkiewicz *The Finite Element Method in Engineering* (McGraw-Hill)
Heubner *The Finite Element Method for Engineers* (Wiley Interscience)
Washizu *Variational Methods in Elasticity and Plasticity* (Pergamon)

Library classification: 620, 620.11,624.17

U4.740 Aircraft Design 2 — 4 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Prerequisites: U3.740 Aircraft Design 1 and U3.725 Aerodynamics 2. ,

Classes: one 3hr class/wk throughout the year.

Assessment: course assignments.

Syllabus summary: Design requirements. Sources of information for aircraft design. Configuration design: performance, weight and balance, propulsion. Aerodynamic design: lift, drag and control. Structural design: loads, philosophies, materials and analysis.

Systems design: requirements and specification system design procedures, systems integration.

Reference book

Torenbeek *Synthesis of Subsonic Airplane Design* (Delft U.P.)

U4.750 Mechanics of Flight 3 — 4 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Prerequisites: U3.725 Aerodynamics 2 and U3.755 Mechanics of Hight 2; U3.750 Mechanics of Flight 1.

Classes: 4 lec/wk with associated tutorials for one sem.

Assessment: written exam at end of sem and course assignments.

Syllabus summary: Aircraft dynamics; equations of motion including arbitrary modes. Inertial coupling between longitudinal and lateral degrees of freedom. Typical applications involving complex aircraft motion.

Introduction to aeroelasticity.

Elementary rotary-wing dynamics.

Mechanicsofaircraftcontrolsystems;controlsystem devices; gyroscopic motion; reference inputs for control and navigation. Transient response to control inputs.

Closed-loop control systems; transfer functions for complete aircraft and control system; stability of closed loop system. Mechanical/analogue/digitalmodification of basic aircraft stability. Human pilot as part of closed-loop system; aircraft handling qualities; description and specification.

Flight simulators.

Reference books

Etkin *Dynamics of Flight—Stability and Control* (Wiley, 1982)
Etkin *Dynamics of Atmospheric Flight* (Wiley, 1972)
Seckel *Stability and Control of Airplanes and Helicopters* (Academic Press, 1964)
Babister *Aircraft Stability and Control* (Pergamon, 1961)
Babister *Aircraft Dynamic Stability and Response* (Pergamon, 1980)
McCormick *Aerodynamics, Aeronautics and Flight Mechanics* (Wiley, 1979)
NATO AGARD *Flight Test Manual Vol. 2 — Stability and Control* (Pergamon, 1963)
Perkins and Hage *Airplane Performance, Stability and Control* (Wiley, 1949)
Bisplinghoff and Ashley *Principles of Aeroelasticity* (Dover, 1962)

U4.770 Propulsion — 4 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Prerequisites: U3.421 Thermodynamics and U3.725 Aerodynamics 2.

Classes: (3 lec/wk with associated tut and project work) in Semi.

Assessment: written exam at end of Sem 1.

Syllabus summary: Propulsion unit requirements for subsonic and supersonic flight; thrust components, efficiencies, additive drag of intakes. Airscrew theory. Operation and thermodynamics of turbojet and turbofan engines; intakes and jet nozzles. Piston and other types of engines. Performance of propulsion units. Component design and performance. Noise and pollution.

Reference books
HMandPeteisonMechanicsandThermodynamics ofPropulsion (Addison-Wesley, 1965)
Glauert *The Elements of Aerofoil and Airscrew Theory* (C.U.P.)
Kerrebrock *Aircraft Engines and Gas Turbines* (M.I.T. Press, 1977)

U4.775 Engineering Experience 4 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Prerequisite: 40 units of Senior courses.

Corequisite: nil.

Classes: 12 weeks of prac work experience.

Assessment: a written report.

Syllabus summary: Each student is required to work as an employee of an approved engineering organisation and to submit a satisfactory written report of his or her work. Normally 12 weeks of practical work experience (375 hours minimum) is required and this is undertaken after the completion of some or all of the prescribed Senior core courses and before enrolment in the final year of study. The University Careers and Appointments Service is available to assiststudents to obtain suitable employment.

U4.780 Seminar 2 units

Senior Advanced core course for the degree in Aeronautical Engineering.

Prerequisite: credit for 40 units of Senior courses.

Syllabus summary: Each student is required to give a seminar on a selected topic, and is expected to take part in the discussion sessions following the formal oral presentations of other students.

U4.785 Thesis or Design Project 12 units

Senior Advanced core course for the degree in Aeronautical Engineering. Thehonours course U5.785 Honours Thesis (16 units) may be taken instead of this core course by Honours candidates.

Prerequisite: credit for 40 units of Senior courses.

Classes: literature survey and experimental work.

Assessment: assessment by the supervisor of a submitted written thesis or design.

Syllabus summary: Each student is required to conduct one piece of experimental, theoretical or design work in greater detail than is possible in ordinary classes and to write a thesis presenting the results of his or her investigations.

The student is expected to design and, if possible, construct any special apparatus or models that maybe necessary.

Reference books
As advised

U4.790 Rotary Wing Aircraft 4 units

Senior Advanced elective course for the degree in Aeronautical Engineering.

Prerequisites: U3.720 Aerodynamics 1 and U3.750 Mechanics ofHightl.

Corequisite: U4.720 Aerodynamics 3.

Classes: (3 lec with associated tutorials) in Sem 1.

Assessment: course assignments and a written exam.

Syllabus summary: Introduction to rotary wing aircraft; vertical flight performance; forward flight performance; blade motion and control; dynamics of rotors; rotorcraft stabilities; rotor blade design.

Reference books
Gessow and Myres *Aerodynamics of the Helicopter* (Macmillan)
Bramwell *Helicopter Dynamics* (Arnold)

U4.791 Advanced Rotary Wing Aerodynamics 2 units

Senior Advanced elective course for the degree in Aeronautical Engineering.

Corequisite: U4.790 Rotary Wing Aircraft.

Classes: 2hrs/wk for one sem.

Assessment: course assignment.

Syllabus summary: This course provides an extension of the course U4.790 Rotary Wing Aircraft in the specific area of blade aerodynamics.

Theory of rotating and translating blade elements. Vortex theory of rotor blades, including vortex formation, wake geometry and trailing vortices. Requirements for blade aerofoils and aerofoil design.

Reference book
NASA CR-3082

U4.792 Aviation Operation and Management 2 units

Senior Advanced elective course for the degree in Aeronautical Engineering.

Prerequisite: nil.

Classes: This course is given by visiting lecturers from airlines and by aviation officials. Times are arranged to suit lecturers and classes may be held in the evening. The course is not provided every year.

Assessment: to be advised during classes.

Syllabus summary: Principles and practice of aviation and airline management. Discussion and analysis of airline operations. Discussion of flight safety and airworthiness standards,

Reference books
As advised during lectures

U4.793 Probabilistic Design 4 units

Senior Advanced elective course for the degree in Aeronautical Engineering.

Prerequisite: U4.740 Aircraft Design 2.

Classes: 3hrs/wk for one sem.

Assessment: course assignments.

Syllabus summary: Optimisation methods: linear and dynamic programming, simplex method,

Application of probability theory to loads, strength and structural degradation. Estimation of time to failure, survival rate and MTBF.

Optimisation of designs: replaceable, fail-safe, safe life and damage-tolerant systems. Minimum-weight and minimum cost optimisation.

Reference books
As advised during lectures

U4.794 Advanced Aerodynamics 2 units

Senior Advanced elective course for the degree in Aeronautical Engineering.

Prerequisite: U3.725 Aerodynamics 2.

Corequisites: U4.720 Aerodynamics 3, U4.725 Aerodynamics 4-

Classes: 2hrs/wk and associated tutorials in one sem.

Assessment: course assignments.

Syllabus summary: Advanced two- and three-dimensional panel method techniques; calculation of aerodynamic derivatives. Pressure distributions for complete aircraft configuration. Unsteady subsonic aerodynamics; aerodynamic calculations for flutter and divergence prediction.

Reference books

Bertin and Smith *Aerodynamics for Engineers* (Prentice Hall, 1979)
Abbott and Von Doenhoff *Theory of Wing Sections* (Dover, 1959)
Moran *Introduction to Theoretical and Computational Aerodynamics* (Wiley, 1984)
Morino *Computational Methods in Potential Aerodynamics* (Springer-Verlag, 1985)

U4.795 Flight Dynamics and Digital Control 3 units

Senior Advanced elective course for the degree in Aeronautical Engineering.

Prerequisites: U3.750 Mechanics of Right 1 and U3.755 Mechanics of Flight 2.

Corequisite: U4.750 Mechanics of Flight 3.

Classes: 2 lec/wk and associated tutorials and laboratory work in Sem 2.

Assessment: based on a major assignment/project during semester and 1hr written examination at end of semester.

Syllabus summary: Overview of applications of digital control systems. Review of linearisation of aircraft equations of motion, separation of trim and perturbation equations, state space form of equations, classical continuous controller system characteristics.

Continuous, discretised, sampled-data and digital system characteristics. Discrete difference equations. System stability. Z-transform, time response and frequency response of sampled systems. Discrete optimal regulators and the Riccati equation. Proportional integral filter control and command generator tracking. Controllability and observability. Effects of modelling errors, noise, digital filtering techniques. Introduction to Kalman filter. Control system design techniques. Sample rate and processing power effects.

Application examples to commonguidance,control, navigation and structural-dynamic problems. Comparisons with conventional control system solutions in various applications. Hardware for digital flight control systems. Data system standards, bus standards and architecture, applications to other than primary flight control systems. Common control system design software.

Reference books

Franklin and Powell *Digital Control of Dynamic Systems* (Addison-Wesley, 1980)
Nelson *Flight Stability and Automatic Control* (McGraw-Hill, 1989)
Etkin *Dynamics of Atmosphere'Flight* (John Wiley & Sons, 1972)
ESDU *Dynamics Sub-Series, Vols 1 and 2* (RAeS & ESDU, various dates)
Roskam *Airplane Flight Dynamics and Automatic Flight Controls* (Roskam A&EC, 1979)
US DoD MIL-STD-1553 *Aircraft Internal TDM Data Bus* (US NTIS, various dates)

U4.802 Engineering Construction 3 4 units

Senior Advanced core course for the degree in Project Engineering and Management (Civil).

Prerequisite: U3.801 Engineering Construction 2.

Assessment: coursework, project and written examination.

Syllabus summary: Environmental impact assessment and mitigation, construction safety fundamentals, construction power/energy supply analysis and design, system and optimisation of temporary structures for both on- and off-shore facilities, construction techniques for large caisson, diversion and retaining structures.

U4.812 Operations Research 4 units

Senior Advanced core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisite: U2.000 Mathematics 2.

Assessment: coursework and written examination.

Syllabus summary: Introduction to operations research inconstructionmanagement, methods and procedures in operations research, problem formulation, optimisation functions and constraints, linear programming, transportation and network distribution systems, allocation of resources, inventory management, queues, simulation and Monte Carlo methods, discrete sequential problems and dynamic programming, reliability analysis.

U4.822 Value Engineering and Risk Analysis 4 units

Senior Advanced core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisite: U2.820 Engineering Economics.

Corequisite: U4.823 Cost Engineering.

Assessment: project work and written examination.

Syllabus summary: Value engineering techniques and methods, life cycle costing, cost/ worth ratio, creativity and brainstorming, overall and specific project risks using deterministic and probabilistic methods, computerised techniques for risk analysis.

U4.823 Cost Engineering 4 units

Senior Advanced core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Assessment: coursework, assignments and written examinations.

Syllabus summary: Estimating fundamentals, parametric estimating, preliminary and operational estimating, bidding strategy, quotations, tendering, cash flow projection and management, work analysis and design, productivity control, productivity database, computerised techniques for cost engineering.

U4.824 Project Formulation 4 units

Senior Advanced core course for the degree in Project Engineering and Management (Civil). Elective course for other branches.

Prerequisites: U2.820 Engineering Economics and U2.821 Engineering Accounting.

Classes, assessment and syllabus summary: see U4.293 Civil Engineering Project Design.

U5.204 Thesis Honours 10 units

Senior Advanced elective course for the degree in Civil Engineering and in Project "Engineering and Management (Civil).

Prerequisite: nil.

Corequisites: a Senior core course in the field of the thesis.

Classes: 104hrs of study over the year.

Assessment: submitted typed thesis and oral presentation.

Syllabus summary: A study, in groups of two students, of a selected topic in Civil Engineering. Detailed information sheets are available from the School of Civil and Mining Engineering at the beginning of the semester.

U5.213 Materials Honours 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: U4.214 Materials Aspects in Design.

Classes: lec: 40hrs and lab/tut: 12hrs.

Course objectives: To develop an understanding of advanced cement-based and metallic materials for new and challenging applications.

Course outcomes: Ability to select advanced cement-based and metallic materials for use under demanding service conditions for which their traditional counterparts may be less suitable.

Assessment: one 3hr exam plus assignments.

Syllabus summary: Advanced cementitious materials, fibre-reinforced concrete. Modern ceramics and mechanisms for their toughening. High strength steels, stainless steels, multiaxial fatigue, impact strength of materials, stress corrosioncrackingin metals. Thermal properties of mass concrete, dynamic effects on concrete properties, statistical analysis and interpretation of concrete data. Durability problems of prestressed and post-tensioned members. The laboratory sessions are held in the Microscope Unit and familiarise students with transmission and scanning microscopy, microanalysis and image analysis.

Reference books

Campbell-Allen and Roper, *Concrete Structures: Materials Maintenance and Repairs* (Longman Scientific & Technical)
Others to be advised

U5.224 Steel Structures Honours 4 units

Senior Advanced elective course lot the degree in Civil Engineering.

Mutually exclusive with: U4.238 Steel Structures 2.

Prerequisite: U3.235 Steel Structures 1.

Corequisite: nil.

Classes: lec: 28hrs, tut: 28hrs.

Assessment: one 3hr exam at end of the semester plus assessment of assignment work.

Course objectives: To develop a working knowledge of the analysis, behaviour and design of steel structures beyond a basic competency.

Expected outcomes: Proficiency in the analysis and design of steel structures

Syllabus summary: Three of the 4 subjects will be available: (1) Elastic and plastic analysis and design for torsion in steel structures; (2) Elastic local buckling of plates, behaviour, and design of plate web girders; (3) Flexural-torsional buckling—behaviour, analysis, and design; (4) Shell structures—behaviour, analysis, and design.

Textbooks

Trahair and Bradford *Behaviour and Design of Steel Structures* (Chapman & Hall, 1991)
TmhaiT Flexural-Torsional Buckling of Structures (Spon, 1993)
Standards Australia AS4100 — *Steel Structures* (1990)
Gibson *Thin Shells* (Pergamon, 1980)
Vinson *The Behaviour of Plates and Shells* (Wiley, 1974)

Reference books

Timoshenko and Gere *Theory of Elastic Stability* (McGraw-Hill, 1961)
Kraus *Thin Elastic Shells* (Wiley, 1967,1983)
Gould *Finite Element Analysis of Shells of Revolution* (Pitman, 1985)
Calladine *Theory of Shell Structures(CUP,* 1983)
Hugge *Stresses in Shells* (Springer Verlag, 1973)
Bulson *Stability of Flat Plates* (Chatto & Windus, 1970)
Hancock *Design of Cold-Formed Structures* (AISC, 1994)
Other books as indicated during classes

Library classifications: 624.17,624.182

U5.225 Advanced Finite Elements Honours 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisites: nil.

Corequisite: U4.223 Finite Element Methods.

Classes: (lec: 26hrs and tut: 26hrs) for one sem.
Assessment: class work, assignments and one 3hr exam.

Syllabus summary: Advanced elastic analysis, high order elements, isoparametric elements. Analysis of seepage and consolidation. Boundary element analysis, analysis of plates and shells. Advanced topics, computational techniques.

Textbooks
As prescribed during the course

Reference books
Zienkiewicz *The Finite Element Method* (McGraw-Hill, 1977)
Crouch and Starfield *The Boundary Element in Solid Mechanics* (Allen & Unwin, 1983)

U5.226 Finite Element Applications Honours 4 units

Assoc. Prof. Ansourian, Dr Clarke, Prof. Carter, Prof. Small.

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisites: nil.

Corequisite U4.223 Finite Element Methods.

Classes: 4hr/wk for one semester, including lecture plus tutorials and computer lab sessions.

Assessment: assessment of computer assignments during sem and one 2hr exam at end of course.

Syllabus summary: Linear plate theory. Analysis of plate systems using finite strip and finite element methods. Finite element nonlinear analysis of frame structures, geometric and inelastic nonlinearities, solution techniques. Application of finite element packages to analysis of settlement, seepage, and consolidation. Use of microcomputers. Analysis of problems using finite layer methods.

Reference books
Zienkiewicz *The Finite Element Method* (McGraw-Hill, 1989)
Cook *Concepts and Applications of Finite Element Analysis* (Wiley, 1981)
Bathe *Finite Element Procedures in Engineering Analysis* (Prentice-Hall, 1982)
Cheung *Finite Strip Method in Structural Analysis (Pergamon,* 1976)
Relevant computer manuals

U5.233 Concrete Structures Honours 4 units

Assoc. Prof. Ansourian, Prof. Bridge, Dr Reid.

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisites: nil.

Corequisites: U4.222 Structural Analysis 2 and U4.231 Structural Behaviour 2.

Classes: 4hr/wk including lec and tut.
Assessment: one 3hr exam.

Syllabus summary:
(a) Composite structures: shear connection, full and partial interaction. Simply supported and continuous beams, columns, bridge design, fatigue.
(b) Concrete structures: analysis of time-dependent effects in concrete structures: mathematical models of concrete creep and- shrinkage, analysis of reinforced concrete beams, slabs and columns.

Non-linear behaviour of prestressed and reinforced concrete sections and members; load-moment-curvature relationships; analysis of beams, columns and beam-columns; stability of members and frames.

Textbooks
Park and Paulay *Reinforced Concrete Structures* (Wiley, 1975)
Warner and Faulkes Pres *tressed Concrete* (Longman Cheshire, 1988)
Australian Standard for Concrete Structures *AS3600-1988*

U5.234 Structural Dynamics Honours 4 units

Assoc. Prof. Kwok, Prof. Hancock.

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisites: nil.

Corequisites: U4.222 Structural Analysis 2 and U4.231 Structural Behaviour 2.

Classes: 26hrs lec and 26hrs tut.

Assessment: one 3hr exam.

Syllabus summary: Structural dynamics, wind loading on structures. Finite element dynamic analysis, consistentmassinarrix,dampmgmatrix, free vibration, forced vibration, Eigenvalue routines.

Reference books
Thomson *Theory of Vibration with Applications* (Allen & Unwin, 1981)
Clough and Penzien *Dynamics of Structure* (McGraw-Hill, 1982)

U5.243 Soil Engineering Honours 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: U4.241 Soil Engineering.

Classes: 39hrs lec and 13hrs tut.

Assessment: one 3hr paper on the whole syllabus; assignment work may count towards the final assessment.

Syllabus summary: Real soil behaviour. Models of soil behaviour. Advanced foundation analysis. Offshore geotechnology.

Reference books
Atkinson and Bransby *TheMechanics of Soils—An Introduction to Critical State Soil Mechanics* (McGraw-Hill, 1978)
Mitchell *Fundamentals of Soil Behaviour* (John Wiley & Sons, 1976)
Poulos *Marine Geotechnics* (Unwin Hyman, 1988)

U5.253 Surveying Honours 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Prerequisite: nil.

Corequisite: U4.251 Surveying 2.

Classes: (26hrs lec and 26hrs tut/lab) for one sem.

Assessment: fieldwork and one 3hr exam at end of course.

Syllabus summary: The earth — its motions, gravity field, size and shape, deformations. Geodesy and geophysics. Classes of mathematical models. Leastsquares solution of over-determined problems. Positioning—point positioning, relative positioning, three-dimensional networks, horizontal networks, height networks. Precise surveys in industry and engineering. Satellite surveying. Remote sensing for engineers. Photogrammetry.

Textbook
Uren and Price *Surveying for Engineers* 2nd edn (Macmillan)

Reference books
Vanicek and Krakiwsky *Geodesy: The Concepts* 2nd edn (North-Holland)
Clark *Plane and Geodetic Surveying, Vol. II* (Constable)
Library classification: 526.9

U5.267 Environmental Fluids Honours 4 units

Senior Advanced elective course for the degree in Civil Engineering.

Mutually exclusive with: U4.265 Environmental Fluids 2.

Prerequisite: U3.262 Fluids 2.

Corequisite: nil.

Classes: lec: 26hrs, tut: 26hrs.

Course objectives: To develop an understanding of: the methods of; analysis of the turbulent flow of fluids; fluid flow in open channels under complex conditions; aspects of fluid-structure interaction; ocean waves and their effect on offshore structures; advanced flood analysis techniques.

Expected outcomes: Students will be able to: apply the Navier-Stokes equations to a range of different flow systems; describe the behaviour of flows in open channels near channel transitions; detail open channel surface profiles under sub- and super-critical flow conditions; describe several types of fluid structures, together with associated fluid-structure interaction, including, but not limited to, spillways, stilling basins, bridge piers, water supply intakes; list and evaluate the parameters affecting ocean wave generation and transmission; describe the behaviour of waves in shallow water and explain energy transfer by waves; calculate forces exerted on structures subjected to wave action; describe design considerations for flood detention basins; explain the principles of river routing and discuss the applications of flood modelling techniques and use of computer programs.

Assessment: one 3hr exam covering the whole syllabus at the end of the semester. Satisfactory performance in class assignments is also a requirement. Credit will be given for assignment submissions, as indicated at the beginning of the course.

Syllabus summary: Advanced fluid mechanics. Waves. Flood analysis Advanced open channel flow. Aspects of fluid engineering.

Reference books
As advised during the course

U5.294 Civil Engineering Design Honours 4 units

Senior Advanced elective honours course for the degree in Civil Engineering.

Corequisite: U4.292 Civil Engineering Design.

Classes: 13hrs lec and 39hrs of drawing office work.

Assessment: no formal exam; assessment will be based on submitted work.

Syllabus summary: Aspects of the design cycle from concept to detailed design documentation are explored by way of selected project design assignments.

Design assignments will have a complexity requiring the selection and use of advanced analytical techniques and the interpretation of results, for incorporation in the design.

The course will be conducted by a practising professional engineer and will draw on the specialist expertise of academic staff.

Text and reference books
Advice will be given in class at the commencement of each assignment

U5.785 Honours Thesis 16 units

Honours course for the degree in Aeronautical Engineering. Alternative to the Senior Advanced core course U4.785 Thesis.

Prerequisite: credit for 36 units of Senior courses.

Refer to course U4.785 for details.

Poor performance will lead to consideration for the award of a grade in the Pass course U4.785 only.

5 Other faculty information

General University information
This chapter of the handbook is concerned specifically with the Faculty of Engineering. For further details about the University — its organisation, examinations, child care facilities, assistance for disabled students, housing, health, counselling, financial assistance, careers advice and a range of other matters - see the separate publication *University of Sydney Diary*, available free from the Student Centre or from University of Sydney Union outlets.

The Faculty

Faculty adviser

You may discuss with the Secretary to the Faculty any questions about your studies, or any other questions or problems that may arise. As difficulties can usually be handled more easily in the early stages, you should seek help without delay. Discussions are held in confidence and an appointment is not normally required — simply come to the Faculty Office, in Room 226, Engineering Faculty Building.

Noticeboards

Faculty noticeboards, one for Junior courses and one for Intermediate courses, located outside the Student Enquiry Office, 2nd level, Faculty Building. Each of the Engineering departments has a noticeboard for Senior and Senior Advanced students.

Noticeboards are also in the various Science departments, and information concerning the courses given by those departments will be posted on these boards.

Details of class lists, timetable variations, examination times and other information relating to courses of study will be posted on the relevant noticeboards. Students are expected to inspect the noticeboards at frequent intervals.

Notices referring to cadetships, scholarships, vacation employment opportunities and other matters of this nature will be displayed on the noticeboard in the first floor vestibule of the PNR Building immediately adjacent to tutorial rooms 5 and 6.

The Faculty library

The University of Sydney Library consists of a central library — called Fisher Library — and a number of branch libraries of which Engineering is one. The Engineering Library is on the ground floor of the PNR Building in the Engineering Precinct. Other branch and department libraries within the University contain relevant material, e.g. Architecture, Physics, Mathematics, Chemistry, Wolstenholme and Badham Libraries. Engineering students may use all the libraries of the University.

Multiple copies of reference books for Junior arid Intermediate courses are held in the undergraduate section of Fisher Library. Students in the senior years in Engineering will find most of their reference material in the Engineering Faculty Library. Books may be borrowed for two weeks with two loan renewals permitted. Journals may not be borrowed but photocopying facilities are available.

The Engineering Library opens from 8.45 am to 6.00 pm Monday-Friday during term. Vacation hours are 9.00 am to 5.00 pm Monday to Friday.

Dewey Decimal Classification numbers are given for some courses in chapter 4: *Courses of Study*. These are not meant to be exhaustive lists and reference should also be made to the subject catalogue in the library.

Engineering associations

SUCEA

The Sydney University Chemical Engineering Association (SUCEA) is a body representing the graduates of the Department of Chemical Engineering. Established in"the 1950s; it is one of the oldest alumni associations at the University of Sydney. With 1326 members living in over 20 countries around the world, it is also one of the largest.

SUCEA holds a number of social events and a technical symposium each year with the aim of maintaining strong contact between the Department and its graduates (some of whom are well into their sixties). So, via SUCEA, you will still be part of the 'Chem Eng' family even after you graduate.

SUEUA

The objects of SUEUA, the Sydney University Engineering Undergraduates' Association, are:
(a) to perform such actions and to organise such functions as the committee may deem necessary and desirable in the interests of the Faculty of Engineering, University of Sydney, and the students thereof;
(b) to act as an intermediary body between the teaching staff on the one hand and the members of the Association on the other;
(c) to organise Engineering teams for inter-faculty sport.

The office of the SUEUA is on the ground floor of the PNR Building close to the Faculty library.

In this office the association conducts a bookshop where many items of stationery, and some textbooks and codes of practice, are available at competitive prices.

The SUEUA normally holds an election for the president and other office bearers in March each year and all financial members of the association are eligible to vote. The president becomes a member of the Faculty by virtue of this office. The by-laws of the University provide for the undergraduates in

Engineering to elect two others of their number to be members of Faculty and an election for this purpose is conducted in October each year. All Engineering undergraduates, including those enrolled in the Faculty of Science as candidates for the double degree, are eligible to vote.

Institution of Engineers, Australia

The professional body for Engineering in Australia is the Institution of Engineers, Australia, whose first objective is to 'promote the science and practice of engineering in all its branches'.

The institution functions through a series of divisions, the local one being the Sydney Division. Within each division are branches representing the main interests within the profession — e.g. civil, electrical, mechanical, chemical and transportation to name a few.

Any student of an approved School of Engineering can join the Institution as a student member (StudIE Aust).

As a student member you will receive the fortnightly magazine *Engineers Australia,* containing articles of general engineering interest and advising you of site tours, conferences, technical meetings of all branches, harbour cruises, film nights, and so on.

Studentmembersmayfreelyusethecomprehensive library and reference facilities maintained by the Institution — a handy place to obtain a hard-to-get book or periodical.

Within most divisions is a Graduates and Students Section, known as GAS, and all graduates of, or students at, approved engineering schools are eligible for membership.

The Graduates and Students Sections organise film nights, site tours and other activities of general interest. The MalcolmStanley Speakers' Competition for public speaking is held each year, usually in September, and prizes are awarded for the best speeches.

For membership information and application forms enquire at the Faculty Office or at the Sydney Division Office, 118 Alfred Street, Milsons Point 2061 (P.O. Box 138).

The Institution of Chemical Engineers

An alternative organisation for Chemical Engineering students is the Institution of Chemical Engineers. The Institution welcomes and values student members, offering special rates for technical meetings, together with Institution literature and guides to gaining employment. For further information contact the General Office in Chemical Engineering.

Enrolment

Special enrolment instructions

These are the special requirements for Engineering students.

To complete your enrolment in Engineering you proceed to the PNR Enrolment Centre in the Drawing Office, where you

—collect your enrolment form
—complete a registration form
—consult an adviser about your plan of courses
—record your courses on the computer and receive your timetable

Examinations

Freedom of Information Act

Examination scripts, or copies of same, are available for viewing or collection from Departmental Offices for three months after final examinations each year, after which they will be shredded.

Enquiries

The Engineering Faculty Office is open for enquiries about Junior arid Intermediate results during January. All enquiries should be made *in person* during this period. Enquiries about the Senior and Senior Advanced results should be made to the adviser in the appropriate department.

Supplementary examinations

A supplementary examination may be granted by the Faculty:

(a) to candidates whose performance in an examination has been significantly affected by duly certified illness or misadventure;

(b) to candidates who have failed an examination but whose overall level of performance in the year's work is deemed sufficient to warrant the concession of a further test.

Supplementary examinations under category (b) are normally granted *only* to those candidates who are in their first year of attendance.

The award of supplementary examinations is a privilege and not a right.

Illness or misadventure

The Faculty of Engineering recognises that the performance of students may be adversely affected by illness or other misadventure, and makes provision for special consideration of such disabilities when examination results are considered.

Any student who believes that his/her performance has been or may be adversely affected by an occurrence of illness or misadventure may request the Faculty to make special consideration of same. All such requests must include a special consideration application on the form provided by the Faculty, supplied within one week of the occurrence and accompanied by an appropriate medical certificate or other relevant documentary evidence apart from the student's own submission. Such certificates or documentary evidence *should state not only the nature of the illness or misadventure but also (where relevant) the opinion of the issuer as to the extent of the disability involved.*

If the student has completed the assessment for which special consideration is requested, then further documentary evidence of the extent of the disability from a specialist medical practitioner/counsellor etc. must also be supplied. For example, if a student completes an examination but still wishes to request special consideration for it, this additional specialist evidence is required.

Finally, the Faculty intends only to compensate for sub-standard performance in assessments which do not reflect a student's true competence in a subject, and such provisions must not act to the disadvantage of other students. The Faculty will only compensate students when there is clear evidence that results have been adversely affected by the disability for which special consideration is requested.

Financial assistance

Special assistance

In certain circumstances assistance is available to students who encounter some unforeseen financial difficulty during their studies. The assistance is usually in the form of bursaries or interest free loans.

Students wishing to apply for financial assistance should make enquiries from either of the following:

Financial Assistance Office, Student Services, tel. 3512416.

President of the Students' Representative Council, tel. 660 5222.

J.N. Ellis Memorial Fund

The J.N. Ellis Memorial Fund was established in 1969 following an appeal made to all graduates in engineering to honour the memory of Neil Ellis, who as Sub-Dean and later as Administrative Assistant to the Dean over a considerable period of years was able, by sympathetic counselling, to help many students who were having difficulties in completing their studies.

The object of the fund is to provide financial assistance to students in the Faculty of Engineering who are in such a position that without assistance they would not be able to continue their studies. Students seeking such assistance should apply to Financial Assistance, Student Services, tel. 3512416. Awards are made on the recommendation of the Dean. Value: $500. Applications may be made at any time.

Those who receive assistance from the fund are asked to make a contribution to it when they are financially able to do so. In this way the fund will be able to continue and grow in the extent to which it can help deserving students in future years.

Learning assistance

The University's Learning Assistance Centre offers a wide range of workshops and other activities to assist students develop the learning and language skills needed for academic study. The workshops are available free to all enrolled students of the University. Workshop topics include essay and assignment writing, oral communication skills, studying at university, conducting research.

The Learning Assistance Centre is located on Level 7 of the new Education Building next to Manning House (tel. 351 3853).

Cadetships, scholarships and prizes

Many students enrolling in the Faculty of Engineering obtain financial assistance by way of a cadetship or scholarship, either at the time of enrolment, or at a later stage in their studies.

Information about the Australian government *Austudy Scheme* is available from the State Director, Departmentof Employment, Educationand Training, 477 Pitt Street, Sydney 2000.

Scholarships are also awarded by a number of industrial organisations. Many of these do not require the student to enter into a financial bond.

Some government departments and public authorities provide cadetships or traineeships which require the student to enter into an agreement to work for the employer for a specified number of years after graduation.

Before accepting a bonded cadetship or traineeship students should give careful consideration to the conditions of the award and in particular the obligations which they will incur should they decide to relinquish the award for any reason.

Cadetships

Benefits	Tenure	Qualifications	Applications close	Objects and conditions	Enquiries/ applications
Army, Australian Regular					
Salary, living allowance, text-books	Duration of course	Undergraduates who have completed 1 or more years of a 3 or 4 year course or 2 years of a 5 or 6 year course	—	For medical science, medicine, dentistry, pharmacy, electrical, and mechanical engineering students over 20 yrs old. Applicants are required to serve 2-5 years on graduation	Army Careers Officer, Defence Forces Recruitment, 323 Castlereagh St, Sydney 2000. Phone 219 5549/5550
Commonwealth Industrial Gases Ltd					
Living allowance, HECS liability and textbooks. Vacation employ-ment and possible employment after graduation	Duration of course subject to satisfactory academic performance	Undergraduates who have completed 1 or more years	February	For students in Chemical or Mechanical Engineering	Sandra Edwards Employee Develop-ment Manager, C.I.G., 500 Pacific Hwy, St Leonards N.S.W. 2065 Phone 965 6666

Benefits	Tenure	Qualifications	Applica-tions close	Objects and conditions	Enquiries/ applications
Department of Defence					
Salary in the range $5997-$9738 p.a. Compulsory fees, book allowance, Vacation employment	Up to 4 years	Preference to undergraduate students who have completed 2nd year	mid-August	For Mechanical, Electrical, Aeronautical, Electronics and Communications Engineering students and ' naval architecture students	Mr A. Pengelly, Department of Defence, P.O.BoxE33, Queen Victoria Terrace, Canberra, A.C.T. 2600. Phone (06) 266 2058
Electricity Commission ofN.S.W.					
Salary, Vacation employment	Duration of course	Matriculation. Undergraduates who have completed 2 or more years are also considered	October/ November	For Civil, Chemical, Mechanical and Electrical Engineering students. Cadets are expected to work for the Commission for 3 years on graduation	Hugh Babbington Training and Development Manager, Electricity Commission ofN.S.W. Electricity House, P.O. Box 5257, Park and Elizabeth Sts, Sydney 2000. Phone268 8111,ext.7946
Overseas Telecommunications Commission (Aust.)					
Annual salary, book allowance plus compulsory fees. Vacation employment	Duration of course	Undergraduates who have completed 2 or more years	October-January	For Electrical Engineering students	Personnel Officer, Overseas Telecommunications Commission, Box 7000, G.P.O. Sydney 2001. Phone 287 5000
Royal Australian Air Force					
Salary and compulsory fees. Vacation employment	Duration of course	Undergraduates who have completed 1 or more years	Anytime	For Aeronautical, Civil Mechanical and Electrical Engineering students. Applicants are required to serve 2-5 years after graduation	R.A.A.F. Careers Officer Defence Forces Recruitment 323 Castlereagh St, Sydney 2000. Phone 219 5551/5552
Royal Australian Navy					
Salary according to rank, fees, textbooks and instruments	Duration of course	Undergraduates who have completed 1 or more years	When advertised	For Mechanical, Aeronautical or Electrical Engineering students. Applicants are required to serve for 5 years after graduation	Navy Careers Officer, Defence Forces Recruitment, 323 Castlereagh St, Sydney 2000. Phone 219 5547
Telecom Australia					
Fees, textbook allowance ($200). Pay while studying varies from $10 000 to $17 000 for hired duty, dependent on age	Reviewed annually	Undergraduates who have completed 2 years of engineering	end of September	For Electrical Engineering students. Paid industrial training is preferred during all vacations	Alex Virdun, The Manager, Engineer Development, 20th floor, 233 Castlereagh Street, Sydney, N.S.W. 2000. Phone 263 1640 Fax 264 6249

Scholarships

Scholarships offered by private industrial or ganisations usually do not require a student to enter into a financial bond. However, this may not apply in all cases and students are advised to make enquiries directly to the organisation concerned.

Benefits	Tenure	Qualifications	Applica-tions close	Objects and conditions	Enquiries/ applications
Altona Petrochemical Co.					
$1000 p.a.	Year 3 of course	Students proceeding to the degree in Chemical Engin-eering who have completed 2nd year	As advertised	For Chemical Engineering students	Head of Department, Chemical Engineering University of Sydney, N.S.W.2006
Australian Public Service— Departments of Aviation, Communications, Defence Support, Transport, Housing and Construction					
As advertised	1-2 years	Completion of at least 2 years of degree	As advertised	All fields of Engineering	Office of the Public Service Board, Chifley Square Sydney 2000. Phone 239 3000
Chancellor's Scholarships in Engineering					
$9800 p.a.	Renewable for 4 years based on satisfactory progress	Student proceeding to the degree Bachelor of Engineering	As advertised	All fields of Engineering for school-leavers	CSE Office, Faculty of Engineering, University of Sydney, N.S.W. 2006. Phone 351 2834
CIG					
$10 000 p.a.	Years 2,3 and 4 of course subject to satisfactory progress	Students proceeding to the degree in Chemical Engineering who have completed 1st year	Early April	For Chemical Engineering students	The Manager, Employment Development, CIG Ltd, P.O. Box 288, St Leonards, N.S.W. 2065
Coca Cola AustraliaScholarship in Chemical Engineering					
$1500 p.a.	Renewable for 4 years based on satisfactory progress	Student proceeding to the degree in Chemical Engineering	As advertised	Full-time junior student in Chemical Engineering	Head of Department, Chemical Engineering, University of Sydney, N.S.W. 2006.
Joint Coal Board					
Living allowance $1600-$2300 p.a. depending on year of progress	Duration of course subject to satisfactory progress	Matriculation. Undergraduates who have completed 1 or more years	7 days after HSC results	For Mining Engineering students	Ms C. Olsen, Personnel Officer, Joint Coal Board, G.P.O. Box 3842, Sydney 2001. Phone 235 9666
Metropolitan Water Sewerage and Drainage Board					
Allowance, compulsory fees and incidental expenses	Duration of course	Matriculation or undergraduate	When advertised	May seek Chemical, Electrical, Civil or Mechanical Engineering students	Recruitment Officer, Personnel Branch, Box A53, Sydney South 2000. Phone 269 5723
Mining and Metallurgical Bursaries Fund					
	Duration of course subject to satisfactory progress	Completed 1st year of course"	31 March	For general assistance to Mining Engineering students who have shown special merit	Faculty of Engineering Office, University of Sydney, N.S.W. 2006.
Mobil Oil Australia					
$1500 to $3500	Years 3 and 4 of course subject to satisfactory progress	Students proceeding to the degree in Chemical Engineering who have completed 2nd year	As advertised	For Chemical Engineering students	Head of Department, Chemical Engineering, University of Sydney, N.S.W. 2006

Benefits	Tenure	Qualifications	Applica-tions close	Objects and conditions	Enquiries/ applications
New South Wales Coal Association Scholarship					
$3000 p.a.	Duration of course	Undergraduates who have completed one or more years	mid-January	Prefer Mining students but also open to Electrical, Civil and Mechanical **Engineering** students and geology and metallurgy students	Ken Allen, N.S.W. Coal Association, P.O. BoxA244, Sydney South, N.S.W.2000. Phone 267 6488
OTC Scholarship for Women in Electrical Engineering					
$1500 p.a.	Tenable for one year only	HSC examina-tion. Permanent residents of Australia and enrolled in first year of degree	—	For women enrolled in First Year Electrical Engineering	Head of Department, Electrical Engineering, University of Sydney, N.S.W.2006.
Peter Nicol Russell					
$1500 p.a.	One year, renewable for second, third or fourth year	Matriculation or undergraduate	As advertised	For Mechanical Engineering students	Faculty of Engineering Office, University of Sydney, N.S.W. 2006.
Proctor and Gamble Australia					
S2500 p.a.	Year 4 of course	Students proceeding to the degree in Chemical Engineering who have completed 3rd year	As advertised	For Chemical Engineering students	Head of Department, Chemical Engineering, University of Sydney, N.S.W. 2006
Renison Gold Fields Consolidated Ltd (RGC)					
Upto$1250p.a. plus $500 living away from home . allowance; possibility of vacation employment	Duration of course	Undergraduates who have completed one or more years	1 December	For Electrical, Mining or Mechanical Engineering and Geology students interested in Mining industry. No financial bond	Employee Relations Department, Renison Gold Fields Cons. Ltd Gold Fields House, 1 Alfred St, Sydney Cove 2000. Phone 934 8888

Prizes

A number of prizes may be awarded to students in the Faculty of Engineering. The conditions of award are summarised below; full details may be obtained from the Scholarships Office.

Title	Value	Qualifications	Work for which prize is awarded
Abbott Prize	$150	Student proceeding to the degree in Chemical Engineering	Most distinguished performance Biochemica Engineering
Ampol Limited Prize in Chemical Engineering	$200	Student in Chemical Engineering	Most improved student in Intermediate, Senior or Senior Advanced courses
Association of Consulting Structural Engineers of New South Wales Prizes No. I and No. II in Civil Engineering	$175 and $225	Students proceeding to the degree in Civil Engineering	Greatest proficiency in Structural Design II and Civil Engineering Design in their third and fourth years of enrolment respectively
ARC Engineering Pry Ltd Prize	$100	Any student enrolled in the Faculty of Engineering	Greatest proficiency in studies related to reinforced concrete
ASTA Book Prize in Aeronautical Engineering	$500	Students in Aeronautical Engineering II	Greatest proficiency in coursework
R. L. Aston Prize	$120	Any student enrolled in the Faculty of Engineering	Greatest proficiency in Surveying

Title	Value	Qualifications	Work for which prize is awarded
Australian Gas Light Company Prize in Chemical Engineering	$300	Student proceeding to the degree in Chemical Engineering	Proficiency in the Intermediate courses
Australian Institute of Steel Construction Prize	$250	Student proceeding to the degree in Civil Engineering	Proficiency in the field of steel structures
Australian Paper Manufacturers'	$250	Students proceeding to the degree in Chemical Engineering	Proficiency in U3.670 Chemical Engineering Laboratory
The Blackwood Hodge Prize	$130	Student graduating in Civil Engineering	Proficiency
Bradfield Memorial Prize	$75	Students graduating with first class honours in Civil Engineering	Most distinguished student
W.T. Burke Prize	$100	Students in Aeronautical Engineering	Greatest proficiency in the Engineering Seminar
Cable Makers Australia Proprietary Limited Prize	$21	Electrical Engineering graduate or undergraduate	Essay or thesis of outstanding merit
G. S. Caird Scholarship in Electrical Engineering	$650	A candidate for the Honours degree in Electrical Engineering	General proficiency in the Senior core courses
Ian Callander Memorial Prize	$70	Student enrolled in Senior Advanced courses in Chemical Engineering	Thesis in biochemical field
Caltex Refining Co. Pry Ltd Prize	$300	Student proceeding to the degree in Chemical Engineering	Proficiency in the Senior courses
Caltex Refining Co. Pty Ltd Prize in Process/Simulation Control	$300	Student proceeding to the degree in Chemical Engineering	Proficiency in Process/Simulation Control for the Senior Advanced Year
D. Campbell-Allen Prize	$100	Student proceeding to the degree in Civil Engineering	Proficiency
Carrier Prize in Air Conditioning	$300	Students in Mechanical Engineering	Best project on air conditioning
Wargon Chapman Partners — R.F. Chapman Memorial Prize	$50-$350	Students proceeding to the degree in Civil Engineering	Selected major assignments
Chemical Engineering Foundation Prize	$600	Students proceeding to the degree in Chemical Engineering	Written report of vacation work at an approved site
Chemplex Australia Ltd Prize	$200	Intermediate student enrolled in Chemical Engineering	Proficiency in the Intermediate courses
Civil Engineering Graduates Prize	$110	Intermediate year candidate	Greatest proficiency in U2.290 Structural Design 1 and U2.220 Structures 1
Commonwealth Industrial Gases Limited Prize in Chemical Engineering	$250	Student proceeding to the degree in Chemical Engineering who enrols in the Intermediate core courses	Proficiency in the Junior courses
Harvey Dare Prize	$125	Student graduating with first class honours in Civil Engineering	Proficiency in the fields of Hydrodynamics and Hydraulic Engineering
E.H. Davis Prize	$120	Senior Advanced student in Civil or Mining Engineering	Proficiency in Geotechnical Engineering
Electrical Engineering Foundation Prize for First Year Students	$400	Student enrolled in Junior courses in Electrical Engineering	Proficiency and interview
Electrical Engineering Foundation Prize for Second Year Students	$600	Student enrolled in Intermediate courses in Electrical Engineering	Proficiency
Electrical Engineering Foundation Prize for Third Year Students	$800	Student enrolled in Senior courses in Electrical Engineering	Written report and proficiency
Electrical Engineering Foundation Prize for Fourth Year Students	$1000	Student enrolled in Senior Advanced courses in Electrical Engineering	Written paper and interview
Electrical Manufacturers' Association of N.S.W. Prize for Electrical Power Engineering	$150	Honours student in Electrical Engineering	Thesis in power engineering

Title-	Value	Qualifications	Work for which prize is awarded
Electrical Manufacturers' Association of N.S.VV. Prize for Electrical Power Engineering .No. 2	$150	Student enrolled in Senior Advanced courses in Electrical Engineering	Proficiency
Electricity Supply Engineers' Association of N.S.W. Prize	$100	Student enrolled in the Senior courses for the degree in Electrical Engineering	Outstanding merit in the field of Electric Power Distribution
Esso Australia Limited Prize in Chemical Engineering	$200	Student proceeding to the degree in Chemical Engineering who enrols in the Intermediate core courses	Proficiency in the Junior courses
John Antony Garnsey Memorial Prize	$25	Any student enrolled in the Faculty of Engineering	Proficiency in the course U1.210 Materials 1
Graduates' Prize in Aerodynamics	$110	Final year student in Aeronautical Engineering	Proficiency in Aerodynamics
Graduates' Prize for Proficiency in Aeronautical Engineering	$75	Student proceeding to the degree in Aeronautical Engineering	Proficiency in the Senior courses
Graduates' Prize for Proficiency in Aeronautical Engineering—Senior Advanced Courses	$75	Student enrolled in Senior Advanced courses in Aeronautical Engineering	Proficiency in Senior Advanced courses inAeronautical Engineering
William and Jane Grahame Mechanical Engineering Prizes	$65	Any student enrolled in the Faculty of Engineering	Outstanding merit in any of the courses prescribed for the degree in Mechanical Engineering
William and Jane Grahame Mechanical Engineering Scholarship	$620	Student admitted as candidate for the Honours degree in Mechanical Engineering	Proficiency in the Senior courses
Clifford Dawson Holliday Prize	$150	Student in first year of attendance	Greatest proficiency at annual examinations
The Hot Dip Galvanising Award in Corrosion	$500	Student enrolled in Senior year courses in Chemical Engineering	Proficiency in U3.650 Materials and Corrosion
The Hot Dip Galvanising Award No.1	$500	Student enrolled in Senior year courses in Chemical Engineering	Proficiency in corrosion project
The Hot Dip Galvanising Award No. 2	$250	Student enrolled in Senior year courses in Chemical Engineering	Proficiency in corrosion project
IBM Prize in Computing	$200	Student proceeding to the degree degree in Chemical Engineering	Most distinguished in Computing
ICI Botany Operations Prize	$1500	Chemical Engineering student who has completed Senior year	Overall distinction, including academic achievement, character, other activities
Institution of Chemical Engineers Prize in Chemical Engineering	$150 and medal	Student enrolled in the Senior Advanced courses for the degree in Chemical Engineering	Best undergraduate thesis
Institution of Engineers, Australia Prize in Engineering, R.A. Priddle Medal	$200 and medal	Candidate graduating Bachelor of Engineering	Greatest proficiency
Institution of Electrical Engineers Prize	$1000	Student enrolled in Third Year Electrical Engineering	Proficiency
Institution of Engineers, Australia, Electrical College Prize	$400	Student enrolled in Senior Advanced courses in Electrical Engineering	Highest WAM in final year
Jeffery and Katauskas Prize	$500	Student enrolled in Final Year Civil Engineering or Mining Engineering	Proficiency in all courses in geomechanics
R.E. Jeffries Memorial Prize	$260	Student enrolled in the Intermediate courses for the degree of Bachelor Bachelor of Engineering	Proficiency in introductory electrical engineering courses
Joint Coal Board Scholarship	$500	Student enrolled in Third Year Mining Engineering in alternate years with Department of Geology and Geophysics	Field study or thesis related to coal mining industry

Title	Value	Qualifications	Work for which prize is awarded
Phil Jones Award	$500	Student enrolled in Intermediate or Senior year for degree of Bachelor of Engineering	General proficiency and contribution to University life
Kent Instruments (Australia) Pty Ltd Prize in Chemical Engineering	$200 shared	Senior Advanced year candidates for Bachelor of Engineering in Chemical Engineering	Best design report in Chemical Engineering
Charles Kolling Graduation Prize in Mechanical Engineering	$1000	Final year student in Mechanical Engineering	Graduation thesis
A.S. MacDonald Prize of the Association of Consulting Structural Engineers of New South Wales	$150	Honours candidate in Civil' Engineering	Work in the field of Structural Engineering
McGraw Hill Book Prize in Chemical Engineering	Copy of 'Perry's Chemical Engineers' Handbook'	Student enrolled in the degree of Chemical Engineering.	Highest grades in First Semester examinations in Chemical Engineering 1
R.W. McKenzie Prize	$120	Final year Aeronautical Engineering student	Greatest proficiency in Aircraft Structures and Solid Mechanics in the Senior and Senior Advanced courses
Hugh Giffin McKinney Prize	$35	Student in second year of attendance	Greatest proficiency in the Intermediate courses
John Main Prize	$200	Student graduating with first class honours in Civil Engineering	Most distinguished student
Metal Building Products Manufacturers' Association Prize	$150	Any student enrolled in the Faculty of Engineering	Proficiency relating to the design of cold-formed steel structures
Mining Engineering Graduates' Prize	$200	Student proceeding to the degree in Mining Engineering	Greatest proficiency in the Senior courses
P.G. Morgan Memorial Prize in Mechanical Engineering Design	$135	Candidate for undergraduate or postgraduate degree in the Faculty of Engineering	Outstanding work in an under-graduate or postgraduate course in Mechanical Engineering Design
Nabalco Pty Ltd Prize in Chemical Engineering	$300	Student proceeding to the degree in Chemical Engineering	Proficiency in the Senior courses
OTC Scholarship for Women in Electrical Engineering	$1500	Student in her first year of attendance	Highest selection aggregate on entry to Faculty
J.W. Roderick Prize	$150	Final year student in Civil Engineering	Greatest proficiency in final year thesis
Susan Mary Rouse Memorial Prizes No. 1	$40	Final year student in Aeronautical, Electrical or Mechanical Engineering	Final thesis
No. 2	$40	Final year student in Chemical, Civil or Mining Engineering	Final thesis
Sandvik Australia Prize	$75	Any student enrolled in the Faculty of Engineering	Proficiency in the course Ul.21.0 Materials 1
K.K. Saxby Prize	$180	Student in first year of attendance	Proficiency in the course U1.000 Mathematics 1
K.C. Seale Prize in Electrical Engineering	$15	Final year Electrical Engineering student	Proficiency in practical work
Shell Prizes in Chemical Engineering (2)	$200 each	Student proceeding to the degree in Chemical Engineering	Proficiency in final year of attendance
Shell Refining (Australia) Pty Ltd Prizes in Mechanical Engineering (4)	$100	.Student proceeding to the degree in Mechanical Engineering	Proficiency in Junior courses — workshop practice and management Intermediate courses — applied thermodynamics and fluid mechanics

Title	Value	Qualifications	Work for which prize is awarded
Shell Refining (Australia) Pty Ltd Prizes in Mechanical Engineering (4) *(continued)*			Senior core courses— systems engineering and electrical technology Senior Advanced courses — industrial management
Scitec Prize in Communications	$500	Final year Electrical Engineering student	Best project in the area of voice or data communications
Murray Rainsford Smith Prize Smith Prize	$120	Student proceeding to the degree in Civil Engineering	General proficiency in the Senior courses in Materials, Structural Analysis and Structural Behaviour
Staedtler Prize in Engineering	Drawing instru-ments to the value of $100	Any student enrolled in the Faculty of Engineering	Greatest proficiency in the course U1.405 Engineering Drawing and in the Engineering Drawing section of U2.440 Mechanical Design 1 and U2.441 Mechanical Design 1A
H.J. and C.K. Swain Prize in Mechanical Engineering	$100	Student proceeding to the degree in Mechanical Engineering or a research student in Mechanical Engineering	Thesis or postgraduate research work in the Theory and Practice of Heat Engines, especially Internal Combustion Engineering
Telecom Australia Prize in Electrical Engineering	$300, certificate AND medal	Student proceeding to the degree in Electrical Engineering	Best thesis in the final year of candidature on any aspect of telecommunications systems
USMEA Prizes in Professional Communication Major Minor	 $100 $50	Student proceeding to the degree degree in Mechanical Engineering	Best seminar in the course U4.485 Professional Communication Second best seminar in course U4.485 Professional Communication
D.G. Walkom Prize	$150	Student graduating with first class honours in Civil Engineering	Most distinguished student
Western Mining Corporation Prizes (4)	$150 each	For details see the Faculty Office	
Percy L. Weston Prize	$75	Student proceeding to the degree in Electrical Engineering	General proficiency in the Senior courses

The Faculty of Engineering offers a wide range of postgraduate research and coursework programs within the Departments of Aeronautical, Chemical, Electrical and Mechanical and Mechatronic Engineering and the specialisation, Environmental Engineering.

Full details of the postgraduate degrees and diplomas are contained in a leaflet which is available from the Faculty Office.

Doctor of Engineering

The senior of the higher degrees in the field of engineering is the DEng degree. Originally called Doctor of Science in Engineering, DScEng, the name was changed to Doctor of Engineering in 1981. The degree is awarded for distinguished published work. The first doctorate in engineering was conferred in 1924 and in the intervening years sixteen awards have been made.

DScEng
William George Baker, 1932
David Milton Myers, 1938
David Lipscombe Hollway, 1954
Bernard Yarnton Mills, 1959
Robert Thomas Fowler, 1960
James Brydon Rudd, 1962
John Ernest Benson, 1975
Harry George Poulos, 1976
George Kossoff, 1981
Robert Henry Frater, 1982

DEng
John Robert Booker
Nicholas Snowden Trahair

Doctor of Philosophy

The degree of Doctor of Philosophy is a research degree awarded for a thesis considered to be a substantially original contribution to the subject concerned. This degree is becoming a prerequisite for research appointments in government and industrial research and development laboratories.

Applicants should normally hold a master's degree or a bachelor's degree with fir st or second class honours of the University of Sydney, or an equivalent qualification from another university or institution.

The degree may be taken on either a full-time or part-time basis.

In the case of full-time candidates, the minimum period of candidature is six semesters (3 years), but this may be reduced to four semesters (2 years) for candidates who already hold a master's degree. The maximum period of candidature is normally ten semesters.

Part-time candidature may be approved for applicants who can demonstrate that they are engaged in an occupation or other activity which leaves them substantially free to pursue their candidature for the degree. Normally theminimumperiod ofcandidature will be determined on the recommendation of the Faculty but in any case will not be less than six semesters; the maximum period of candidature is normally fourteen semesters.

Master of Engineering

Graduates in engineering of the University of Sydney who have had at least three years' experience after graduation may be admitted as candidates for the ME degree. The award is made for a thesis or a design of special merit, and may be looked upon as an external degree reserved by the Faculty for its own graduates.

Master of Engineering (Research)

The Master of Engineering (Research) degree provides candidates with opportunities to develop specialist interests through a program of supervised research (theoretical or applied), shorter than the three years usually .required for the PhD degree. Candidature is normally on a full-time basis but may also be undertaken part-time. The ME(Res) degree may be undertaken in the Departments of Aeronautical, Chemical, Electrical or Mechanical Engineering in the School of Civil and Mining Engineering or in the specialisation, Environmental Engineering.

The minimum academic entry requirement is normally the 4-year Bachelor of Engineering degree from the University of Sydney with first or second class honours in the same branch of engineering as that in which the ME(Res) degree is to be undertaken, or an equivalent qualification from another university or tertiary institution. In exceptional circumstances a graduate in engineering with a pass degree or a graduate with an honours degree in a different branch of engineering or from another Faculty may be admitted to candidature but such an applicant may be required to undergo a preliminary examination.

The Faculty may admit some applicants on a probationary basis for a period not exceeding twelve months.

The minimum period of candidature is one year full-time and two years part-time and the maximum period of candidature is two years full-time and three years part-time. If a candidate is required to undertake a preliminary examination then the candidature commences after the completion of the preliminary examination.

Special attentionis drawn to the need for applicants to provide concise details of their proposed research program including aims and methodology and evidence of their ability to carry out intensive research and advanced study. Candidates who enrol for this degree with the object of later transferring to candidature for the PhD degree should select a research project that is suitable for this purpose.

Applicants admitted to candidature for the ME(Res) degree are expected to workindividually onadvanced study and researchunder the direction of a supervisor, with whom regular consultation about their work and the general planning of their thesis is required. On completion of their candidature a thesis must be submitted embodying the results of their work.

Master of Engineering Studies

The MES degree provides candidates with programs of formal coursework alone or coursework and applied research aimed at meeting the professional development needs of engineers and scientists in the private and public sectors of industry and in private practice.

The minimum academic entry requirement is the 4-year Bachelor of Engineering degree from the University of Sydney, or an equivalent qualification from another university or tertiary institution.

The minimum period of candidature is one year full-time and two years part-time and the maximum period of candidature for all candidates is two years full-time and three years part-time.

Candidates for the MES have two alternative methods of candidature, by coursework alone or by coursework and thesis. They are required to complete either 30 units of coursework or at least 20 units of coursework and a design project or thesis valued at 10 units.

Candidates may choose to complete the units of coursework from the same subject area or from rela ted subject areas, in the same department or school, or they may choose to complete courses from departments other than the one in which they are primarily studying. Candidates may also be given permission to take courses from another Faculty at this University or from another tertiary institutionsuchas the University of New South Wales or the University of Technology, Sydney. If you wish to apply to count courses from another tertiary institution, you would of course need approval from that institution to enrol there and the permission of the University of Sydney. The coursework requirement is governed by the following rules:

- The maximum number of units that a candidate will be permitted to take at postgraduate level at another tertiary institutionis 10. These units should be in engineering-related courses and in courses not being offered at the University of Sydney.
- The maximum number of units that a candidate will be permitted to take at postgraduate level from another Faculty in this University is 12.
- Candidates will not be permitted to take undergraduate courses at other tertiary institutions to count towards the coursework requirement. Up to 5 units of approved undergraduate courses at this University may be included within the prescribed coursework.
- Candidates must complete at least half their coursework from postgraduate courses offered by the Faculty of Engineering at the University of Sydney and they will not be given permission to take more than 12 units from other institutions/ faculties (in total).
- Approval to take courses at another institution is given on the understanding that you may not count these courses towards a degree, diploma or any other qualification at the other institution where you are taking them.
- A candidate who fails to demonstrate satisfactory progress may be asked to show good cause why his or her candidature should not be terminated. A candidate who fails (or discontinues without permission) in more than 2 courses or 6 units (whichever is the higher) will be deemed not to have made satisfactory progress and may be asked to show good cause why he or she should be allowed to re-enrol.

Most postgraduate courses are run in the afternoon or evening.

A 1-hour lecture each week for one semester (i.e. 14 weeks) together with the associated tutorial, laboratory and assignment work, is rated normally as one unit.

For their projects, candidates are encouraged to select problems based on their professional experience or their researchinterests. Many projects will be closely related to the research activity within the Faculty, and in some cases itmaybe possible for original work to be reported in the project report. A design study or a critical examination of a professional problem may also be acceptable as a project. The work on the project is expected to occupy about one-third of a candidate's total program.

Aeronautical and Mechatronic Engineering

There is no coursework program currently available.

Chemical Engineering

There is no coursework program currently available.

Civil Engineering

The School of Civil and Mining Engineering offers the MES coursework program in the areas of Geotechnical Engineering, Structural Engineering and Structural and Foundation Engineering.

You should note, however, that the School of Civil and Mining Engineering may not be able to offer all its courses each year, so that even a full-time candidate may take 18 months or two years to complete the degree requirements in that School.

Electrical Engineering

The Department of Electrical Engineering is not able to offer its full coursework program each year. It therefore may take candidates two years to complete the degree requirements.

Mechanical and Mechatronic Engineering

The coursework program is available on both a full- and part-time basis.

In order to complete the degree requirements in one year, however, a candidate would need to take courses from those offered by other departments or by another tertiary institution.

Environmental Engineering

The Faculty of Engineering offers a coursework program in Environmental Engineering for the MES degree and DipEnvironEng. While the program is managed by the Department of Chemical Engineering, teaching is by Chemical, Civil and Mechanical Engineering, as well as by other departments in the University.

Both MES and Diploma candidates will be required to complete certain core requirements:

- MES candidates will need to choose at least 15 units from the list of postgraduate environmental courses taught by the Faculty of Engineering and Diploma candidates 10. The course P4.300 Environmental ImpacteAssessment will be a core requirement for all candidates within these 15/10 compulsory units. This will mean that 50% of the coursework will have to be taken from postgraduate Environmental Engineering courses.
- All candidates will also be required to complete at least one course from each of the approved Economics subjects and Planning and Law subjects.
- The remaining units to be completed may be chosen from any of the postgraduate courses offered by the Faculty of Engineering.

Diplomas

Courses leading to the award of a diploma are currently available in the following specialist areas:

Geotechnical Engineering	DipGeotEng
Structural Engineering	DipStructEng
Structural and Foundation Engineering	DipStructFoundEng
Power Engineering	DipPowEng
Computer Systems Engineering	DipCompSystEng
Telecommunications	DipTelecomm
Environmental Engineering	DipEnvironEng

The minimum academic entry requirement is the 4-year Bachelor of Engineering degree from the University of Sydney, or an equivalent qualification from another university or tertiary institution.

The minimum period of candidature is one year full-time and two years part-time and the maximum period of candidature for all candidates is two years full-time and three years part-time.

Candidates are required to complete 20 units of coursework, chosen from the coursework available for the MES degree. The Diploma requirements differ from the MES requirements only in that no project is required.

The School of Civil and Mining Engineering offers Diplomas in Geotechnical Engineering, in Structural Engineering and in Structural and Foundation Engineering. As for the MES, even full-time candidates could take 18 months to two years to complete the diploma requirements.

The Department of Electrical Engineering offers Diplomas in Computer Systems Engineering, inPower Engineering and in Telecommunications. As for the MES degree, it may take candidates longer than the minimum period of candidature to complete the Diploma requirements.

The Diploma in Environmental Engineering is managed by the Departmentof Chemical Engineering. The teaching is provided by Chemical, Civil and Mechanical Engineering and by other teaching departments in the University. As for the MES in Environmental Engineering, the DipEnvironEng has certain requirements:

- Diploma candidates will need to choose at least 10 units from the list of postgraduate environmental courses taught by the Faculty of Engineering.
- The course P4.300 Environmental Impact Assessment will be a core requirement, as will the completion of at least one course from each of the approved Economics and Planning and Law subjects.

The Committee for Postgraduate Studies of the Faculty of Engineering has prescribed the following courses which may be taken by candidates for the degree of Master of Engineering Studies and by candidates for postgraduate diplomas within the Faculty.

Course No.	Name	Unit Value
CHEMICAL ENGINEERING		
P6.202	Hazard Assessment and Reduction	4
P6.300	Chemical Equilibrium Modelling of Aqueous Systems	4
P6.301	Water Pollution Control	4
P6.302	Bioseparation	2
P6.303	Dynamics of Chemicals in the Environment	3
P6.304	Soil and Sediment Contamination	4
P6.305	Air Pollution and Its Control	4
P6.306	Management and Auditing of Environmental Hazards	4

CIVIL ENGINEERING

Not all courses will be offered each year; where a course is only offered in alternate years, * denotes a course offered only in even-numbered years, and ** denotes a course offered only in odd-numbered years.

Course No.	Name	Unit Value
P2.000	Civil Engineering Project	5
P2.100	Engineering Properties of Materials **	2.5
P2.200	Frame Analysis 1 **	2.5
P2.201	Stability of Structures *	2.5
P2.202	Plates and Shells *	2.5
P2.203	Steel Structures: Members and Connections **	2.5
P2.204	Steel Structures: Loading, Behaviour and Design **	2.5

Course No.	Name	Unit Value
P2.205	Concrete Structures: Durability and Environmental Response *	2.5
P2.206	Concrete Structures: Serviceability and Strength *	2.5
P2.207	Concrete Structures: Prestressed Concrete **	• 2.5
P2.400	The Analysis and Design of Pile Foundations **	2.5
P2.401	Numerical and Computer Methods in Geotechnical Engineering *	2.5
P2.402	Foundation Engineering *	2.5
P2.403	Analysis of Settlement and Soil Consolidation **	2.5
P2.404	Rock Engineering **	2.5
P2.405	Engineering Properties of Soils *	2.5
P2.406	Earth and Rockfill Dams **	2.5
P2.407	Geotechnical Investigations, Instrumentations and Case Studies *	2.5
P2.600#	Advanced Materials	2.5
P2.601#	Advanced Thin-walled Structures	2.5
P2.602#	Advanced Finite Elements	2.5
P2.603#	Advanced Finite'Element Applications	2.5
P2.604#	Advanced Concrete and Composite Structures	2.5
P2.605#	Advanced Structural Dynamics	2.5
P2.606#	Advanced Soil Engineering	2.5
, P2.607#	Advanced Surveying	2.5
P2.608#	Advanced Fluid Engineering	2.5
P2.609#	Advanced Civil Engineering Design	2.5
P2.700	Project Planning and Optimisation	2.5
P2.701	Introduction to Cost Engineering/Linear Programming	2.5
P2.702	Principles of Contract Management	2.5

These courses will only be available to full-time postgradua te students under special circumstances and only with the permission of the Head of School.

ELECTRICAL ENGINEERING

P5.101	Laboratory 1H	3
P5.102	Laboratory 2H	3
P5.103	Laboratory IF	6
P5.104	Laboratory 2F	6
P5.105	Laboratory 3H	3
P5.106	Laboratory 4H	3
P5.200	Energy and Power Generation	3
P5.201	Transmission Design and Switching	3
P5.202	Dynamics of Machines	3
P5.203	Power Electronics 1	3
P5.204	Power Electronics 2	3
P5.206	Planning Design and Performance of 132kV Transmission Systems	3
P5.302	Coding Fundamentals and Applications	3
P5.303	Introductory Optical Fibre Systems	2
P5.304	Optical Fibre Systems	3
P5.305	Communications Networks 1	3
P5.306	Communications Networks 2	3
P5.307	High Frequency Engineering	3
P5.308	Advanced Communication Networks	3
P5.309	Satellite Communication Systems	3
P5.310	Fuzzy Systems	3
P5.311	Adaptive Control	3
P5.312	Non-linear Optics	3
P5.400	Computer Systems Engineering 1	3
P5.401	Computer Systems Engineering 2	3
P5.402	Digital Products Engineering 1	3
P5.403	Digital Products Engineering 2	3
P5.601	Image Processing and Computer Vision	3
P5.602	Medical Imaging Systems	3
P5.603	Adaptive Pattern Recognition	3
P5.604	Machine Intelligence and Pattern Recognition	3
P5.700	Business Practices and Policies (Elec)l	4

Course No.	Name	Unit Value
P5.701	Business Practices and Policies (Elec)2	4
P5.705	Special Course in Electrical Engineering A	3
P5.706	Special Course in Electrical Engineering B	3
MECHANICAL ENGINEERING		
P4.100	Introduction to Computer Aided Drafting	2
P4.101	Introduction to Computer Aided Design	4
P4.102	Science and Technology of Polymer Processing	2
P4.200	Business Policies and Practices A	4
P4.201	Business Policies and Practices B	4
P4.202	Human and Industrial Relations	6
P4.300	Environmental Impact Assessment	4
P4.301	Environmental Acoustics	2
P4.302	Combustion and Air Pollution	3
P4.303	Solar Power 1	2
P4.304	Solar Power 2	**2**
P4.305	Engineering and Public Policy	4
P4.400	Computational Methods in Engineering	3
P4.401	BEM in Computer Aided Engineering	2
P4.402	Introduction to Computer Aided Manufacturing	2
P4.403	Advanced Computational Methods in Engineering	2
P4.500	Stochastic Processes in Engineering Systems	3
P4.501	Fracture Design	3
P4.502	Friction, Wear and Lubrication of Solids	3
P4.503	Engineering Reliability Analysis	2
P4.601	Basic Engineering Computation	4
P4.602	Finite Element and Boundary Element Methods	**4**
P4.603	High Performance Computing Techniques	4
P4.604	Engineering Computational Fluid Mechanics	4
P4.605	Foundations of Computational Solid Mechanics	4
P4.606	Engineering Analysis and Symbolic Algebra	4
ENVIRONMENTAL ENGINEERING		
Environmental Engineering courses taught by the Faculty of Engineering.		
P2.501	Environmental Geotechnics	2
P2.503	Environmental Oceanography and Meteorology	**2**
P2.504	Ocean Mixing	2
P2.505	Water Resources — Management and Use	2
P2.506	Inorganic Waste	**2**
P2.507	Solid Household Waste	2
P4.300	Environmental Impact Assessment	4
P4.301	Environmental Acoustics	2
P4.302	Combustion and Air Pollution	3
P4.305	Engineering and Public Policy	4
P6.202	Hazard Assessment and Reduction	4
P6.300	Chemical Equilibrium Modelling of Aqueous Systems	4
P6.301	Water Pollution Control	4
P6.303	Dynamics of Chemicals in the Environment	4
P6.304	Soil and Sediment Contamination	4
P6.305	Air Pollution and Its Control	4
P6.306	Management and Auditing of Environmental Hazards	4
Environmental Engineering courses **taught by other** faculties		
Economic subjects		
P9.100	Resource Economics and Social Cost-Benefit Analysis	4
P9.101	Environmental Economics	2
Environmental Science subjects		
P9.200	Environmental Chemistry	3
P9.201	Coastal Zone Environmental Management	3
P9.202	Hydrogeomorphology and Environmental Geomorphology	4

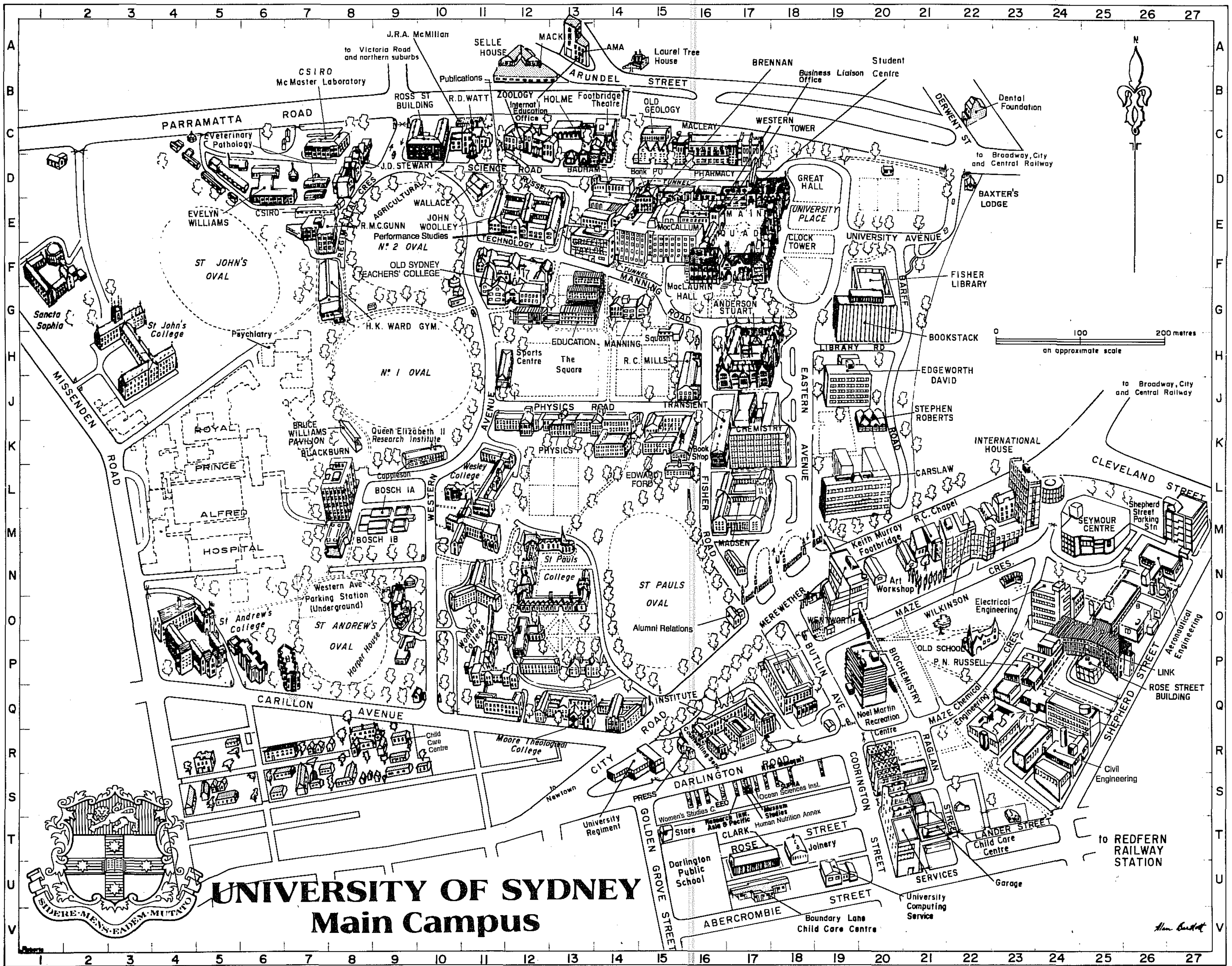
Course No.	Name	Unit Value
P9.204	Optics and Solar Energy	**2**
P9.205	Ecological Topics for Engineers	2
Planning and Law subjects		
P9.300	Physical and Transportation Planning	4
P9.301	Planning Law and Procedures	4
Other subjects		
P9.400	Environmental Health	2
P9.401	Engineers, Environment and Design Intervention	2
AUSTRALIAN CENTRE FOR INNOVATION AND INTERNATIONAL COMPETITIVENESS		
P7.100	Innovation for International Markets	3

7 Timetables

The timetable of classes for Junior and Intermediate courses is available in the Engineering Faculty Office. Students should consult individual Engineering departments for the times and places of Senior and Senior Advanced courses.

Buildings, departments and operations (main campus)

13G Accommodation Service A35
16S Accounting H51
16E Admin. Policy & Strategic Planning Division A14
17D Admin. Support Services Division A14
17D Admissions A14
26N Aeronautical Engineering J07
UC Agricultural Annexe A07
IOC Agricultural Chemistry & Soil Science A03
11C Agricultural Economics A04
11C Agricultural Glasshouses A06
11C Agriculture Faculty Office A05
23N Alma Street Glasshouse G07
170 Alumni Relations F18
17H Anderson Stuart Building F13
17H Anatomy & Histology F13
7E Animal Science Bl9
16F Anthropology A14
16S ANZAASH44
16F Archaeology, Classics & Ancient History A14
22M Architectural & Design Science G04
22M Architecture, Dept & Faculty Office G04
20G Archives F04
20N Art Workshop G03
16E Arts Faculty Office A14
14F Asian Studies A18
170 Attendant's Lodge F18
14D Badham Building & Library A16
Banks
19N Advance G01
13C Commonwealth A09
19N Commonwealth G01
15D National Australia A15
19N National Australia G01
22D Baxter's Lodge F02
8L Behav. Sciences in Medicine D06
20P Biochemistry G08
12C Biological Sciences, Zoology A08
16C Biological Science, Botany A12
8L Blackburn Building D06
16K Bookshop F12
8L Bookshop, Medical D06
19N Bookshop SRC Secondhand G01
8M Bosch Building D05
9M Bosch Lecture Theatres D04
16C Botany A12
14F Brennan, C, Building A18
17H Burkitt Library F13
17E Business Liaison Office A14
12A Careers & Appts Service KOI
6C Caretaker's Cottage (Vet. area) B03
19L Carslaw Building F07
16D Cashier A14
15E Celtic Studies A17
21S Central Stores G12
19L Centre for Teach & Learning F07
17D Chancellor's Committee Shop A14
10G Chaplains, University Dll
23Q Chemical Engineering J01
21S Chemical Store Gil
17K Chemistry Fll
Child Care
17U Boundary Lane
9R Carillon Avenue
14A Laurel Tree House (Glebe) K05
21S Union (Darlington) G10
24R Civil Engineering J05
17T Clark Building H12
17E Clock Tower A14
17L Computer Science, Basser Dept F09
12A Continuing Education KOI
9K COppleson Postgrad. Med. Inst. D02
13G Counselling Service, University A35
14C Credit Union A09
12E Crop Sciences A20
UC Agricultural Entomology A04
11C Agricultural Genetics & Plant Breeding A04
12E Agronomy A20
IOC Biometry A03
12E Horticulture A20
11C Plant Pathology A04
7C CSIRO McMaster Laboratory B02
7E —, Annexe B14
22B Dental H. Educ. & Res. Fndn K03
16K Dentistry Faculty Office A27
18Q Econometrics H04
18Q Economic History H04
18P Economics H04
18P Economics Faculty Office H04
19J Edgeworth David Building F05
13G Education A35
15K Edward Ford Building A27
24P Electrical Engineering J03
17L Electron Microscope Unit F09
23Q Engineering Faculty Office J02
24S Engineering Workshop J06
12E English A20
16S Equal Employment Opportunity H47
6D Evelyn Williams Building BIO
8L Experimental Medicine D06
17D External Relations Division A14
17D Financial Services Division A14
16H Fine Arts A26
20F Fisher Library F03
14C Footbridge Theatre A09
14E Found Property A19
14F French Studies A18
21T Garage, University G13
17Q Geography H03
19J Geology & Geophysics F05
14F Germanic Studies A18
18Q Govt & Public Admin H04
8K Grandstand No. 1 Oval D01
18D Great Hall A14
17E Greek—Ancient A14
13F Greek—Modern A19
13F Griffith Taylor Building A19
7E Gunn, R.M.C., Building B19
Health Service, University
13C Holme Building A09
19N Wentworth Building G01
15F History A17
17K History & Philosophy of Science Fll
13C Holme Building A09
5D Horse Stables B09
20P Human Nutrition Unit G08
17Q Industrial Relations H03
8L Infectious Diseases D06
191! Information Services H08
17Q Institute Building H03
17Q Internal Auditor H03
13D International Education Office K07
23L International House G06
4D Isolation Block—large animal bull pen B05
16H Italian Studies A26
18T Joinery G12
12F Koori Centre A22
13F Language Centre A19
17E Latin A14
13G Learning Assistance Centre A35
16K Linguistics F12
250 Link Building J13
12A Mackie Building KOI
16F MacLaurin Hall A14
16C Macleay Building A12
16C Macleay Museum A12
7C McMaster Laboratory CSIRO B02
UC McMillan, J.R.A., Building A05
17L Madsen Building F09
15C Mail Room (Internal) All
17E Main Building A14
14G Manning House A23
13A Margaret Telfer Building K07
16K Mathematics Learning Centre F12
19L Mathematics & Statistics F07
26N Mechan4& Aero. Eng Bdg J07
250 Mechanical Engineering J07
15K Medicine Faculty Office A27
8L Med., Paradinical & Clinical D06
17H Medicine, Preclinical F13
18P Merewether Building H04
20P Microbiology G08
16H Mills, R.C., Building A26
14Q Moore Theological College 1
15F Mungo MacCallum Building A17
17S Museum Studies H36
24M Music J09
16F Nicholson Museum A14
10K Obstetrics & Gynaecology D02
17S Ocean Sciences Institute H34
15C Old Geology Building All
220 Old SchoolBuilding G15
12F Old Teachers' College Building A22
8L Pathology & Path Museum D06
12E Performance Studies A20
13A Personnel Services K07
8L Pharmacology D06
15D Pharmacy A15
17F Philosophy A14
16K Phonetics Laboratory F12
21T Photography G12
13K Physics A28
17H Physiology F13
10K Postgraduate C'ttee in Medicine D02
15D Post Office A15
16R Press Building H02
21T Printing Service G12
16E Professorial Board Room A14
13A Properties Office K07
6H Psychiatry D06
15F Psychology Al 7
11D Publications A20
15K Public Health A27
17E Quadrangle A14
10K Queen Elizabeth II Res. Inst. D02
16D Records A14
15R Regiment, University HOI
13F Religion; School of Studies in A19
17S Research Institute for Asia & the Pacific H40
18S Risk Management H31
25P Rose Street Building J04
IOC Ross Street Building A03
7D Round House Bll
23P Russell, Peter Nicol, Building J02
16K SAUT F12
5P St Andrew's College 2
3H St John's College 3
21M St Michael's College
12N St Paul's College 4
IF Sancta Sophia College 5
4C Sand roll shed B04
19L Science Faculty Office F07
14E Security A19
12A Selle House K02
18E Semitic Studies A14
18E Senate Room A14
21T Services Building G12
25M Seymour Theatre Centre J09
SD Sheep Building & Pens B07 .
17H Shellshear Museum F13
21S Shepherd Centre G10
27M Shepherd St Parking Station J10
16H Social Work A26
Sports
20R Noel Martin Recreation Centre, Darlington G09
12H Sports Centre Western Ave A30
7F Sports Union D08
7F Ward, H.K., Gymnasium D08
20J Stephen Roberts Theatre F06
8D Stewart, J.D., Building B01
17L Student Centre F09
19N SRC G01
21T Supply Department G12
7U8S SUPRA H28
8L Surgery D06
20R Swimming Pool G09
20D Tennis pa v. & women's courts FOI
14E Traffic Office A19
16K Transient Building F12
19N Union, University of Sydney G01
15F University of Sydney Club A17
22M Urban & Regional Planning G04
8D Vet. Anatomy B01
6D Vet. Clinic, hospital, surgery BIO
6D Vet. Clinical Sciences BIO
7D Vet. Operating theatre & animal house B13
7D Vet. Pathology B12
7E Vet. Physiology B19
8D Vet. Science, Faculty Office B01
16E Vice-Chancellor A14
11D Wallace Theatre A21
17D War Memorial Gallery A14
250 Warren Centre for Adv. Engin. J07
UC Watt, R.D., Building A04
17L Welfare Association F09
19N Wentworth Building G01
11L Wesley College 6
8N Western Avenue Underground Parking Station D07
16E Western Tower A14
22M Wilkinson Building G04
17H Wilson (Anatomy) Museum F13
110 Women's College 7
12H Women's Sports Association
16S Women's Studies Centre H53
12E Woolley Building A20
17D Yeoman Bedell A14
12C Zoology A08



UNIVERSITY OF SYDNEY
Main Campus
SIDERE·MENS·EADEM·MUTATO
PARRAMATTA ROAD
ARUNDEL STREET
CITY ROAD
CLEVELAND STREET
MISSENDEN ROAD
CARILLON AVENUE
DARLINGTON ROAD
CODRINGTON STREET
GOLDEN GROVE STREET
ABERCROMBIE STREET
CLARK STREET
LANDER STREET
SHEPHERD STREET
RAGLAN STREET
BUTLIN AVE
EASTERN AVENUE
WESTERN AVENUE
FISHER ROAD
SCIENCE ROAD
PHYSICS ROAD
MANNING ROAD
UNIVERSITY AVENUE
BARFF ROAD
LIBRARY RD
MAZE CRES.
WILKINSON
MEREWETHER
INSTITUTE ROAD
AGRICULTURAL
DERWENT ST
RUSSELL
TECHNOLOGY L.
to Victoria Road and northern suburbs
to Broadway, City and Central Railway
to Broadway, City and Central Railway
to Newtown
to REDFERN RAILWAY STATION
CSIRO McMaster Laboratory
Veterinary Pathology
CSIRO
J.R.A. McMillan
SELLE HOUSE
MACK
AMA
Laurel Tree House
BRENNAN
Business Liaison Office
Student Centre
Dental Foundation
Publications
ROSS ST BUILDING
R.D. WATT
ZOOLOGY
Internat'l Education Office
HOLME
Footbridge Theatre
OLD GEOLOGY
MACLEAY
WESTERN TOWER
J.D. STEWART
BADHAM
Bank
PO
TUNNEL
PHARMACY
GREAT HALL
BAXTER'S LODGE
MAIN QUAD
UNIVERSITY PLACE
CLOCK TOWER
McCALLUM
GRIFFITH TAYLOR
EVELYN WILLIAMS
WALLACE
JOHN WOOLLEY
R.M.C. GUNN
Performance Studies
No. 2 OVAL
ST JOHN'S OVAL
OLD SYDNEY TEACHERS' COLLEGE
MacLAURIN HALL
ANDERSON STUART
FISHER LIBRARY
BOOKSTACK
0 100 200 metres
on approximate scale
Sancta Sophia
St John's College
Psychiatry
H.K. WARD GYM.
No. 1 OVAL
Sports Centre
The Square
EDUCATION
MANNING
Squash
R.C. MILLS
EDGEWORTH DAVID
STEPHEN ROBERTS
TRANSIENT
CHEMISTRY
ROYAL PRINCE ALFRED HOSPITAL
BRUCE WILLIAMS PAVILION
BLACKBURN
Queen Elizabeth II Research Institute
Coppleson
BOSCH IA
BOSCH IB
PHYSICS
Wesley College
Book Shop
EDWARD FORD
INTERNATIONAL HOUSE
CARSLAW
MADSEN
Keith Murray Footbridge
R.C. Chapel
Shepherd Street Parking Stn
SEYMOUR CENTRE
St Pauls College
Western Ave Parking Station (Underground)
St Andrews College
ST ANDREW'S OVAL
Harper House
Women's College
ST PAULS OVAL
Alumni Relations
Art Workshop
WENTWORTH
Electrical Engineering
OLD SCHOOL
P. N. RUSSELL
Aeronautical Engineering
LINK
ROSE STREET BUILDING
BIOCHEMISTRY
Noel Martin Recreation Centre
Chemical Engineering
Civil Engineering
Child Care Centre
Moore Theological College
University Regiment
PRESS
Ocean Sciences Inst.
Women's Studies
Museum Studies
Human Nutrition Annex
Store
ROSE
Joinery
Darlington Public School
Child Care Centre
SERVICES
Garage
University Computing Service
Boundary Lane Child Care Centre